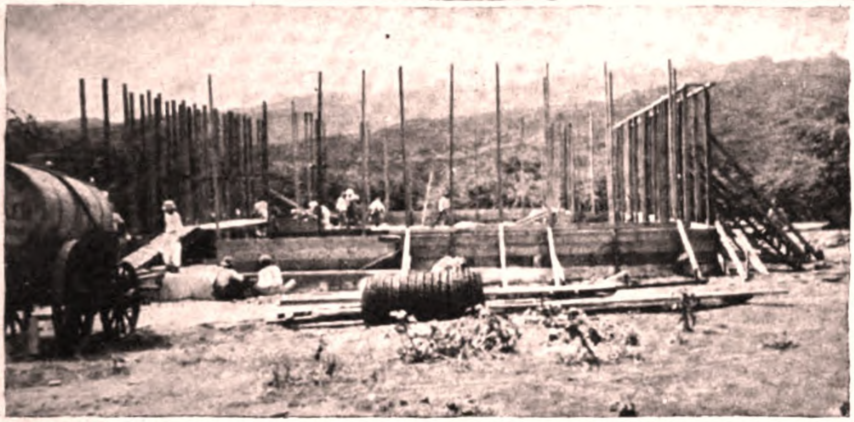
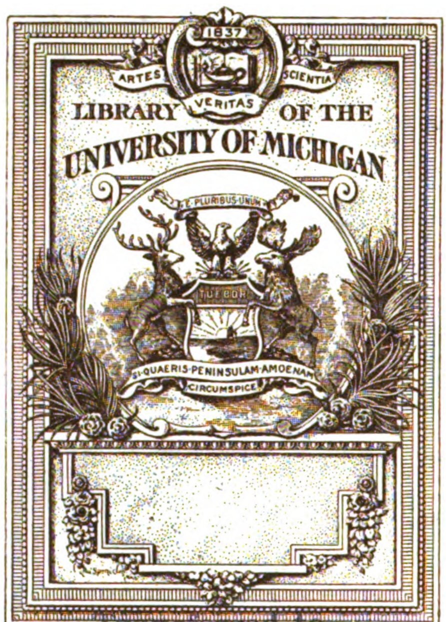


Operating Building at Honolulu receiving site, as it looked six weeks ago.

A good example of the handsome tapestry brick fireplaces in the Operators' Homes lending an air of coziness to the living rooms

The Wireless Age

Completing the first floor of the Assistant Engineer's Cottage at Marshalls, a fine type of the Modern fireproof bungalow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The Wireless Age

An Illustrated Monthly Magazine of Radio Communication

VOLUME I

From October, 1913, to September, 1914

Issued by the

MARCONI PUBLISHING CORPORATION

450 Fourth Avenue - - - - - - New York City

Index---Volume I

October, 1913, to September, 1914

AUTHORS

THE WIRELESS AGE

OCTOBER, 1913

ABOUT OURSELVES

WITHOUT preliminary flourish we beg to introduce The Wireless Age.

Now an introduction is at best an awkward thing, and it becomes far more so when it is one-sided. For an impression must be made on the new acquaintance, and in trying to do this it is so easy to appear very egotistical, which is the polite name for stupidity, or take a chance of not doing ourselves justice.

By doing ourselves justice we do not mean that our readers are to hearken while we call their attention to what we consider meritorious in our pages, for that is one thing we want them to decide for themselves. A clear conception of our aims and purposes, a friendly spirit and a reasonable appreciation of our efforts to please, is all we seek.

Our Aims and Purposes

What we have in view for our subscribers will be spoken of presently; just now we have a very pleasant duty to perform. We want to thank our friends for their loyal support, their kindly criticism, and even for the occasional tirades of good-natured abuse, that have been aimed our way.

That we claim friends may appear paradoxical in view of this being the first issue of The Wireless Age, and as we are to acknowledge a great number of them a word of explanation may be timely.

Just one year ago we had an idea that a certain proportion of the American public would welcome a magazine devoted to wireless telegraphy. We set about to discover just how large an audience we could address, providing we reached each individual concerned with radio communication. From the best sources of information we could command, one hundred thousand seemed to be a fairly accurate estimate. Surely, here was an audience worth addressing, for careful and painstaking investigation had shown us that while practically all of these people were engaged in serious experimenting, or were devoting their energies to advancing the commercial phases of the art, they had no adequate medium of expression, had little opportunity of learning what their co-workers were accomplishing, and had been depending principally upon a few scattered text books, new and old, for a way around the difficulties they encountered.

It was to fill this noticeable gap that our magazine entered the field. We called it The Marconigraph, an illustrated monthly magazine of wireless telegraphy.

From a very inauspicious beginning, this little publication—"pamphlet," some of the early scoffers called it—grew steadily in scope and influence, plodding onward and upward through a maze of discouragements and with little to reward its sincerity of purpose or the arduous labor its publication entailed. It was a long while before expressions of appreciation began to drift in.

Our First Bouquet

HOW well we remember the first indication of the kind! We (speaking personally for the moment) had dropped into the offices of a New York newspaper, intent upon correcting an inaccurate news item relating to wireless that had found its way into print. Explaining our mission and calling attention to the true facts in the case as detailed in a copy of The Marconigraph carried along for that purpose, we were assured of a retraction and courteously invited to meet the Exchange Editor. In passing, it may be well to explain that this official's duty is to search all manner of publications for news items and suggestions of value to the paper; in a phrase, to keep his finger on the pulse of the world for the good of the paper. This man listened carefully to all we had to say about our sincerity of purpose and our willingness to aid in distributing accurate information on wireless matters through the daily press of the country. In conclusion, we offered him a copy of The Marconigraph. Declining the proffered number with a warm smile that in itself was a handsome reward, he pointed to a copy then lying on his desk, adding that it had arrived in that morning's mail and would receive attention in its regular order. This looked encouraging, for there were but a few magazines and papers on the desk, in contrast to heaps reposing in nearby waste baskets and scattered about the floor. We glanced apprehensively at these, which called forth another smile.

"No, your little publication does not meet that fate," he volunteered. "I have carefully read every issue since the first one, and I am happy to say that The Marconigraph has been a source of inspiration in more than one instance. Furthermore, I trust you will continue to keep us on your mailing list, for after our little chat I am going to watch it even more carefully. And if it is worth anything, you have my assurance that I will suggest its value to other men of my calling."

Further Encouragement Added

THIS, the first expression of appreciation we had heard, meant a great deal to us, but when a little later we began to receive letters from our readers commenting on this and that, asking for information on definite phases of the art and suggesting articles that would interest them—then we felt that our initial purpose had been realized. We had a definite place in the activities of a certain proportion of the people we had set out to reach, and recognition as a standard semi-technical publication. Once started, the letters poured in steadily until we had a considerable collection. Some of these letters proved very valuable to us, for they told us what our readers wanted and where they thought we were lacking. The mere fact that these letters were written, that the writers were sufficiently interested in our development, proved to us that we had friends—a goodly number of them.

We hope to retain them during the life of The Wireless Age and add a great many more to the list.

Whether in the past we have lived up to the standard set by our readers, we cannot say. We have tried. What we are sure of, though, is that we have made a very definite amount of progress. We did not reach each one of the hundred thousand we set out to—not half, nor a quarter of that number—but our circulation books to-day show a volume of paid subscribers that gives us a very comfortable feeling. It was this feeling that led us to attempt some great strides forward.

Hence the passing of The Marconigraph and the creation of The Wireless Age, broader in scope, larger in volume, and, we trust, more interesting and instructive in contents.

What we purpose to give you is the best wireless magazine that money and brains properly applied will produce. There will be highly technical articles for the engineer, practical suggestions for the commercial operator, helpful hints for the advanced amateur and carefully considered instruction for the novice. The new stations, new instruments and new methods of commercial operation will be dealt with each month and genuine radio achievement will be impartially chronicled. By this, we do not mean that we will attempt to record everything that is, and has been, done; for this is almost beyond human possibility and, if it were possible, hardly desirable. All we promise is to use our best judgment in selecting what we consider to be valuable discoveries and practical applications of wireless to the problems of the day, presenting them to our readers with little, if any, comment.

We will not confine ourselves to strictly educational articles. We shall attempt to entertain as well. Good fiction, well illustrated, and narratives seething with human interest will appear regularly. We will also make it a point to cover the features of commercial wireless that are of absorbing interest to holders of wireless securities.

THIS is one point about which there has been some misunderstanding in the past.

We have been accused of recording only the achievements of the Marconi system to the exclusion of all others. It has been said that we purposely ignore "other companies operating in the commercial field." To the best of our knowledge there is only one commercial wireless company in the United States conducting a regular message traffic every day in the year. If there are any others, we would like to learn what they are doing. If they are doing things worth

Clearing Away the Fog

while, we will tell the public about them. Anything we consider worthy of mention will be chronicled; we will be unbiased in our columns—but we shall insist upon verification of everything contained in communications of this nature.

It may as well be understood from the start, however, that we are going to be intensely loyal to the Marconi Company. The reason for this is plain. As it stands to-day the Marconi Company is an organization years ahead of any possible competitors. With very few exceptions the vessels of the merchant marine of this and every other country in the world are equipped with Marconi apparatus, in communication with Marconi land stations, and operated under the traffic system perfected only after years of experience and the expenditure of vast sums of money. To others who have accomplished good work in wireless we offer our sincerest admiration, but the powerful commercial institution made possible by the genius of Marconi, his co-workers and those who offered financial support will always receive first consideration. Which is eminently fair in view of the fact that Marconi activities are many times greater than those of all the others combined. The sole purpose of The Wireless Age is to record the progress of the art of radio communication, so you may expect to hear a great deal about the Marconi Company.

One of our critics in the days of The Marconigraph said that we were "constantly cramming the Marconi system down the throats of readers." What if we did? And what if we continue to do so? It's good for him and all the others. Every sincere experimenter, engineer or commercial man is naturally interested most in what the leaders in the wireless field are doing. Marconi and wireless are synonymous words, and Marconi development is pre-eminent in wireless affairs. However, let it be understood that we will recognize the work of others, for we know that their affairs may be of interest too. In short, we expect to cover all wireless activities to the best of our ability.

Our Limitations and the Remedy

WE do not hope to please everyone; there never was a periodical of any importance published that did not have at least one reader who was fully convinced that things would be greatly improved if he were the editor. It is very likely that a number of our readers are going to feel that way about The Wireless Age. Those are the ones we want to hear from, for the man who refuses to let other people form his opinions for him usually has something to say. If there are things you don't like about our policy, the articles we publish, or if you feel that we have overlooked opportunities, tell us about it. You have our assurance that your letters will receive careful attention.

If we can get the right kind of letters we will publish them, whether favorable or unfavorable. Experience has proven that there are a number of deep thinkers in the wireless field, men who appreciate the value or original thought and research and find new ways, new possibilities, in connection with their work. If we can assist these men by printing information that will aid them in the smallest degree, we will be in the way of realizing some of our ambitions. But we cannot be expected to guess what they want to know.

We are firmly convinced that many of our readers are working along original lines. Perhaps they are experimenters of the higher order, sincere workers who are more than anxious to give their fellow men the benefit of knowledge acquired through painstaking research, but their modesty restrains them from mentioning what they have learned. To these men we say that no matter how trivial a discovery may appear, it is likely to be of a very great assistance to some other experimenter struggling along under difficulties, and if we can become the medium for an exchange of ideas among all classes of wireless men our educational work will be greatly augmented.

How You Can Help Us

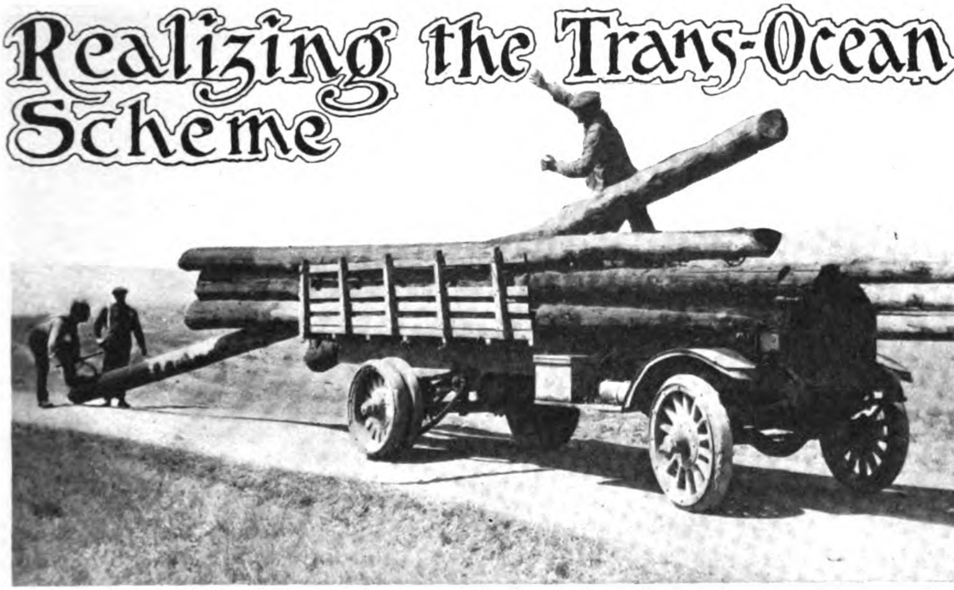
HAVE the courage to make your convictions public; don't be afraid of ridicule. Every man bringing to the world a message worth while is misunderstood because it is human nature to reverence the past and be oblivious to new truths. Pythagoras was misunderstood, and Socrates and Luther and Copernicus and Galileo and Newton and Marconi, and every wise human that has added something to the knowledge of the world. The thing to do is to know *why* you think as you do think, explain it clearly to your fellow men, and you will gain the respect of all—if not at once, surely later on.

Once again, this is our editorial policy: To record interestingly the development of radio communication and to assist progress in the art by publishing all the instructive material we can secure.

We will make every effort in our power to prepare this material ourselves. Any assistance outsiders may give us will add just that much to the value of a magazine published solely to add something to the knowledge of each individual reader.

THE EDITOR.

Realizing the Trans-Ocean Scheme



TWO miles out from the old historic city of New Brunswick, N. J., on a road that follows the banks of the Raritan river and the Raritan canal lies the transmitting half of the new wireless station to communicate with a similar station in Wales. Approaching the site from the south one sees a beautiful meadow streatching from the road to the canal bank. In this meadow are located the powerhouse, the auxiliary transmitting office and the first set of two masts. To the west of the road the land rises sharply for about a thousand feet and then runs nearly level for a mile or more. Looking up this rise the two cottages for the chief engineer and the assistant engineer are to be seen, and, further up the hill, the hotel which will accommodate the engineering force, the few operators required to work the auxiliary receiving apparatus and the riggers who keep the aerials and the mast system in shape.

The powerhouse is now beginning to look like a building, for the concrete work is completed up to the first story and ready for the brick work. The foundations for the motor generators are well under way and the steel girders and beams for the first floor are being placed. The observer is particularly impressed by the permanent and fire proof nature of the work on all of the buildings.

The auxiliary operating building, located about a hundred feet north of the power house, has the brick work completed to the roof and awaits the steel and roof tile to finish the work on the structure proper. All of the buildings at the station are being constructed of rough tapestry brick, laid up with a wide joint in black mortar. With red tile roofs and an attractive design they make a handsome appearance.

The two cottages are situated well back from the road among fine trees and, as they are above the highway, command an excellent view of meadow, canal and river. The porches are wide and big doors connect with the living rooms; the latter can virtually be made parts of the porches when it is desired to do so. The surrounding country is beautiful and the summer months will be appreciated by the engineers lucky enough to obtain positions at the .station. Open fire places add to the coziness of the living room, while the sanitary arrangements are to be the best obtainable. When the station is completed a road will wind up the hill between the cottages and among the trees and shrubbery to the front of the hotel which is in course of construction.

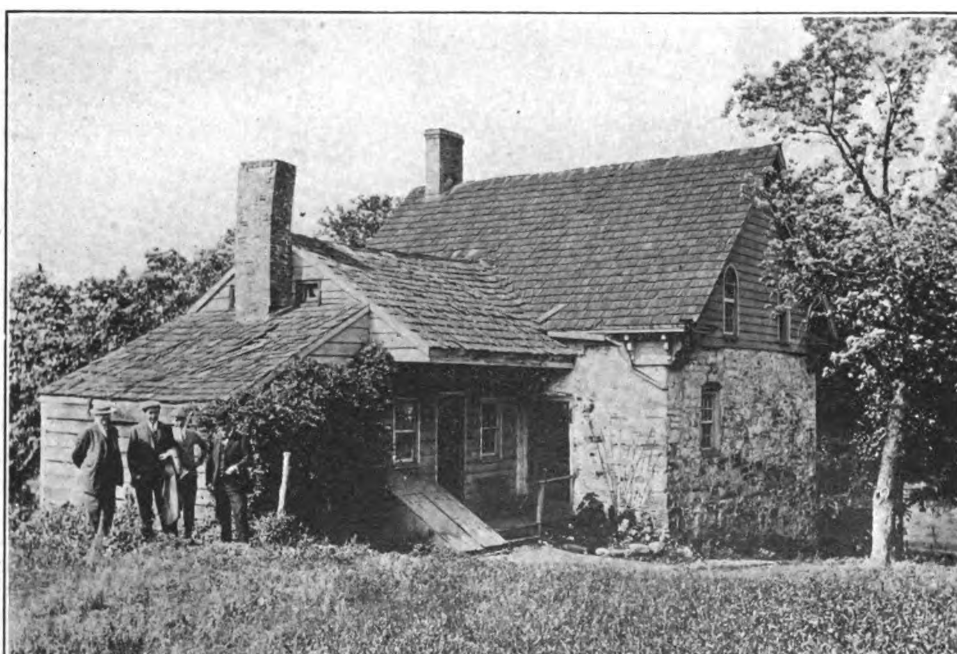
Far in the rear of the hotel are the temporary bunk houses for the laborers with accommodations for about seventy men. These living structures are more useful than beautiful, and, with their outdoor fire places and eating tables, give the appearance of a home for summer campers.

The non-arrival of steel has been holding up the structural work on all of the buildings. Among the building materials lacking are the steel sections for the masts. However, some mast sections are in transit from the manufacturers and will soon be shooting skyward. Practically all of the mast foundations are completed and forty-seven of the fifty-two mast anchors are ready to take the stays. A hoisting engine has arrived for hoisting the wooden topmasts which are assembled in the first two sections. All of the mast sections, bolts, etc., as well as the workmen, will be hoisted by the engine. The working force numbers only seventy-five men because of the delay in the arrival of materials.

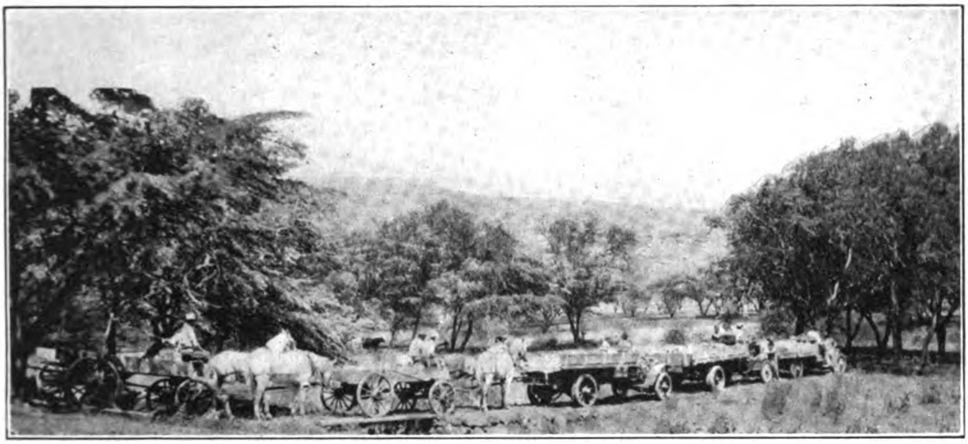
An important feature of the sanitary arrangements was the establishment of good water supply and sewerage system. On the hill far above the hotel has been sunk a well which has a flow of good water. There was a drouth in the neighborhood last summer, but it was possible to obtain water at all times from the well. A gasoline pump lifts the water high enough to fill the tanks in the wagons which carry it to the mast foundations for concreting.

An old historic farm house, long since in its prime, is being utilized as the construction office. The house has stood for more than one hundred and fifty years and, judging from the appearance of the huge hand hewn timbers, will stand for another century or so. In Revolutionary days this dilapidated house was a mansion of importance, having been at one time the paymaster's office of the Revolutionary Army; and rumor has it that Lafayette for a time had his headquarters in the building.

A lively demonstration occurred on the occasion of Mr. Marconi's last visit to this country. When he was looking over the station near New Brunswick, he was met by a delegation of the Italian



An Historic Farmhouse, Over 150 Years Old and Good for Another Century of Service, is Being Utilized as the Construction Office at the New Brunswick Transmitting Site. Back in the Days of the Revolution this House Did Service as the Army Paymaster's Office.

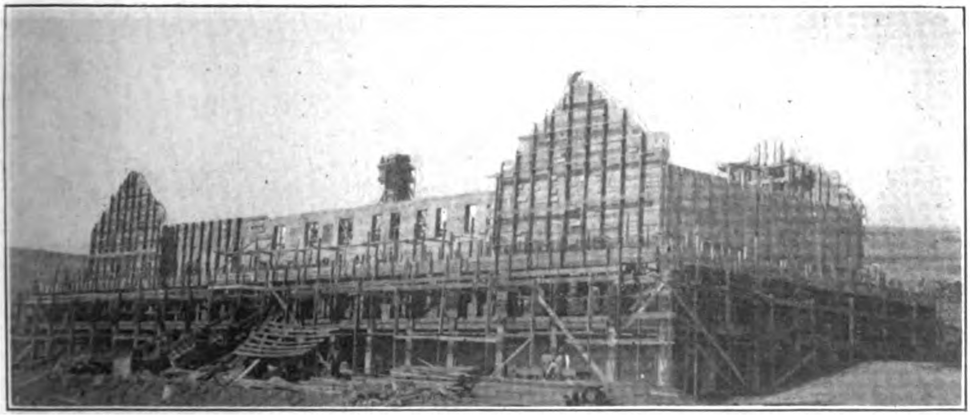


Three Motor Trucks and a Number of Teams are Used to Haul Material for the Honolulu Stations

workmen. He talked to them in their own language about the wireless stations and created much enthusiasm among the men regarding the work. An attempt was made to photograph the men at work, but when the camera was pointed at them they ceased their efforts and assumed artistic poses.

The crisp fall days add considerably to the attractiveness of a trip to Belmar, the receiving half of the New Jersey station to work with Wales. The summer crowds have left this resort, but the beauty of the woods and farms remain. It is an attractive road that runs from the station at Belmar to the property of the Marconi Company. The way leads along the Shark River, a famous salt water inlet, which has been dotted all summer by sailboats and launches. The countryside looks rather deserted as one travels to the Marconi Station. At the station, however, the busy season is still on and there is life aplenty.

The road leads along the top of a bluff overlooking the river. The living quarters are located on the bluff, while the operating house is at the foot of the hill close to the river. From the operating house the receiving aerials will rise to the first mast, located on top of the hill. Crossing the road at nearly right angles, and stretching westward for almost a mile, they will be carried on the top of six masts, each 300 feet high. The back ends of these aerials will be carried down at an angle of thirty degrees, being insulated near the mast top,



The Hotel Built at Marshall, Cal., for the Accommodation of the Operators is Nearing Completion and having steel running ropes attached. These ropes come down to the anchors, which consist of a pillar fifteen feet high with heavy iron weights free to slide up and down on them.

These weights balance the pull of the wires and are calculated to keep a definite tension in the aerial wires at all times, so that when the wind blows or sleet incrusts the aerials, the spans between the masts will sag down and the counter weights rise, keeping the tension constant. This straining pillar anchorage, as it is called, is an ingenious device which is a new departure in cable suspension. All of the heavy steel cables for staying the masts are in transit to the property and will be on the ground by the time the first of the mast sections arrive. The foundations for masts and anchors have been completed.

Approaching the property from Belmar, the hotel is on the left side of the road. It stands on the high ground, and from the porches one will be able to see over Shark River and out to the ocean. The building construction is the same as at New Brunswick; that is, red brick with concrete and red tile roof. The hotel will accommodate about thirty-five men. It is 168 feet long and is completed up to the second story. The cottages are located, one on each of two points of the bluff, to the east of the road, and at some little distance from the hotel. The work on these living quarters is more advanced than at the hotel, for the brick is all in place and the cottages are ready for the roof steel and the tile.

The operating house, down on the narrow strip of beach below the bluff, is progressing well, even though some trouble was experienced in making the foundation water tight. This trouble was due to the nature of the soil, for the entire hill side above the house is full of springs and the ground is always saturated with water. This condition will be of advantage when the grounding system is put in. The fifth building of the group will be a lighting plant equipped with a twenty-five horse power heavy oil engine, driving a 125 volt, direct current generator with a duplicate steam equipment for emergency use. Work on this building is in progress.

It seems there is always something to hold up construction work and at Belmar one of the incidents which contributed to this end was a strike by the laborers. The situation, however, did not become acute, as it was well handled by the construction superintendent, who soon had the situation well in hand. Since that time the work has been uninterrupted.

A large force will be required to handle the operating work and much will be done to make the hotel and grounds attractive as a place to live. The boating on Shark river will be a pastime in the summer, while tennis and other sports will be encouraged. In fact a jolly little community will soon be thriving in the section which is now cluttered up with building materials.

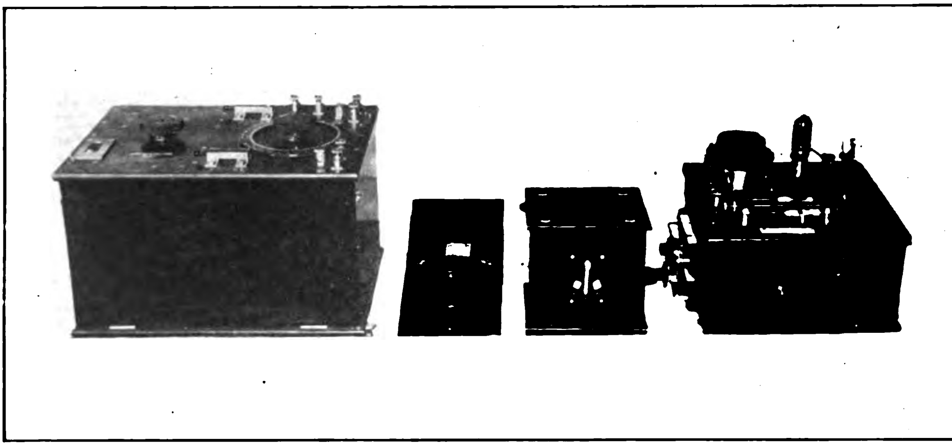
$100,000 STATION IN ILLINOIS

One of the largest wireless stations in the world will be established at the United States Naval Training Station at Lake Bluff, Ill. Captain E. R. Clark, commandant, has announced that $100,000 will be expended in its construction. The station will be able to communicate directly with San Francisco and New York.

SUBMARINE SYSTEM SUCCESSFUL

Christian Berger, of Hungary, the inventor of the signaling system for submarines, recently made a visit to Newport, R. I. Mr. Berger supervised the installation of his system on the submarines now building at Quincy, Mass.

The Berger method is a marked success, say the authorities who have conducted trials in this country, and the apparatus has been perfected by the inventor until communication can be established between immerged vessels within a radius of seven miles. It is said that the system will be installed on many battleships of the American navy. Count Szechenyi, husband of Gladys Vanderbilt, is interested in the Berger system.



From Left to Right, the Radio-Goniometer, Angle Divider, Test Buzzer and Tuned Receiver

The Direction Finder

An instrument which has made it possible to tell the exact points of the compass from which distress signals are being sent, also enabling navigators to avoid collisions with other vessels.

ANOTHER positive step toward safeguarding the lives of persons aboard ships at sea was taken when the Marconi radio-goniometer, or direction finder, was invented. This was shown during a recent test of the device on the steamship Northland, of the Eastern Steamship Company, on a trip from New York to Portland. The successful outcome of the test means that it will now be possible to tell the exact points of the compass from which distress signals are being sent, without regard to weather conditions, and that the captain of the rescue ship will be able to set his course immediately, and arrive alongside the disabled craft, in some cases, many hours before he could reach the scene without the aid of the invention.

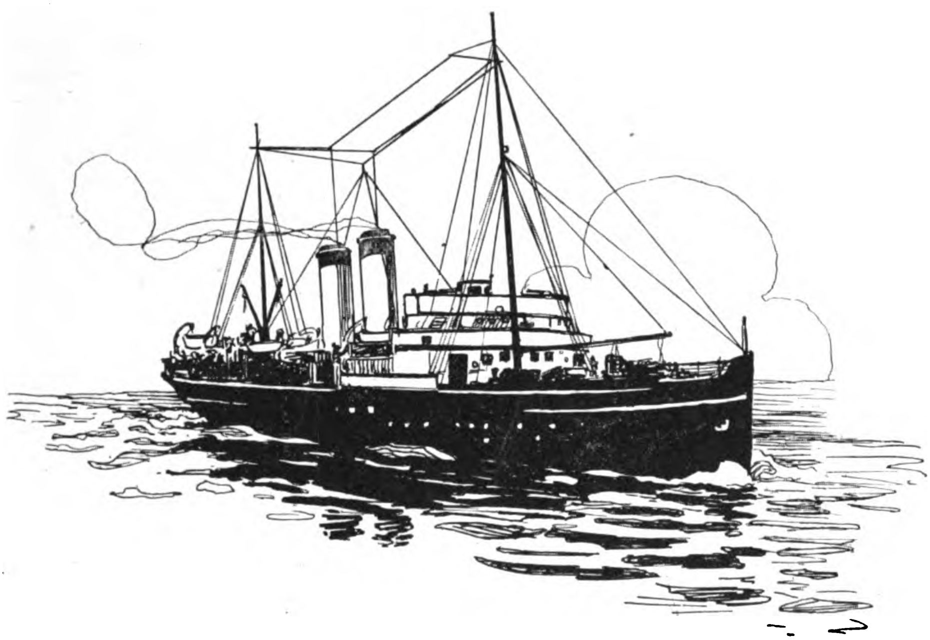
Inventors have studied for a considerable number of years to perfect a device that would indicate the directions from which wireless signals arrived. Various attempts were made to bring about the invention of the apparatus, but without success. It is now an established fact, however, that the question of furnishing this important aid to navigators has been solved by the development of the Marconi-Bellini-Tosi system. In 1905 Mr. Marconi took preliminary steps toward inventing a direction-finder, and in September, 1907, Messrs. Bellini and Tosi had succeeded in patenting an invention which proved adequate. In this invention the main principle is the use of two directive aerials at right angles to each other, and of an instrument called the radio-goniometer, by which their indications are compared.

The primary object of the invention is to enable the navigating officer of a vessel to take bearings of wireless telegraph stations, with a view to finding the position of his ship, or avoiding collisions with other craft. It is not asserted in behalf of the direction finder that the bearings taken with it exceed, or even equal in accuracy, those taken with an accurate optical instrument under favorable conditions. It is claimed, however, that reliable bearings may be obtained by means of the instrument when direct bearings cannot be taken because of unsettled weather, or for other reasons. Bearings may be taken within two or three degrees under reasonably good conditions. Under adverse conditions they may be taken within five degrees. In order to take bearings it is not necessary to swing the ship.

The power of the wireless station from which signals are being received governs largely the range of the installation. It is from ten to fifty miles, or more.

Aerial wires, distinct from those used for the main wireless installation of the vessel, are required for the direction finder. Two loops of wires of equal size, suspended vertically and crossing each other at right angles, are the essential features of the aerial system. As a rule the loops are in the form of a triangle of wires suspended by their top corners through insulators from a triatic, or other fore and aft stay, or from a sprit, gaff or bracket on one of the masts. Their horizontal base wires cross the ship at an angle of forty-five degrees on either side of its centre line and at right angles to each other, the two bottom corners of each triangle being ordinarily made fast through insulators to stanchions at the side of the ship. Connecting wires are taken to the instruments from the centers of the horizontal base wires of the triangular aerials, which are split by an insulator at their point of intersection. The range of the installation suffers to some extent if these connecting wires are very long, in addition to which the possibility of injury to the wires decreases the reliability of the system. Therefore it is advisable to keep the distance between the instruments and the center of the aerial system as short as is practicable.

The instrument indicates the angle which the direction of the station makes with the center line of the ship. It shows the line on which the wireless transmitting station lies. It does not, however, show in what direction along that line. For instance, it may indicate a direction twenty degrees off the port bow, but it does not distinguish between this direction and that which is diametrically opposite to it, namely, twenty degrees off the starboard quarter. To use geometrical language, it shows the direction, but not the sense. There will, however, seldom be any doubt as to whether the ship is approaching or receding from a land station, and, indeed, in most cases there is only one possible way of interpreting the indication of the instrument, as by the reverse interpretation the ship would be found to be somewhere inland.



Sketch Showing the Arrangement of the Aerial Used with the Direction Finder

If there is any ambiguity, two successive bearings taken of the same station, while keeping the ship on a fixed course, will place the matter beyond doubt, and will at the same time give the ship's distance from the station by the method ordinarily in use for that purpose. In the same way the ship's position may be found by taking simultaneous bearings of two fixed stations.

An obvious application of the direction finder is to find out whether the ship is on a course which will take it inside or outside a lightship or isolated lighthouse. A few signals from the lightship or lighthouse will settle the question as certainly as if the light were visible. Similarly, when making a harbor, a few signals from a station in the harbor will show immediately if the ship has drifted to one side of the entrance. When trying to locate another vessel while going slow in a fog, the indication of the direction finder would show by a steadily increasing strength of signal if the other ship were approaching, but might leave a doubt as to whether it was approaching on the port bow or overhauling on the starboard quarter. But a wireless query as to her course, addressed to the other ship, would remove the doubt at once.

Mr. Marconi, in his early attempts to perfect a direction finder, showed that a horizontally bent aerial would radiate and receive most strongly in a direction opposite to the free end. He also demonstrated that the relative intensities in various directions, when plotted out, gave a polar curve of a certain shape. A demonstration was soon afterward given by which the direction of arriving signals was found by swinging round such an aerial until the position of maximum strength of signals was found; or rather, in the actual experiment, by connecting the receiver in turn to several similar aerials arranged radially. The indications furnished by this method, however, were only approximate, and the type of aerial used did not provide a complete solution of the problem. G. S. Brown, as far back as 1899, had taken out a suggestive patent for a directive aerial, which was subsequently further developed by Andre Blondel in 1903. This aerial bears an important relationship to the latest development in the invention for finding directions.

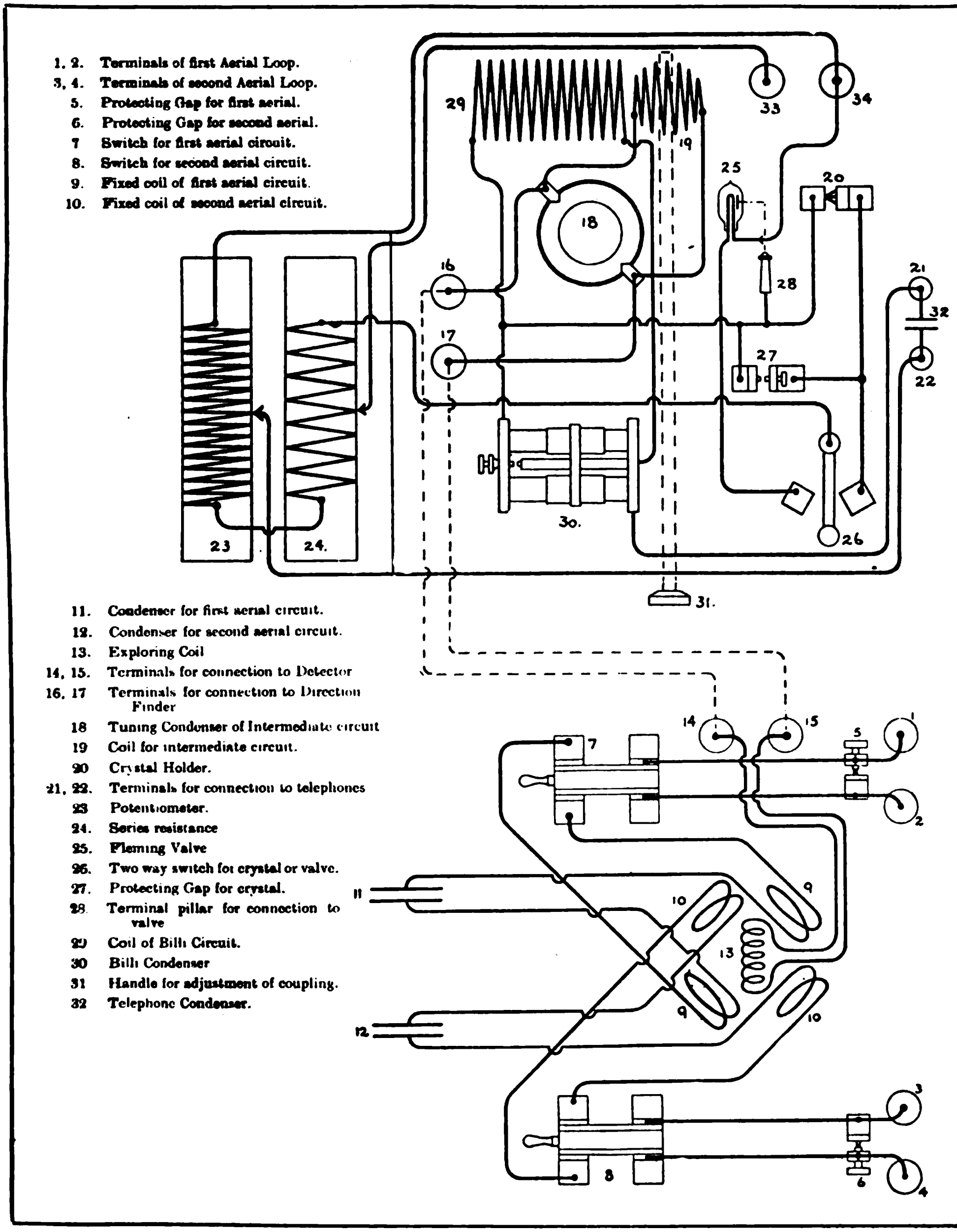
The direction finder, as it is to-day, consists electrically of two main parts, the aerial circuits and the detecting circuits. The aerial system is made up of two closed oscillatory circuits which are insulated from each other throughout and also from earth. Each of these oscillatory circuits consists of an aerial loop, in series with which are inserted a coil of wire and a condenser; the condenser is inserted in the middle of the coil of wire, for symmetry. The two aerial loops, which are of equal size, are suspended in vertical planes crossing each other at right angles. The two coils of wire are also of equal size and also cross each other at right angles in vertical planes. They are contained in a box, together with their respective condensers, which are made variable for the purpose of tuning the aerial circuit to various waves. One handle varies the two condensers simultaneously. Inside the crossed coils, a third coil called the exploring coil is mounted on a vertical spindle by means of which it can be set at various angles with reference to the fixed coils. The detecting system consists of a pair of telephones, and a crystal of carborundum, in a series with a potentiometer and battery, which are required to bring the carborundum into a sensitive condition. The detecting system is contained in a separate box, and is connected by wires to the exploring coil, which picks up the signals from the aerial circuits and hands them on to the detector, where they are rendered audible in the telephone.

Each aerial loop is a directional aerial which receives best when its plane is in the direction of the sending station. If its plane is at right angles to the direction from which the signals are coming, it receives nothing. In intermediate positions it receives signals, the induced current due to which varies as the cosine of the angle between the plane of the aerial loop and the direction of the sending station. Except in the case when one of the aerials is in a plane exactly at right angles to the direction from which signals are coming, currents are induced in both the aerials, their relative strength depending on the direction of the sending station with reference to the planes of the two aerial loops. These currents pass through the corresponding crossed coils in the direction finding instrument, and produce in the space enclosed by them two magnetic fields at right angles to each other. The two fields, whose relative strength depends on the relative strength of the currents induced in two aerials, combine to form a resultant field at right angles to the direction from which signals are coming. The exploring coil will consequently receive the strongest signals when its plane is at right angles to that of the resultant field; or in other words, when its plane is in the direction from which signals are coming. A pointer attached to the splindle on which the exploring coil is mounted indicates the position of the latter, and consequently the direction of the sending station. It has been assumed that the crossed coils are in the same planes as the crossed aerials. If the instrument is moved from this position the positions on the scale which represent the crossed aerials remain the same, so the pointer indicates correctly with reference to them.

The testing instrument consists of an oscillatory circuit composed of a condenser and a coil of wire, the wave length of which can be adjusted by a switch to either 600 or 300 meters. This oscillatory circuit is excited by means of a buzzer and battery which are switched on by the same switch that sets the wave length. The aerial connecting wires are taken past the coil of the testing circuit at equal distances, so that the two aerials are equally excited by it. If the aerials are in every way identical, as they should be, the direction finder will show a direction corresponding to the position of the testing coil with reference to the aerial connections. This is ordinarily arranged to give a direction along the course of the ship, which is 0° on the scale of the direction finder. If there is a bad connection in one of the aerials, the introduction of the resistance due to it reduces the current in that aerial and consequently alters the direction shown by the direction finder; and if the insulation between two ends of one of the aerials becomes bad, the same effect is found. When one of the aerials becomes earthed, the phase of the current in it is altered, with the result that a rotating field is produced in the direction finder, and no point can be found in which there is no sound in the telephone. The type of buzzer employed is one in which a non-inductive shunt is connected across the magnet coils, with a view to reducing the sparking at the contacts and consequently making the interruption as sudden as possible. The current which works the buzzer is passed through the coil of the testing circuits, and the electro-magnetic energy so stored is released by the sudden interruption of the current which discharges itself into the condenser, and sets up oscillations in the circuit.

The exact position of the aerials naturally differs on each ship, and is mainly a matter of convenience. Deviation, owing to the ironwork of the vessel, is practically non-existent, unless the conditions are quite exceptionally unfavorable. If it exists it is a constant factor that can be allowed for. It is generally convenient that the instruments should be in the wireless cabin, chiefly for silence, and in order to be in touch with the ordinary installation for calling up shore stations, or to disconnect the direction finder, and so protect it before transmitting on the ordinary aerial. But it can equally well be installed in the chart house, or any other position convenient for a navigating officer, which is connected with the wireless cabin by telephone.

Whatever position be fixed upon, the wires from the aerial system are led directly to the radio-goniometer box, which contains two very accurately paired air condensers with an adjusting handle and the radio-goniometer proper. One condenser is inserted in the circuit of each aerial and both aerials are thus tuned simultaneously. When the instruments have been adjusted to any arriving wave, its direction, or rather the plane of its direction, is indicated directly by turning the index handle of the radio-goniometer till the position of exact signals is found. The accuracy with which the direction can be determined depends almost entirely upon the care with which the observations are taken, as the error due to the instrument does not



Connections of Direction Finder with Tuned Receiver exceed one degree. Any error in laying out the aerials will appear in the result, because they are the base line with respect to which the observations are made. Under ordinary conditions, however, bearings can be taken within two or three degrees and the error should never exceed five degrees.

One of the occasions on which the direction finder can be used to advantage will be in time of fog. It is essential, say, for the commander of a ship to determine whether the vessel is on a course which will take her inside or outside of a lightship or isolated lighthouse. A few signals from the lightship will settle the question as surely as if lights were visible. On the other hand, a ship's position can be found either by taking bearings of two fixed stations simultaneously, or by taking two bearings of the same station at an interval of time, while keeping the ship on a fixed course. It is possible that in time of fog it will become the custom for each ship and lighthouse to send out a pre-arranged series of signals. If a ship, however, wishes to take the bearing of another ship or station within range, it can call up the latter by the ordinary wireless installation, and ask for a few signals for the purpose.

The test of the direction finder on the Northland was made under unfavorable conditions. The wireless cabin on the vessel is centrally located between two smokestacks on the boat deck and the height of the aerial above the cabin is only about forty feet. These conditions made the installation of the special antennæ difficult. They also made the vertical and base lines of the wire triangles very short, decreasing to a considerable extent the efficiency of the set. Despite these drawbacks, signals were received on the direction finder from the Marconi station at Siaconsett, Mass. These signals were accurately measured and the bearing of the Northland from Siaconsett was determined by means of the direction finder at a distance of forty-two miles. The signals from Siaconsett were strong and were good for approximately twenty to twenty-five miles more. About twelve observations were taken with various ship and shore stations in both daylight and darkness, at distances ranging from five to forty miles. In each case the results obtained were compared with the navigating officers' charts and compass. The readings were pronounced correct. A wireless message, telling of the successful result of the test, was sent to Mr. Marconi.

An inspector of the American Marconi Company, who was aboard the Northland during the test, spoke as follows regarding the invention:

"We will imagine that we are on a ship going along at the rate of fifteen miles an hour. The operator on board our ship receives a message that another ship making twenty-five miles an hour is near us. He cannot tell whether the ship is ahead, astern or abeam. Now, with the radio-goniometer equipment he receives the exact location of the other vessel, and the danger of that vessel running us down is removed, as our captain can easily change his course sufficiently to allow the faster vessel to pass in safety

"On the trip up from New York we made several tests along the same lines and, by using the apparatus after I had secured the position and bearings of the Northland from a certain point, I compared my figures with the captain's compass and charts and found that we were absolutely correct.

"The apparatus will be particularly valuable in foggy weather, as ships will be able to know their position at all times. On many vessels the captains lay their course for the Nantucket light vessel, and after they have made the light vessel they trace their course to another point. Often they run inside of the lightship and often they miss sighting the light vessel. That danger is removed by the radiogoniometer, as the Nantucket light vessel is equipped with the wireless."

Hoodoo Jenkins' Cowardice

A Fiction Story

By **WALTER S. HIATT**

If since the day you were born your existence had been a series of mishaps, often resulting in injury and even death to others, and you were asked to take charge of the wireless equipment of a dirigible balloon, what would you do? That is the problem presented to Hoodoo Jenkins. The story tells how he worked it out.

"WELL, my hearty, will you come with me?"

The person who put this question to Hoodoo Hero Jenkins was Mademoiselle Marie, lady aeronaut. Scheduled to give an exhibition of plain and fancy air navigation at a New Jersey seacoast fair, she had discovered at the last moment that the wireless man engaged to complete the exhibition by sending messages from the sky had failed to appear. Whereupon Jenkins had been routed out of the crowd, presented to this wonderfully striking young woman, and offered one hundred dollars to fly with her in her dirigible balloon runabout.

Jenkins, short, tough as a cypress tree, face fairly shining with hope, stood uncertainly and looked into the handsomest pair of eyes that he had ever seen. They were blue, sea blue, blue-grass blue, full of bold beauty, yet softened by an indefinable, indefinite flash of modesty lurking in them.

It seemed to him that he would give his soul for the asking to the tall owner of that pair of eyes; which made it hard to refuse her request. Besides, he needed that hundred badly. But what could he do? From experience, he knew that should he go up in that balloon a fatal accident would happen, one that would probably result in the death of the fair aeronaut.

"But I'd rather not," he replied lamely to her still questioning eyes. "I don't like the looks of the sky. There might be an accident."

A gleam of insolent scorn flashed out of her eyes and burned him to the quick.

"So you're afraid, my dear little one; that's the way the wind sets? Fear not! I assure you that I'll take good care of you." The men holding the ropes laughed at this sally. The blood rushed to the face of the operator; but he still hung back.

"I'm afraid—for you," Jenkins explained simply, in a low, earnest undertone.

Mademoiselle Marie's face lighted with a certain pity. She had nothing but scorn for the unmanly excuses.

"Oh, please come," she begged; "the crowd is waiting."

"You see I'm not very lucky—" Jenkins interposed, desperately trying to tell her why she should not fly with him.

But Mademoiselle Marie, unaccustomed to refusals, would not listen. She had in the brief moments of the conversation observed the evident admiration of the man for her, and so she now unceremoniously took him by the shoulders and bundled him into the car.

Jenkins had wanted to tell her that he had lost every job he ever held because of the accidents that happened to the ships he had sailed with. Every ship he had set foot on, except submarines, had blown up or broken up or burnt up or run ashore or been run down. That was why he was out of a job now. Superstitious, the captains wouldn't have him any more, although he had the reputation for always doing the best he could in time of danger. That's how he got the name of the Hoodoo Hero.

While his heart wanted to tell all this to Mademoiselle Marie, his lips said: "All right, I'll go." So soon as he said these words, Jenkins' face illumined with a bright smile. He hoped for the moment that nothing would happen. Hope was his strong point.

The blue eyes of Mademoiselle Marie danced joyfully. She would now be able to give in all of its perfected completeness her famous exhibition.

"Fine!" she exclaimed in her picturesque slang. "Just move along to your seat. You'll find your instruments in order, I guess. Let's give these rubes a run for their money and then we'll drop over to a roof garden in New York tonight and have a bite to eat all by our lonelies."

Jenkins' face grew brighter yet with hope when he heard this. He resolved that if he could escape an accident this time, and enjoy with her the promised evening, he would cheerfully accept all the overwhelming catastrophes that might come ever afterwards.

Mademoiselle Marie gave some quick orders to the helpers, took her place at the steering gear, made a few deft motions with her hands, and soon the earth began dropping beneath them. A wild cheer broke from the upturned faces of the vast crowd of people below; the continued cries growing fainter as they quickly swam upward at a gentle angle.

Reaching the thousand-foot level, Mademoiselle began her convolutions; she dropped the dirigible up and down, spun about in lazy circles for a few minutes to show the crowd the ease with which she could manipulate her machine; darted here and there with seeming recklessness, and slid dizzily down on a great S until Jenkins could see the rushing to and fro of the frightened crowd. As she reached the tail end of the S, while the crowd stampeded to get out of the way of the falling projectile, she righted and sharply wound upward along the twisted track.

"Look at the boobs," exclaimed Mademoiselle Marie, turning her pair of twinkling eyes in Jenkins' direction. "They're afraid of having this machine fall on them. My, how they'd like to see us fall and break our necks! How would you like to fall?" she asked mischievously, with a mocking curl of her firm rosy lips.

"Oh, I'm not afraid with you," he replied. "You certainly are some aeronaut. But please do be careful." There was no need to tell her just how afraid he was, nor why. The proverbial bad luck would come soon enough without coaxing it along. Then, too, it might make her nervous to suggest his trail of misfortunes.

"I promised you I'd be careful and bring you back safely to earth and I will, little boy," cried Mademoiselle Marie, as she toyed with the self-starter and threw the switch open. An answering roar told him that the propeller was revolving swiftly. At the same time the machine quivered and they rushed upwards again. A peep at the barograph a few minutes later told him that they were past the first thousand-foot mark. She held her planes at a dangerous angle as they sped on, upwards. She was giving the spectators their money's worth and at the same time, he fancied, amusing herself by trying to frighten him. Assuming a composure he did not feel, Jenkins leaned over the rail and glanced anxiously at the land as he observed the hot, stifling vapor of the early afternoon, warning of weather changes. He could see the shore line indistinctly, where the flat land met the flatter sea.

When the dirigible must have been but a mere fleck of cloud to the people below, Mademoiselle Marie brought the planes to a level and began circling on even keel.

"Now you can do your part of the job," she announced. "Just put your fist on the sending key and tell the operator waiting down there that we are now some 4,500 feet high and that Mademoiselle Marie sends greetings to the rubes and invites them to call on her."

The Hoodoo Hero dropped the aerial radiator over, received an answer to his call, and clicked off the message.

The land operator gave his O K, but before signing off sent this:

> FAIR MANAGER SAYS TO HURRY WITH THE REST OF YOUR PERFORMANCE, AS THE WEATHER IS THREATENING. CROWD MAY LEAVE.

Jenkins repeated it to his companion. "Tell him we will try to give the water act and a full performance," she said, with a brisk toss of her head that made her hair glisten like gold in the white light.

With a Swift Movement He Leaped Into the Angry Waters

The rest of the performance included a gliding stunt over the sea, which could be properly seen only from the grand stand overlooking the beach. This feature, intended only for the eyes of those who had paid an additional fee, consisted in disappearing entirely in the sky in a landward direction and then, while the crowd was wondering if she was lost for good, to double back and suddenly reappear from the unobserved sea side of the crowd.

She rapidly explained her trick to Jenkins. "Have you got the nerve to get out of sight of land?" she demanded, with a steadfast gleam in her eyes.

"I'd rather not. It's not quite safe to go so high with a storm threatening," he objected. "Oh, bother!" she exclaimed, in a tone eloquent of her annoyance. "It advertises my act. Of course, if ——"

Jenkins saw that she was about to use the despised word, "coward," and he could not bear to have her say it.

"All right, go ahead," he interrupted, briskly.

Mademoiselle Marie grasped the steering wheel firmly; again the motor roared and the propeller whirred and tore at the air. Up, up, up they went into that brassy sky until the earth disappeared from view. Then they soared about and sped seaward. They ran thus for perhaps twenty minutes. Jenkins kept on his head 'phones and listened in to the messages flying along the coast. The noise of the motor made hearing difficult, but he managed to catch one message from the Caronia, fifty miles out, telling the Baltic that it was raining cats and dogs, with promise of a blow. "The bottom is falling out of the barometer," it added.

Jenkins shouted this message to Mademoiselle Marie.

"I should worry, brother," she replied. "We're almost far enough out now, so we'll begin dropping soon."

They sped on in silence, the air growing colder with every turn of the propeller. The white light, too, began to shade. Presently Jenkins' ear caught an ominous sound. The engine skipped an explosion. Pale as death he glanced at his fair companion. Intent on steering, she had not noted it. Jenkins, still afraid of that cold, disdainful word "coward" on the curl of her lips, waited for further warning. Listening intently, he heard the engine skip three beats in quick succession. Now he was certain. The Hoodoo Hero was again on the job. Ten to one they were running on the dregs of the gasoline tanks.

He looked quickly at his partner. There was an answering gleam in her eyes—not one of alarm or of fright, but of recognition. She had heard too. It was plain to both that soon their flight would come to an end. How and when? It was a detail hardly worth considering. He saw that Mademoiselle was preparing to drop, possibly hoping to reach land before the last of the gasoline puffed away.

"Hold her steady," he cried, with a warning gesture. A new note of command rang in his voice, the note that had won for him the "hero" part of his title.

His instruments crackled the call of the land operator with whom he had been in communication, and told him to get motor boats out to sea to search for them in case they had to abandon the dirigible. He received his O K, none too soon. Already the beats of the engine were coming more and more intermittently.

"Now you can volplane!" he shouted to the pilot. "I've sent a message that will give a real thrill to that crowd you were so anxious to interest."

"Nix on the sarcasm, Bill," and she smiled in that wonderful way of hers.

The glide was abrupt, yet not so steep as to send them tumbling through space at the first sharp gust of wind they met. Soon they began to meet shifty air currents, and then the sea appeared as a dark flat surface far below them, faintly disturbed by tiny tossing caps of white. The shore line seemed like a huge, endless cable cast adrift.

Could they make that shore line before their carrier, robbed of its motor power, and heavily weighted, settled into a sea that soon would be raging?

Jenkins looked at the woman and she looked at him. Neither could answer that dreadful question. But if the silken bag of gas overhead would only breast the wild winds, Jenkins thought he knew a way to keep Mademoiselle Marie afloat until help came.

"Don't be afraid, there's a chance yet," she called, seeming to divine his thoughts.

A grim smile crept about the lips of Jenkins as he heard her use that word "afraid." He would show her how much afraid he was. He had not been called "hero" for nothing, even if it had the "hoodoo" qualification.

Just then the wind gave a decided answer to the question of reaching that straggling shore line. It broke from off the land in a diagonal direction from the south, carrying them rapidly off shore. Jenkins took another look at the sea, where the rollers were now beginning to pile up under the first blasts of a yoke-of-oxen gale. A tiny motor boat was racing along, vainly trying to follow their course.

Then, as the runabout kept dropping lower and lower, splashes of spray began to leap up and snatch at them; the wind fell off and veered, carrying them again inshore.

"O joy!" shouted Mademoiselle Marie, with a laugh in which there was a catch. A new danger had arisen.

For just as the wind began to seem favorable, the peril from the vicious waves presented itself. With the dull thud of a piece of lead, a cross wave broke aboard and drenched them.

Jenkins saw a greater one flying towards them. Death was in it. The weight in the machine must be lightened. "Good bye, sister!" he called, flinging off his coat.

She reached over and grabbed him. "If you go, I go too!" Admiration was shining in her deep blue eyes.

"I'm some swimmer—for a coward," he answered, trying to twist a choking sob into a laugh. With a swift movement he threw her to the bottom of the car and leaped into the angry waters. As he sank, he saw the lightened car sweep onwards toward the shore.

The hungry maw of the sea reached out and grabbed him, tossed him up like a ball, rolled him over and over, and dragged him down like a bucket in a well. Then, gasping for breath, his eyes struggling for light, he came up in the hollow of a great wave. Again he was churned and rolled and smashed, carried in the grasp of a myriad-fingered monster. After a world of night, he rose upon the crest of a wave for an instant. He saw the runabout gliding shoreward to safety. With a tired sigh he closed his eyes.

A long while afterward he was vaguely conscious of muffled voices and a strange rocking motion. His eyes opened and he discovered that he was being borne up the beach by a group of life guards. He felt himself lowered to the soft, warm sand.

Two arms stole about his neck. The blue eyes of Mademoiselle Marie looked into his; their lips met. The Hoodoo Hero struggled to his feet, as if prodded with a live wire.

"Say, how about those eats all by our lonelies?" he demanded.

"Surest thing you know," came the response in a tone that suggested a long series of cozy dinners à deux.

Annual Meeting of English Marconi Co.

At Which a Final Dividend of Ten Per Cent Was Declared—A Policy on Radiotelephony Outlined—Nearly a Half-Million Dollars Was Set Aside for a Reserve Fund, and Development Along Broader Lines Was Announced

REPORTS of the world-wide progress and development made by the Marconi system, of interest to the public as well as to the stockholders of the corporation, were brought out at the sixteenth ordinary general meeting of the English Marconi Company held recently in the Whitehall rooms in the Hotel Metropole, London. The plans for development include the formation of a new Brazilian company and the Betulander Automatic Telephone Company. It was announced that the directors of the English Marconi Company had recommended the payment of a final dividend for the year 1912 of ten per cent. on both classes of shares, and that they had also appropriated $486,600 for a reserve account.

Reference to Imperial Scheme

Interest and applause marked the meeting. Mr. Marconi, chairman of the Board of Directors, in his remarks, referred to the contract entered into by the English company with the British government regarding the imperial wireless scheme and said that when he had addressed the stockholders on a previous occasion on the same subject he would not for a moment have believed that the spirit of fair play in this country could have reached so low an ebb. Godfrey C. Isaacs, managing director, mentioned the criticism which had been aimed at him and thanked the stockholders for their loyal support throughout. In referring to wireless telephony Mr. Isaacs stated that "until the Marconi Company is prepared to say exactly what definite results in a practical way can be obtained from wireless telephony it will remain silent."

The Company's Share Transactions

In his opening remarks Mr. Marconi spoke of the report of the directors. "We have endeavored in that report," he declared, "to dispose of the misunderstandings which seem to have prevailed in some directions respecting the patents and shares in associated companies, and I hope we have now made it quite clear that there is no such thing in our accounts as profits derived by means of writing up shares."

Mr. Marconi said that he wanted it understood that the company does not buy and sell shares, in the meaning which is generally given to those terms. "Such share transactions as we enter into are closely allied," he declared; "in fact it would be difficult to separate many of them from business which would come under the heading of contracts. To give an example; speaking in a general way, we may enter into an agreement to erect certain stations or do certain work, all of which, of course, is the legitimate business of our company, for which it may not be convenient at the time to pay us in cash. In such cases we may receive payment in shares. In due course we will dispose of a number of these shares and turn them into cash. The fact, however, is that the money which we have received for those shares is a payment for contracts executed, services rendered or whatever the particular consideration may have been. If we are fortunate enough to dispose of shares higher than the par value or the price at which they have represented payment to us, so much the better for our profit and loss account. During the past year, as is well known, and as we have stated in our report, we benefited in this way, and accordingly we think it prudent to take advantage of the occasion and allocate £100,000 ($486,600) to a general reserve account."

Mr. Marconi's remarks regarding the imperial wireless scheme were greeted with cries of "hear, hear." He declared that he would not have believed that "for such considerations which obtained in connection with the whole of this campaign a British industry such as ours should have been so imperilled." He continued as follows: "I would remind you that wireless telegraphy has become an industry of considerable importance, and we are, and for many years have been, the only company maintaining British supremacy throughout the world in this industry, and always in the keenest competition with foreign companies. We manufacture on a very large scale in this country and give employment to an immense number of British subjects. I think that it should not be easily forgotten that, while this company is carrying on a remunerative business for its stockholders and establishing a large industry, it is also accomplishing work of the highest importance for civilization by facilitating and cheapening telegraphic communication between England, its colonies, and foreign nations, besides greatly reducing the peril of ships at sea. Has it been our fault and have we been deserving of the treatment to which we have been submitted because we have been the only company to maintain British supremacy in this wireless industry?

The Action of Parliament

"It has required the most strenuous efforts on the part of our managers and administrators to protect our interests abroad during all this period, and I am glad to say that we have succeeded in doing so. But it must not be supposed that much of the programme which we had in immediate contemplation when we addressed you last year has not suffered some delay. Our accounts speak of the progress which we have made, but that progress would have been far greater to-day had it not been for the circumstances to which I have just referred. When our tender for the construction of the imperial stations was accepted in March last year, we considered, as we had every right to do, that we had entered into a definite contract requiring only such minor modifications, if any, that we might be willing to agree to in the actual wording of the agreement itself and to the formalities of ratification by Parliament. I use the word, 'formality,' for I cannot learn of any instance when a contract has been negotiated by a number of government departments, all of which were in continuous consultation, each putting forward proposals and suggestions and doing its utmost to obtain everything it could reasonably demand and support, and, finally, all being parties to the striking of a definite bargain. I cannot learn of an instance where Parliament has ever before had recourse to the sledge-hammer power which it possesses of placing a private enterprise in such a position that its only alternate to making further concessions demanded of it would be the imperilling of its reputation and business throughout the world.

Plans of the Brazilian Company

"Such has been the anxious and responsible position which your directors have had to face, and it is therefore with no small degree of relief and satisfaction that we have been able to inform you that, notwithstanding Parliamentary intervention, we do not believe that the altered conditions of the contract will prove of any material disadvantage to the company—but thanks only to the strong position which our company holds. We have also great hopes that the company, having emerged successfully from such a severe and ruthless attack, its reputation abroad will have been not only maintained but enhanced."

Mr. Marconi declared that the business of the company continued to make most satisfactory progress. He said that since 1910 the company had been making efforts to open telegraphic communication between Europe and Rio Janeiro and other centres of the Brazilian Republic. The president of Brazil, he declared, had signed a concession for this enterprise for a period of fifty years. He spoke optimistically of the formation of the Brazilian company. "At the earliest possible moment," he said, "we shall form a new Brazilian company which will purchase from us our long distance rights together with this concession, and every effort will be made to construct the stations with the least possible delay. The new company will no doubt enter into an agreement with the American company by which the station to be built at Para will conduct a service with New York and other parts of the United States. We hope that this work will be the start of a network of stations opening up cheaper telegraphic communication between the South American States, Europe, the United States, and other parts of the world, which should not only secure to this company a substantial, increasing and lasting revenue, but add considerably in value both to our interests in the American and other of our subsidiary companies. We regard the completion of these negotiations as the laying of the foundation stone of one of the most important edifices in the world of wireless telegraphy which will further cement the business which the company is creating independently of any competition and irrespective of all patent rights."

Subsidiary Companies Doing Well

The progress of the subsidiary companies is very satisfactory, Mr. Marconi declared. He said that "we are each year coming nearer to the time when, with the completion of long distance stations either under construction or about to be constructed, we shall realize the principal source of profit and the one to which we attach most importance to be derived from wireless telegraphy." He remarked that the construction of the long-distance Norwegian station had been commenced and commented favorably on the assistance which the Norwegian government was giving to aid carrying on the work.

The increased business of the Marconi International Marine Communication Company, Limited, necessitated the issue of more of the authorized capital of that company. "The business of the company is sound and continually increasing, and I have every hope that the dividend for 1913 will show an increase over the ten per cent. paid for the preceding year," declared Mr. Marconi. "I have reason to believe that the directors of the company intend in the future to pay six-monthly dividends, an interim at the end of the year, and a final upon the completion of the accounts."

Growth of the Russian Company

To such an extent has the business of the Russian Marconi Company grown that it has been necessary to increase its capital and it is planned to make a further increase. Consent was obtained from the Russian government, Mr. Marconi said, for an increase of 600,000 rubles ($309,000) and authority has been asked for a like sum. He added that there was a plan in contemplation to convert the shares into shares in a trust company, in order to have a market for them in England. In Australia a new subsidiary company has been formed and considerable business has been transacted by the English company with the Italian government, which is giving a full measure of support to the Marconi enterprises.

A hint regarding the plans of the company to expand in the future was given by Mr. Marconi in the following words: "We have other important negotiations pending about which, however, we cannot give any particulars at present. Shareholders may rely, however, that, as and when they are completed, full information will be immediately communicated to them."

Mr. Marconi believes that there is a good business future for the automatic telephone. He declared that "your directors resolved to avail themselves of the opportunity of securing the patent rights of what they are advised and believe to be the best automatic telephone. That a very considerable business is to be done in automatic telephones there is no doubt, and the world-wide organization which we possess should be an asset of considerable importance to the development of such a business." The Betulander Automatic Telephone Company will purchase from the English Marconi Company the patent rights and take over the contracts and negotiations which have already been entered into in various countries. The system will be shown in operation at Marconi House, where visitors will have an opportunity to inspect it.

In speaking of the growth of wireless telegraphy Mr. Marconi said: "Although there is no doubt that wireless telegraphy is in a condition of rapid development, I think that it can safely be said that this method of communication is based, and will continue to be based, on the production and utilization of electric waves. Now there is no mystery about electric waves, to my mind. They can vary in length and intensity, or they may be continuous or discontinuous.

Spark and Continuous Systems

"There seems to be a prevalent misconception in the lay mind that continuous waves are in some way essentially different from the discontinuous waves produced by what are called spark systems. Such a view is quite erroneous. The Marconi Company possesses methods of its own which permit it to utilize when and where it may think desirable either a spark system or a continuous wave system, and this was demonstrated to the members of the Advisory Committee appointed by the government during the tests carried out for them between Clifden and Glace Bay. My system of continuous waves is now installed and in working order at the Transatlantic station at Clifden. Important tests are now being conducted, but considerable work and time are required before it will be possible to determine in a definite manner whether the continuous wave system possesses advantages for long-distance transmission over the discontinuous, or what is called the spark system. In any event I think it well to make quite clear that this company possesses efficient methods for utilizing either system. As in the past, we have this year applied for several, and what I believe to be, valuable patents which embrace further important improvements in the transmitting and receiving apparatus."

What Others Have Tried To Do

Mr. Marconi next spoke of trans-ocean work, saying: "I should like, without in any way desiring to belittle the attempts made by others, to establish communication by means of wireless telegraphy across the Atlantic Ocean to point out to shareholders that the achievement of telegraphing across the Atlantic is not such an easy matter as it may appear, and I think that the public, and even distinguished inventors, have erred on the side of optimism with regard to what they expected would shortly be done.

"During the last few months we have read in the public press that communication was shortly to be established between Europe and America by means of the Poulsen or Goldschmidt system. I should like to remind you that Professor Fessenden, writing in the Electrician, issue of February 22, 1907, said that in January, 1906—that is well over seven years from this date—he received messages in Scotland from Massachusetts with an expenditure of less than one kilowatt of electrical energy. Again, the Poulsen Company, in the Electrician of November 15, 1907, nearly six years ago, stated: 'The engineers of the company are very confident that they will succeed in printing transatlantic messages, and are positive that they will not be limited to telephonic reception.' Then again, with regard to the De Forest system, we have the following extract from the Electrical Review of April 6, 1906—seven years ago: 'The daily press announces that the De Forest Wireless Telegraph Company has sent messages from its station at Coney Island to Ireland, a distance of 3,200 miles. On one night 1,000 words were transmitted, of which 572 were received and recorded.' It is further added that when the correct pitch to use for Ireland has been ascertained, commercial work will be started across the Atlantic. It is then proposed to send messages from San Francisco to Ireland, with two relay stations.' None of these systems I have just mentioned has yet succeeded in establishing a service of any kind across the Atlantic, notwithstanding these statements which were made six or seven years ago."

Prudence in Business Policy

The financial affairs of the company were touched upon by Mr. Marconi as follows: "In view of what I said at the meeting last year, no doubt there was some little disappointment at our not declaring a second interim dividend in December last, and also that we should have decided to recommend a final dividend for last year of ten per cent. on both classes of shares, which, as you know, represents seventeen per cent. for the preference and twenty per cent. upon the ordinary. The unforeseen circumstances, however, which occurred since my last address have dictated a policy of prudence with which I feel sure shareholders will not quarrel."

In explanation of the establishment of the reserve fund of $486,600 Mr. Marconi says that "In a new industry such as ours developments are continuous and lead frequently to sudden and substantial demands upon our resources." He declared also, that "we have thought it wise, therefore . . . to carry forward to the next account £146,000 ($730,436.)"

In concluding his remarks regarding the financial affairs of the company Mr. Marconi said: "The final dividend of the year must, of course, be declared at the general meeting, when the accounts have been passed by our auditors. At the end of each year, however, we should be in a position to estimate approximately the profit earned during the year, and so decide upon any interim dividend which should be declared and paid at that period. By adopting this course, assuming our business continues to progress as we hope, distributions would take place six-monthly."

Mr. Marconi then took occasion to defend and praise Mr. Isaacs. "Your managing director, Mr. Godfrey Isaacs," he said, "has been subjected to a great number of most ungenerous insinuations which never could have been made by any one personally acquainted with him and which could not be and are not believed by any one who knows him, or who has worked with him. But it would appear in this country, as in most others, when politics is introduced, an atmosphere prevails in which there would seem to be let loose some pernicious element destructive of the equilibrium of an otherwise well-balanced mind.

"I think Mr. Isaacs merits the most sincere congratulations of the shareholders on having carried on the business so successfully during the past year under the great difficulties which I have rereferred to, and considering what a great amount of time was taken up in defending the interests of the company and even in protecting his own honor and reputation, all of which he has done so effectively."

Mr. Marconi next made a motion that the report of the directors and the statement of accounts be submitted, approved and adopted. He called upon Mr. Isaacs to second the motion and the latter said:

Mr. Isaacs' Tribute to Mr. Marconi

"It would be idle for me to pretend for a moment to you that the troubles which we have gone through during the past year have not been of an extremely painful nature to me, and it has required all the assistance, the support, the confidence, the loyalty and the encouragement which I have received, firstly from our illustrious chairman; secondly from every single member of my board; thirdly from every manager and head of department throughout the whole of this great Marconi organization, and fourthly, and to which I attach no small degree of satisfaction, the immense number of letters which I have received from stockholders not only throughout this country, but I think I may say throughout the whole world, in which they have expressed their deep sympathy and their absolute confidence. Under these circumstances, and largely due to these circumstances, one has been able to face a condition of things which became well nigh intolerable."

Mr. Isaacs mentioned the activities of Mr. Marconi and said that he had taken out within a comparatively recent date a number of important patents which "I feel sure are going to play a part at least as important, if perhaps even not more important, than the patents which he has taken out in the past." Mr. Isaacs continued as follows: "We shall no doubt see further important developments in which we are engaged, and which we look to him to continue to pioneer, and I am confident that so long as he is with us, we, the Marconi Company, will continue to pioneer that great science of which he is the inventor. We all know that, through Mr. Marconi's genius, when we go to sea we are able to receive telegrams with our morning cup of tea from those whom we have left behind.

Wireless Telephony Coming

"I am not very fond of prophesying, but I am going to venture on this occasion to prophesy that the date is not far distant when with our cup of tea in the morning we may hear the ring of the bell and, taking our telephone from its hook, we may talk to those whom we have left at home; we may tell what sort of a night we have passed and learn what sort of a night they have passed, and be able to speak of the disposition we may feel toward our coming breakfast. The Marconi Company has not made it a habit, and I think in that they have perhaps been influenced by the modesty which we all learned to love so much in our chairman—to boast at any time of the work it was doing or contemplated doing. I suppose you have all read, as I have frequently read, paragraphs in the papers speaking of the wonderful things which were being done by those whose names perhaps most of you do not know, in connection with wireless telephony. Well, all I want to tell you is that whatever you have read in the papers as having been done by wireless telephony, the Marconi Company has done more. We shall perhaps at an early date be able to turn wireless telephony to practical commercial account, and it will then be time enough to speak.

"Some of our shareholders have, perhaps not unnaturally, been a little disappointed—or shall I say a little impatient—in connection with the progress, which was a little slower than they would have liked, of one or two of our associated companies; but I would ask you to remember that in an industry of this nature a little time is required in any country for the development of that industry and to turn it to profitable commercial account. I would ask the shareholders to bear those facts in mind. There are innumerable difficulties to be surmounted, particularly when you remember that for the most part one has to negotiate with governments abroad and who are much the same as the government we have here. Government departments do not move very quickly. A little time is required for those companies to pull themselves together and to become profitable investments, and a little patience is accordingly wanted from those who hold the shares. I would ask for that little indulgence in so far as it is possible for such of our associated companies which have not yet entered the dividend-paying stage. I had intended to endeavor to give some assistance to certain of those companies by paying visits to them. I had arranged to leave early this year and spend a little while in America and a little while in Canada. I had also intended spending a little time in Spain, but the circumstances which we have had to meet during the last twelve months made it quite impossible for me to leave London."

Pension Scheme For Employes

Mr. Isaacs said that the directors of the company had almost completed arrangements for a pension scheme for the benefit of the members of its staff. He echoed the remarks of Mr. Marconi regarding the satisfactory progress of the company's business and said that "our principal attention is directed to the creation of what we believe will be the most profitable side of wireless telegraphy in the shape of constructing and conducting long-distance telegraph services throughout the world." He declared that the realization of that end was coming nearer and nearer. "In the course of a little time," he said, "when many of the stations which are now under construction, and in a little time more when many of the stations which are about to be constructed are completed, you will realize that we have created a sound, substantial and profitable business, which will be entirely independent of whether or not others are able to introduce something which Mr. Marconi has not previously thought of in connection with wireless telegraphy."

Considerable amusement was caused by a question put by Reginald C. Corry, who asked for information regarding how the "rumor managed to get about that there was a question of something between thirty and forty per cent. dividend being declared at this meeting." Mr. O'Brien, a member of the firm of Grenfell & Company, official brokers for the English Marconi Company, said that he had no knowledge of such a rumor.

Mr. Woodward, a shareholder, said that he wanted to congratulate Mr. Isaacs and the members of the board "on having had the courage to maintain the dividend simply without any increase on the present occasion, putting by such a large sum as £100,000 ($486,600) to reserve." He followed this statement with the remark that he hoped "as a small stockholder in this company that, if you do see your way to increasing the dividend a little in the future, you will only take that step if you see your way to maintaining the increased dividend."

Mr. Marshall, a shareholder, said that he had noticed that there was a contingent liability upon the shares in associated companies of £51,000 ($248,166). "Are those shares at a premium or at a discount or would any of the money be lost at the present price of the shares?" he asked.

He was answered by Mr. Isaacs who said that "in our opinion they are fully worth their par value at least." He said that he believed that they would soon be quoted at a fair and reasonable premium. "The amount represents calls which have not yet been made because the money has not been required," he declared. "It is in conjunction with work which is being carried out and from which we hope to obtain a substantial revenue by and by."

The following resolutions were adopted:

The Directors Thanked

That a final dividend for the year ending December 31, 1912, of ten per centum on the 250,000 cumulative participating preference shares be paid on October 1, 1913, to the members who are on the register as present holders thereof.

That a final dividend for the year ending December 31, 1912, of ten per centum on the ordinary shares be paid on October 1, 1913, to the members who are on the register as present holders thereof.

That the retiring directors, Commendatore Guglielmo Marconi, Alfonso Marconi, and Captain H. Riall Sankey be re-elected directors of the company.

That Messrs. Cooper Brothers & Company be re-elected auditors for the coming year.

Mr. Marconi announced that "an interim dividend in respect of the year 1913 of seven per centum on the 250,000 cumulative participating preference shares will be paid on October 1, 1913, to the members who are on the register as present holders thereof."

After a resolution expressing the thanks of the shareholders to the directors for their management of the affairs of the company had been adopted, the meeting adjourned.

The Report of the Directors

THE report of the directors for the year of 1912 showed that the gross profits of the company amounted to £537,243 4s. 11d. ($2,614,225.63). The gross profits of the preceding year amounted to £214,407 1s. 4d. ($1,043,304.79). The total cost of shares and patents shows an increase over the figures of the preceding year of £347,596 0s. 4d. ($1,691,402.22). This is explained in a great measure by the addition of shares in the American company, which were acquired at par. As compared with the preceding year, the total par value of shares shows a decrease of £480,139 19s. 6d. ($2,336,356.95). This decrease is due principally to the readjustment of the capital of the Argentine company. There has also been a change in the management and directorate of that company. The construction of a high-power station in Argentine has been started, with the view of establishing direct wireless service between that republic and England.

In referring to the American Marconi Company, the directors call attention to the fact that that company declared a dividend of two per cent. for the year ending January 31, 1913. Reference is made to the stations in course of construction at San Francisco and the Hawaiian Islands. "It is hoped that before the end of the year," the directors declare, "we shall see a wireless telegraph service in operation between the United States and Japan, which will then be extended to the Philippine Islands and China. The contract with the Norwegian government having been ratified by the Norwegian Storthing, a further transatlantic station will be erected immediately to conduct a telegraph service direct with the north of Europe."

The report notes, too, that "important negotiations are in progress with South American states, which should result in the construction of additional stations in the United States in the early future, and open up direct wireless service between North and South America." Mention is made of the fact that automatic sending and receiving apparatus has been supplied at the stations, by means of which it is possible to transmit messages at the rate of at least 100 words a minute.

New types of stations, including one for transportation by cart or motor car, and another for transportation by horses or camels, have been added to the equipment of the English company. Another new type of station supplied is to be used as a permanent station where space is limited. Important orders have been received from the British and other governments for field-station apparatus. The total sales of this kind of apparatus have nearly doubled during the year 1912.

The old contract for the construction of the imperial stations is no longer considered binding, the directors declare, and a new contract has been made.

"Notwithstanding all that has been stated and published in recent times respecting the continuous wave system of wireless telegraphy," the report asserts, "experience has not yet proved that that system will be capable of conducting a long-distance telegraph service as efficiently as the slightly damped spark system at present in use. Mr. Marconi has invented what your directors believe to be the simplest and most economical method of generating, transmitting and receiving continuous waves, and he alone has been able to transmit messages across the Atlantic by a continuous wave system, of which a satisfactory demonstration, and the only one, was given to the Advisory Committee appointed by the government." Further tests are being made, the directors say.

It is expected that the high-power station, in course of construction at Carnarvon, will be opened for service during the present year. It will be used to conduct a direct service with New York.

"The successful arrangements," says the report, "made in April, 1912, for placing share capital of the American company have recently been made the subject of legal proceedings by Mr. O. Locker-Lampson, M.P., and Mr. P. E. Wright against the company, your directors and other persons. Within the last few months, and shortly before the issue of the writ, these gentlemen acquired two and one shares, respectively, of the company. Mr. Locker-Lampson has since increased his holding by twenty shares. No relief is claimed against the company, which is merely joined as a nominal defendant." The report asserts that the apparent object of the suit is to impeach the action of the directors and other persons in connection with the share capital arrangement.

The report also notes that the suit for infringement of patents against the National Electric Signaling Company was heard in New York last June, and that Guglielmo Marconi gave evidence.

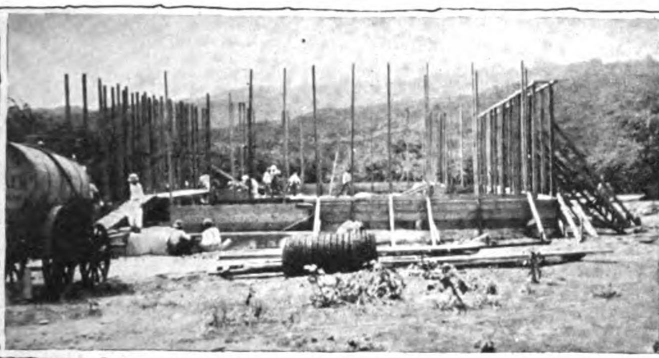
Progress at the High Power

The Operating Building at New Brunswick, where all the Edifices combine sightliness with utility

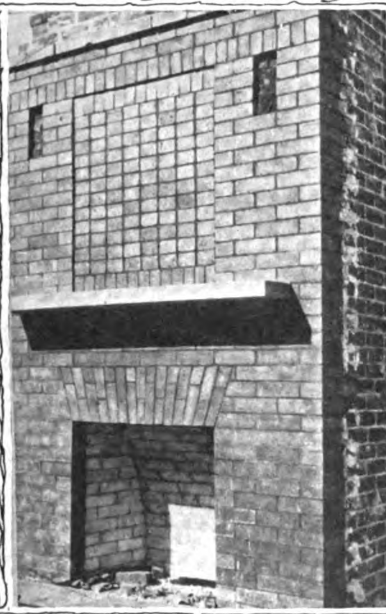
A blast at the Marconi Company's Honolulu Stone Quarry

The first of the erection topmasts and cages, upon their arrival at New Brunswick

Stations told in Pictures



Operating Building at Honolulu receiving site, as it looked six weeks ago.



A good example of the handsome tapestry brick fireplaces in the Operators' Homes lending an air of coziness to the living rooms

Completing the first floor of the Assistant Engineer's Cottage at Marshalls, a fine type of the Modern fireproof bungalow.

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By WM. H. PREISS, R. E.

ARTICLE I

The Necessity for Mathematics

1. An important tool for the experimenter, whether amateur or professional, is a working knowledge of the essential principles of mathematics. So often has this subject been taught as philosophy—an exercise in thinking—that many men have labeled it "theoretical" as distinguished from practical.

But is this just when mathematics is necessary common sense applied to laboratory observations?

For example, with its help the dimensions of inductances or capacities can be predetermined to any degree of accuracy, and that extremely elusive quantity, the "equivalent radio-frequency resistance," can be calculated from the reasonance curve. Then, too, all general statements of the conditions of a circuit with regard to damping, wave length, voltage and current can be obtained from mathematical equations.

2. At first glance, the principles appear as numerous and as codified to the uninitiated as the combinations and form of the radio operators' telegraph code do to the layman. Yet the principles are few in number and written in a simple manner. For instance, the processes of arithmetic, addition, subtraction, multiplication, division, raising to a power (evolution), and finding the root (involution)—are the only operations used in algebra up to quadratic equations.

Algebraic Language

3. To give an idea of the power and exactness of mathematical method, we consider the following important problem:

In direct current work we are chiefly concerned with the resistance, voltage, and current in a circuit. Ohm's Law, which states that the voltage is equal to the product of the current and the resistance, gives us a direct relation between these quantities. If we call the voltage E, the current I, and the resistance R, we express Ohm's Law in simple algebraic language by $E = R \times I$. We have represented quantities by letters and connected these letters by the sign of equality, according to a physical law, which gives us the true engineering *algebraic equation.* What at first arrests our attention is the simple form such an expression takes. We are next impressed by the fact that it gives an answer for any number of cases where we know all but one of the quantities involved. For example, suppose the resistance of a wire to be equal to 5 ohms and we desire a current of 2 amperes to pass through it; what is the voltage we must apply at the terminals of the wire? In practice such a problem often arises.

Example—

$$E = R \times I$$
$$E = 5 \times 2$$
$$E = 10 \text{ volts.}$$

This equation gives solutions to two other possible questions with regard to a direct-current circuit where two of the three quantities are known:

(a) Given the voltage and the resistance, what current would flow? Dividing both sides of the equation $E = R \times I$, by R we arrive at the form,

$$\frac{E}{R} = I$$

Suppose the voltage is equal to twelve

volts, and the resistance is three ohms, then substituting in the equation 12 for E, and 3 for R, we get the value of the current I.

$$\frac{12}{3} = I$$

$$I = 4 \text{ amperes}$$

(b) Given the voltage applied and the current flowing, what is the resistance of the circuit? Dividing both sides of the equation $E = R \times I$ by I we arrive at the form

$$\frac{E}{I} = R$$

Suppose the voltage is equal to one hundred and ten volts, and the current is equal to one-half an ampere; then substituting 110 for E, and 0.5 for I, we get the value of the resistance R

$$\frac{110}{0.5} = R$$

$$R = 220 \text{ ohms}$$

(This is the case of the ordinary 16 c. p. 110-volt carbon incandescent lamp.)

4. *This representation of quantities by symbols and numbers (to which may be assigned values to fit the particular case), equated to another set of symbols and numbers, is the algebraic form of representing experimental facts.*

For instance, Coulomb's Law states that the attraction between two electrically charged bodies varies directly as the product of the charges and inversely as the square of the distance between them. *One quantity varies inversely as another quantity, when the first quantity is decreased by an increase of the second quantity.* For example, as the time between sparks in a radio transmitting set decreases, the pitch of the note of the received signals increases. The square of the distance means the product of the distance by the distance. Calling the charge on the first body q_1 (the subscript (1) indicating the first body) the charge on the second body q_2, the distance d, and the force F; then the algebraic expression of this law becomes:

$$F = \frac{q_1 \times q_2}{d \times d}$$

The reader must accustom himself to look upon the symbols of algebra as a most convenient and valuable shorthand method of writing physical quantities, such as voltages, charges, distances, etc., and not merely as letters of no meaning.

Operations of Algebra

5. Before taking up the processes of algebra, the conventional symbols should be well understood. Besides the use of letters to represent quantities, symbols are employed which represent operations; for example, the operations indicated by +, —, × and ÷. These are familiar from their use in arithmetic. Generally speaking, the multiplication sign (×) is omitted between letters that form a product, and no sign is used at all; while the division sign (÷) is dispensed with and the fractional representation indicated, as in arithmetical fractions.

$a \times b \times c$ is expressed abc

$a \times b \div c$ is expressed $\frac{ab}{c}$

Although several letters written together indicate a product, several numbers written together indicate an addition. For instance, the number 524 represents the addition of 500, 20 and 4; and not $5 \times 2 \times 4$. If we wish to represent $5 \times 2 \times 4$, a dot (.) is used instead of the × sign between the *factors* (quantities which form the product). The compactness of this method of indicating multiplications and divisions, and the ease with which formulæ given in this form may be handled and remembered, are immediately apparent, for instance, when important relations, such as the induced e. m. f. in the armature of a generator, are expressed.

Example—

$$E = \frac{N\ C\ ns}{10^8} \text{ volts}$$

Where E is the induced e. m. f. (*Electro-motive force*) in volts in the armature of a generator, N is the magnetic flux from one pole, C is the total number of conductors on the armature, n is the number of revolutions the machine makes during a second of time, s is the number of armature sections in series, and 10^8 is a number which changes E to volts.

6. The use of a small letter *n*—representing an *integer* (whole number)—placed to the right and above a quantity, indicates that the quantity is to be taken *n* times as a factor.

$$a^4 = a\ a\ a\ a$$

and is read a to the fourth *power*. The *n* (in this case the number 4) is known as the *exponent* or *index*. When the exponent is 2 or 3, we speak of the quantities as *squared* or *cubed* respectively.

7. The use of a radical sign ($\sqrt{\ }$) covering a quantity, with an exponent *n* above the angle, represents a number which, when raised to the *nth* power, gives the quantity.

$$\sqrt[3]{8} = 2$$

for 2 raised to the third power equals 8

$$2 \times 2 \times 2 = 8$$

This expression is read the third root, or *cube root* of eight. The radical sign used without an index indicates the second or *square root* of the quantity is to be taken.

8. The order of operations is the same as in arithmetic; that is, if we have an expression we perform the operations from left to right, remembering that $\times$ and $\div$ take precedent over $+$ and $-$, that is, are performed first. In the example

$$4 + 6 \times 10 - 25 \div 5$$

we first perform the multiplication 6×10, then add to the product 4, then perform the division $25 \div 5$, and finally subtract this quotient from the previous sum.

9. The parenthesis ( ), the brackets [ ], and the braces { } placed at the beginning and end of a series of quantities, indicate that the operations within these inclosures must be performed before any outside operation is to be applied. They imply that the quantities inclosed are to be treated as a single quantity.

$(a + b)\ c$ means a must be added to b, and the sum multiplied by c.

$(a - b)\ (c + d)$ means that b must be subtracted from a, and the difference multiplied by the result of adding c and d.

10. A straight line over quantities is equivalent to a parenthesis around them.

11. We may have complicated expressions built up as follows: A bracket incloses among other things a brace, which in turn includes among other things a parenthesis. The procedure is to work *from the inside out,* evaluating and removing the parenthesis, brace and brackets in that order.

For example evaluate the following:

$$g - \{f + [\ (a - b)\ c - d]\ e\}$$

removing the parenthesis

$$g - \{f + [ac - bc - d]\ e\}$$

removing the brace

$$g - \{f + ace - bce - de\}$$

removing the brackets

$$g - f - ace + bce + de$$

Representation of Quantities by Letters

12. The algebraic expression contains a collection of figures and letters. Those quantities, the values of which we know, are usually represented by the first portion of the alphabet a, b, c, etc.; while those to be calculated (that is unknown quantities) are represented by the last letters of the alphabet, x, y, z. For instance, the power or rate at which energy is being expended by a direct current circuit is the product of the voltage across the terminals and the current flowing in the circuit.

$$X = E\ I$$

Thus, if we know the value of the voltage E, in volts, and the current I in amperes, we can calculate the power X in watts.

If an induction coil is used across a ten volt battery line, and an ammeter in the line reads 5 amperes, what is the rate at which energy is being supplied to the coil?

$$X = E\ I$$
$$X = 10 \times 5 = 50 \text{ watts.}$$

Terms

13. If we have an expression in which the various quantities are connected by $+$ or $-$ signs, these quantities are called *terms.*

A term is composed of one letter or several letters connected by a combination of multiplication and division operations. If one of the factors of a term is a number, this number is called the *numerical coefficient.* In the term $3a^2b$, 3 is the numerical coefficient. Coefficients are always written in front of the term. When we have two terms each of which contains the same letters, raised to the same respective powers, the terms are called *like terms.* To be like terms they must be alike with regard to letters and indices, but may have different coefficients. Thus the expression

$$2\,ab^2cx + 3\,a^2bcx + 6\,ax^2 - ab^2cx$$

contains four terms, two of which are like terms. The importance of like terms will be made clear when we reach the various processes of algebra; for by means of this fortunate class of terms complicated expressions are easily reduced to elementary forms.

Negative Quantities

14. The reader is familiar with the fact that, starting at any point on a line, he may consider points forward or backward; or starting at any epoch in time, he may compute past or future time; or starting at a zero in temperature he may read temperatures above or below zero. Thus we have in actual experience two opposite ways in which quantities can be reckoned from a zero or starting point. Let us call quantities in the direction of increase + and note the effect of going in the opposite direction on the value of this quantity. If we went forward five feet from a zero point on a line and back three feet we would be two feet in advance of that starting point, or at a position + 2 feet. In other words going back is equivalent to subtraction, and indicated by —. If we went back another five feet we would be three feet behind the zero or in a position — 3.

15. Thus, besides the common meaning of addition and subtraction, + and — have an additional meaning, that of *distinction between magnitudes of opposite kinds.* The size of a quantity, regardless of its sense, is called its *absolute value* or magnitude. For example, 5 feet or 20 seconds do not indicate a measurement from a fixed zero.

16. A striking example of the existence of magnitudes in opposite directions is found in the heterodyne device employed for receiving radio waves of undamped or slightly damped characteristics. It consists of an arc and an antenna circuit inductively coupled to a receiving circuit. The arc and antenna circuits differ in frequency, by the frequency of an audible note. For example, if the frequency of the incoming signals in the antenna circuit is 200,000 oscillations per second (corresponding to a 1,500 meter wave length) and we desire to receive them with a pitch, due to 1,000 vibrations per second, the arc is tuned to a frequency of 199,000 or 201,000 oscillations per second. The difference of wave length of the antenna and arc is 7½ meters.

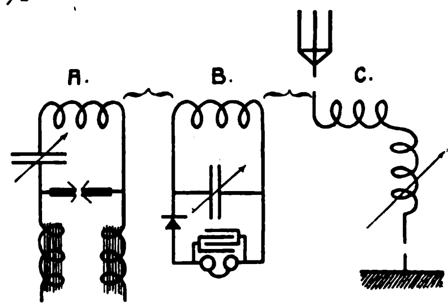


Fig. 1

The currents in the A and C circuit (Fig. 1) are periodically in the same, and then in opposite directions. These currents induce a voltage in the B circuit which depends for its direction on the direction of the currents in the A and C circuit. When the currents in the A and C circuit are both in the same direction, that is are both + or both —, the induced voltage in the B circuit (due to their algebraic sum) produces an amplified current in the B circuit. When the currents in the A and C circuits are in opposite directions, that is, one is + and the other — the induced voltage in the B circuit (due as before to their algebraic sum) produces a much reduced current in the B circuit. This phenomenon is known as *beats,* and gives a method of receiving undamped oscillations (with any desired note) without breaking them up mechanically. Beats are the physical result of recurrent opposition or assistance of alternating currents, as indicated by the algebraic fact that the signs of the two currents (currents in circuits A and B) are sometimes alike, and sometimes different.

17. These (—) quantities are called *negative quantities,* but this name cer-

tainly does not do them justice. They are perfectly real and tangible. For example, a voltage which drives a current in one direction along a wire is just as real as a voltage which drives a current in the opposite direction, although the voltages are called + and —.

18. This discussion of magnitudes with direction leads us to the principles of addition and subtraction; for since a series of positive (+) quantities increase the resultant magnitude, and negative quantities decrease the resultant magnitude, to add a minus quantity we subtract its absolute magnitude, and to subtract a minus quantity we add its absolute magnitude.

Addition

19. *The rule may be stated that to add a term to an expression affix it with its sign unchanged to the expression to which it is to be added. If we are adding one expression to another we affix to the first expression each of the terms of the second expression with their respective signs unchanged.*

20. In most practical cases, the expressions to be added contain like terms; that is, terms containing the same letters, the latter being raised to the same respective powers.

Example—

$$\begin{array}{ll} \text{To} & 2\,a^2b - 3\,cx + d^3 \\ \text{add} & 7\,a^2b + cx \end{array}$$

We notice that there are two pair of like terms. When we have like terms we group them together and add their coefficients, for since

$$3a = a + a + a \text{ and } 2a = a + a$$
$$3a + 2a = a + a + a + a + a = 5a$$

Therefore the problem reduces to

$$9\,a^2b - 2\,cx + d^3.$$

21. In general when adding several expression together, the expressions are arranged according to the ascending or descending powers of some letter. They are then written in horizontal rows with like terms in vertical rows. For example,

$$\begin{array}{ll} \text{To} & 3\,ab + 7b^2 + 2a^2 \\ \text{add} & 3c^2 - 4a^2 + 4b^2 + ab \\ \text{and} & b^2 - 9c^2 + 6a^2 \end{array}$$

First arrange the terms according to the descending power of some letter, say *a*. Then place the expressions one under the other, with like terms in vertical rows. Then add the coefficients of the terms in the vertical rows.

$$\begin{array}{rrrrr} +2a^2 & +3ab & +7b^2 & & \\ -4a^2 & +ab & +4b^2 & +3c^2 & \\ +6a^2 & & & -9c^2 & +b \\ \hline +4a^2 & +4ab & +11b^2 & -6c & +b \end{array}$$

(Note $+3c^2$ added to $-9c^2 = -6c^2$)

The advantages of clearness cannot be overestimated, especially in cases where long expressions enter.

Subtraction

22. *Since subtraction is the inverse operation of addition, we may formulate the rule, that, to subtract a term from an expression, affix the term with its sign changed to the expression. If we wish to subtract a second expression from a first, we affix each of the terms of the second expression, to the first, with their signs changed.* This is equivalent to changing the signs of the terms of the second expression and adding the result to the first expression. Furthermore, if we have several expressions that are to be subtracted from a given expression we change the signs of the terms of these several expressions and add the result to the given expression.

Example—

$$\begin{array}{ll} \text{From} & 9a^2 + 6\,ab + c^2 \\ \text{Subtract} & 3a^2 + 4\,ab + c^2 \\ \text{And} & 5c^2 - d \end{array}$$

Changing the signs of last two expressions, arranging like terms in columns and adding, we get

$$\begin{array}{rrrr} 9a^2 & +6\,ab & +c & \\ -3a & -4\,ab & -c & \\ & & -5c & +d \\ \hline +6a^2 & +2\,ab & -5c & +d \end{array}$$

[This is the first of a series of articles on mathematics by Mr. Preiss The second will appear in an early issue.]

Prince who has Wireless Piano

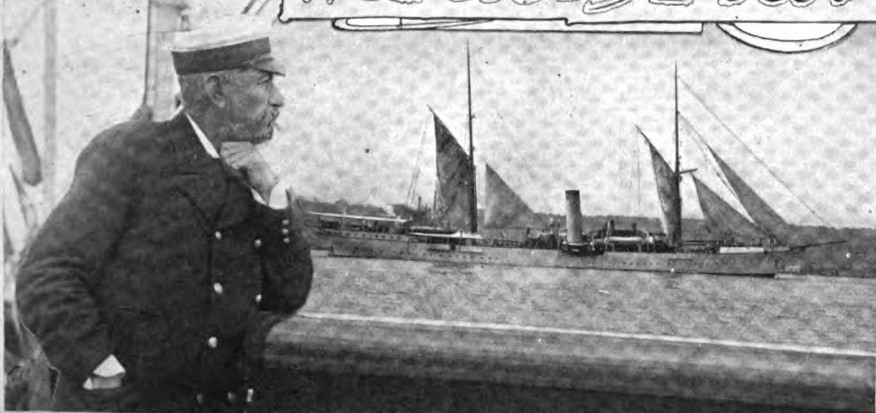


Photo. Underwood & Underwood.

The Prince of Monaco and His Yacht Hirondelle. Photograph Taken During His Recent Visit to New York

WIRELESS operators in New York harbor and at other points along the Atlantic coast were mystified recently by hearing strains of music wafted through the air, coming from a source which no one was able to determine. The mystery was solved when the steam yacht Hirondelle, bearing her owner, Albert I. Prince of Monaco, and a wireless outfit connected with a piano-like attachment, arrived off Sandy Hook.

After the craft had entered the harbor she sent out a radio request broadcast that all vessels within range give attention to the concert about to begin. Then followed selections which included the "Marsellaise" and "America." Operators on the water and at land stations for miles around, including those at the Brooklyn Navy Yard and other places, heard the music and, at the conclusion of the programme, sent their thanks through the ether.

The Hirondelle, after leaving Monaco early in the summer, went to the Azores, then to Halifax. She cruised for a time about the Grand Banks and then set out for New York. She arrived several days sooner than she was expected, and therefore the aerial concert came as a surprise. Several vessels bound for New York had reported hearing siren strains as they neared the coast, and in the proximity of the Hirondelle they found the explanation of the mysterious music.

Equipped with appliances which have been used in solving the puzzles of nature, the Hirondelle is a veritable wonder craft. The wireless piano, however, is the crowning feature of all the amazement-producing things to be found on the vessel.

The wireless system in use on the Hirondelle employs a continuous current with a high pressure of 1,500 volts, which charges the condensers without a transformer. It has a revolving sparker, a series of small wheels. The spark is only a tenth of an inch in length and is always the same for the different powers. The whole apparatus is remarkably compact, for both the sending and receiving appliances easily are placed on one small table. The primary coil consists of one spiral and in the secondary coil are forty turns or spirals.

With this system, which is called an impulsive one, it is possible to get high frequency oscillations. The vibrations are so many that often it is impossible for the ear to perceive them and the note to be heard. The inventor has put on the sparker another oscillatory circuit, and a variable condenser. He can thus lower the frequency of the system. The use of a variable condenser in the second circuit makes it possible to get different frequencies, which may be tuned to musical notes. The variations are made by striking a bank of ten keys, arranged in the form of a keyboard of a piano.

The operator, Pierre Boutteville, sitting at the table, can let his fingers stray on a piano. The system on board is really a remarkable one. We are able to communicate fifteen hundred miles, and so, in crossing the Atlantic, are not likely to be out of touch with land for very long."

Erect of figure, with an air of abounding vitality, the Prince is the typical yachtsman and sportsman. His beard, slightly touched with gray, is the only evidence of his sixty-five years. His eye is clear and kindly, his step light and elastic. Harpooning whales, shooting big game and wooing the sea in all kinds of

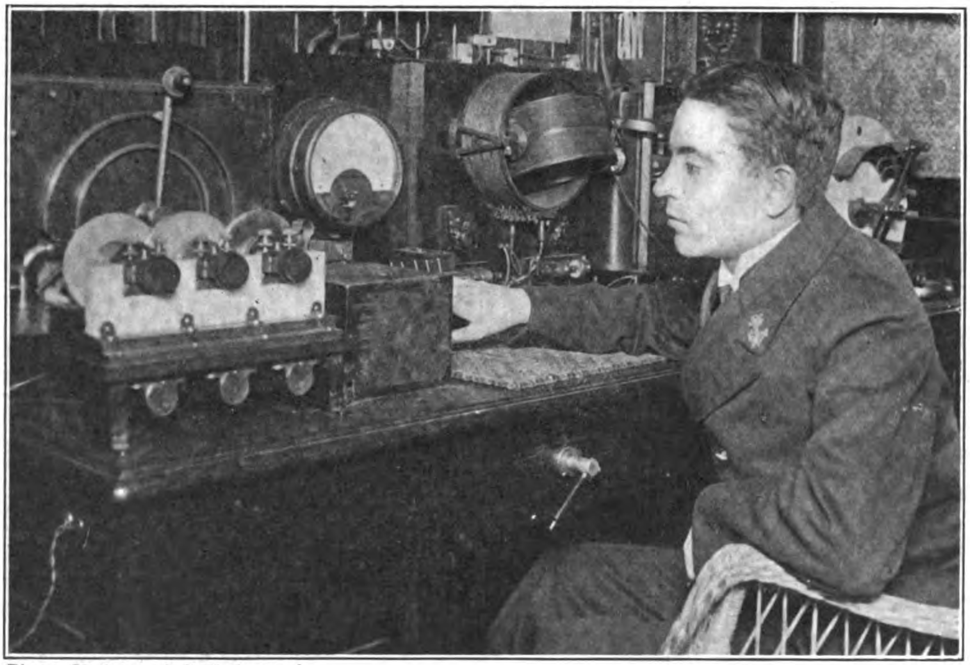


Photo. Underwood & Underwood.

The Wireless Piano Aboard the Prince of Monaco's Private Yacht and Pierre Boutteville Who Plays the Instrument

over them and by certain adjustments can get twenty variations. This is a stock of notes enough for a Paderewski. From the wireless piano of the Hirondelle have come "God Save the King," national anthems and even waltzes from such sprightly operas as "The Merry Widow."

"It always causes astonishment," said the Prince, in speaking of the wireless music, "and we have been asked at sea if the music could possibly be made in this way. Yet it is all very simple. The harmony is produced as easily as playing

weather have kept him lithe and strong.

He is a teetotaler and does not smoke. The recipe which he has for keeping young is work and sport. He always is busy. The head of a principality, in which is glittering Monte Carlo, he is also a biologist and an oceanographer. He is the author of scores of books.

The Hirondelle is a steel twin screw steam yacht, with an auxiliary brigantine rig. She carries unusually lofty masts, which seem to dwarf the single funnel. The yacht is 291 feet over all, thirty-six feet in beam and has a draught of seventeen feet eight inches. Her lines indicate that she is a very dry vessel indeed, with her high top gallant forecastle and the raised after deck. She has a clipper bow and her lines are trim and graceful. On the flag is the coat of arms of Monaco, with the Latin motto "Deo Juvante" (With God Aiding). Below decks there is every evidence of strength and careful workmanship. There are substantial bulkheads, with heavy doors. The crew, under command of Captain d'Arodes, of the French navy, consists of fifty men and the total number of persons on board is sixty-eight, including officers, scientists, photographers and artists. Not only has the Hirondelle every appliance which modern naval architecture has prescribed for a yacht, but it has special apparatus, which represents inventive talents of a high order. Among them is a machine for sounding, invented by the Prince himself, by means of which the seas have been measured for a depth of 5,200 meters, or about three miles. Here also are contrivances for bringing up water from great depths for analysis. There are nets with which the strange denizens of the uttermost depths are drawn to the surface.

The yacht has a laboratory which is filled with an array of bottles and jars. The creatures of the depths are studied here and preserved for further examination at the museum which the Prince established at Monaco.

One of the significant facts which the explorations of the Hirondelle expedition has revealed is that there is a constant vertical migration in the ocean, and that forms of life which scientists have believed could only live near the ocean floor are constantly coming up near the surface. They travel very slowly in order to get accustomed to the variations of pressure. Those which are brought up by the nets from the depths usually collapse and die because of the too surden change.

There are many new forms of life to be seen in the laboratory. The Prince spends much of his time in the laboratory studying the phosphorescent fish and the other strange forms which come under his observation.

HEARS MUSIC 225 MILES AWAY

Raymond H. Shaw, of East Washington street, Rutland, Vt., who for some time has experimented with wireless telegraphy, recently heard a wireless telephone message while listening to a wireless telegraph message sent out from a Southern station.

The receivers used in the wireless telegraph and wireless telephone service are the same. While Shaw was listening to the faint click of the faraway telegraph instrument he was surprised to catch the words, "My country, 'tis of thee—" to the familiar tune of "America." Further listening revealed that the tune was being played on a phonograph in the Metropolitan wireless telephone tower in New York City. The air-line distance was more than 225 miles.

THE SHARE MARKET

New York, September 19.

During the past week Wall Street has seen a marked change for the better; industrial issues have been stronger, and the trading has increased to a degree that seems to warrant the assertion that the long period of stagnation is at an end.

Marconi issues have been featured prominently in the curb trading, and have remained steady during the last few days. American Marconis are quoted about the same as last month, and the English issues show but a fractional decline, mainly due, the brokers say, to the rumor that a higher dividend than ten per cent. would be declared at the annual meeting. Canadian issues remain about the same, with trading light, owing to the fact that buyers are awaiting some indications of what the forthcoming meeting will disclose.

Compared with other industrials, Marconis are well supported and show a higher average market price. The brokers are optimistic, and a number of them are predicting steady advances under the relieved conditions of the share market.

Bid and asked prices to-day:

American, 5¼-5½; Canadian, 2¾-3⅛; English, common, 19½-21; English, preferred, 16¼-17½.

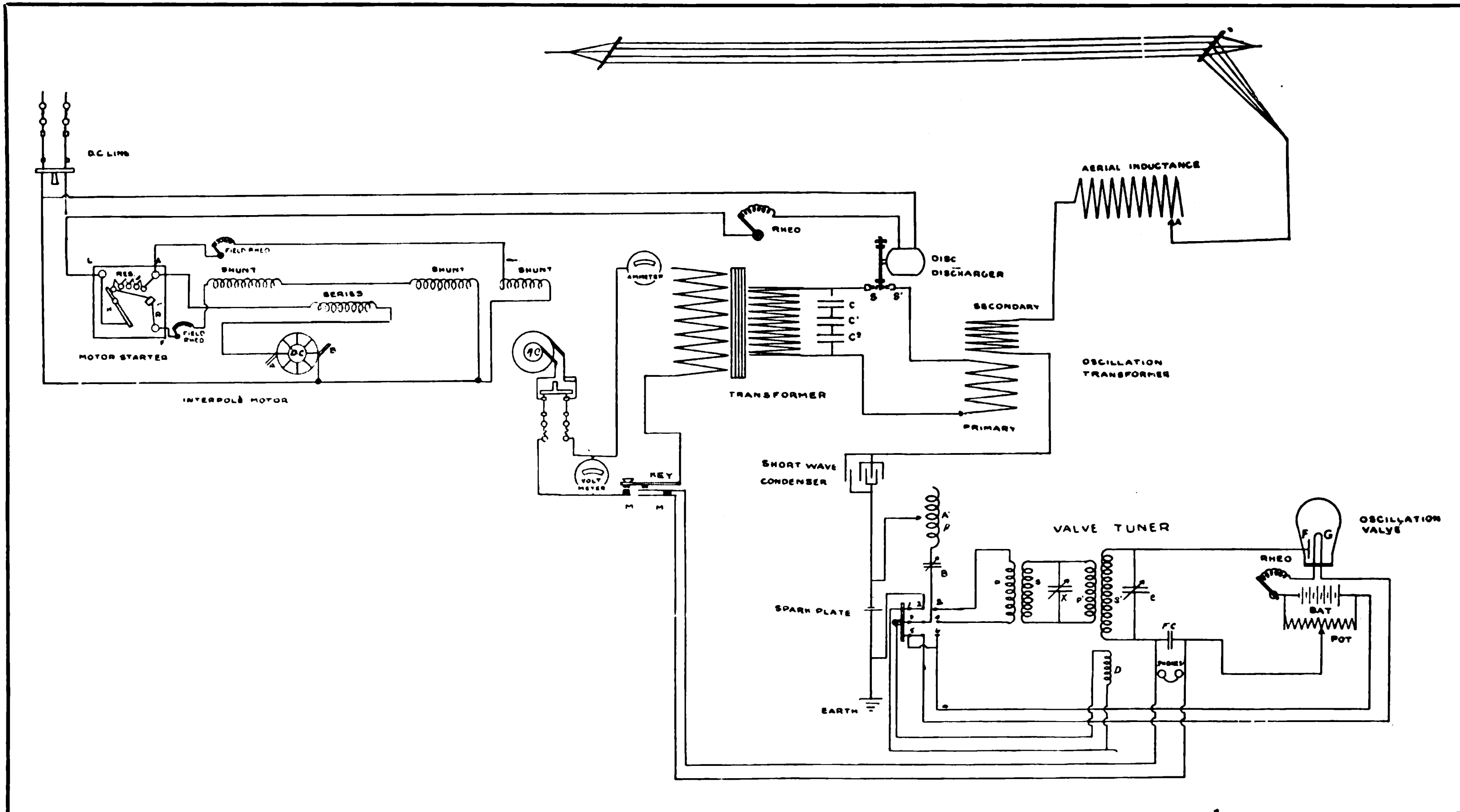

D.C. LINE
MOTOR STARTER
RES.
FIELD RHEO
SHUNT
SERIES
SHUNT
SHUNT
INTERPOLE MOTOR
RHEO
AMMETER
VOLT METER
KEY
TRANSFORMER
C
C'
C²
S
S'
DISC DISCHARGER
SECONDARY
PRIMARY
OSCILLATION TRANSFORMER
AERIAL INDUCTANCE
SHORT WAVE CONDENSER
SPARK PLATE
EARTH
VALVE TUNER
OSCILLATION VALVE
F
G
RHEO
BAT
POT
PHONES
D

Fig. 6

CHAPTER IV

Disc Discharger Sets—Figure 6 indicates the complete circuits of the Marconi 240 cycle discharger transmitting set in conjunction with the valve tuner.

Motor Starter—The motor starter is of the regulation Cutler Hammer type and, as it has been previously described, there is no need of further explanation. The motor of the motor-generator differs in that it has an interpole winding. That is to say, the series winding of the motor is in series with the armature and has field poles of its own, while the shunt winding is made upon a separate set of field poles. The series poles are known as interpoles because they are placed between the shunt poles.

The object of the interpole winding is to give sparkless commutation with a varying load, and to maintain as near as possible a uniform speed. Briefly, the reason for obtaining sparkless commutation may be explained as follows: The interpole field coil destroys the current due to the self-induction of an armature coil as it passes through the neutral field; consequently when the segments which are connected to this coil pass a brush, there will be no sparking.

Moreover, the magnetic flux produced by the interpoles oppose the flux of the shunt poles, resulting in a decrease of the total flux surrounding the armature, and, as previously explained, if the flux about a motor armature is decreased an increase in speed is secured. Thus a very steady speed regulation is maintained, which is especially desirable in wireless telegraph sets. By referring to the drawing it will be noted that the series winding is placed between two shunt windings. This was done to give the student an idea of how the machine is wired up in actual practice.

Generator Fields—A simple shunt winding, above the A. C. armature is indicated. This, in turn, is directly connected across the D. C. line (through the starter). It will be noted that one side of this shunt field is connected to the A. post of the Cutler Hammer Starter. This is done to prevent current flowing into the generator fields before the motor is started.

The Transformer—The transformer is of the open core type and is substantially the same as the one previously described.

Condensers—The condensers are shown at C, C^1 and C^2. It will be observed that there are three sets in series and by so connecting the potential strain on each is considerably reduced. These condensers consist of flat plates of glass coated with tin foil which are immersed in oil.

In case of the 2 K. W. 240 cycle set thirty-six glass plates are used. There are three banks in a series, each bank consisting of twelve plates in parallel.

Spark Gap—It will be noted that the spark gap (or disc discharger) is mounted directly on the shaft of the motor. The disc has studs projecting through it which are spaced at a uniform distance around the periphery.

The stationary electrodes, two in number, are shown at S and S^1. When this gap is in operation a spark discharge takes place when one of the rotating studs comes opposite the two stationary members. Since the studs are uniformly spaced a certain number of discharges take place per second, and if the revolutions are of a certain number per minute an even succession of discharges will take place, the gap emitting a pure musical note. The advantage of this gap lies in the fact that it gives a high note which is easily read through atmospheric disturbances. It also keeps the spark electrodes cool, thereby keeping the antennae radiation constant.

Particular care should be taken in the adjustment of the spark to keep the actual distance between the stationary electrodes and the fixed electrodes so that there will be a very small air gap. The effective sparking distance, however, will be greater than the air gap would indicate, as the spark will start discharging as the moving electrodes approach the stationary electrodes.

In some cases the spark gap is rotated by a shunt wound D. C. motor, the speed of which is regulated by means of the rheostat as indicated in the drawing. The discharger may also be mounted on the shaft of the motor-generator. A note of greater regularity is thus secured.

Oscillation Transformer—The oscillation transformer shown in the drawing is of the inductive coupled type known as type B, consisting of a fixed inductance sliding in and out of the primary inductance. The number of turns in use in the primary are determined by the position of the variable contact L. The wave length of this circuit then can be increased or decreased by increasing or decreasing the number of turns included by the variable contact.

Aerial Tuning Inductance—The aerial tuning inductance is indicated at A. It affords a wide range of wave lengths in the open circuit and is used on both the 300 and 600 meter adjustment.

The Coupling—The degree of coupling between the open and closed oscillatory circuits is varied by drawing the two helices apart; thus any degree of coupling is secured and the emission of two wave lengths readily reduced to one.

The Spark Plate—The spark plate consists of two brass plates separated by a thin sheet of mica, making a very minute spark gap around which is connected the aerial and earth binding posts of the valve tuner. The plate is connected in series with the earth lead and should be placed as near to the actual earth connection as possible. The spark plate should be watched from time to time to see that it is not short-circuited by carbon deposits.

The gap also gives a free discharge path for the antennae to earth, affording protection during severe electrical storms.

The Valve Tuner—The complete circuits of the valve tuner are shown to the right of the drawing.

The triple pole double throw switch, as indicated, not only serves the purpose of disconnecting the receiving apparatus from the antennae while sending, but also enables the operator to change from a broad adjustment of the apparatus so as to receive signals of varying wave length with very little manipulation of the tuner; or to connect to the tuning side wherein a great degree of separation of wave lengths can be produced.

When the switch is thrown to the right, the open circuit of the receiving apparatus comprises the antennae inductance A^1, connected to a multiple point switch, a variable condenser B in series with it, and a fixed inductance P, which constitutes the primary of the oscillation transformer. The aerial inductance A^1, popularly known as a "loading coil," enables the wave length of the open circuit to be increased or decreased as desired, while the variable condenser, B, is used to alter the wave length of the open oscillatory circuit, its small values being for the shorter wave lengths. The variable condenser, B, is arranged so that, when turned to the right as far as possible, it short-circuits itself and is thereby cut out of the circuit.

It will be noted that all the adjustments of wave length in the open circuit are made by the inductance, A^1, and the variable condenser, B.

An intermediate circuit consisting of the fixed inductance, S, the variable condenser, X, and the fixed inductance, P^1, is placed in inductive relation to the inductance, S^1, in the local detector circuit, and also to the fixed inductance, P, in the open oscillatory or antennae circuit; that is, the coil, S, is inductively coupled to coil P, and coil S^1 is inductively coupled to coil P^1.

It will be noted that the period or wave length of the intermediate circuit is varied only by means of the variable condenser X. The two fixed inductances, S and P^1, comprising the intermediate circuit, are mounted on a shaft so that the coupling between them and their associated circuits can be varied simultaneously by turning a graduated hard rubber knob.

The Local or Detcctor Circuit—The local or detector circuit comprises the fixed inductance, S^1, the variable condenser, E, the fixed condenser, FC, around which are connected the head phones and the oscillation valve.

The Oscillation Valve—The oscillation valve consists of a plate, F, and a filament, G, used in connection with the rheostat, Rheo, the storage cells, Bat, and the potentiometer, Pot, which is in shunt with the cells.

Operation of the Set—When the tuner which has been described is in operation its action is as follows: The high frequency oscillations induced into the antennae from a distant transmitting station traverse the aerial inductance, the secondary coil of the transmitting oscillation transformer, the loading coil, A^1, the variable condenser, B, and the primary of the oscillation transformer, P. The magnetic flux produced in the primary, P, sets up corresponding oscillations of high frequency in the intermediate circuit through coil S, which are increased in amplitude by adjusting the intermediate circuit to resonance with the open circuit by means of the variable condenser, X.

Since the oscillations produced in this circuit traverse P^1, currents of high frequency are set up in the inductance, S^1, and thence through the local detector circuit. The valve acts as a rectifier, allowing the high frequency oscillations to pass in one direction, with the result that the closed oscillatory circuit is traversed by a series of direct current impulses which actuate the head phones, producing audible signals.

This rectification takes place in the space between the hot filament to the cold plate. As in other detectors it is found that if a very small electro-motive force is caused to pass through the rectifying space in the bulb, it materially increases the sensitiveness of the detector; consequently a potentiometer of about 300 or 400 ohms resistance is shunted across the same storage cells which supply the current for lighting and filament, F.

By means of the potentiometer the amount of current flowing through the head phones, and the fixed space between the cold plate and filament of the valve, can readily be adjusted to any given amount. For best working and for securing the most sensitive results, a certain degree of heat from the filament is necessary; consequently the rheostat, marked Rheo, is included in series with the battery to the lamp filament, so that the glow of the filament may be increased or decreased as desired.

As stated, the fixed space between the hot filament, F, to the cold filament, G, is conductive to impulses in one direction, while those coming in the opposite direction will either be stopped entirely, or reduced to such an amount that they are practically negligible. It will readily be seen that only one-half of the oscillations produced in the local or detector circuit are allowed to pass. The other half has been, practically speaking, annulled.

The variable condenser, E, connected across the inductance, S^1, enables the wave length of the local circuit to be increased or decreased within certain limits. This variable condenser is of small capacity. A condenser of large capacity could not be used at this point. The description which has been given covers only the tuning side of the set.

"Standby" Circuits—When the double pole double throw switch is thrown to the left and the antennae and earth connections are thrown on to contact 1 and 3, it will be observed that the intermediate circuit, and also the primary circuit, P, are disconnected and a special primary winding, D, is connected into the open circuit. D is an inductance of fixed value wound closely around the inductance, S^1, of the local detector circuit. This gives a tight coupling and adjusts the apparatus to receive a number of varying wave lengths with little adjustment of the tuning appliances. Contacts

5 and 6 close the battery circuit to the lamp filament.

When the transmitting key is depressed the triple pole switch is raised, breaking all contacts; as a result the tuning circuits are disconnected from the antennae and the earth and the current is cut off from the filament of the oscillation valve. In addition to closing the primary circuit of the sending transformer the transmitting key has an extra pair of contacts, M and M[1], which short-circuit or shunt the head phones of the receiving apparatus. Hence, just before the primary circuit to the sending transformer is closed by the key, the head phones are shunted, thereby affording protection from the inductive influences of the transmitting spark.

To repeat again, when the triple pole switch is thrown to the left, "broad" tuning is secured and a wider range of wave lengths can be received without manipulating the tuning appliances to any great extent. On the other hand, when the switch is thrown to the right, the tuning circuits are connected, thus making it possible to differentiate sharply the various wave lengths.

The Intermediate Circuit—The reason for obtaining such a degree of selectivity in the intermediate circuit lies in the fact that, owing to the absence of a great amount of resistance, it is a circuit of low damping; therefore it does not matter how "broad" the currents traversing the open circuit are because they will induce in the intermediate circuit oscillations of corresponding wave length, but of relatively low damping, i. e., "sharper waves." Hence it will readily be understood that it will be easier to separate signals of various wave length and avoid interference. This statement is only true when the coupling between the intermediate circuit and the associated circuits is fairly loose.

Range of Wave Length—The range of wave length to be obtained in the various circuits of the valve tuner, when connected in the regular manner (Figure 6) is as follows:

	Meters
Open circuit	300 to 1675
Intermediate circuit	250 to 1515
Detector circuit, when using the small condenser	760 to 1515

A table showing approximately the wave length adjustment of the intermediate circuit at various positions of the variable condenser as indicated by the scale follows:

INTERMEDIATE CIRCUIT

Condenser Scale.	Wave Lengths in Meters.
0	250
.5	345
1	500
2	550
3	775
4	940
5	1040
6	1150
7	1260
8	1360
9	1435
10	1515

Generally speaking, this tabulation holds good for all valve tuners produced by the Marconi Wireless Telegraph Company of America to date.

Procedure for Determination of Wave Length—If the operator desires an approximation of the wave length of a distant transmitting station, he should throw the three-blade switch on the valve tuner to the right-hand position and adjust the circuits to resonance at a very loose coupling (about ten degrees on the coupling bnob). The reading on the variable condenser is noted, and by referring to the table which is published the wave length is obtained.

The Type E Tuner.—Figure 7 indicates the circuits of the type E tuner, a number of which are at present distributed

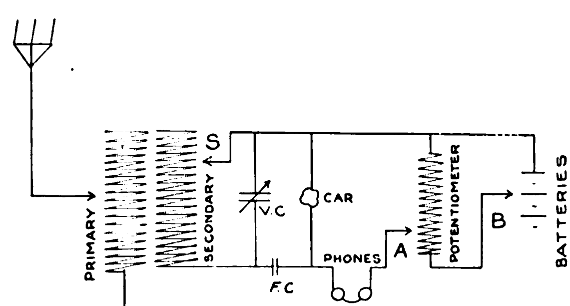


Fig. 7

throughout the Marconi Service. It is an inductively coupled arrangement, and the primary coil is in series with the antenna circuit to the earth. The sliding contract enables the amount of inductance inserted in series with the antenna to be varied as desired. As a result the wave length of the open circuit can be increased or decreased to suit the frequency with which the incoming signals arrive from a distant transmitting station.

The secondary coil slides in and out of the primary and is so arranged that the mutual induction between the two coils can be easily varied by placing the coils together or by drawing them apart. The turns of the secondary coil are in reality connected to a multiple point switch and are represented by a sliding contact.

A variable condenser, VC, is connected across the inductance of the secondary coil, making it a resonant closed oscillatory circuit. The fixed condenser, FC, known as a "stopping condenser," prevents the battery current from flowing through the secondary inductance.

A carborundum crystal, Car, is in series with the closed oscillatory circuits and acts as a detector of the oscillations in that circuit. As stated in a previous paragraph, it is found that a very small E. M. F. from the battery increases its sensitiveness. A potentiometer is used to vary the battery current flowing through the crystal and head-phones (by means of variable contact A).

Operation—When oscillations traverse the primary coil, magnetic lines of force rise and fall about its turns which intersect or cut through the turns of the secondary coil, setting up in it corresponding high frequency currents which are made audible in the phones by the carborundum crystal. By using the variable condenser, VC, the closed circuit is made a resonant circuit and currents of large value are set up in it.

A portion of the energy so produced in that circuit is drawn off by the carborundum crystal and made audible as described.

The student should thoroughly understand that when making use of loose coupling between the primary and secondary circuits, i. e.: when the secondary is drawn out of the primary, the variable condenser, VC, connected in shunt with the secondary of the receiving transformer, must be used in order to effect an efficient transfer of energy. For elimination of interference, and for sharper tuning, the secondary coil is moved out of the primary and the condenser, VC, varied. The period of the local circuit can also be regulated by the sliding contact. Thus any degree of coupling can be obtained and the set as a whole adjusted for any of the waves emitted by a distant transmitting station.

Range of Wave Length—With the average antenna, wave length adjustment up to 2,800 meters may be had in the open circuit. The closed or detector circuit can be adjusted from 200 to 2,800 meters.

300 *and* 600 *Meter Adjustments*—In some of the 240 cycle, 2 K. W. transmitters it is found that the leads from the condensers to helix and spark gap are of too great length to obtain a 300 meter wave adjustment in the closed oscillatory circuit. In order to efficiently transfer energy from the closed to the open circuit at least one turn of inductance should be included in the primary of the oscillation transformer. Since this is not obtainable, a separate tank of oil condensers is connected in series with the regular tank of three units, consequently the total capacity is reduced and the wave length is correspondingly diminished. It is then possible on the 300 meter adjustment to secure one or two turns in the primary of the oscillation transformer. This hookup is clearly shown in Figure 8.

When working on the 600 meter wave the extra tank of condensers is disconnected from the closed oscillatory circuit and the regular tank used. The connections of the secondary of the transformer are removed and connected to the regular tank as shown by the dotted lines; or, if it is so desired, a short circuiting strap can be placed across the extra condenser when working on the 600 meter wave adjustment. It will be observed that when using the 300 meter wave, a short wave condenser is used in series with the open circuit, and the extra tank of condensers to permit of the 300 meter wave in the closed circuit.

In addition to giving a 300 meter ad-

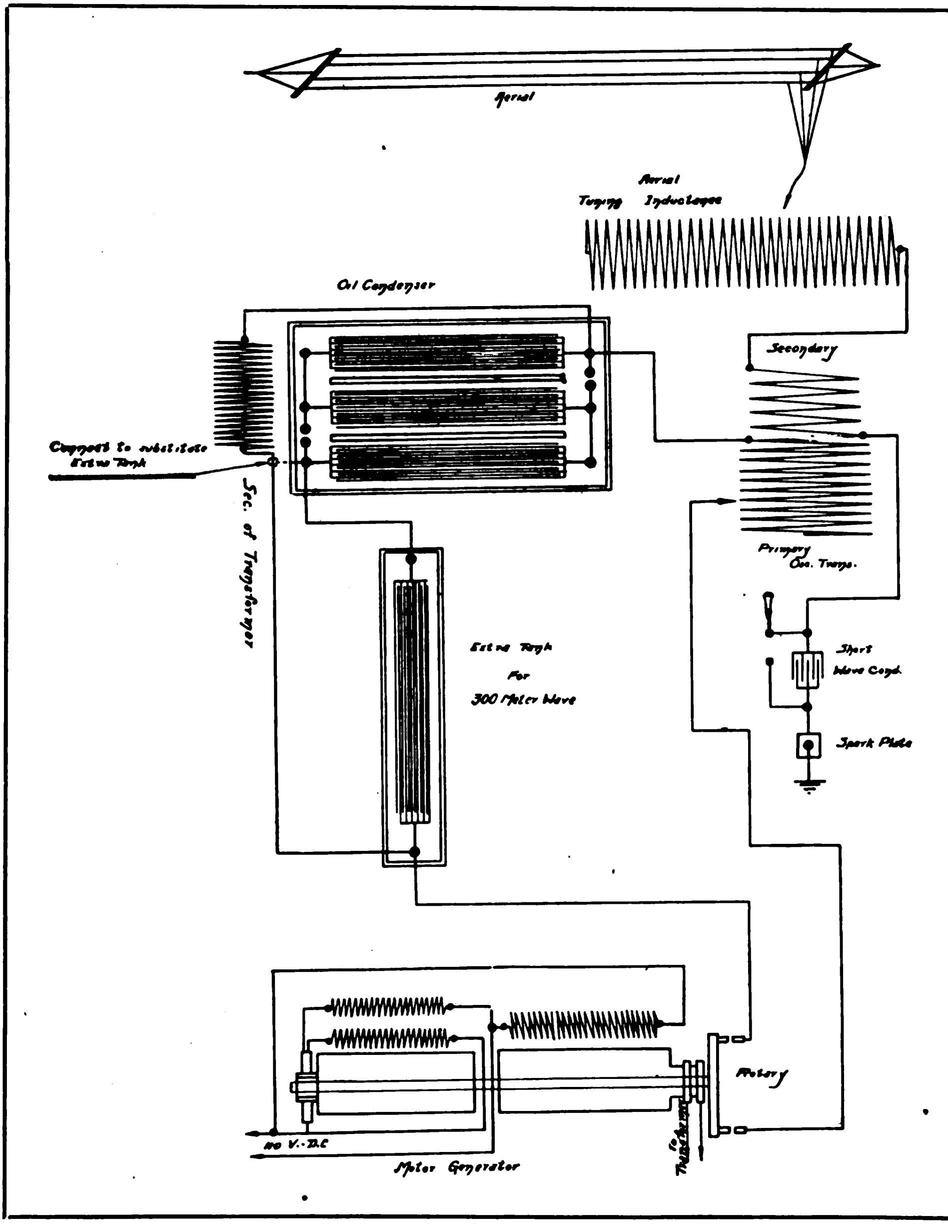


Fig. 8

justment in the closed oscillatory circuit, this tank also serves as an emergency condenser in case one of the units in the regular tank should be punctured. Under these conditions, when working on the 600 meter wave it will not be necessary to dismantle a punctured unit. After it has been found, however, it should be disconnected from the remaining units and replaced by the extra tank of 12, which is generally used with the 300 meter wave.

Figure 8 is a clear exposition of the high frequency circuits of a modern wireless telegraph transmitter and should be thoroughly studied by the learner. It gives further understanding of the elementary circuits of the motor-generator.

(*To be continued*)

My Trip to the Icefields

by

David Sarnoff

AFTER due reflection, I have decided that I am not very different from the average wireless man who follows the sea. This in spite of the fact that I have come to acknowledge a more serious trend of mind, and an alarming increase in waist measure since my duties have kept me on shore; but that is mainly due, I think, to the heavier responsibility of inspection rounds and a more regular mode of living, each in their proper order. The spirit of adventure, the fascination of visiting remote corners of the earth, coming in close touch with the wonders of Nature, the spell of the sea—all of these remain with me. At heart I am still the operator who some little time ago sailed gaily forth to the ice-fields, willing and anxious to take a trip that has more than once ended disastrously. But then, as now, I loved travel for travel's sake.

Someone has told me that my experiences on that trip would prove interesting reading, so I have set them down on paper. If my effort proves futile it is not the fault of the material; the responsibility lies with a pen that is far from graphic.

It may be well to mention here that these experiences of mine are not in the least exaggerated; they are all extracted from my diary. I have always kept a diary, more as a matter of reference than for entertainment. With very few changes I present the record as it was jotted down during the trip.

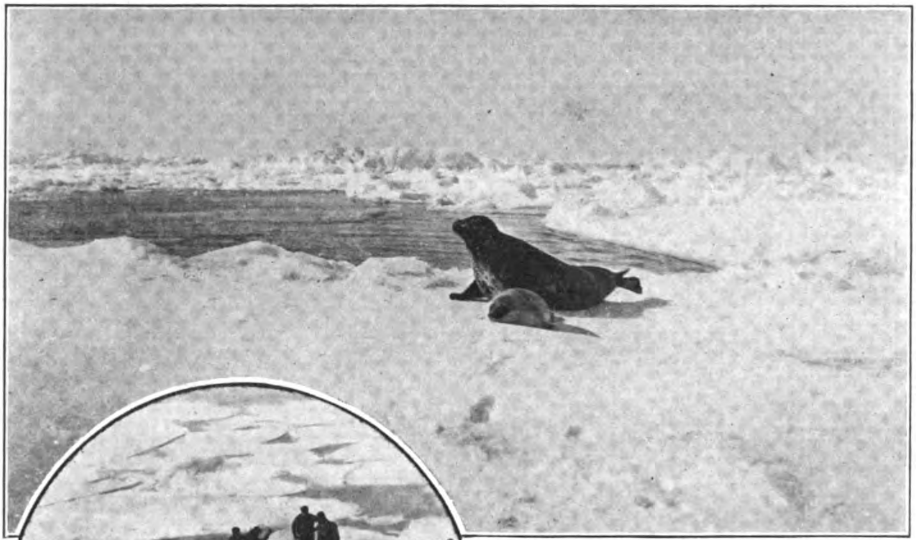
Preliminary to the actual story of my trip, let me explain the reason for it by glancing at the industry that only recently felt the need of wireless—seal fishing. Seal fishing is one of the most important industries of Newfoundland, a considerable percentage of the population depending upon it for their livelihood.

Early in the spring of each year upwards of twenty sealing vessels depart from St. Johns for the Arctic regions in quest of these sea-animals. The ancient type of sealing vessels, famed in song and story, are no longer used on these expeditions, having been supplanted by the modern "ice-breaker," a vessel especially constructed to withstand the heavy strain of forcing a path through the ice to reach the seals.

There are several types of seals, differing in name, in appearance and in natural habits. The methods of procuring differ also. The reader will be given a description of the several classes of seals a little later.

lubrication for fine machinery. Once the skin has been stripped of its fat it is salted and dried for use in the manufacture of seal skin boots and many other necessities of life.

The exact location of seals in the icefields is a matter upon which every captain has his own opinion. They are usually found several hundred miles north of Newfoundland, but it is a



The Arctic seals, good types of which are shown in the larger illustration, are not "fur" seals. They are sought chiefly for the pelt, from which medicinal and lubricating oils are extracted and the skin used for ladies' purses and boots.

The method of hauling the pelts to the sealing ship is shown in the circular picture.

None of the seals found in the Arctic regions are, as is commonly supposed, "fur" seals. The fur seal is found in the Behring Straits and Alaska. The Arctic seal is sought chiefly for its pelt, which, when separated from its carcass or body, consists of the skin together with fat or blubber ranging from three to four inches in thickness. From this fat is extracted the finest of seal oil, which is refined and utilized for medicinal purposes. Seal oil is also used as a

matter of great difficulty to navigate the vessels through the heavy ice to locate the main "patches." A peculiar characteristic of seals is that they travel together in great numbers, and it is no extraordinary occurrence for a sealing vessel to miss the main bodies and return home but lightly loaded, if not empty-handed.

Should one vessel be fortunate enough to locate a large body of seals there is generally sufficient for several ships, and it is then that the fortunate master is desirous of spreading the glad news to vessels of his own line.

In these days two sealing vessels tell each other of their success or failure when separated by several hundred miles of ice and icebergs. Twenty years ago this would have been a wild dream. The genius of Marconi made this possible, and the owners of sealing vessels were quick to realize the worth of wireless, both as a business adjunct and for its humanitarian value. Many are the tales of woe and suffering, death by starvation and exposure among those who in the past braved the dangers of the icefields in craft often battered by the heavy floes of ice or lost in the terrible storms without a chance to advise others of their plight. Many a time a dozen vessels lay but a few miles away, yet they may as well have been a million miles off.

Wireless has to a great extent stripped the industry of its danger. It has now become a necessary part of the sealing steamer's equipment and is looked upon as indespensable in obtaining the seals and for safe navigation.

Love of adventure is part of the make-up of the average young man; in the wireless operator it is usually developed to a fine point, for when news comes that the Marconi Company has equipped several sealing vessels, the thought of a trip to the perilous Arctic would seem especially attractive, judging from the number of applications for employment. Under such extraordinary conditions men are not "told" to go; a call for volunteers is posted.

A pleasant smile greeted me when I entered the manager's office offering myself as a volunteer. That official asked if I had read the stories of Peary and Dr. Cook, wanted to know if I objected to being frozen twice a day and was generally cheerful over the whole matter. But nothing, except his refusal to accept me, could or would prevent me from going; and after listening to a brief outline of what was expected of me, I pledged allegiance and left a short time afterward for the steamer which carried me to St. Johns.

The vessel to which I was assigned was the Beothic, belonging to the old Newfoundland sealing firm of Job Brothers.

Installing the wireless outfit and aerial wires aboard this vessel proved to be rather a chilly process, for the temperature, even at the St. Johns wharves, was considerably below the zero mark. This done, we set sail for Newfoundland's islands—"outparts" they are called—to pick up the sealing crew.

For the most part the sealers who make up these expeditions are fishermen who live by the spoils of the sea, and when not sealing are engaged in cod or salmon fishing, an industry of which Newfoundland can proudly boast. Education at these places is so limited that it is almost unknown. But though the majority are illiterate, these hardy fishermen are honest, hard working and thrifty.

They join the sealing expeditions on the condition that the crew receive one-third of the value of the fat obtained on all seals caught; this share is equally distributed among the entire crew, which in this instance numbered 271 strong.

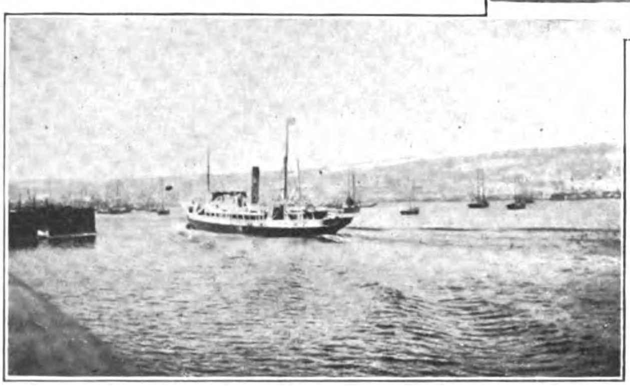
While the share per man is governed by good or bad luck, more sealers apply for berths than there are vacancies and the selection is left to the captain of the vessel. Bools Island, an outport situated about 150 miles north of St. Johns, was our chief place of recruits.

As soon as our vessel was sighted the men started over the ice to meet her, each man carrying his all in a box temporarily converted into a sleigh. The women and children followed in their wake, so that they might, in their simple way, bid these breadwinners Godspeed for a journey the return from which is ofttimes problematical.

The spectacle of these women and children walking across the ice and close up to a gigantic liner, which crashes through and breaks into smithereens tons and tons of ice, is indeed impressive.

After collecting our full complement we returned to St. Johns, to await in day upon which we were to start in company with all other sealing vessels on the long search. This day is not optional; it is regulated by the laws of Newfoundland, which provide that seal hunting is permissible only between March 15 and May 1 of each year, for the reason that the young seals are born on the 1st of March of each year and must be two weeks old before man is permitted to kill them.

The day of departure was set for Monday, March 12, and ranged along the shores of the City of St. Johns was the entire population, which had turned out to wave a farewell to the seal hunters. The city was wild with excitement. On every hand discussions were heard as to who would be the first through the outlet from St. Johns Harbor to the mighty Atlantic. Restricted by two large mountains on either side of the harbor, the shores of the outlet are separated by a distance so small that only one vessel can pass in or out at one time. To add to the excitement of the chase the sealing vessels race as they depart, each vessel endeavoring to pass through the narrows first; the race is closely watched by the excited mobs on shore and many bets are made on the result.



On the day of departure the entire population had turned out to wave a farewell to the seal hunters.

To me it was an exciting moment when, at six o'clock on the day mentioned, the signal was given, and simultaneously all vessels moved forward to the accompaniment of blowing of whistles, ringing of bells and cheers from the thousands of people lined up along the water front.

To me it was an exciting moment when, at six o'clock on the day mentioned, the signal to start was given and simultaneously all vessels moved forward to the accompaniment of the blowing of whistles, ringing of bells, shouting from the crew, waving of flags, and cheers from the thousands and thousands of people lined up along the water front.

The race is on, some dozen vessels are almost within arm's length, and in their frantic attempt to clear the narrows first a collision seems inevitable. Then the Beothic, our ship, pushes her way forward and swings through the narrows first, leaving the others behind. Although this means nothing so far as future luck is concerned, the mere fact of being on the victorious ship fills me and all the rest of the crew with joy and an ovation is given to the skipper.

After the abatement of all this excitement, I critically viewed my shipmates, who were to be my sole companions for six weeks or longer, and without reaching any particular conclusions or forming any opinions I returned to my wireless cabin. There I called up the wireless station at Cape Race, and after establishing communication with it and several neighboring vessels, I turned to my bunk to gain the necessary rest from an exciting and novel day's experience.

We encountered heavy ice from the start; our progress was extremely slow, and I received many bumps while lying in my bunk during the night. The following morning only one of the other steamers, the Bellaventure, was in sight, each vessel having its own route.

To pass through the heaviest floes of ice it is necessary to "butt," which simply means going full speed ahead until the resistance of the ice becomes too great to make further progress possible. Then the engines are reversed and the vessel moves back a short distance and repeats the process, each time cracking the ice and forming a "lead" through which to proceed. The lower part of the bow of these ice breakers is round and, instead of going through the ice, it slides up upon it, crushing enormous sheets by its own weight. It can be easily seen that the force of two steamers "butting" into the same sheet of ice produces quicker results than if only one was struggling against it, and for this reason it was arranged with the captain of our neighboring vessel to have the two ships travel close together. Some distance was covered in this manner before each of us took our separate routes.

This "butting" process is indeed a shaky proposition, for each time that the vessel crashes into a new pan of ice the impact is felt throughout the ship; and but for its staunch construction, in the way of extra heavy steel plates and a specially designed bow, the result might not be unlike that which befell the ill-fated Titanic.

Outside of the presence of our neighboring vessel, nothing was in sight but a pure white surface as far as could be seen, dazzling and causing a dull ache in the observer's eyes. The decks were crowded with the sealers, despite the biting cold. After a time I made the acquaintance of a young man who seemed as strange on board as myself, and after a preliminary chat he told me that he was our doctor. Having just graduated from college and desiring both professional and adventurous experiences he had welcomed the opportunity to join the expedition. It was a relief to meet this young Newfoundlander, for I immediately recognized that here lay my only chance for a congenial shipmate.

This being the first time a doctor as well as wireless equipment and wireless operator were carried to the icefields on board this vessel, we were looked upon as curiosities and afforded an endless subject for discussion amongst the crew. As for the wireless equipment, this was viewed with no undue degree of skepticism and distrust, not only by the crew but by the master; to the latter the entire equipment seemed too mysterious an arrangement to permit of any special faith in its reliability. Strange as it may sound, the master of this vessel, the chief executive of this cargo of human lives, later to be joined by a cargo of sealskins the value of which runs into the hundred thousands, was one of the most illiterate men I have ever met, unable to even sign his own name. Yet he had no peer in navigating seal craft and in locating the seals, according to one of the oldest sealers, who assured me that "the Cap'n knows every piece of ice by sight and some to speak to."

Although these sealers are an English-speaking race, their mode of expression must be best understood by their own kind, for at first I found it difficult to fully understand their speech with any degree of accuracy. I was promptly christened the "Coni Man"—the name Marconi apparently being too difficult for them to handle. What they longed most for was information as to whether any of our neighbors were faring better than ourselves in the way of seals. The wireless man being the only one who could possibly shed any light on this vital question, I was repeatedly accosted throughout the voyage with the question, "Any bit of fresh news dis marnin', Coni Man?"

When I could not relieve their anxiety with definite news they decided, at least among themselves, that "dem sparks" was not all that "it was cracked up" to be. However, these early disappointments on their part were not evidenced in any marked manner, and no discourtesy was shown to the "Coni Man." In fact these poor sealers showed me every consideration and, it is pleasant to recall some of their sterling characteristics, which, though crudely manifested, showed the kindliness of spirit which that type of man always entertains towards one whom they consider to be of a higher order of intelligence.

The first two days did not disclose any signs of seals and they were devoted to a continuous struggle with the heavy ice, which did its best to prevent the mighty Beothic from making any great headway. With the assistance of our neighbor, the Bellaventure, however, we were able to make a trifle more progress than we should have otherwise. But the best of friends and ships must part, and on the third day the captains of the two vessels decided to separate and follow different routes, or "leads," as they are called by the sealers. We were separated by scarcely more than a few miles, when the captain of the Bellaventure signaled that he wished to come near us again.

This seemed strange, but when the two vessels got within hearing distance the reason was megaphoned across. The wireless outfit on the Bellaventure was out of commission, and it was requested that I go over there, locate the fault and remedy it.

The wireless equipment was viewed with skepticism and distrust, the crew deciding that "dem sparks" was not all that "it was cracked up" to be.

One of the stokers become quite friendly with a "white coat" seal.

The ships were then about a thousand feet apart and at a standstill. I confess I lacked the courage to risk my avordupois on the ice, and I viewed the prospect with considerable apprehension. I recalled falling through the ice in my youthful days when ice-skating and felt sure that I was to renew my acquaintance with the frigid water under this ice too. It was probably this inward fear—which I wouldn't have that admitted for the world—that led me to extend an invitation to the doctor to accompany me on my walk across the ice. Much to my surprise, he consented to go with me.

We were dressed in the usual sealing attire—sealskin boots, with spikes on the bottom to grip the ice, goggles over eyes to prevent snow-blindness—and carried in our hands a gaff, a pole about six feet long to the end of which is attached an ordinary iron boathook. These gaffs are always carried by the men while on ice and serve as a support as well as a guide. The hook is stuck into the ice before a step is taken, thus avoiding soft or "slob-ice," which if stepped upon means a ducking.

The doctor and I, in our attempt to walk over the ice, must have furnished a good deal of amusement to the sealers on board, for we were continually picking each other up. After an awful struggle, which was in no way alleviated by the ostensible mirth of the crew, we managed to land aboard the Bellaventure.

We were greeted with supercilious smiles and satirical queries as to our love for walking over ice. Nevertheless we were welcome arrivals, and after some five or six hours the wireless gear was again in commission and the vessels once more came to a halt, permitting the doctor and myself to descend to the ice and depart for our own good ship.

It was late in the day and the atmosphere was extremely cold; the ice in spots was broken; huge patches of slob ice were in evidence. Under such conditions the only way to make your distance is to jump from one pan of ice on to another, disregarding temporarily the water between the sheets of ice. This may seem a very simple process, but you have my word for it that a special race of people must have been designed for just this stunt, this race being no other than the Newfoundland seal hunters. They will jump on a piece of ice, no matter how small it may be, and keep their weight on it just long enough to get away to the next sheet. Being extremely deficient at this art, both the doctor and myself soon found ourselves in an uncomfortable as well as an extremely dangerous dilemma. At every second step we fell into the water, grabbing at a sheet of ice en route, which, after we had mounted it, promptly broke in half and floated off, separating us from each other. In but very few moments we were both played out and lay grasping on the individual ice cake which happened to hold us for the moment. The crews of both vessels kept shouting directions, suggesting which way to make for, but this only added to our confusion. At the moment which seemed above all others the most inauspicious, the captain of the Beothic, realizing our plight, committed what was in my opinion a gross indiscretion. He set the bow of the vessel straight for us and ordered full speed ahead. It will be a long time before I shall forget the sight of the big vessel bearing straight down upon us, smashing the very sheets of ice upon which we stood! To be caught between two heavy sheets of ice and jammed into a jelly was not exactly en couraging and, besides, did not conform to my ideas of a proper and fitting end for a young and industrious citizen.

The only way to make your distance is to jump from one pan of ice to another, disregarding temporarily the water between.

But the captain realized our dangerous position in time and probably chuckled as he reversed the engines to full speed astern. Then he sent a dozen or more sealers—regular "ice-trotters"—to our rescue. In scarcely a minute two of these men had us in their clutches and began passing us along from one man to another, adding a final touch by actually carrying us on board. Our safe arrival was marked by an ovation, which, if designed to add to the discomfiture of one who would and couldn't, cretainly fulfilled its purpose.

But all these and many more experiences were to be expected. In the next installment it will be shown the dramatic part the ethereal waves performed.

This is the first of a series of articles by Mr. Sarnoff relating his experiences in the Arctic. The second will appear in an early issue.

STORM WARNINGS TO SHIPS

The United States Department of Agriculture, through the Weather Bureau, has inaugurated a plan of supplying a regular daily weather bulletin to all vessels and radio stations within range of the naval radio station at Radio, Va., and Key West, Fla. Each night, a few minutes after ten o'clock, the two big naval radio stations make a broadcast distribution of a weather bulletin, which deals particularly with wind conditions and barometric pressure, and gives special warning of severe storms along the coast. Other naval radio stations will continue to distribute weather information and forecasts, as they are at present doing, but the new broadcast distribution will be exclusively through the two big radio stations.

The daily bulletin consists of two parts. This first part announces in code letters and figures the actual weather conditions at eight o'clock in the evening (75th Meridian time) at certain points: Sydney, Nantucket, Atlantic City, Hatteras, Charleston, Key West, Pensacola and Bermuda. The same part of the bulletin contains a special forecast of the probable winds to be experienced 100 miles or so off shore. In the second part are the storm warnings and forecasts, which will cover a period of forty-eight hours from the time of issue. At the end of the forecast is appended a statement of the location and movement of any barometric depressions that may be likely to affect the winds over the ocean.

STATION ON PIKE'S PEAK POSSIBLE

A wireless station, to be one of the links of a chain of such stations which will connect the Atlantic and Pacific coasts, may be established on the summit of Pike's Peak as the result of a trip made by Seretary Franklin K. Lane, of the Department of the Interior, who was the guest of the management of the Cog road.

Although the trip was made primarily to look over the watershed, its purpose was also to determine whether the summit of Pike's Peak would be a fit place on which to build a powerful wireless station, which will connect the two oceans and be used solely by the United States government. As a result of Secretary Lane's visit, the Weather Bureau, which was maintained by the government for so many years in the summit house, may be re-established.

WIRELESS TROUBLES AFRICANS

Wireless telegraphy is interfering with the happiness of natives of Central Africa, for it has deprived them of an unfailing supply of wire to be worked up into ornaments and weapons. Several mines, operated by European capital in Central Africa, have recently abandoned their wire-telegraph lines from railroads to the mines, and established communication by wireless.

Maintenance of the wire lines has been difficult, because of the demand for the wire by native belles, and also because of the occasional wanton destruction of pole lines.

The Engineering Measurements of Radio Telegraphy

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ARTICLE I

In this, the first of a series of articles by a well-known authority, several formulae to be used in the construction of laboratory standards of capacity are given; equations covering the influence of the combinations of capacity, inductance and resistance on the behavior of circuits are furnished; a method for measuring capacity by means of the Wheatstone bridge is discussed and the apparatus described in detail. The errors of the method, their elimination and probable accuracy are shown.

THE precision of measurement and the soundness of the theory underlying the measurements in any branch of engineering may be said to bè a measure of the scientific and technical standing of that profession. For it is only in so far as guesswork is replaced by calculation and measurement, empirical methods by logically exact procedure, that a division of technology finds an extended sphere of usefulness. The early days of any branch of engineering always display ignorance of underlying physical principles and crude methods of measurement. Both are usually masked by a pretense of mystery and claims that the obtaining of exact data is not "practical." Fortunately for radio engineering, it may safely be said that such an era of literal groping in the dark has come and gone, and that there is no excuse for failure to obtain quantitatively exact measurements.

It is the aim of the following series of articles to place before those actively interested in radio communication a practically complete series of methods of measurements dealing with the widely diversified electrical constants of radio apparatus. A knowledge by the reader of the principal laws of electricity, and of commonly used electrical machinery, is presupposed. The methods described have been chosen from an engineering standpoint, only those which are made in radio stations or in laboratories intended for the development of commercial apparatus being fully considered. Those of purely scientific interest, or those requiring especially elaborate experimental facilities, will be merely cited.

The three most important elements of the usual circuit in which flow radio frequency currents are (concentrated) capacity, inductance and resistance. They determine the electrical behavior of a circuit under the action of any definite type of impressed electromotive force. The logarithmic decrement, or the associated quantity, the damping, of the circuit is a function of these three; but it is of great importance in radio circuits, and special means of determining it are used. The wave length, or the related quantity, the frequency, of the circuit, is also a function of these three, and again can be directly measured by special methods. Passing to the electrical means of linking circuits for purposes of energy transfer, measurements of the various coefficients of coupling—direct, inductive and capacity couplings—will be considered.

Having established definite methods of determining these fundamental electrical constants, methods of testing separate pieces of radio apparatus will be treated. The separation of the losses in each instrument, from the power plant to the antenna insulators, are to be discussed. Under this heading many of the highly special types of radio apparatus will be considered; for instance, arc and spark-gap dischargers, transformers, radio frequency alternators and relays for break systems.

A number of tests of receiving apparatus will follow. Critical quantitative tests of the sensitiveness, ease of adjustment and holding of sensitiveness of the various detectors will be treated.

And, finally, over-all efficiency station tests, the consideration of antenna types and ground connections, and some transmission tests will be given.

I.—MEASUREMENTS OF CAPACITY.

General Considerations.

1. *Calculation of Capacity of Definite Systems.*—Since it is necessary to construct standard capacities, and desirable to know in advance their approximate value, the following formulæ are of value:

(a) Capacity of a Sphere, radius u, placed in air, and distant from the ground, the capacity in microfarads (abbreviated μf),

$$c = \frac{u}{900{,}000} \qquad (1)$$

(b) Capacity of a cylindrical wire, length v cm., radius u cm., stretched vertically and distant from the ground, in microfarads,

$$c = \frac{v}{900{,}000 \log \dfrac{v}{u}} \qquad (2)$$

Note.—The logarithm here given is a natural logarithm, and is obtained by multiplying the usual logarithm to the base 10 by 2.3026. Unless otherwise stated, all logarithms hereafter referred to are to the base e—that is, natural logarithms.

(c) Capacity of the same wire, but stretched horizontally s cm. from the ground, in microfarads,

$$c = \frac{v}{900{,}000 \log \dfrac{2s}{u}} \qquad (3)$$

(d) Capacity of a flat circular plate, radius u cm., in air distant from the ground, in microfarads,

$$c = \frac{2u}{900{,}000\pi} \qquad (4)$$

(e) Two parallel thin plates, area f sq. cm., with the small separation of s cm., in microfarads, neglecting edge correction, dielectric constant K,

$$c = \frac{fK}{(4\pi)900{,}000\,s} \qquad (5)$$

(f) Capacity of two circular plates, radius u cm., separation s cm., thickness w cm., dielectric constant of separating medium K, with partial edge correction, in microfarads,

$$c = \frac{K}{900{,}000}\left[\frac{u^2}{4s} + \frac{u}{4\pi}\left(\log\frac{16\pi u(s+w)}{s^2} - 1 + \frac{w}{s}\log\frac{s+w}{w}\right)\right] \qquad (6)$$

(g) Capacity of y semi-circular plates. arranged as in (f), in their position of maximum capacity—that is, interleaved (taking only the capacity between pairs of adjacent plates).

$c = \left(\dfrac{y-1}{2}\right)$ times (the capacity of two similar circular plates as given by (f) above). (7)

(h) Capacity of two coaxial cylinders, length v cm., outer radius of inner cylinder u_1 cm., inner radius of outer cylinder u_2 cm.

$$c = \frac{v}{2\left(\log\dfrac{u_2}{u_1}\right)900{,}000} \qquad (8)$$

2. *Calculation of Capacities in Series and Parallel.*—If the individual capacities—c_1, c_2, c_3, etc.—are connected in parallel, the total capacity of the system (neglecting the connecting wires and the capacities between the condensers) is given by the equation,

$$c = c_1 + c_2 + c_3 + \text{etc.} \qquad (9)$$

If the same capacities are connected in series, the total capacity under the same conditions as before is,

$$c = \frac{1}{\dfrac{1}{c_1} + \dfrac{1}{c_2} + \dfrac{1}{c_3} + \text{etc.}} \qquad (10)$$

3. *Electrical Behavior of Capacity.*—Suppose a capacity of value c to be placed in an alternating current circuit, frequency n, angular velocity ω,

$$(\omega = 2\pi n)$$

The reactance of this capacity is,

$$X = -\frac{1}{2\pi nc} = -\frac{1}{\omega c} \qquad (11)$$

The current which passes through this capacity when an electromotive force E (R. M. S. value) is applied is,

$$I = \frac{E}{X} = \frac{E}{-\frac{1}{\omega c}} = -\omega c E \qquad (12)$$

(In this equation, the minus sign signifies that the current "leads" the electromotive force.)

4. *Equivalent Impedance, Reactance and Capacity of Combinations of Capacity, Inductance and Resistance in Series.*—The first case we shall consider is that of a capacity c in series with a resistance r. The equivalent resistance is r, the equivalent capacity c, and the impedance is

$$Z = \sqrt{r^2 + \frac{1}{\omega^2 c^2}} \qquad (13)$$

For a capacity c in series with an inductance l, the reactance is

$$X = \omega l - \frac{1}{\omega c} \qquad (14)$$

and the impedance has the same value. The impedance of a capacity c, an inductance 1, and a resistance r, all in series, is

$$Z = \sqrt{r^2 + \left(\omega l - \frac{1}{\omega c}\right)^2} \qquad (15)$$

In each of the above cases, if we divide the impressed alternating electromotive force E by the corresponding impedance for reactance, where no impedance is given), we obtain the current I, *for a steady state.* Considering equation (15) further, the current under a given impressed voltage will be greatest when the impedance is least. Assuming constant resistance in the circuit, the impedance Z is least when

$$\omega l - \frac{1}{\omega c} = 0 \qquad (16)$$

which is the condition for resonance to a forced alternating current.

5. *Equivalent Impedance, Reactance and Capacity of Combinations of Capacity, Inductance and Resistance in Parallel.*—The first case to be considered is a capacity c in parallel with a resistance r. It is of importance, because in many wave-meter arrangements detectors or resistances of other kinds are shunted across the variable condenser. The equivalent resistance is

$$r_e = \frac{r}{1 + \omega^2 c^2 r^2} \qquad (17)$$

The equivalent capacity is

$$c_e = \frac{1 + \omega^2 c^2 r^2}{\omega^2 c^2 r^2} \qquad (18)$$

The impedance is

$$Z = \frac{r}{\sqrt{1 + \omega^2 c^2 r^2}} \qquad (19)$$

Consider now a capacity c in parallel with an inductance l. The equivalent capacity is

$$c_e = \frac{1 - \omega^2 lc}{\omega^2 l} \qquad (20)$$

and the reactance is

$$X = \frac{1}{1 - \omega^2 lc} \qquad (21)$$

An arrangement, to which we shall have occasion to refer when giving a method of constructing an artificial antenna which closely duplicates in behavior actual antennæ, involves a capacity c_1 in parallel with and inductance l and a capacity c_2, the latter capacity and inductance being in series. The reactance is

$$X = \frac{\omega^2 l c_2 - 1}{\omega c_2 + \omega c_1(1 - \omega^2 l c_2)} \qquad (22)$$

The arrangements given under sections 4 and 5 are shown in order in Figure 1. It is to be noted that in all these cases the forced alternating current through the desired combination can be found by dividing the impressed voltage by the impedance (or reactance, where the impedance is not given). That component of the current which is in phase with the voltage can be found by dividing the voltage by the equivalent resistance, and that component of the current which leads the voltage by 90° can be found by multiplying the voltage by ω times the equivalent capacity. It is, however, to be noted that these formulæ cannot be used to obtain the *natural* frequency or wave length of the corresponding circuit. Formulæ for this latter purpose will be given under measurements of wave length.

6. *Conditions of Measurement of Capacity.*—Capacities may be measured at high or low voltages, and at audio frequencies (that is, between 20 and 20,000 cycles per second), or radio frequencies (above 20,000 cycles per second). The distinction here given between audio and radio frequencies is solely one of convenience, and is not meant to imply that radiation is confined to currents of radio frequencies, though usually such is the case, practically speaking. It is generally found that capacities are apparently larger at high voltages than at low voltage, because of the brush discharges increasing the equivalent jar surface, and because of heating and the consequent increase of conductivity of the dielectric. And, in general, capacities are apparently less at radio frequencies than at audio frequencies, because of the altered distribution of charge in the plates of the condenser.

We pass now to a series of measurements of capacity under these various conditions.

7. *Measurement of Capacity at Audio Frequencies and Low Voltages* (using the Wheatstone Bridge).

(a) *Arrangement of the Apparatus.*—In Figure 2 is shown a diagrammatic representation of the apparatus used. S is a source of alternating or pulsating current. r_1 and r_2 are non-inductive resistance s, c_x is an unknown capacity, and c_n is a standard known capacity. T is a telephone receiver or other device which is is sensitive to small alternating currents.

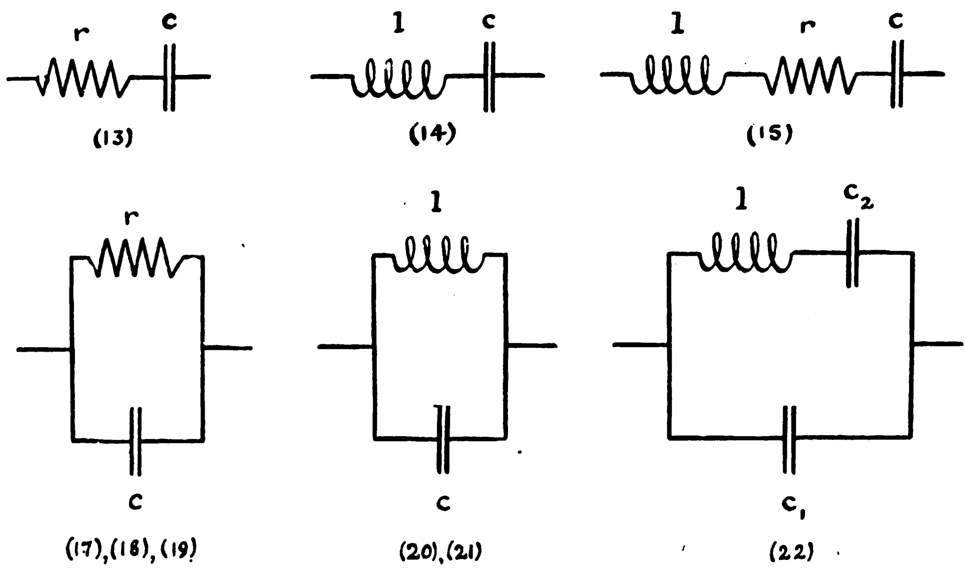


Fig. 1

The actual arrangement of the apparatus is as shown in Figure 3. The fluctuating current source S is the buzzer M. This buzzer has a third terminal U, so that both of the interrupter terminals are accessible from the outside. The buzzer itself is operated from the battery V, controlled by the rheostat R. Connected across the interrupter is the condenser C_t and the coil P. P is the primary of an ordinary telephone induction coil, and therefore a fairly high voltage is produced at the terminals of S, the secondary. A, B is an ordinary slide wire bridge with special wire, and the remainder of the apparatus is as explained above.

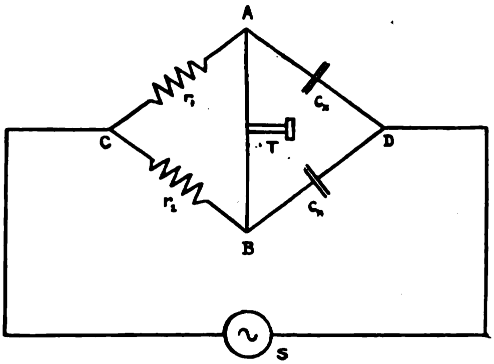


Fig. 2

In Figure 4, a photograph of the assembly of the apparatus is given. To the left, the box containing the buzzer, the telephone induction coil, the battery circuit rheostat and the primary circuit condenser are seen. The bridge itself in in the foreground, with the telephone receiver directly behind it. The box of standard capacities is at the right, just back of the bridge. In the background are a number of different types of air and solid dielectric condensers which were tested.

(b) *Theory of the Method.*—If no sound is heard in the telephones, the potentials at A and B are the same. That is, the drop of potential along AC is the same portion of the total drop along CAD as the drop of potential along CB is of the total drop along CBD. But the drops of potential are proportional to the corresponding reactances or impedances of the included portions of the circuits. Hence, from equation (13) above,

$$\frac{r_1}{\sqrt{r_1^2 + \left(\frac{1}{\omega c_x}\right)^2}} = \frac{r_2}{\sqrt{r_2^2 + \left(\frac{2}{\omega c_n}\right)^2}}$$

which can be readily simplified to

$$c_x = \frac{r_2}{r_1} c_n \qquad (23)$$

So that, if r_1 and r_2 are appropriately adjusted, or c_n is varied, silence will be attained in the receiver, and the unknown capacity can be calculated from equation (23).

(c) *Procedure.*—The experiment should be performed in as quiet a room as possible. The tone of the buzzer is preferably higher than that of the usual buzzer, because of the increased sensitiveness of the ear to high-pitched notes. The balance point for silence is first roughly located by moving the contact up and down the slide wire. If no balance point is found, either a connection is open at some point of the bridge or the two capacities which are being compared are not nearly enough equal. It is always desirable to have them not very far from equality; that is, their ratio should not be greater than one to four or four to one. Otherwise the accuracy of the measurement is decreased.

To locate the silence point, it is usually desirable to find two points, one on each side of it, where the intensities of sound in the telephones are equal in the two cases. The balance point is then taken half way between these points. If the bridge wire is known to be of uniform resistance per unit length, the resistances r_1 and r_2 can be replaced by the lengths m and n, the ratio of which will be the same as the ratio of the corresponding resistance. If this is not the case, the bridge wire must be separately calibrated on a usual Wheatstone bridge, so that the resistances of various lengths of it are known. If care is taken not to damage the slide wire by rough handling, such a calibration will usually not be necessary.

(d) *Detailed Description of Apparatus.*—In this measurement it is desir-

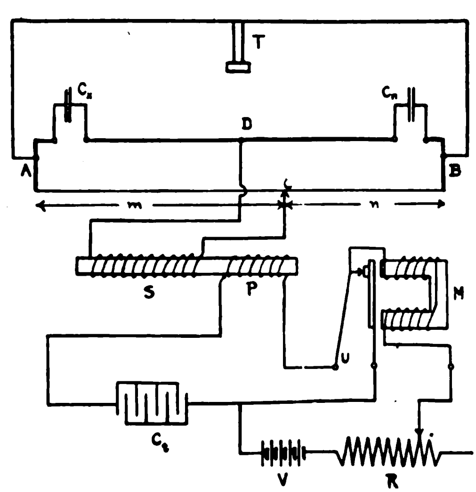


Fig. 3

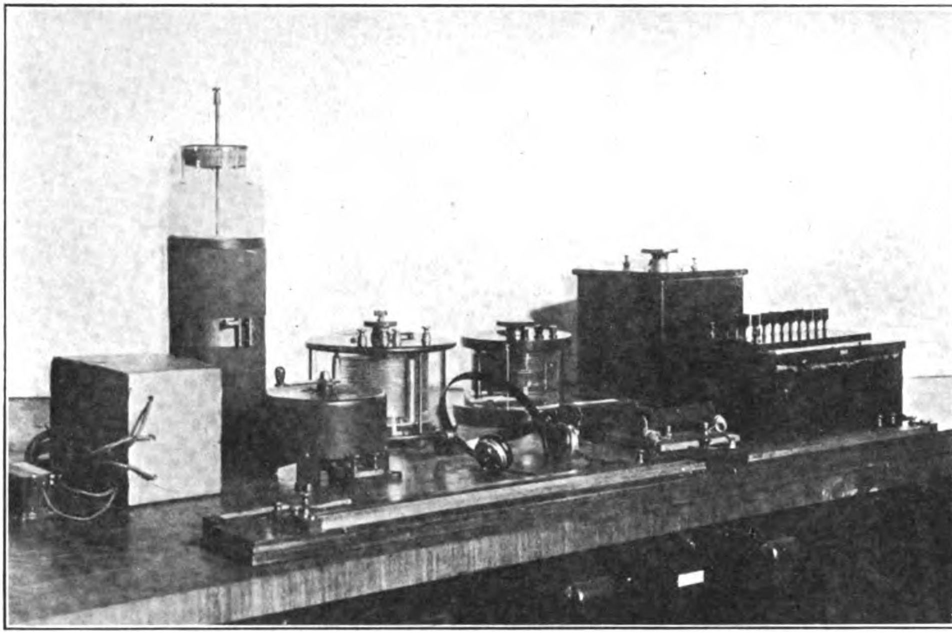


Fig. 5

able for high sensitiveness to use a slide wire of large resistance. A meter of 0.003 inch "Therlo" wire, having a resistance of 104 ohms, was used. The buzzer was a small, high-pitched one, the battery voltage was 10, and the regulating resistance R was 12 ohms. The condenser c_t was 2 microfarads, and the telephone induction coil was a No. 5 Western Electric induction coil, resistance of primary being 0.39 ohms, and of the secondary 149.2 ohms. If the reactance of a capacity of 0.1 μf is calculated at 500 cycles, it will be found to be about 3,300 ohms, so that for maximum sensitiveness in measuring a capacity of this order of magnitude the bridge wire should have a resistance of about 6,700 ohms. The reason for this statement is that maximum sensitiveness of a Wheatstone bridge arrangement is attained when the impedances of the four arms of the bridge are equal. Of course, a bridge wire of so high a resistance would be too fragile, so that for more accurate measurements a post office type of box Wheatstone bridge must be employed. To avoid the serious error of the distributed capacity of the coils of such a bridge, the resistance coils of higher values must be made up of a number of smaller resistances connected in series. In this way the distributed inductance of the set of coils is less than that of a single coil (see equation 10, above). Another method of obtaining a high-resistance bridge wire, of low capacity, is to use specially prepared uniform graphite resistance rods in place of a metallic wire. Such rods will usually require a preliminary resistance calibration, because of their lack of homogeneity. Any fairly high-resistance telephone of good sensitiveness suffices for this measurement. It should, however, fit tightly to the ears, because even when the buzzer is placed in a large box packed in cotton waste or felt its sound is still audible. And it may be mentioned that other sources of alternating or fluctuating current may be used with equal success and convenience in these measurements. For example, ordinary alternating current, properly controlled by lamp-board resistances, or rotating commutator so arranged as to charge the condenser C_t periodically and permit it to discharge through P, may be employed.

The capacity of the various portions of the bridge to ground may introduce a slight error in these measurements, This error may be partially eliminated by connecting the point C to ground, and not tonching any metallic part of the circuit with the fingers while taking readings.

And, finally, it is desirable to have the same dielectric in the standard condenser and the unknown condenser; because, otherwise, dielectric hysteresis being unequal in the two condensers, it will be impossible to get an absolute silence point. In such cases, the best that can be obtained is a minimum of sound.

(e) *Errors of the Method, their Elimination and Probable Accuracy.*—The errors and disadvantages of the method are the lack of sensitiveness of the ear to very faint sounds, dielectric losses in the condensers causing difficulty in getting complete silence, the inductance and capacity of the resistance arms of the bridge, and the capacity of all connecting wires. These errors can be minimized by finding the silence point through taking readings equidistant from it on both sides, by employing an air or oil dielectric for the condensers, by using straight wires or rods of high specific resistance for the resistance elements, and by having all connecting wires as short as possible and far apart. As an example of a typical measurement, the following may be instanced:

c_x Paper dielectric condenser, nominal value $= 0.1\ \mu f$.

c_n Edelman standard mica dielectric condenser, capacity (according to the Reichsanstalt) $= 0.0992\ \mu f$.

At balance point:

$$m = 48.1 \pm 0.1 \text{ cm.}$$
$$n = 51.9 \pm 0.1 \text{ cm.}$$
$$c_x = \frac{n}{m} c_n = 0.1036 \pm 0.0004\ \mu f.$$

Accuracy of the measurement $= 0.5\%$.

This is the first of a series of articles on engineering measurements, by Dr. Goldsmith. The second will appear in an early issue.

NEW NAVY STATION AT CAIMITO

Work will soon be commenced on a large wireless station which will be constructed by the United States at Caimito, in the Canal Zone. When completed it is expected to make wireless communication with Washington, D. C., possible at all hours of the day and night. The station will be officially known as the Darien Radio Station, and will be in charge of the Navy Department. It will be even larger than the one at Arlington, Va.

All of the three masts will be 600 feet high, whereas at Arlington one of the towers is 600 feet in height and two are 450 feet high. The bases of the towers will be about 180 feet above the sea level, and they will be arranged in a triangle, approximately 900 feet on a side. The sending and receiving radius will be nominally 3,000 miles, so that communication may be held direct with the Arlington station, instead of by way of Key West, as at present.

The present stations at Colon and Balboa will be continued in use to handle messages for ships using the canal, and the Caimito station will be used exclusively for official business of the government.

10,000 MILES BY WIRELESS

A wireless communication was sent more than 10,000 miles by means of the flagship Australia, which was traveling from Durban, South Africa, to Albany, Queensland. A message from the Governor of New Zealand to Lord Gladstone at Pretoria was sent from Wellington to the high-power station at Sydney, thence to Perth, and thence via the Australia, in mid-ocean, to Cape Town and Durban.

SERVICE ITEMS

John Young, auditor of the American Marconi Company, has sailed for Scotland, where he will spend a vacation. He is accompanied by his wife.

* * *

N. E. Albee, who was manager of the Marconi station at Tampa, Fla., has been placed in charge of the Cape Hatteras station. R. I. Young, who was assistant to Albee, has succeeded him as manager of the Tampa station.

* * *

John R. Irwin, who is well known as a wireless operator, has been appointed superintendent of the Northern district of the Pacific coast division of the American Marconi Company. He will make his headquarters in Seattle, Wash.

Prize Money for Ideas About Wireless

IN order to induce readers interested in wireless telegraphy and telephony to exchange ideas and relate what progress they have made in the art, THE WIRELESS AGE will start two prize contests. The contests are open to all, whether subscribers or non-subscribers to THE WIRELESS AGE. Four prizes will be given every month for new ideas and suggestions, accompanied by drawings, regarding wireless apparatus and how to bring about improvements in it. For the best descriptive articles, accompanied by photographs, of wireless apparatus, stations or any thing that pertains to wireless communication feats, four prizes will also be given every month.

Three prizes of $10, $5 and $3 each, and one prize of a year's subscription to THE WIRELESS AGE will be awarded for the best ideas and suggestions, with drawings, submitted. Two prizes, of $5 and $3 each, and two prizes of $1 each, will be awarded for the best articles. describing station equipment, with photographs. THE WIRELESS AGE reserves the right to publish any of the contributions received, regardless of whether or not prizes have been awarded for them.

Contributions should be written on one side of the paper. It is desirable to have typewritten manuscripts, double spaced, and India ink should be used in making the drawings. Sketches should be forwarded with suggestions whenever possible, even if they are rough. Articles submitted should not exceed 1,000 words. In order to obtain proper consideration, contributions should be sent to THE WIRELESS AGE as soon as posible.

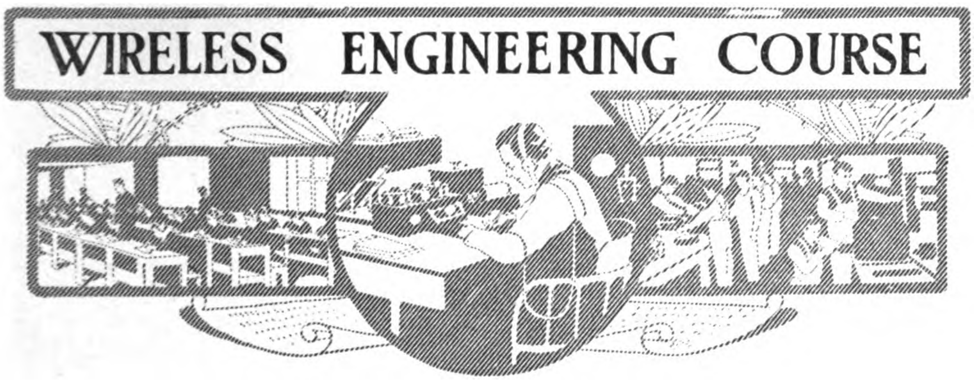
Almost every student of wireless has ideas which are of interest to other students. If, in the course of experimenting, you have made discoveries that will tend to throw new light on the art, send an account of them to this magazine. They may, perhaps, appear trivial to you, but it is possible that they will prove of considerable value to other readers, who have been experimenting along the same lines. Through the publication of these ideas there will be established what may be termed a co-operative information bureau on wireless subjects.

Everyone is able to discuss intelligently that which absorbs considerable of his attention. Wireless operators, therefore, will welcome an opportunity to tell all about their outfits. It is advisable to include the dimensions of the apparatus in a description of the outfit. If you made the outfit yourself that fact will also be of interest. Do not hesitate to send in details of your apparatus because it is small; a description of the outfit might prove very interesting.

It is not necessary that competitors in these contests should own or operate outfits themselves. Contributions from persons who, while they do not own outfits, are interested in the science will be welcomed.

The competitors should also bear in mind that the details of an article contribute in no small degree to its interest. If you have an outfit that you made yourself, tell how the idea of taking up wireless first came to you. Relate the difficulties you had in making the apparatus. Of course, the main interest in the article is in the apparatus itself, and every part of the outfit should be described. After you have completed your article, read it over carefully to correct errors of statements, grammar and spelling.

There is an unlimited field for persons ambitious to win prizes in the contest for ideas and suggestions. If you have no ideas in mind at present, examine carefully all parts of your apparatus and pick out the defects. It is likely that a little time and thought spent on the outfit will reveal possibilities for improvement which had not previoussly occurred to you.



ERRATA

In the September issue of The Marconigraph, in the chapter on thermo meters, in the wireless engineering course, the expression, "between the poles of a perminate magnet," appears. The expression, "perminate magnet," appears also in another section of the article. In each case "perminate" should have read "permanent."

By H. SHOEMAKER

Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER X

Electrical Oscillations

ELECTRICAL oscillations may be defined as alternating currents whose successive maximum values gradually decrease to zero. Like alternating currents, they can be produced at almost any frequency. Fig. 10 of the preceding articles is a graphic representation of alternating current produced by a generator or dynamo. In this case the successive current maximums are the same, and their value will depend on the voltage, resistance or self-induction of the circuit.

Fig. 44 is a graphic representation of electric oscillations produced by the discharge of a condenser. Fig. 45 is a circuit diagram of an oscillation circuit. K is a condenser which can withstand very high voltages, L is an inductance and S is a spark gap. All three of these elements are connected in series to form a complete circuit except the spark gap S. If the condenser K is charged by means of a transformer or other suitable device, its potential will rise until a discharge takes place across the spark gap S. When this discharge takes place the spark gap is rendered conducting and the current flows through the circuit, which oscillates as shown graphically in Fig. 44.

X X′ is the time axis and Y Y′ the axis of current values.

O is the origin or starting point of the oscillations and corresponds to the instant the discharge across the gap S starts; a b represents the maximum value to which the current rises in the time o b, which is one-fourth of a complete period. The current now decreases to zero at the point c corresponding to one-half of a complete

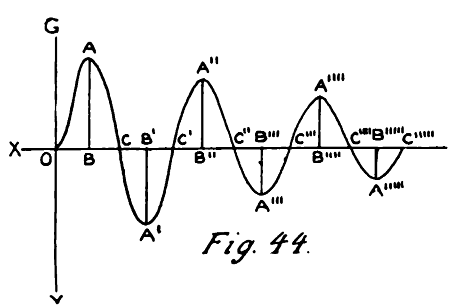


Fig. 44.

period. It now reverses in direction and again increases in value to a maximum represented by a′ b′, corresponding to three-fourths of a complete period. It now decreases again to zero, corresponding to a complete

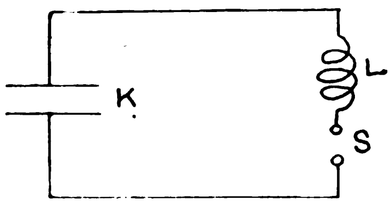


Fig 45

period. This process repeats itself and each successive maximum has a smaller value until it reaches zero, where all action stops. This series of oscillations is called a wave train. The oscillations are said to decay, due to the fact that the condenser contained a definite amount of energy before the discharge took place, and each time the current passed through the circuit a certain amount of energy was lost or dissipated by the resistance of the circuit.

As the resistance of the circuit increases, the difference between the successive maximum current values increases, and the number of oscillations of the wave train decreases. The oscillations are said to be damped.

If the resistance of the circuit is greater than a certain critical value, then the oscillations will be entirely damped out and the condenser will discharge in one direction only. In this case the circuit is said to be dead beat or aperiodic, and the current flow can be represented graphically by Fig. 46; it rises in value until it reaches a maximum and then decreases until it reaches zero.

The time for a complete discharge will depend on the resistance of the circuit and the capacity and self induction, and is independent of the voltage to which the condenser is charged. The time period of the discharge of condenser, whether oscillatory or aperiodic, depends on the three quantities, viz.: self induction, capacity and resistance of the circuit. It is independent of the voltage. The current value, however, depends on the voltage and the ratio of the capacity to the self induction.

If the circuit has iron or other magnetic material having a variable permeability, then the time period will be dependent on the current, which in turn is dependent on the voltage. Iron is never used in high frequency circuits for this reason; and also for the reason that it is a poor conductor.

The relation between the time period and the resistance, self induction and capacity can be expressed by simple formula where the values remain constant with different values of current, which is the case in practice.

Let T = the complete time period of the oscilations.
n = the frequency.
π = 3.1416.
L = the self-induction in henrys.
K = the capacity in farads.
R = the resistance corrected for frequency, in ohms.
I = the maximum current value in amperes.
i = the instantaneous current value at any instant.
λ = the wave length of the oscillation in meters.

If R is greater than $\sqrt{4L/K}$ there will be no oscillations and the discharge will be aperiodic or unidirectional.

If R is less than $\sqrt{4L/K}$, then there will be oscillations and

$$2\pi = \sqrt{\frac{1}{KL} - \frac{R^2}{4L^2}} \qquad (1)$$

In nearly all practical cases R is so small that is can be neglected entirely so fas as the frequency is concerned. Then,

$$2\pi n = \sqrt{\frac{1}{KL}}, \text{ or } n = \frac{1}{2n\sqrt{LK}} \qquad (2)$$

$$T = \frac{1}{n}, \text{ therefore } T = 2\pi\sqrt{LK} \qquad (3)$$

The wave length (λ) is the distance a free wave of frequency (n) will travel in time (T). It is used to measure the free wave produced in space by the electrical oscillations, rather than to measure the oscillations.

It has been found by direct experiment that these waves travel 3×10^{10} cm., or 3×10^{8} meters, per second (300,-000,000 meters).

Therefore,

$$\lambda = \frac{3 \times 10^{8}}{n} \text{ met., or } \lambda = 3 \times 10^{8} \times T \text{ met.}$$

From the foregoing it will be seen that the frequency can be readily varied by varing either K or L or both, and that it is inversely proportional to the $\sqrt{LK}$. This quantity $\sqrt{LK}$ is called the oscillation constant, and the wave length (λ) is proportional to this quantity.

The reader should fully understand these fundamental relations, for they are of great importance in wireless telegraphy. As the frequencies used in wireless telegraphy are of the order 1,000,000 (10^{6}) to 100,000 (10^{5}), and even lower in some cases, the values of L and K are small, being of the order of a few thousand millionths of a farad (10^{-9} farads) and millionths of a henry (10^{-6} henrys) or micro-henry.

The micro-farad is used as the unit of capacity and the centimeter as the unit of inductance, 1,000 centimeters being equal to one micro-henry. It is desirable to put equation 2 in the form for solution with these units, viz.: micro farads and centimeters,

$$n = \frac{5.033 \times 10^{6}}{\sqrt{LK}} \qquad (4)$$

Where K is in micro-farads and L in centimeters.

1 Micro-farad = 10^{-6} farads

1 Centimeter = 10^{-9} henrys

By equation (2)

$$n = \frac{1}{2\pi\sqrt{LK}}.$$

where L is in henrys and K in farads, therefore,

$$n = \frac{1}{2\pi\sqrt{L\,10^{-9}\,K\,10^{-6}}} = \frac{1}{2\pi\sqrt{LK\,10^{-15}}}$$

or,

$$n = \frac{1}{2\pi\sqrt{10^{-15}}\sqrt{LK}} = \frac{1}{2\pi\sqrt{10^{-3}}\sqrt{10^{-12}}\sqrt{LK}}$$

Which can be put in the form,

$$\frac{\sqrt{1{,}000} \times 10^{6}}{2\pi\sqrt{LK}}$$

$$\frac{\sqrt{1{,}000}}{2\pi} = 5.033$$

Therefore,

$$n = \frac{5.033 \times 10^{6}}{\sqrt{LK}},$$

and for approximate values we can say,

$$n = \frac{5 \times 10^{6}}{\sqrt{LK}},$$

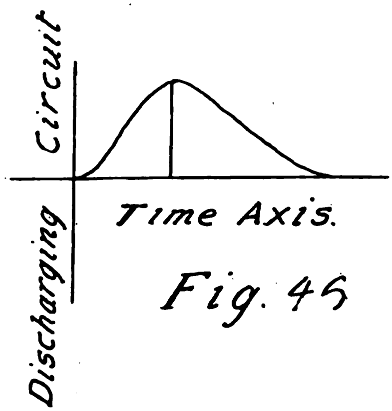


Fig. 45

While the resistance of the circuit does not affect the frequency unless it is great, it does affect the character of the oscillations and the number in a wave train. If we could measure the successive maximum currents in a wave train we would find that,

$$\frac{I}{I_1} = \frac{I_1}{I_2} = \frac{I_2}{I_3},$$

etc, where I is the first maximum, I_2 the second maximum, and I_3 the third maximum, etc. The Napierian logarithm of this ratio is called the logarithmic decrement.

If ϵ is the base of the Napierian logarithms than we can say,

$$\frac{I}{I_1} = \frac{I_1}{I_2} = \frac{I_2}{I_3} = \epsilon^{\delta}$$

where δ is the logarithmic decrement or,

$$\delta = \text{Log.}_{\epsilon} \frac{I}{I_1} = \text{Log.}_{\epsilon} \frac{I_1}{I_2}$$

We can also write,

$$\frac{I}{I_1} = \frac{I_1}{I_2} = \frac{I_2}{I_3} = \text{etc.} = \epsilon^{\frac{aT}{2}}$$

where a is a quantity called the damping factor.

The quantity

$$\frac{aT}{2} = \frac{a}{2n} = \frac{R}{4nL} = \delta$$

If we substitute in

$$\frac{R}{4nL}$$

the value of n, which is

$$\frac{1}{2\pi\sqrt{LK}}$$

we get the equation

$$\delta = \frac{\pi R}{2} = \frac{\sqrt{K}}{\sqrt{L}} \quad (5)$$

It will be seen that when R is constant, δ is proportional to

$$\frac{\sqrt{K}}{\sqrt{L}}.$$

Therefore we can make the decrem.nt small by making K small and L large, or by reducing R. In practice we are limited in several ways and must therefore compromise on these values. The order of the actual values in use will appear later.

By the use of formula 5 the number of oscillations in a wave train can be determined; for if δ is known, then (m) the number of oscillations in a wave train, when the last current maximum bears a certain ratio to the first, can be determined by the formula.

$$\frac{I}{I_m} = \epsilon^{(m-1)\delta}$$

or,

$$\text{Log.}_{\epsilon} \frac{I}{I_m} = (m-1)\delta$$

where I_m is the current maximum of the *m*th oscillation.

We must assign a value of

$$\frac{I}{I_m}$$

so that I_m is a certain percentage of I.

For instance, if I_m is .2% of I, then

$$\frac{I}{I_m} = \frac{1}{.02} = 50.$$

Therefore,

$$\text{Log.}_{\epsilon} \frac{I}{I_m} = \text{Log.}_{\epsilon} 50,$$

and,

$$\text{Log.}_{\epsilon} 50 = (m-1)\delta,$$

or,

$$2.3026 \log_{10} 50 = (m-1)\delta,$$

and,

$$2.3026 \times 1.69897 = (m-1)\delta,$$

or,

$$3.935 = (m-1)\delta.$$

Therefore,

$$m = \frac{3.935 = \delta}{\delta}.$$

$$\delta = .02 \text{ then } m - 195.$$

If $\delta = .02$ then $m = 195$.

There will therefore be 195 semi or 97.5 complete oscillations before the last one is reduced to .02 of the first.

The full proof of these equations and their derivation will be found in chapters I and III of Principles of Electric Wave Telegraphy, by J. A. Fleming. The reader is advised to study this matter so as to become familiar with all the terms and their meaning.

(To be continued)

This course commenced in The Marconigraph, issue of December, 1912. *Copies of previous lessons may be secured. Address Technical Department,* The Wireless Age.

Donald Perkins —Hero.

Snapshot of the Heroic Wireless Operator Taken by a Passenger Aboard the Ill-Fated Steamer

FAITHFUL to his duty, even as he faced death, Donald C. Perkins, chief wireless operator on the steamship State of California, lost his life when the vessel crashed onto a reef in Gambier Bay, Alaska, on August 18, and sank, carrying with her, according to newspaper reports, thirty-two persons.

Before he went to his grave, Perkins succeeded in sending the S. O. S. signal, which brought another steamship to the aid of the survivors. "Jack" Irwin, of the American Marconi Company, declares that Perkins was entrapped in his cabin and drowned, while newspaper stories are to the effect that he was struck by a falling mast and killed.

The ill-fated vessel was going at full speed when she struck the rock, which was uncharted. A large portion of her bottom was torn off, letting in a mountainous deluge. Three minutes afterward she sank. The disaster came without warning at half-past eight o'clock in the morning, and many of the passengers who perished met death in their staterooms.

In the three minutes before the State of California went to the bottom, Perkins, by sticking to his post, was able to send out his distress call, which was picked up by the Jefferson, of the Alaska Steamship Company, only a short distance away. When the rescue ship arrived on the scene, the survivors were in lifeboats and liferafts. It was broad daylight, and it was easy to pick them up. It was seen at once that there was no possibility that any of the missing reached shore.

Ten of the rescued passengers had suffered so severely from exposure that they were hurried to a hospital at Juneau, ninety miles from the scene of the wreck. First Officer Abernathy and four men were left with the wreck, in the vain hope of saving any of the missing.

The State of California was one of the best-known vessels on the Pacific coast, having been for a long time in the passenger trade between Puget Sound and San Francisco. She was built in Philadelphia in 1879, and was of 2,276 gross tonnage. The vessel was in command of Captain T. H. Cann, who had command of the steamship Valencia on her last trip to San Francisco from Seattle. He was transferred to another ship when the Valencia reached that port, thus barely missing being on the steamship when she went ashore at Cape Beale, B. C., January 22, 1906, with a loss of 117 lives.

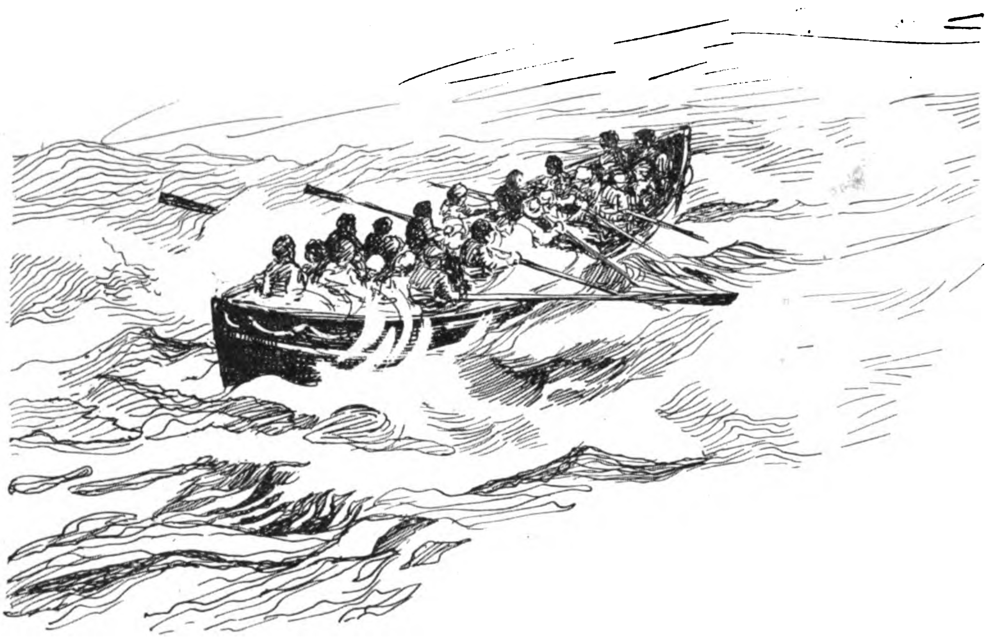
The State of California had been placed temporarily on the southeastern Alaska run during the Spokane tourist season, and had made only three Alaska trips. Regular travel to Skagway has been unusually heavy because of the Shushanna gold stampede. In fact, the vessel carried nine horses for that camp, all of the animals perishing in the wreck.

The ship had an uneventful voyage from the time she left Seattle until the accident occurred. She made the British Columbia port of Prince Rupert, as well as the American ports of Ketchikan, Wrangel and Petersburg, and had headed into Gambier Bay when she struck the reef.

sel. She had fifty-six on leaving Seattle, but she is known to have picked up twenty more from the ports at which she touched, and have discharged ten.

"Jack" Irwin, who, it will be recalled, received the Marconigram giving the first news of the Republic disaster, has written as follows to the Wireless Age, telling of the heroism of Perkins:

"Regarding the death of Perkins, it will be of interest to you to know that he has received considerable credit for the way in which he handled the wireless end of this disaster. The press has en-



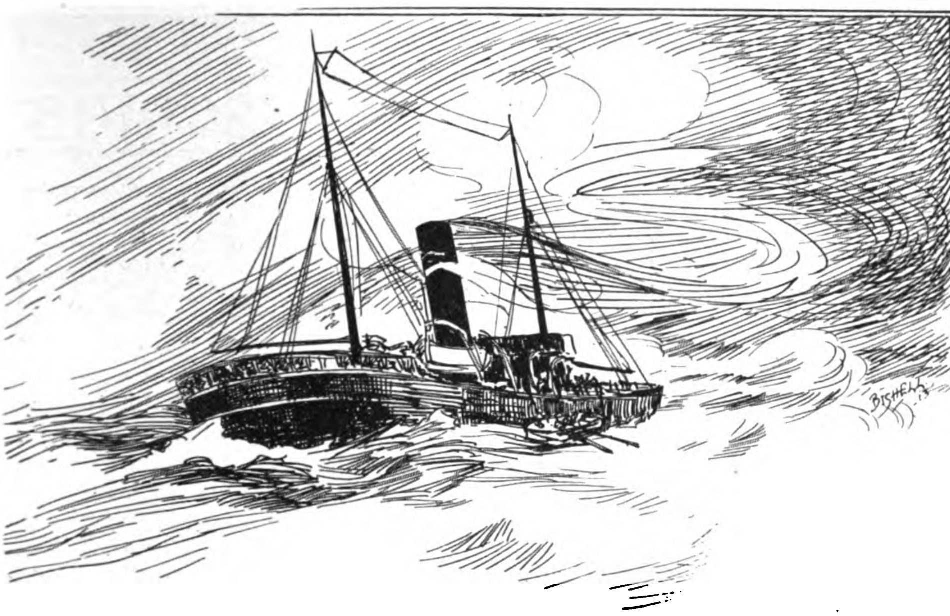
Gambier Bay is accounted one of the most dangerous pieces of water in Alaska. Last year the Admiralty Trading Company built a cannery there and made a contract with the Pacific Coast Steamship Company, by which the latter was to handle its business. The bay had not been navigated by large vessels until last year, and it is said that it has never been officially surveyed.

A reef must be skirted for a long distance, and big boats have very little room in which to turn. The State of California went to her doom a few minutes after leaving the cannery. The death-dealing rock is at the very entrance to the harbor.

It is not definitely known just how many passengers were on board the ves-

rolled him as a wireless hero. It appears that at the time of the disaster his assistant, W. Chamberlain, was on duty, Perkins being asleep. When the vessel struck the main set was put out of commission, due to the fact that the inrush of water extinguished the fires.

"Perkins rushed from his cabin in his pajamas, took charge of the wireless, adjusted his auxiliary set and commenced to call for help. In the meantime, he ordered Chamberlain on deck to assist in launching the lifeboats. There was a lifeboat immediately in front of the wireless cabin, which they were unable to launch. When the vessel later took a list to port this boat broke adrift and jammed fast the door of the wireless cabin. This



made Perkins a prisoner; but, notwithstanding his peril, he continued to send the S. O. S. signal.

"I think you will agree with me that we should be proud to have had a man of his caliber in our service. Perkins was a clean cut young fellow."

Perkins was born in Madura, South India, August 17, 1888. Love of adventure induced him to take up wireless, and he entered the Marconi service on the Pacific coast December 20, 1912. His home was in Berkeley, Cal., where his nearest relative, Miss R. Perkins, resides at No. 2431 College avenue. He had never married.

The wreck was productive of several dramatic incidents. Mrs. Nellie Ward, wife of Assistant Manager E. C. Ward, of the Pacific Coast Steamship Company, was drowned after reaching the deck from her stateroom. Her daughter, Lillian, was struck by a falling mast and died several hours later on board the Jefferson, after having suffered agonies on a liferaft.

Of the three lifeboats launched, the survivors said, one was useless, having been smashed by falling wreckage, and one was carried down by the suction of the boat. The first survivors to reach Seattle from the wreck brought details of the death of Mrs. H. C. Riordan, of Chicago, eighty-four years old. R. E. Baker, a water-tender, who rushed on deck as the cabins filled, found boat No. 4 with a few persons in it, among them Mrs. Riordan.

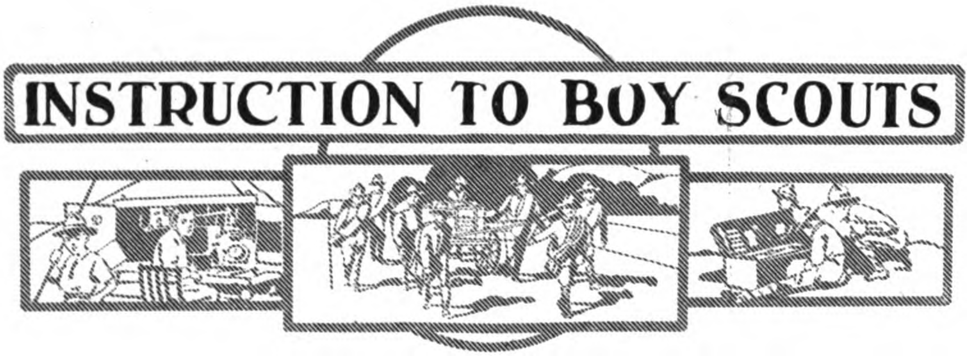
"The water was just up to the boat, but in the excitement it had not been loosened from the fastenings which held it to the deck," he said. "I grabbed an ax and cut it loose, and as the steamship sank it floated, but the afterdraft sucked it down. I caught a piece of wreckage and tried to save Mrs. Riordan, but she went down before I could reach her."

Officers of the Pacific Coast Steamship Company, which owned the wrecked vessel, estimated the financial loss at $200,000.

It has been definitely settled that Perkins' name will be added to those which will appear on the memorial fountain in New York. This fountain will be placed at the base of the campanile of the new Barge Office. The design and the site have both been acted on favorably by the Municipal Art Commission, and Park Commissioner Stover will push the matter.

There will be inscribed the following words: "Erected in Memory of Wireless Operators Lost at Sea at the Post of Duty."

INSTRUCTION TO BOY SCOUTS



By A. B. COLE

WIRELESS telegraphy has become such an important factor in signal work among the Boy Scouts that THE WIRELESS AGE will, beginning with this issue, present a series of articles on the art, prepared especially for the Scouts. The Boy Scout movement, since its inception, has made rapid strides, and the use of wireless telegraphy has been widely adopted in the organization. The great interest in the Boy Scout movement was shown when 30,000 Scouts met at a rally held recently in Birmingham, England. Boy Scout experts from all over the world were at the rally to give detailed explanations to the public and to the younger Scouts regarding the preparations necessary to pass the higher tests which are open only to first class Scouts.

At the reunion of the veterans of the North and South at Gettysburg last summer, the Boy Scouts of America were able to show what service they were able to furnish for others. The policing of the big camp was under the direction of the regular army, and the sanitary arrangements were under the direction of the American Red Cross Society. The large crowds, however, could not have been handled so well if it had not been for the assistance given by the Boy Scouts. Officials of the camp even went so far as to declare that the boys alone prevented chaos on several occasions. The Scouts did good work in caring for veterans who were exhausted or overcome by the heat. Hundreds of veterans were attended by the Scouts, and the physicians and nurses said that they would have had many difficulties to overcome if it had not been for the aid rendered by the boys.

THE WIRELESS AGE will publish not only a full elementary course in the principles of wireless telegraphy, but also a complete description of several portable outfits, designed especially foı field service, so that our readers may build their own outfits. In this and several succeeding issues will be explained the essential principles upon which wireless telegraphy depends, and it is suggested that this be followed just as carefully as the description of the actual construction of the sets, since accurate knowledge of the elements of electricity and magnetism is essential to the successful operation of a wireless telegraph set.

Chapter I

ELECTRICITY AND ITS LAWS.

Since the art of wireless telegraphy involves, to a large extent, the various principles and laws of electricity, we must fix the latter firmly in mind before we can fully understand those governing wireless communication.

Although the exact nature of electricity is not definitely known, many laws have been derived governing the applications of electricity; we are more familiar with it from the standpoint of results than from a knowledge of what it really is.

Electricity travels equally well up hill and down hill, in any direction, and,

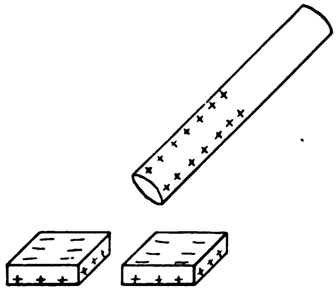


Fig. 1.—Static Charges of Electricity

to use a familiar phrase, travels "like lightning," for lightning is, in reality, a manifestation of electricity. The rate at which electricity travels has been found to be approximately 186,000 miles per second. At this rate of motion the circumference of the earth might be encircled in a small fraction of a second.

Electricity traverses some materials more readily than others. Those which offer the least resistance to its passage are called *conductors,* while those which impede its flow to a marked degree are termed *insulators.*

The actions of electricity may be grouped into two general classes—those where it remains practically in one place are termed actions of "static" electricity, and those in which it is in motion are classed as actions of "current" electricity. In either event the electricity is the same, and obeys the same laws, but the grouping is simply a matter of convenience for the study of its principles.

STATIC ELECTRICITY.—Electricity is rather uniformly distributed through all space. Its presence may be discovered by rubbing a glass rod with a piece of silk or flannel cloth. If the rod is then held over a number of small pieces of paper it will attract them toward itself. After the paper pieces have been attracted so as to touch the rod it will be noticed that they are quickly repelled. (See Fig. 1.)

This indicates that a change takes place in the pieces of paper as soon as they touch the rod, and causes us to believe that an opposite force from that which attracted them also exists.

Two opposite kinds of electricity exist; these are called negative (—) and positive (+), respectively. Like charges, or small quantities, of electricity repel each other, and, unlike charges, attract each other.

All materials have more or less of both kinds of electricity upon their surfaces. When a glass rod is rubbed with a piece of silk cloth, the negative charges move from the surface of the rod to the surface of the silk, and the positive charges on the silk pass to the rod, which is then positively charged. When the rod is brought near the bits of paper, this charge acts through the intervening space and charges their nearer sides oppositely—that is, negatively—by attracting the negative charges residing in them, and charges their under sides positively by repelling their positive charges.

The electrical condition which exists when the charged rod is held over the pieces of paper is shown in Fig. 1. As soon as they rise so far as to touch the rod, the negative charges on their upper surfaces are neutralized by an equal number of positive charges from the surface of the rod. This condition is shown in Fig. 2. Only positive charges remain on the paper pieces, which are, consequently, repelled from the rod, for it is still positively charged.

RELATION BETWEEN STATIC AND CURRENT ELECTRICITY.—When static charges are formed in rapid succession, so many may accumulate that their attraction for some oppositely charged body is almost irresistible, and the charges are neutralized by the passage of an electric spark between the two points. This shown in the well known action of lightning. In this case we have an accumulation of static charges in clouds, which suddenly neutralize some opposite charge in other clouds or in the earth, and this is ac-

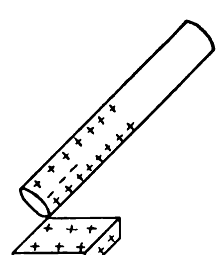


Fig. 2.—Static Charges of Electricity

companied by a flash of lightning, which is a manifestation of the passage of an electric current through the air.

Another example of the relation between static charges and current electricity is the primary cell.

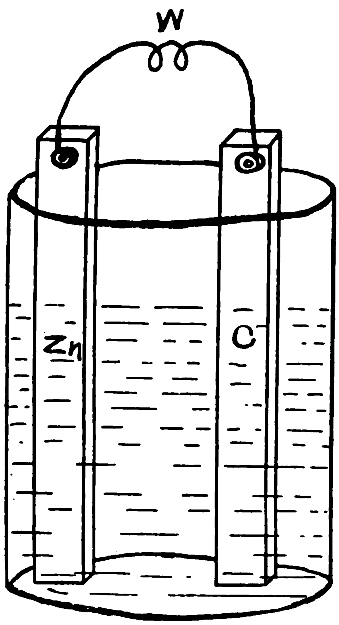


Fig. 3.—Simple Primary Cell

PRIMARY CELL.—A primary cell consists of two unlike conductors, immersed in some solution which has a stronger chemical action on one than on the other. Such a cell is illustrated in Fig. 3, where the conductors are in the form of plates, one being zinc (Zn) and the other carbon (C). The solution in the glass jar may be dilute sulphuric acid. The acid acts on the zinc, dissolving it, but has no action on the carbon plate.

When a wire (W) is connected to both the zinc and carbon plates, or electrodes, as shown, the zinc becomes positively charged, due to the action of the acid upon it, and a rapid succession of charges pass to the carbon through the solution, returning to the zinc through the wire (W). This rapid flow of charges is known as a *current* of electricity.

It will be observed that the zinc electrode is positively charged in the solution, while that portion extending above the solution is negatively charged, since the current flows back to it through the wire.

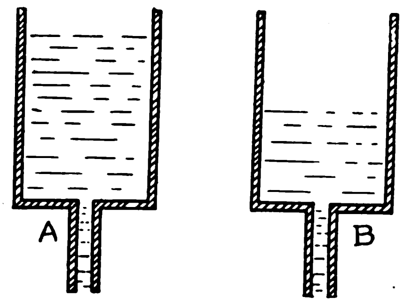


Fig. 4.—Hydraulic Analogy of Electromotive Force

That part of either electrode which projects above the solution is called a *pole* of the cell. For this reason the zinc is the positive electrode, but the negative pole; and the carbon plate is the negative electrode, but the positive pole.

The wire (W), or any other conductor which may be connected to the poles of a cell, through which the current flows, is termed an electric circuit.

Various materials are employed in the construction of primary cells. In some, zinc and copper form the electrodes; in others, zinc and lead, and various other combinations are employed.

UNITS OF MEASUREMENT.—That force which causes the current to flow between the electrodes and around the circuit (W) is the electrical pressure, or electromotive force, which is abbreviated E. M. F., and is measured in a unit called a *volt*. The E. M. F. is similar to the hydraulic pressure at the lower ends of the pipes leading from (A) and (B) in Fig. 4, which represents the level of water in two tanks. It is easily seen that the pressure at the lower end of the pipe leading from (A) is greater than that in the outlet of (B). Likewise, cells may exhibit more or less pressure.

The E. M. F. of a cell is largely dependent upon the kind of electrodes used, and also upon the solution. Thus, a cell composed of zinc and copper electrodes immersed in a sulphuric acid solution has an E. M. F. of 1.1 volts; while if carbon is substituted for the copper, the E. M. F. may be 1.5 volts.

The quantity of current flowing past a point on the electric circuit, or the intensity of the current, is measured in *amperes*. If the circuit connected to the poles of a cell is of copper wire of large diameter, a current of greater intensity will flow through it than if the wire is of a small diameter; just as in the hydraulic system illustrated in Fig. 5, a greater quantity of water will flow out of tank (A) through the outlet pipe of large diameter than will flow from tank (B), which has an outlet pipe of small diameter. The larger pipe offers less resistance to the flow of the water, and likewise a large wire offers less electrical *resistance* to the flow of current through it.

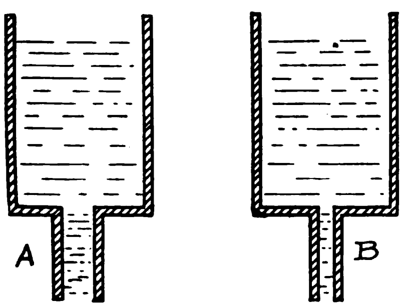


Fig. 5.—Hydraulic Analogy of Current

The resistance of wires or other electrical conductors depends also upon the materials of which they are made. For example, an iron wire, ten feet long and one inch in diameter, would have a much greater electrical resistance than a wire of the same dimensions made of copper. Resistance is expressed by a unit known as the ohm.

Conductivity is the reciprocal of resistance. A wire which offers a high resistance to the flow of current through it does not conduct well, and so has low conductivity. The following table compares the conductivities of a number of materials. It will be observed that silver has the highest conductivity or the lowest resistance of any of the common metals, while mercury has a low conductivity and, consequently, a high resistance. The unit of conductivity is the mho (ohm spelled backwards). If a circuit has a resistance of 7 ohms, it has a conductivity of one-seventh mhos.

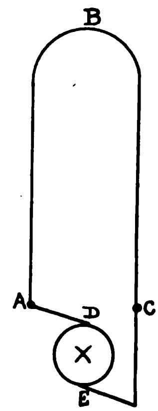


Fig. 6.—Application of Ohm's Law

CONDUCTIVITIES OF MATERIALS.

Material.	Relative Conductivity.
Copper (soft)	100
Copper (hard)	98.1
Silver (soft)	104.9
Silver (hard)	98.1
Gold	76
Aluminum (soft)	54
Iron	10
Lead	8.3
Mercury	1.6

The resistance of pure water is extremely high, but salt water is rendered a very fair conductor by virtue of the dissolved salt.

When one ampere has flowed through a circuit for one hour, the volume of current which has passed is called one *ampere* hour. The same volume would have passed if two amperes had flowed for one-half hour, or if 10 amperes had flowed for one-tenth part of an hour.

The unit of electrical energy is the *watt,* which is that work done per second in a circuit through which one ampere is flowing at a pressure of one volt; 746 watts represent one electrical horsepower, and through this relation electricity and mechanics are directly connected.

OHM'S LAW.—Probably the most important and most useful rule or law in all electrical engineering is known as *Ohm's Law*. It shows the relation between E. M. F., resistance and rate of current flow. If we know any two of these quantities, it is a very simple matter to determine the third by means of this law. Ohm's Law is expressed $I = \frac{E}{R}$, where (I) represents intensity, or rate of flow of current, in a circuit, in amperes, (E) is the E. M. F. at the terminals of the circut, measured in volts, and (R) is the resistance of the circuit in ohms.

The practical application of this law is illustrated in Fig. 6, where the wire (ABC) terminates in two points (A) and (C), and where the resistance of the wires or leads [(AD) and (CE)] connecting these points to the source of current supply is very small, in comparison to that of the circuit (ABC). (X) represents the source of current supply, which, we will assume, has a very low resistance.

Then, if the E. M. F. at the terminals (A) and (C) is 100 volts, and the resistance of the circuit (ABC) is 50 ohms, 2 amperes will flow around the circuit, since by Ohm's Law $I = \frac{E}{R}$, or $I = \frac{100}{50} = 2$.

Or, if we wish to force 5 amperes around the circuit (ABC), whose resistance we may assume to be 10 ohms, an E. M. F. of 50 volts would be required, since by Ohm's Law $I = \frac{E}{R}$, or $5 = \frac{E}{10}$. Hence $E = 50$.

To consider a different case, if the E. M. F. at the terminals of circuit (ABC) were 200 volts, and the current flowing around the circuit were found to be 5 amperes, the problem would be to determine the resistance of the circuit. Simply substitute the known quantities in the formula, and the resistance required will be found to be 40 ohms, since $I = \frac{200}{R}$, or $5 = \frac{200}{R}$. Hence $R = 40$.

This is the first of a series of instruction articles for Boy Scouts. The second lesson by Mr. Cole will appear in an early issue.

UNIQUE METHODS OF INSPECTOR

With a recently invented instrument of great delicacy, Henry C. Gawler, United States radio wireless inspector of the New England district, is able to trace with remarkable accuracy any operator who is interfering with naval or commercial stations. An instrument, composed of two flat sticks, joined together by a pivot, and which can be closed almost to the size of one, the ends being connected with cable wire of delicate construction and embracing thirty tiny wires, forms this simple tracer.

From the top of any roof or at any wireless station, Gawler can locate the general direction of wireless .waves. From that position he goes to another station nearby, and from observations taken there does a little geometrical computation, getting the general location of the station. Then he goes as near to his station as possible, and by means of a hand instrument, about the size of a watch, locates the exact spot where the wireless waves are generating.

Wireless as a Commercial Fact

From the Inventor's Testimony in the United States Court in Brooklyn

GUGLIELMO MARCONI

PART III

IN 1894 I was studying under a tutor. In 1895 I attended scientific lectures. I think one was given by Dessau, and some others by Prof. Righi, and one or two by Prof. Rosa, on general electrical engineering, but not on Hertzian waves or anything to do with transmission of waves through space. Prof. Rosa was instructor in physics in the government technical school at Leghorn, near my home. Before that I was at the secondary school in Leghorn. When I left school I was about eighteen.

I found that the technical education at that school was not sufficient or up to date, considering the special interest I had taken in that subject, and therefore my father engaged special tutors to give me a course in advance of what was taught. I was in the habit of studying on physics in books and magazines. I never studied Fleming's books on alternating current. I am sorry to say, I did not read any of Fleming's works. I first saw Jones' translation of Prof. Hertz's work, published in 1893, I think, after I came to England in 1896 or 1897 or 1898. It was after I filed my first application for a patent. Of course, I do not mean to say that I was not acquainted with the general research and results described in that book. I do not think I ever read Dr. Lodge's "Lightning Conductors and Lightning Guards." I do not think I ever read his "Modern Views of Electricity." I read parts of a book by Martin, entitled "Inventions, Researches and Writings of Nikola Tesla," published in 1894. I think I read the Scientific American once or twice.

I did not read any of the contemporaneous writings of Dr. Lodge, because my language was another language. I have spoken English all my life, but it is not my language. All my education was in Italy. If I had had Lodge's work before me in English I certainly would have got it and read it; but all my scientific thought and education was carried out by means of the Italian instructors and by means of Italian publications. I venture to say that, in Italy, Lodge did not have that position which he had in England, or perhaps in America. In Italy great attention was given to Hertz, Righi and others, and not to Lodge. I know the works of Hertz; the subject-matter of the inventions and discoveries of Hertz were translated into Italian, and I read the Italian publications. I first heard of Dr. Lodge's work in the direction of wireless telegraphy after I had applied for my patent.

I saw an account of Hertz's work in German, "Wiedermann's Annalen." It had a few pictures. I saw them in 1894 or 1895. I knew that if Hertz's oscillator or radiator and a Hertz receiver were to be responsive in a most efficient manner, the greatest distance apart, they were to be tuned together—the electrical oscillation should have the same period. The circuit had to be a certain length or a certain size. When I was using plates or wires of certain dimensions those plates had to be of a certain length. If you were using a loop they would have to be of a certain size. That was all I knew about it at that time.

A straight wire has both capacity and inductance, and I could change the inductance by cutting off part of the wire. That was the only way I adjusted the period in my early apparatus. I did not at that time use any coils of wire. My antenna, in 1896, varied from six to thirty or forty feet. If I wanted to change the period I let it down and cut it off at the bottom.

I first used an inductance coil in the antenna about the end of 1898. In regard to the transmitter, it slows down the period of the electric vibration of the system, and also causes it to radiate more slowly. It gets rid of its energy at a slower rate. The result of that is that the energy remains in the system longer, and that the energy is radiated more gradually in a great number of waves. While, again, according to the principles of tuning, it simply depends upon the accumulative effect of a great number of waves or impulses properly tuned. That coil enables an ordinary detector, a vertical wire, to give out a greater number of waves than if it were not there. It has been used to a considerable extent, especially in the later apparatus, in which it is necessary to time the oscillations accurately.

* * *

Without the grounded antenna, the maximum, as I remember, was about three-quarters of a mile, with large plates of one and three-quarters, when reflectors were used to concentrate the waves in a given direction. The greatest distance I have actually transmitted messages, using grounded antenna and upright wires, is, I think, over six thousand miles—from a station at Clifden, Ireland, to another station at Buenos Ayres, in the Argentine Republic.

* * *

When the ordinary classical Hertz transmitter is used, radiation is what we call free in space, proceeds across space in the same way as the light of a lamp or the sound of a human voice. When the transmitter is connected to earth, half the wave is transmitted through the ether of space and the other half through the ether of the earth. Professor Zenneck and others have given diagrammatical illustrations of what is believed to occur in that case; but the result is that when a transmitter is connected to the ground these waves seem to be able to follow the curvature of the earth, and to surmount or pass over other obstacles, such as hills or mountains, which may intervene between the transmitter and the receiving stations.

* * *

I first arrived in England in February, 1896. Mr. Preece was engineer-in-chief of the General Post Office. I met him socially in March. I told him I had this invention for transmitting messages without wires, and he evinced a considerable interest in what I was doing, and said it was just what the government wanted, because his system of induction, which he had tried, was not available for communication with lightships or with ships, which, according to his idea, was the chief use which wireless telegraphy was destined.

When I talked with Preece in May, 1896, he told me the system he had been working with was a failure. He had telegraphed two or three miles; something like that. I telegraphed nine. He had two base lines, two miles, on each side, and I had a little wire, about twenty or thirty feet high, perhaps higher than that, at each of my stations. Preece, being a reasonable man, knew perfectly well that if the problem were to communicate with a ship you couldn't have a wire extended two miles on a ship, because there was no ship two miles long. Wherefore, I was more useful than him in having an apparatus which could be placed on a ship. I give every credit to Sir William Preece; when he saw that, he was quite fair to put his system in the background on account of it. He got the Post Office to witness my experiments, and he spoke about these tests in his lectures, and he assisted me with his influence in showing what I had done; but he gave me no financial assistance, because, perhaps, the government does not do that. Then, also, I did not require it.

I first installed a wireless apparatus in London in February or March, 1896. The antenna was made of wire, attached to a small wooden mast, a broomstick or something of that kind—a bamboo cage. It was about six or seven feet high. The transmitter was thirty or forty feet from the receiver. I had a wave length of about 150 feet. I was getting radiation, and I was getting electric magnetic effect at the same time.

I know that I am getting radiation, dependent on the apparatus I am using. If it is an apparatus that radiates, I know I am getting the radiation within a wave length, as I am getting it at a hundred miles; but if it is an apparatus that does not radiate, I may still get an effect if I am close enough.

* * *

In the London *Times* of September 23,

1896, is an article saying that on Salisbury Plain I had succeeded in producing electric waves and reflecting them from one parabolic mirror to another one and one-quarter miles distance. No antenna was used in the tests. This reflector apparatus has been used for military purposes or communication between, or tests between, ports or between places of that kind. It is the only apparatus I had available at that time. I have no doubt but that it could be made much better.

That apparatus had certain properties which the government were anxious to test. They were rather afraid of these waves spreading all around, and they were very keen to see something that would send the electric waves in one direction only. It was with them, perhaps, a matter of taste. For that reason these experiments were carried out.

* * *

In my patent, 11,913, a coherer is described. Upon the receipt of electrical oscillations from a distant transmitting station, the action which occurs in such a receiver is a considerable reduction of its resistance on the receipt of an impulse, but it is also established that if a succession of impulses are received, the resistance is still further reduced until the tap occurs, which restores it to its high conducting state. I conducted numerous tests of that fact many years ago.

I had a coherer in a circuit, including a cell and a sensitive galvanometer. I produced impulses upon that circuit by the interruption of a direct current in another circuit. And I remember that, assuming that the resistance of the coherer was initially 100,000 ohms, a first impulse or a disturbance would reduce it to, say, 40,000; the second would reduce it to 30, a third to 25, and a fourth probably to 22 or 20, according to a curve, which I did not ascertain, but which showed that each successive impulse tended to progressively reduce the resistance of that coherer.

* * *

There is a phenomenon there in regard to these coherers which is not very well understood. It varies its resistance in accordance with the voltage applied to it. If the voltage applied to its end, due to electric waves, is great, it will come down in resistance a certain amount, and then the next wave will reduce it, perhaps, a little more, and the third wave still more, until the current passing through is sufficient to make the relay to come over and close the circuit. That is the way I think it acts.

* * *

In the specification of a former patent granted to me, No. 586,193, I described a receiver in which the ends of an imperfect contact in a local circuit were connected, one to earth and the other to an insulated conductor. According to this invention, the conductor is no longer insulated, but is connected to a capacity which may be the earth, through the primary of an induction coil, while the ends of the imperfect contact are connected to the ends of the secondary, one of the connections being through a condenser. I did it in order to use an induction coil or transformer which would give a higher potential at the terminus of the coherer, and make it better, it being understood that the coherer I was then using was a high-resistance coherer. The conductor was connected to an impedance coil, which impeded the transmission of waves between its top and the earth, and, due to the fact of electro-magnetic induction, threw a great part of that energy into the turns of the coil connected to the coherer and the other circuit.

Popoff's apparatus, prior to my patent, was a receiver for recording atmospheric electricity and the effects of thunderstorms or lightning. Well, unless something in nature sent him impulses—and those impulses never come in the form of intelligent messages—I do not see where he was to receive his signals from. I do not think his receiver was capable of taking Morse signals. It is easy enough to record the effect of a lightning flash, but it takes much more accuracy to correctly interpret the signs of the Morse telegraph.

* * *

The magnetic detector disclosed in my patent was conceived in Newfoundland, early in December, 1901. I made the sketch in my notebook the 13th of January, 1902. I disclosed it to quite a few of my friends in New York, I think, in January.

* * *

In the installations which are operated

to-day, at both transmitting and receiving stations, they use vertical grounded antennæ. The matter of connecting one end of the spark producer to an antenna and the other end to the ground, whether inductive or direct connection, at the transmitting and receiving stations, I consider essential, if you are going to have a wireless telegraph at all, so far as my present knowledge goes.

* * *

I have experimented with crystal detectors for many years; I have used them for practical purposes for two or three years. The crystal detector operates by a variation of resistance. If it is not connected in circuit with a battery, I think it opposes a resistance to the current flow in one direction, and does not oppose it in the other direction, the result being that the electrical oscillations are to a certain extent rectified, made to go in one way, which enables an ordinary telephone or other receiver to be directly affected. The conductivity of those crystals, according to my own observations—and I think it is also confirmed by the observations of Professor Pierce, of Harvard—the conductivity is a function of the voltage applied to them. That is to say, if double the voltage is applied to them, more than double the current goes through, provided the voltage is of right value. The crystals do change their resistance undoubtedly. That can be easily proven. In the case of the electrolytic receiver, a variation of the resistance takes place, due to either the thermal effect or the electrolytic effect, or both.

* * *

I am absolutely certain it was myself who first telegraphed across the Atlantic. The exact date was the 12th of December, 1901. The signal that was repeated often was three dots. Between 1901 and 1905 I was not using sufficient power to transmit messages during the daytime. It requires more power than at night, and the power available during the day, during the earlier part, was not strong enough to carry it through. In the first tests it was about twenty-five kilowatts. The energy used at Cape Cod for the transmission of the President's message I don't think was more than ten kilowatts. Messages may be sent very irregularly by day, with as low as ten kilowatts, as an exception, but I do not think they could be sent regularly with ten kilowatts for three thousand miles. At night a distance can be covered very much greater than the normal distances. I don't think the message I mentioned as being six thousand miles was a freak message. It was a distance that could be done by night, and practically every night—every time it was tried by night. At the receiving station at Buenos Ayres the antenna was supported by a kite or balloon.

* * *

The Italian government has established a high-power station at Coltano, Italy, for the purpose of communicating with Italian colonies in East Africa, and also for making wireless telegraph tests. The station was erected by myself and by my assistant, and has been working for about two years. The corresponding station is situated at Massaua, in East Africa, not very far from Aden, and a further receiving station is situated at Mogadiscio, in Italian Somaliland. The station at Coltano has been sending regularly messages by day and night to a station at Massaua, which is situated, I should say, more than 2,500 miles from Coltano, the range between them being nearly all over waste land, desert land and high land, which it is ordinarily admitted is not very favorable to the transmitting of electric waves and wireless messages. A letter, dated the 29th of December, 1912, addressed to the Marconi office in Rome, and signed by the Minister of Marine, the head of the navy, whose department is responsible for the working of those stations, states: "In reply to your request, I declare that during the period of hostilities with Turkey the radio telegraph station at Coltano has carried out a regular service by day and by night with the radio telegraph station at Massaua, and by means of this station with the station at Mogadiscio," signed by the minister, Leonardi Cattolica.

In this Italian apparatus, the condenser has one spark gap, instead of two. It is certain that it did include a condenser circuit, which was oscillatory, and a radiator, consisting of an elevated conductor, connected to earth at the other end. It can use anything from twenty kilowatts to about three hundred. The antenna is two hundred and thirty feet. In the tests, I believe there were three different forms of receiver used. I was not at the receiving station when those tests were carried out, but I knew the receiving station had a magnetic receiver; they had crystal receivers, and they had the Fleming valve.

* * *

In the first transatlantic signals, in December, 1901, I had three or four kinds of detectors. One was the ordinary coherer, which has been described here, with a tapper and a coil. Another was a carbon microphonic detector, which was connected in circuit with the aerial, the earth and a telephone; and the other one, which I recollect and which was the most successful one, was one consisting of an imperfect contact between two pieces of carbon, this contact being made by a globule of mercury. That was a form of detector which had been employed before in the Italian navy. Of course, it was connected in the ordinary way to an aerial and to earth.

* * *

The amount of power in the aerial does not necessarily mean that it is all radiated. Some aerials radiate better than others; but I will assume that conditions are equal; for the sake of hypothetical argument, I should say that 200 kilowatts would give nearly twice as much, go nearly twice as far as 40, but not quite; 1.7 about of the distance. That is what my experience has determined.

* * *

A single wave is taken from a rise of potential or a rise of current, which comes up to a maximum, comes down, and returns to where it started. A train of waves is a succession of those waves, each one attached to the other in proper phase. Damped waves are usually waves which start with large amplitude, and gradually decrease in amplitude until they die off, in the same way as the hum of a bell when it is struck you will hear the sound dying off, unless it is struck again, while a continued wave is like a note given off by a violin string or by a whistle, which can be sustained. In wireless telegraphy I hold that a detector does not act in consequence of the effect of the first wave. It might do so if the waves are extremely strong—if the first wave is very much stronger than what is necessary—than what would be necessary for covering that distance, assuming you are utilizing the train of waves; but I think that what does happen is that a small amount of energy goes through the coherer from the first wave, and a little more from the second wave, until it reaches a critical condition, at which it suddenly breaks down. Of course, the circuit has got to be made in such a way at the receiving end that the oscillations go on oscillating as long as possible, in order that their potential be maintained, or, if possible, increased, and in order, also, that their effect should be continued on the detector for what is, to us, a very short time, but which, electrically, is a fairly long time.

* * *

I do not know that we have a thorough understanding as to what happens between two clouds. They say that pilot sparks occur in the air, or something goes on, before the main discharge takes place, which enables it to take place. Whether it takes a million volts or a micro-volt—that is a millionth of a volt—the principle involved, to my mind, is the same.

Up to a certain electrical pressure, nothing happens. And beyond a certain critical pressure the electricity goes across. That is not the case with my coherers. Some of the oscillations go through it before, and I think the effect helps the following oscillations to further reduce the resistance until it is reduced sufficiently to pass enough current or turn on enough current to actuate the receiving instrument. Of course, if you are using a telephone, no doubt the effect of these currents is heard as one click. With a relay, the total effect of a current is brought into play, and when the tune comes over you see the action or hear the second current which is brought into play. In a discharge of lightning, I do not think there is any cumulative effect due to oscillation between clouds, because I do not think there are any electric oscillations between two clouds; certainly not until the discharge has taken place.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

A. C. G., Springfield, Mass., asks:

(1) Why is it that a transformer will take less current with a rotary spark gap (non-synchronous) than when using the old type of gap?

Ans.—For the reason that the condenser is not discharging across the spark gap for the same length of time as when the ordinary gap is employed.

When the studs of the rotary separate the spark discharge is cut off, and the condenser consumes less current when not discharging across the spark gap. This may not be true in all cases.

(2) Can you give me data on a transformer, open core, that will draw 10 amperes, using 20 points on the gap, and running at a speed approximately 1,800 R. P. M. Power to be used is 110 volts, 60 cycles?

Ans.—Primary core 3 inches diameter, 25 inches in length, covered with Empire cloth, and wound with two layers of No. 10 D. C. C. wire. Secondary, 38 pancakes, each 1/8 inch thickness and having 1,125 turns of No. 30 S. C. C. wire.

(3) Can you furnish me with the address of a manufacturer who makes the enclosed wire?

Ans.—You may be able to secure this wire from the Ansonia Electric Co., Ansonia, Conn.

* * *

W. O. H., Cleveland, Tenn., sends us a sketch of a "T" type flat-top aerial, and desires to know if he should connect all the wires together at the extreme ends of the flat tap. He also states he receives Arlington signals at night very plainly, but not in the daytime.

Ans.—The wires should be connected and soldered together at the extreme ends. If you desire to receive principally the signals from Arlington we would suggest you bring the lead-in wires from one of the ends, making the antenna of the inverted "L" type.

* * *

Ithaca Wireless Club, New York, asks more than five questions, which breaks our rule. We cannot answer more than this number in any case, so have selected five.

(1) What is the power used at Nordeich, and what type aerial is used? Give its vertical height.

Ans.—We are unable to answer this question fully. Complete information may be had from International Bureau at Berne, Switzerland. Nordeich's call letters K. N. D. Range, 500-600 kilometers. Wave length, 600 meters.

(2) Is the aerial at Clifden directional towards America or the European Continent?

Ans.—Towards America.

(3) What wave length does Glace Bay use, and what are its usual working hours?

Ans.—6,600 meters with 24-hour service.

(4) What power is to be used in a transmitting set at the new Marconi station in New Jersey?

Ans.—300 kilowatts.

(5) Compare the arc as used by the Federal Company and the quenched spark gap used by the "Debeg" Company, giving advantages and disadvantages?

Ans.—This is a rather difficult matter to answer specifically. The Federal Company claim that 18 to 20 per cent of the energy supplied to the transmitter is put into the antenna, while the "Deberg" Company claim efficiencies up to 50 per cent. The question is all the more difficult, as a Poulsen arc emits undamped oscillations, while the quenched gap produces feebly damped oscillations in the antennæ circuit. Their characteristics are therefore dissimilar. It would not be fair to promulgate an opinion. Enormous distances have been claimed for the Poulsen transmitter, but as the majority of such work has been done at night time the results cannot be authentically recorded.

* * *

N. S., Ithaca, N. Y., asks:

(1) What is the power, the wave length and hours of service at Glace Bay Transatlantic Station?

Ans.—300 kilowatts; 6,600 meters; 24-hour service.

(2) What is the power and wave length used at Clifden? When and with whom does it do transatlantic work?

Ans.—Power and wave length approximately the same as that of Glace Bay. Works with Glace Bay only.

(3) Please give material and dimensions to make a condenser having .0001 M. F. capacity?

Ans.—A simple condenser having .0001 M. F. capacity (we presume you desire this for receiving purposes) may be constructed of two concentric brass tubes, the outer tube 7 inches in length by 3/4 inch diameter, and the inner tube 7 inches in length by 5/8 inch in diameter, both separated by a cylinder of hard rubber sufficiently thick to allow them to slide one over the other. The resultant capacity will approximate .001 M. F.

(4) Please explain the Heterodyne as put out by the National Electric Signaling Company?

Ans.—The circuits of the Heterodyne, as used when employing crystal detectors for receiving, are shown in Fig. 1.

Briefly, the Heterodyne works on the following principle: When two wave trains of slightly different frequencies are superimposed on the same antenna the phenomena known as "beats" take place. Suppose, for example, a wave train produced in the receiving antenna from a distant transmitting station has a frequency of 200,000 cycles, and we superimpose from a local source of energy (at the receiving station) 201,000 cycles, we will then receive 201,000 minus 200,000, or 1,000 beats or pulses in the antennæ circuit. These in turn are reproduced in the head-phones. The result thus obtained is equivalent to the spark frequency ordinarily employed in radio work. It is found that a greater amplification of the signals takes place when beats are thus produced.

The action may be more readily explained by reference to Fig. 1.

Here A, B, C is the open oscillatory circuit of the receiving transformer; D, the local detector (including inductance, condenser, detector, etc.), and E, F, G the arc circuit, giving forth undamped oscillations whose frequency may be varied either by E or F.

The arc is supplied with direct current from a generator, H.

The complete arc circuit is coupled to the antennæ circuit at C.

The manipulation is as follows: When the operator desires to receive signals from a distant transmitting station, the frequency of the arc circuit is adjusted to, say, 1,000 cycles above or below the frequency of the incoming signals in A, B. C. It is evident that undamped oscillations from the arc constantly traverse A, B, C, and, by their very nature, are inaudible in the phones of the D circuit. But when the antennæ is likewise, and at the same time, excited by damped oscillations from a distant station the inter-action of the two frequencies produce 1,000 electric pulses of greater intensity than if antennæ were not excited by E, F. G.

The detector in the local circuit D is of special construction.

The device as yet is not commercially practicable but of intense scientific interest.

(5) After Arlington sends at 10 P. M. a succession of figures follow. Could you please tell me what they mean? And what does "Q. V." mean?

Ans.—After Arlington sends the time signals at 10 P. M. it is followed by a code message expressing the actual weather at 8 P. M., 75 meridian time. This is followed by the weather conditions at various points on the Atlantic coast. These points are represented by letters as below:

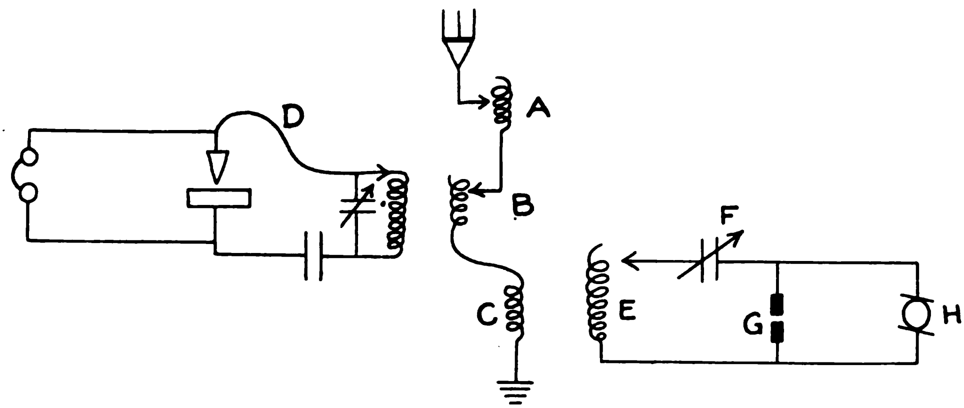


Fig. 1

S..................	Sydney.
T..................	Nantucket.
A..................	Atlantic City.
H..................	Hatteras.
C..................	Charleston.
K..................	Key West.
P..................	Pensacola.
D..................	Bermuda.

A bulletin begins with the letters U. S. W. B. for U. S. Weather Bureau, and the weather conditions follow: The first three figures of the report represent the barometric pressure in inches (.02 = 30.03), the next figure, the fourth in sequence, will represent the direction of the wind to 8 points of the compass: 1,—North; 2,—Northeast; 3.—East; 4,—Southeast; 5,—South; 6,—Southwest; 7.—West; 8,—Northwest; 0,—Calm. The fifth figure will represent the force of wind on the Beaufort scale.

Herewith example of the code:

U. S. W. B.—S, 96465; T, 91674; A, 94686; 899886; C, 01214; J, 02622; P, 03613; B, 00065.

TRANSLATION

Station.	Pressure.	Wind Direction.	Wind Force.
Sidney	29.64	SW	5
Nantucket	29.16	W	4
Atlantic City...	29.46	NW	6
Hatteras	29.98	NW	6
Charleston	30.12	N	4
Key West......	20.26	NE	2
Pensacola	30.86	N	3
Bermuda	30.00	SW	5

This is followed by a wind forecast for the coastel waters of the Eeastern part of the United States and the Gulf of Mexico.

The signal which you believe to be "Q. V." is in reality "Q. S. T." It is an international signal signifying a general call to all stations.

* * *

H. H. S., Chicago, sent us a rather long description of his radio station situated in Chicago in the heart of the skyscraper district, and says he is not able to send or receive more than one-half mile.

Ans.—After looking over the sketch you send we are quite satisfied, providing your appartus is properly hooked up (you sent no sketch of the connections), your antennæ is shielded by the steel in the skyscrapers about you. Still, you should be able to receive more than one-half mile. Go over the connections of your set thoroughly, making sure you have the proper hook-up.

* * *

A. R. M., Minot, N. D., asks:

(1) How is the wave length in meters of a wireless telegraph transmitting station obtained?

Ans.—By means of a wavemeter, consisting of a calibrated inductance and capacity.

(2) Will an aerial 50 feet high, composed of 650 feet of No. 14 B. & S. copper wire, having a capacity of approximately 200 meters, conform to the radio law?

Ans.—We do not know. You have not given us the shape nor type of the aerial.

* * *

H. A. F., Richmond, Va., sends us a sketch of two types of antennæ, asking us which is the better for radiating the energy of his 1-kilowatt set.

Ans.—We prefer the inverted "L" type, as with the "V" type shown with such a small angle between the flat top and the incoming leads, serious reactions will take place between the two, resulting in a decrease in efficiency.

(2) I have a rotary spark gap for this set. Disc is 6 inches in diameter, with eight plugs perpendicular to the face. Would it be an improvement to double the number of plugs and at what speed should the disc be revolved?

Ans.—No; it certainly would not be an improvement. The disc is already too small. We prefer a disc 12 inches in diameter with eight points and a speed of about 2,800 R. P. M.

(3) I have a commercial operator's license, and would like to secure a commercial license for my station in order to communicate with commercial stations. How can I procure such a license, and is there any expense attached to it?

Ans.—You would not be allowed such a license, as no commercial station would care to communicate with you.

(4) In which direction will the aerials shown in my sketches be directed?

Ans.—The "L" type will radiate SW. The "V" type NE.

* * *

W. S., New York City, inquires:

(1) Kindly tell me the best way to connect a 6-wire aerial at both ends, the aerial being 60 feet long and 75 feet high, for receiving purposes only?

Ans.—We do not understand the query. We suggest that you bring the incoming leads in from one end and connect all wires together at the opposite end.

(2) Do you think a "lead-in" 60 feet long would have any effect on the aerial as far as receiving is concerned?

Ans.—Of course not.

(3) Using this aerial, how would you connect the following instruments?

(A) One loose coupler.

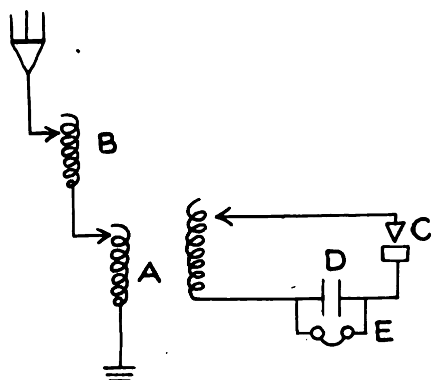
(B) One single-slide tuning coil used as a loading coil.

(C) One silicon detector.

(D) One fixed condenser.

(E) One 2,000-ohm head set.

Ans.—Herewith is a sketch:



(4) Do you think with the above instruments I should be able to get the time signals sent out by the Arlington Station?

Ans.—You have not furnished us with dimensions of the tuning coil; but, offhand, yes.

* * *

A. N., Dark Harbor, Me., asks:

(1) Kindly state approximate wave length of my set. The aerial, 50 feet long, 85 feet high, lead-in wire 25 feet long, helix 1/4 kilowatt, Clapp Eastham type, 2-quart leyden jars, hig-wire ammeter, 3-inch spark coil.

Ans.—The natural wave length of your aerial is approximately 200 meters, which may be increased to 300 meters by the helix.

(2) My ammeter reading is about 150 to 175 milliamperes. Is that sufficient to send through trees for 2½ miles?

Ans.—One-fifth of an ampere is a mighty small antenna current, but about all that you may expect with this set. It should reach 2½ wiles without difficulty, provided the station receiving the signals is equipped with a sensitive receiving set.

(3) How many batteries are needed for the carborundum detector, and in which direction should the current flow?

Ans.—One cell shunted by a potentiometer of 300 ohms is generally sufficient. You can best determine by experiment the proper direction for the flow of current.

* * *

W. J. S., Shenadoah, Pa., asks:

(1) Will the Fleming oscillation valve work with the following apparatus: Receiving transformer, primary, 4⅜ inches in diameter, wound with No. 24 bare copper wire; length of winding, 5 inches, 150 turns.

Secondary, 3¾ inches in diameter, wound with No. 33 S. C. C. wire; length of winding, 5 inches; 500 turns; Murdock variable condenser, maximum capacity, .0005 M. F. Clapp Eastham fixed condenser and 200-ohm double-head phones. These to be used with battery potentiometer and rheostat, shown in the diagram published in the "Marconigraph" for February, 1913.

Ans.—We thank you for your complete description, and you will find that the Fleming oscillation valve will perform its functions quite well with the above described apparatus.

* * *

W. J. F. C., St. Louis, Mo., asks:

(1) I have an antennæ 350 feet long and 150 feet high, composed of six wires, 2 feet apart, with lead-in from the center. Is this antennæ of wrong design?

Ans.—No. However, if you desire to receive a longer wave length I would suggest that you change it to the inverted "L" type.

(2) As the operating room is under one end of the antennæ, should the "lead-in" be brought from that end, or can it come from the center of the antennæ?

Ans.—You should bring your "lead-in" from the end nearest the station.

(3) What kind of spreaders and design of connections do you advise when long ones are used (30 feet or so).

Ans.—From an electrical and mechanical standpoint, we would not advise spreaders of such dimensions. You will secure no increase in efficiency with spreaders of such length. The present spreaders of 18 feet are quite sufficient. and all that is necessary is to insulate these from the halyards supporting them.

(4) Wouldn't four wires, spaced about 8 feet apart, be better than six wires 3 feet apart?

Ans.—No. The best efficiency is usually obtained with the separation between wires of not more than 2 feet.

(5) When the "lead-in" is brought from the center doesn't it cut down efficiency if it is too long and has bends in it?

Ans.—We cannot answer this question definitely, as there are many factors in the case not mentioned. You will find the best results are obtained when the antennæ is of symmetrical design, and it is always better not to have the incoming leads abnormally long.

E. P. K., New York City, inquires:

(1) What is my approximate wave length for sending when I employ an aerial 70 feet long, consisting of three No. 14 copper wires, the lead-in being 40 feet in length and the ground wire about 10 feet? The aerial is about 75 feet above the ground. My sending instrument consists of a 1½-inch spark coil, a one-section Murdock condenser, a zinc spark gap, or rotary gap, and a helix wound with about 20 feet of No. 6 aluminum wire.

Ans.—You must understand our calculations of your wave length are only approximations and are not to be taken as absolute. The natural wave length of your antennæ is about 155 meters and the helix may increase it to 200 meters.

(2) The inquirer encloses a sketch of an aerial split into two parts—one-half used for receiving and the other half for sending. The description is too long to print. He says that when the set is adjusted for receiving on one antennæ, and he connects in the second antennæ, the signals disappear, and he cannot bring them in no matter how much he moves the slides on his tuner. The sending portion of the aerial is 70 feet long and the receiving portion 100 feet. They are separated from one another by insulators.

Ans.—This is rather unusual and of interest. Offhand, when the unused portion of the antennæ is connected in the circuits are undoubtedly thrown out of resonance. You should, however, be able to readjust the circuits to resonance; and since you are unable to do so, it would seem that reactive effects are taking place between the "lead-ins," effectively destroying the signals. It may also be that the second antennæ grounded.

(3) What is the minimum and maximum wave length I can secure when receiving if I employ a 100-portion foot of my aerial, making use of a two-slide tuner, the core of which is 11 inches long, 5 inches in diameter, wound with No. 20 D. & S. enameled wire. The lead-in is about 60 feet and the ground wire about 10 feet. I also use a variable condenser with nine plates, each 4 by 5 inches, a fixed condenser, silicon antimony and carborundum steel detector, superior 2,000-ohm type.

Ans.—We have made some tests and find that you will be able to receive wave lengths up to 2,800.

(4) I employ No. 14 B. & S. copper for the lead-in. Is this all right? or should I use a thicker grade of wire? If so, what number?

Ans.—No. 14 wire is rather light. Your incoming leads should be of No. 8, either bare or rubber-covered wire.

(5) Would a rotary spark gap increase the efficiency of my sending set, or increase my range?

Ans.—No.

We cannot answer the remainder of your questions, as it is an absolute rule to answer no more than five.

Our readers will greatly facilitate the work of this department if their questions are made clear and exact. The details that are often omitted may be the very ones that determine the answer.

AMATEUR CLUB NEWS

AN EFFECTIVE RECEIVING SET

A cabinet wireless receiving outfit that can be used for field as well as station work is owned by Alfred J. Seeley, of Philadelphia, Pa., who says he is able to receive messages from United States wireless stations at Key West, Fla.; Cape Cod., Mass.; Arlington, Va., and Colon in the Canal Zone. In addition to communicating with these stations, he has talked with other long distance points and receives the time twice a day.

Alfred J. Seeley and His Field and Station Combination Outfit

The set includes a Murdock loose coupler, two perikon detectors, one De Forrest audion detector set and two thirty-one plate Clapp-Eastham condensers, operating with fixed condensers by means of a fan switch for a perikon detector circuit. It also has a thirty-stud variation loading coil, two and one-half inches in diameter and fourteen inches long wound with double silk-covered wire.

The antenna of Seeley's outfit is made up of four 7/22 stranded phosphor bronze wires, two feet apart. They are 125 feet in length, eighty-six feet high at one end and thirty-four feet above the roof at the other.

GREAVES TALKS TO MINNESOTA ASSOCIATION

Amateur wireless operators will be interested in what took place at a meeting of the Minnesota Wireless Association held at Minneapolis, Minn. V. Ford Greaves, of the United States Wireless Inspection Department, who was present, asserted that it was not the intention of the government to interfere in undue measure with the activities of amateur wireless operators. He said, however, that special licenses would not be given unless there was an excellent reason for doing so.

Those at the meeting learned from Greaves that a new examination has been made ready. To some of the amateurs who had heard of its features, it appears formidable.

An instance of how an operator in the first radio district attempted to operate secretly was related. The operator used an aerial which was not visible. The inspector, however, by using a loop and "listening in" on house tops in the vicinity of where the operator was working, was able to locate the offender.

NEW CLUB IN CAPITAL

A club, composed of amateur wireless operators, has recently been formed in Albany, N. Y., to further the science of radio communication, and to bring together amateurs who are operating stations in Albany and vicinity. The idea of such a club assumed definite form in Albany when a small group of operators obtained permission from the Board of Education to use a room in the Albany High School for semi-monthly meetings. Burr V. Dietz led the movement, and the formation of the club was guided by Professor F. P. Huested, head of the science department of the Albany High School.

The first meeting was attended by ten persons. A constitution was drawn under the direction of Edward Long, an enthusiastic wireless amateur. "The Hudson Valley Wireless Association" was decided upon as a name for the club.

Under the guidance of Professor F. P. Huested and Professor Brien O. Burgin and an active set of officers, the club made rapid strides. Only those operating a station or expecting to enter the field were admitted to membership. In order to help the members who were having difficulty in obtaining necessary efficiency from their instruments, the club elected Clayton B. Le Gallez, a member well versed in the science of radio telegraphy, as engineer. It is his duty to call each member's station and give assistance and advice if necessary.

The club has not been working along the lines of wireless telegraphy alone. Two of its members have also made advanced experiments in wireless telephony. Clayton Le Gallez and Burr V. Dietz have both been working on a new type of wireless telephone. Other members have been engaged in research work along various lines of radio communication.

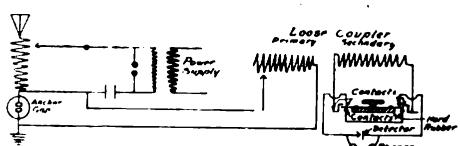
It is the desire of the club to standardize radio communication in Albany, and to place all operators under rules and regulations, so that messages will be uniform. The adoption of the Continental code, the international standard of radio communication, is urged.

It is aimed to make the meetings of the association of an instructive nature, sound technical advice being given by experts from the outside, and theses on practical problems being prepared by members. Some of the amateurs are entering upon the science as a vocation, and a few are engaged in commercial work.

At a recent meeting, an illustrated lecture was given before the club by Mr. Beebe and Mr. Pohlman, representatives of the Schenectady Wireless Club.

BREAK KEY FOR LOOSE COUPLER

For readers using a loose coupler, a break key, devised by H. W. Dickon, of San Francisco, Cal., will be of interest. The accompanying diagram is self-explanatory, and it can be seen that when the key is pressed down the detector is cut out of the circuit and shunted at the same time. When released the detector is put back into the circuit.



BREAK KEY FOR LOOSE COUPLER

The land rubber contact holder should be fastened directly under the key knob, and the contacts should be of spring brass and phosphor-bronze.

THAW NEWS BY WIRELESS

The news of the escape of Harry K. Thaw from Matteawan was received in Chester, Vt., by means of the wireless station of Vincent LaFountain, which he constructed himself.

The first National Conservation Exposition was formally inaugurated in Knoxville, Tenn., by a wireless message from President Wilson.

IS IT WORTH WHILE?

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THE WIRELESS AGE

NOVEMBER, 1913

IN OUR OPINION

THESE have been memorable days in the world of wireless.

Grim tragedies of the sea have stood sharply silhouetted against the saving light of man's greatest triumph over nature, and the fragile antenna of the wireless has again set the consuming flame and raging gale at naught. Truly, we are to be thankful for living in an age that has seen the conquest of the vast and lonely ocean by the hand of man!

With the appalling disaster of the Volturno fresh in our minds, the priceless value of Marconi's gift to humanity is once more apparent. Ten ships answered the call from the immigrant vessel that was being destroyed by fire in mid-ocean, and when dawn broke after a night of horror the ships lay close about waiting for the weather to moderate. Each of the ten made rescues. Four of the Volturno's own boats were crushed like egg shells, and their human cargo lost. And the 521 survivors would have doubtless perished as miserably as the 136 who were drowned had not the wireless appeal brought timely succor. No lifeboat could have long survived in that angry sea except for the bulwark formed by the high sides of the rescuing ships.

A Man's Priceless Gift to Humanity

All the expert seamanship and all the resources of courage, skill and devotion brought to bear on the work of rescue would have failed—as the wisest plans of man have miscarried since time immemorial—had not the wireless triumphed. The story of the Uranium liner is terrible enough, but the realization that the dreary wastes of the seas have been transformed, that no longer when a liner meets disaster in mid-ocean does she remain a helpless hulk looking to nothing but the slim chance of another ship's stumbling upon her in time to aid—only because wireless is the connecting link to life can we feel the thrill of gratification that is echoed in a million hearts at this moment.

Greater than all the widely heralded feats of ship builders is wireless telegraphy, for it does not fail.

There will be more about the Volturno disaster in our next issue. Readers will want to learn the part played by wireless in this great tragedy of the sea, we believe, and we are going to give them the complete story just so soon as we can get the authentic details. Some day this publication should have a historical value, even if only as a record of the chronological progress in the radio art. So we are holding over this story until we can get the particulars accurately.

This is really a very important consideration. So much guesswork attends a disaster of this magnitude that it is very easy to make ridiculous statements. For instance, at the time when the unfaltering hand of Jack Binns brought succor to the sinking Republic, it was reported in the daily press of the country that he was forced to swim under water to the galley to obtain nourishment to sustain him at his post. That this was mere supposition is conclusively revealed in the heroic operator's private statement—that he was not and never has been able to swim a stroke. A trivial point, perhaps, but we don't want this sort of a thing to appear in THE WIRELESS AGE. We make our mistakes, and they probably occur as frequently as elsewhere, but where painstaking verification is made possible we will always adopt this course.

The Men that Go Down and a Word of Appreciation

THE story of Robert Emanuel's devotion to duty in time of danger is told interestingly in this issue. Here is a man who stood by his key in a fire threatened cabin and was the means of saving every single soul aboard his doomed vessel. Yet, outside of the residents of Baltimore who read it in the local papers, the story of his bravery is known to few.

And the simple and supreme courage of Donald Perkins which caused his death when his ship, the State of California, plunged to the bottom of Gambier bay, received little of the eulogy it merited. That this fine man's unselfish act has just been officially recognized by the Government is gratifying.

William C. Redfield, Secretary of Commerce, has written a letter to the only loving member of Perkins' family, a sister, who lives in Berkeley, California. It is our great privilege to print this letter in full:

"There is due to you an expression from this department of its appreciation of the noble self-sacrifice shown by your brother, Donald Campbell Perkins, First Radio Operator on the S. S. State of California, who calmly and with deliberate courage went down to death in pursuance of his duty when the vessel on which he served was wrecked.

"The evidence taken at the inquiry into the disaster shows that Mr. Perkins was off duty when the vessel struck, and presumably in a position where he might have saved his own life. He went instead back to his post, relieved his subordinate whom he sent to help clear away the boats, and taking his place, sounded the call for help continuously during the few minutes that elapsed before the vessel sank. He went down with her, the call of distress still sounding.

"The story is brief and simple, but through it shines the light of a strong unselfish character who preferred others to himself, and faced death fearless in the line of duty.

"From such lives come inspiration; from such deaths our sons learn the value of heroism. Your brother's life was all too brief, but in the heroic act which marked its close he spoke a lesson of fine devotion that I trust may long live for the inspiration of his fellows."

THE sea has always meant peril and mystery to mankind. Its trackless waters carried the commerce of the world, but for ages its darkness was dreaded. Then with its mastery challenged at the fluttering of the curtain which revealed a new application of the forces of nature, the greater fear took wings and the dread of the sea abated.

Will Wireless Solve the Problems of Air Navigation?

With ocean voyages made safer than land travel, wireless may now turn to the conquest of the air.

Some two hundred years ago a series of Eastern tales came out of Constantinople, among which there was one about a mountain of lodestone which destroyed ships through attracting and drawing out all the iron nails.

It was a fanciful tale, and diverting. No one then knew of the existence of magnetic waves which were to be used to transmit signals—for this was before the day of manufactured electricity and electro-magnets—but the yarn contained the germ of a truth which has only begun to be appreciated.

Now that the magnetic needle serves ships as a guide for direction, and the influence of magnetism enables shore stations to send out time signals by which chronometers are checked, and correct determination of longitude made, it certainly seems possible that magnetic lines of forces may be controlled so that air routes may be established in an even more definite manner than the lanes in which ocean-going vessels are operated.

We hear a lot about contemplated transatlantic flights by airship. Is wireless going to make this feat possible?

Aviators tell us that one of the greatest difficulties of long-distance aerial journeys is in maintaining a definite course in the midst of clouds and darkness. The vibration of the aeroplane makes it difficult to take observations even in clear weather. What is needed is some positive guidance, indicating the route which should be followed.

Since magnetic waves can be directed and a number of scientists have proposed definite trains of electrical waves, it is quite within possibility that further development along these lines would result in the discovery of a method of indicating air routes. Could a definite train of waves through space from one continent to the other be set up, the airman would be able to determine through a sensitive detector whether he was in the right road or lane. Then he could give his undivided attention to the operation of his machine and know immediately when he had deviated from the right route.

With the successful transmission of energy for that purpose, it is not improbable that a greater energy, sufficient, say, for use as a propelling power, might be employed. The methods would be widely apart from each other, but who can say that the introduction of directive air channels would not lead to supplying motive power through space? Then, the greatest practical problem of continuous flight, fuel supply, would be eliminated.

Some may term us visionary. Wait and see. The magazine is here, and the period it antedates—THE WIRELESS AGE—is close behind.

THE EDITOR.

Statement of the ownership, management, circulation, etc., of THE WIRELESS AGE, *published monthly at New York, N. Y., required by the Act of August* 24, 1912. *Editor, J. Andrew White,* 456 *Fourth avenue, New York; Business Manager, John Curtiss,* 456 *Fourth avenue, New York; Publisher, Marconi Publishing Corporation,* 456 *Fourth avenue, New York.*

Stockholders holding 1 *per cent. or more of total amount of stock, Marconi Wireless Telegraph Company,* 233 *Broadway, New York City. Known bondholders, mortgagees, and other security holders, holding* 1 *per cent. or more of total amount of bonds, mortgages, or other securities: none.*

JOHN CURTISS,
Business Manager.

Sworn to and published before me this 2nd day of October, 1913.

B. N. Swift,
Commissioner of Deeds,
New York City, No. 163,
New York Register, No. 15,104,
Commission expires April, 1915.

California's Part in the Trans-Ocean Scheme

The Cottages for the Chief and Assistant Engineers at Marshalls are Nearing Completion

THE Marconi high-power stations in California, one of the links in the wireless chain that will girdle the globe, are rapidly nearing completion. This link will be made up of the transmitting plant at Bolinas Point, eighteeen miles northwest of San Francisco, and the receiving station, near the town of Marshalls, about eighteen miles further north on Tomales Bay. Despite the difficulties attending the transportation of building material, the progress on the California sites has been satisfactory. Most of the material for erection purposes—steelwork and machinery, as well as all mast sections and the wire rope—is being made in the East. It is sent from New York by boat to the Isthmus of Panama, across the isthmus by rail and thence by water again to San Francisco. To ship material by this roundabout route requires from four to five weeks. However, the work at the receiving station is further advanced than that on the New Jersey stations.

The site at Bolinas is not advantageously located for bringing in heavy loads of material. The roads leading to it—rough and ungraded—are at least four miles distant from the highway regularly used for traffic. There is no railroad available, and it is necessary to send the material by water from San Francisco, unload it at the wharf at Bolinas Bay, and haul it to the site. Bolinas Bay is obstructed by a sand bar with a shallow opening through which the tide races. This makes it impossible for a boat of any size to get to or from the wharf except at high tide, and the coast is so dangerous to shipping that owners of vessels are reluctant to have their craft navigated in and out of the bay. As a matter of fact only one small schooner, The Jennie Griffen, enters the bay, and she makes the trip only when there is enough material to warrant it. The construction work has strained to the utmost the schooner capacity of 100 tons and overloaded the wharf. A larger derrick has been installed to unload the heavier pieces and the area of the wharf has been extended to give greater space for materials. Spurred on bv the fear of winter storms and consequent impassable roads, the men in charge of the work are making every effort to transport the machinery and heavy materials as quickly as possible. A large number of motor trucks are being used to facilitate the task.

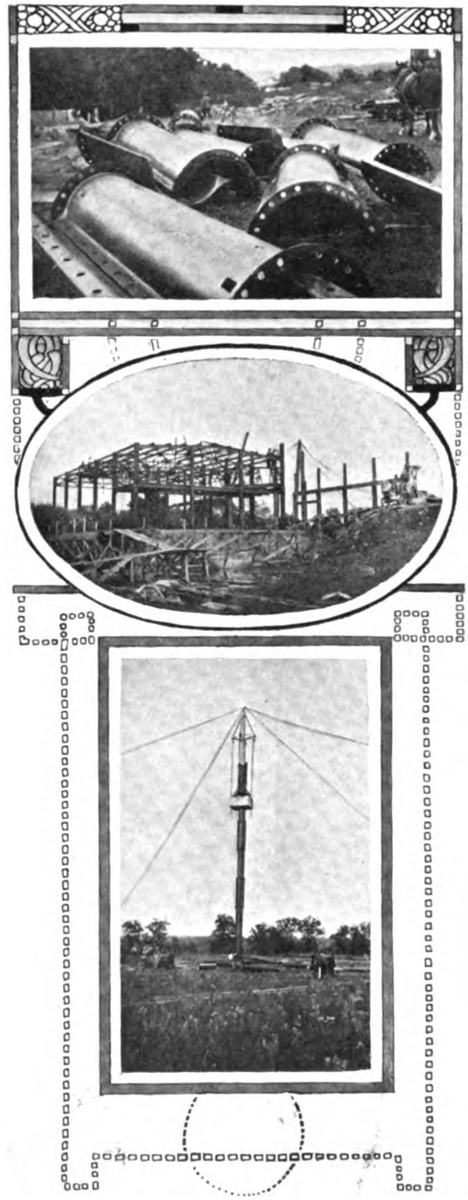
The buildings are located on a bluff about one hundred and sixty feet high and within five hundred feet from the shore. The bluff, rough and rugged, runs down sharply into the ocean with little or no beach. Although the land above the hill is somewhat furrowed from washouts, it commands a wide view of the ocean.

The stay anchorages have been put in place and the masts are being erected. The stay wire rope and insulators have for a considerable time been on the ground waiting for the steel sections. The power house foundations are complete and the piers and foundations for the motor generators, disc dischargers and other machinery are being poured. Rapid progress is being made in the construction of the hotel and the residences for the chief and assistant engineers. These buildings are constructed of steel and concrete, with tile roofs to make them fireproof. Much difficulty was experienced in obtaining a water supply because of the fact that the ground is full of cracks caused by earthquakes and that salt water seeps in from the ocean. It was finally decided to develop a supply by damming Gregorio Creek, and putting in a small pumping plant and a tank with a capacity of 10,000 gallons; the water will be carried through a two-inch pipe for a distance of about two miles to the buildings.

If one crosses in the ferry from San Francisco to Sausalito, boards a train on the North Western Pacific Railroad and travels about an hour and a half or two hours on that narrow gauge road to the little town of Marshalls, he arrives on the eastern shore of Tomales Bay, the site of the receiving station. The railroad runs up a valley, crossing stream time and again. Picturesque and densely wooded, the valley is a popular place for camping and fishing parties. Most of the big redwood timber has been cut down, but a large number of the smaller trees are still standing. At the head of the valley the railroad plunges into a tunnel and emerges into a second valley which is bounded by open, rolling country. On these hill sides the aerials will stretch back about a mile from the shore, and catch the radio messages crossing the Pacific from Honolulu.

For several months workmen have been busy in this section, with the result that a group of buildings dots the hillside. In fact the work has advanced so far that the minds of the engineers have turned

A Close View of the Hotel for Housing the Operating Staff at the High-Power Station at Marshalls, Cal.



At top: Some of the 10-foot steel sections used in mast construction. In oval: A view of the New Brunswick power house, identical with the one at Bolinas. Below: An illustration of the rapidity of mast erection, view taken after day-and-a-half's work.

to sports and grading for tennis courts and baseball grounds has been finished.

Tomales Bay, celebrated for its clams and oysters, is about twelve miles long and a mile wide. It is navigable for good sized boats and is extremely popular with fishermen. On the eastern shore, just south of the Marconi property, is located a fishing colony. Along both shores the hills rise abruptly and stretch away on the eastern side in a rolling tableland. The tongue of land between the bay and the ocean is about three miles wide. Covered with heavy woods, this promontory is a favorite summer resort for campers and hunters. It affords good duck shooting and deer are also to be found in the woods. The hills are not high enough to interfere with the proper working of the receiving aerials.

The distribution of construction material is being carried out from two points. For the buildings and the first two masts nearest these, a spur track from the railroad was put in on the southerly end of the property, where all the material for these parts is unloaded and hauled to the sites by motor trucks. The material for the remainder of the masts was unloaded at the railroad siding at Marshalls, hauled through the town and up a steep incline passing across the rear of the Marconi property.

The group of buildings, consisting of the large hotel, the residences of the two engineers and the lighting and heating plant, are about three hundred yards south of the line of the aerial; the operating building at the end of the aerial line is nearly a fifth of a mile from the other structures. These are arranged in a semicircle above the county road, looking out over the bay from an elevation of one hundred feet. The operating building is on the top of an abrupt hill on an elevation of about one hundred and thirty feet.

The construction of the buildings has advanced rapidly. The hotel, which is the largest of the structures, is one hundred and seventy feet long and the concrete work on it has been completed. The steel for the roof is in place and the conduit for electric lighting is being put in. As soon as the roof tile is laid, the interior finishing will be started. The residences of the chief and assistant engineers are also rapidly nearing completion. Satisfactory progress has been made on the mast erection. One mast has been completed and stayed, while all the others have at least four sections up. The top plate of the mast foundation can now be accurately leveled up and the last grouting concrete poured.

A 200 Meter Amateur Set

By E. E. BUTCHER

FROM the number of inquiries addressed to THE WIRELESS AGE, it is evident that amateur experimenters are meeting with many difficulties in constructing transmitting sets in accordance with the 200 meter adjustment required by law.

Careful examination and tabulation of the corresponding make it appears that a number of amateurs know nothing of the appearance, construction and usage of a wave meter. The formulæ for calculation of inductance and capacity of a radio-telegraphic circuit to determine the wave length are apparently not well known. The purpose of this article is to assist those having no knowledge of wave meters, by giving data for constructing a set with a definite wave length.

Producing a set of simple construction and having a range sufficient to enable them to establish communication with their friends and which will not involve them in an argument with the radio inspector, is somewhat of a problem. It is not so difficult to give the constants of a transmitting set that will meet with all wave length requirements if the apparatus is to be operated on a frequency of 1,000 cycles, for then the capacity in the closed oscillatory circuit of the transmitter will be less than when the usual frequencies are employed; because this increase of frequency allows more energy to be radiated on a short wave length (such as 200 meters), at the same time affording relatively increased range of communication.

But since a frequency of only 60 cycles is generally available, and as few amateurs are able to afford a rotary gap, it is presumed that they are most interested in the actual dimensions of a helix, spark gap and condenser suiting the 200 meter requirements, and, of course, the power necessary to operate a set of this character.

It must be understood, first of all, that the Government regulations will not allow an installation to be operated with the spark-gap connected directly in series with the antenna. An oscillation transformer must be used, and furthermore, neither of the emitted waves is to exceed 200 meters.

A number of tests have been made on a set constructed to meet these restrictions. A sketch of the actual length of connections to be employed is shown in Figure 1; the dimensions of the helix, spark-gap and condenser are also given.

Condensers.—The condenser consists of 25 glass plates 8″ x 8″, having an average thickness of 3/32″. (In this particular case the glass used was supposed to be of 1/8″ stock, but it had an average thickness of 3/32″.) The plates are then covered with sheets of tin-foil 6″ x 6″. The foil is first glued to the glass (any good fish glue may be used), and when it is dry the entire plate is covered with a coating of high grade shellac. The assembly of the condenser is that employed in standard Marconi sets: alternate left and right plates, as shown in the lower portion of Figure 1. The condensers should be immersed in oil and before this done the plates may be held together by winding the entire unit with a few turns of insulating tape.

Spark Gap.—While the spark gap may be of any type ordinarily used with amateur sets, the actual dimensions of the gap employed in a particular instance are given. The discharge points should not be more than 3/16″ in diameter.

Oscillation Transformer.—The form on which the oscillation transformer is wound is a paper mailing tube having an outside diameter of 5¼″. These tubes may be obtained from any manufacturer of fireworks. The primary of the oscillation transformer consists of a single turn of No. 8 D.B.R.C. wire. The secondary has 35 turns of No. 10 D.B.R.C. wire. The insulation at the top 15 turns of the secondary should be cut open at intervals to permit a variable connection to be made with the antenna. The turns of the secondary are wound closely together, the insulation of D.B.R.C. wire being quite sufficient to hold the charge under ordinary conditions. As a special precaution the mailing tube may be immersed in hot paraffin and thus rendering it somewhat impervious to moisture.

Length of Leads.—The actual length of leads employed in the closed oscillatory circuit is given. These dimensions should be strictly duplicated when the set is constructed.

General Instructions.—The condenser is to be immersed in oil, and as series parallel connections are not employed (the plates being all connected in parallel), the amateur should procure a grade of oil having very high insulation qualities. Swan & Finch's "Atlas Special AA," is the standard.

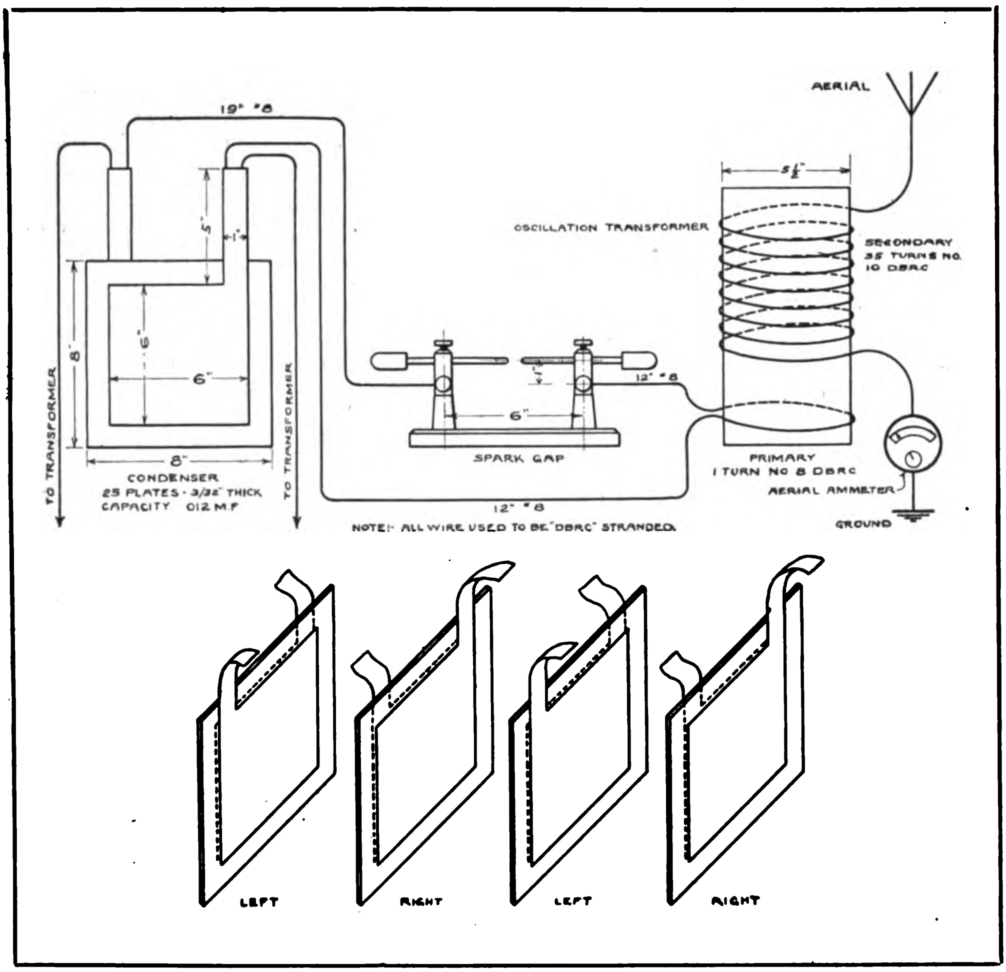


Fig. 1

When a set had been constructed as shown in Figure 1, the closed circuit (condenser, primary oscillation transformer and spark gap) gave wave length of exactly 200 meters. When the secondary of the oscillation transformer was connected to a flat top antenna having a vertical height of 42 feet and a horizontal length of 50 feet, it had a period of exactly 200 meters.

Now it is desired to radiate a single

wave length from the antenna, and of course the coupling must be loose. It is for this reason that but one turn is employed in the primary of the oscillation transformer. This turn may be placed close to the turns of the secondary of the oscillation transformer or, if a still tighter coupling is desired, may be wound closely around the turns of the secondary.

It is understood that the condenser is to be charged from a transformer. Let us see what voltage is necessary when the power consumption of the transformer at the secondary is to be ¼ K.W. Assume one spark per alternation, that is, two sparks per cycle (this is not always obtained in practice with a plain gap, but may be approximated); then the total power consumed will be;

$$W = N V^2 C$$

where N = cycle frequency
V = kilovolts
C = capacity in microfarads

The high voltage capacity of the condenser used with this set upon measurement was found to be .012 mfds.

We now desire to know the voltage required for a capacity of this order when the consumption of energy from the secondary of the transformer is to be ¼ K.W. (250 watts). We may then write equation (1) in the form,

$$V = \sqrt{\frac{W}{N \times C}}$$

substituting

$$V = \sqrt{\frac{250}{60 \times .012}} = \sqrt{347.222} =$$

18.6 kilovolts or 18,600 volts.

Therefore the required voltage will be 18,600. This value is not the root mean square (the value ordinarily specified when designating the voltages of closed core transformers), but it is the maximum value per cycle. (18,600 volts is the maximum allowable for glass of this thickness—⅛″—but if a good grade of glass is obtained and used in connection with oil having high insulating qualities, fear of puncture need not be entertained.)

The root mean square value of the voltage assuming sine curve, is .707 of the maximum value, therefore if a closed core transformer is to be ordered for this set. the amateur should specify the voltage as

$$.707 \times 18{,}600 = 13{,}150 \text{ volts.}$$

(The factor .707 does not hold good in every case and must be considerably changed, depending upon the power factor, but for convenience it may be assumed that the power factor is 100%). The amateur will find that if he should order a ¼ K.W. transformer giving an R.M.S. secondary voltage of 12,500, it will be quite sufficient. Allowing for losses between the primary and secondary of the transformer the watts input to the primary will be slightly greater than 250.

Owing to variations in the dielectric constant of various grades of glass and also because it is practically impossible to purchase glass of a constant thickness, the amateur may find after construction that the wave length of this set is slightly more or less than 200 meters, but he is assured when the Government Inspector arrives that the adjustments are only a very few meters out of the way—not more than 2 or 3 meters. Should this be the case it will only be necessary to lengthen or shorten the lead from the condenser to the spark gap (the 19″ lead) to give the required wave length.

It may be argued that a capacity of .012 mfds. will not allow sufficient inductance at a wave length of 200 meters to properly transfer energy to the secondary of the oscillation transformer. Let us see what value of inductance this capacity will allow.

If $$\lambda = 59.6 \times \sqrt{LC} \qquad (1).$$

where λ = wave length in meters
L = inductance in centimeters
C = capacity in microfarads

then equation (1) may be written,

$$L = \left(\frac{\lambda}{59.6}\right)^2 \times \frac{1}{C}$$

substituting the known values,

$$L = \left(\frac{200}{59.6}\right)^2 \times \frac{1}{.012} =$$

937 centimeters approx.

Roughly figuring, we may subtract half

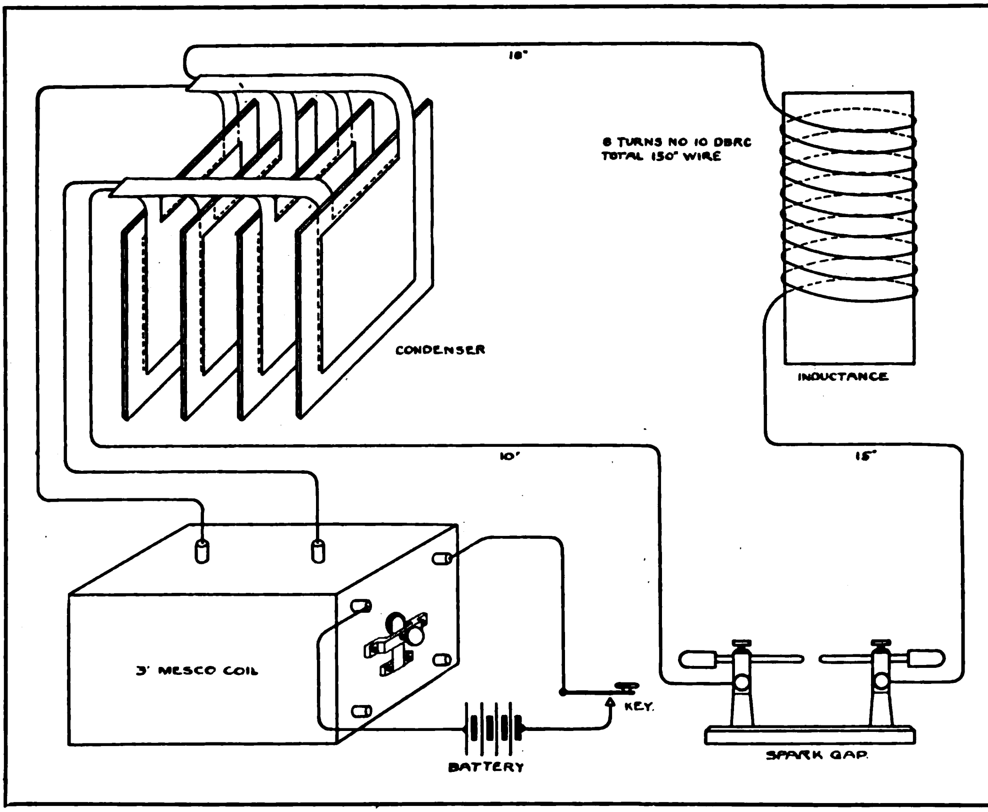


Fig. 2

of this to allow for the connecting leads, leaving about 468 centimeters of inductance for the transference of energy to the secondary of the oscillation transformer. While this value may seem small, yet for the loose degree of coupling desired it is quite sufficient to transfer all the energy that could be expected.

Tuning the Set.—For tuning, a small hot-wire ammeter (its scale reading need not be more than 4 meters) is connected directly in series with the secondary of the oscillation transformer as shown in the sketch. Since the closed circuit is already adjusted to a wave length of 200 meters the open circuit may be adjusted to the same wave length by a simple variation of the inductance in use in the secondary until the aerial ammeter shows the highest possible reading.

This may also be accomplished by inserting a small glow lamp in series with the antenna, the glow lamp being shunted by a loop of wire. This shunt must be adjusted to suit conditions and when maximum glow is obtained resonance between the primary and seconardy is assured. A four volt battery lamp with an adjustable shunt of No. 8 wire may be used.

Coil Sets

Other inquiries received request information as to the arrangement of the circuit when an oscillation transformer and condenser are to be employed in conjunction with a small induction coil. This is likewise a problem, for the voltages for which these coils are designed are of such high value that only a very small condenser capacity is allowable.

For the given wave length of 200 meters, with capacity of such minimum value the amount or inductance required is so large as to make the set practically inoperative; that is to say, inductance predominates in the circuit and its resistance is such as to materially reduce the volume of energy at the spark gap.

A number of tests were made on Mesco coils and it was found that the smallest coil which could be efficiently used in conjunction with a condenser and helix was of the 3" size.

The complete sketch of the connections and the actual linear dimensions are shown in Figure 2.

Condenser.—The condenser consists of 4 plates of the same dimensions shown in Figure 1; these of course are immersed in oil.

Oscillation Transformer.—The primary of the oscillation transformer consists of 8 turns of No. 8 D.B.R.C. wire wound on a paper mailing tube of the same size as given for the power set. The secondary may have the same number of turns as shown in Figure 1.

General Instructions.—The distance between the turns of the primary and secondary may be varied so as to give any degree of coupling desired and the amateur should thoroughly understand that if a single radiation from the antenna is desired the coupling must be very loose.

Antenna Current.—With the 1/4 K.W. set just described, the current to be expected in the antenna will not exceed 2 amperes, and when using the coil set not more than 1 ampere.

OPERATING A TORPEDO FROM A LAND STATION

United States army and navy officers are deeply interested in a mechanism invented by John Hayes Hammond, Jr., for operating a torpedo by non-interfereable radio impulses from a land station. To bring about the realization of the system necessitated, it is said, the taking out of fifty patents and the expenditure of thousands of dollars and an immense amount of labor at the Hammond Radio Research Laboratory in Gloucester, Mass.

Considerable secrecy surrounds Mr. Hammond's mechanism, and he said in response to a request from THE WIRELESS AGE for information regarding his invention that "inasmuch as the U. S. army officials are co-operating with me to-day in my work you will, of course, understand that all the matters of my laboratory are confidential." He has, however, it was learned, brought his invention to such a degree of perfection, after many months of experimenting, that officers of the navy and army have agreed to witness his tests.

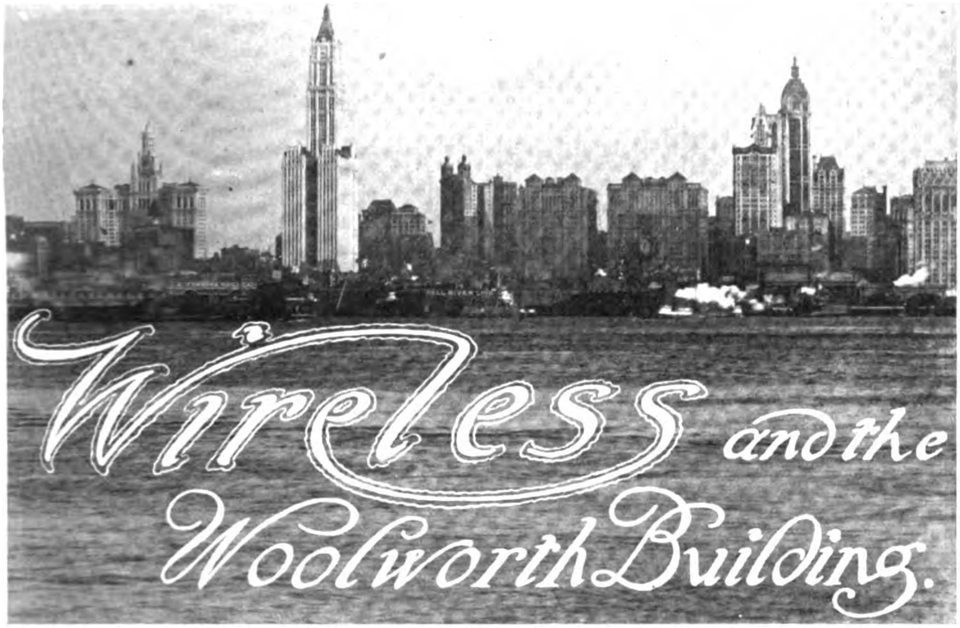
Hitherto it has been possible to operate a torpedo from shore at an eight-mile speed, but the control has always lacked the fundamental essential of immunity from interference by an enemy. That is, a hostile battleship against which a land-operated torpedo might be directed, could, with its own, wireless radio impulses, interfere and negative those of the land station.

Mr. Hammond's invention is credited with making such interference a boomerang for an enemy, for with his new device, in case interference is attempted, the radio forces impelling the projectile, instead of losing their efficiency, are strengthened, and the torpedo is drawn toward its mark at an increased rate of speed.

In the little bay near Gloucester harbor's mouth, beneath the bluffs, where tower the twin finger-like wireless masts, 360 feet high, which Mr. Hammond had built, lies a fifty-foot "house boat" recently remodeled for wireless control operations which the inventor, standing at a mysterious keyboard in his laboratory, can at will put through its paces out in the bay—two, three, four miles from there, running at a twelve-miles speed, turning, stopping, backin, starting forward again, without interference by any one on board if there happens to be any one.

The predecessor of this "house boat," the Radio, a speedier type, was operated by wireless waves at a thirty-three-knot rate. When the navy experts heard of this and satisfied themselves as to its truth, they requested Mr. Hammond to continue the experiments with a slower type, with the result that the Hammond "house boat" was refitted for the radio tests.

From the Steps of City Hall the Home of Wireless Loses Nothing by Contrast with the Handiwork of Nature



Photos. Underwood & Underwood.

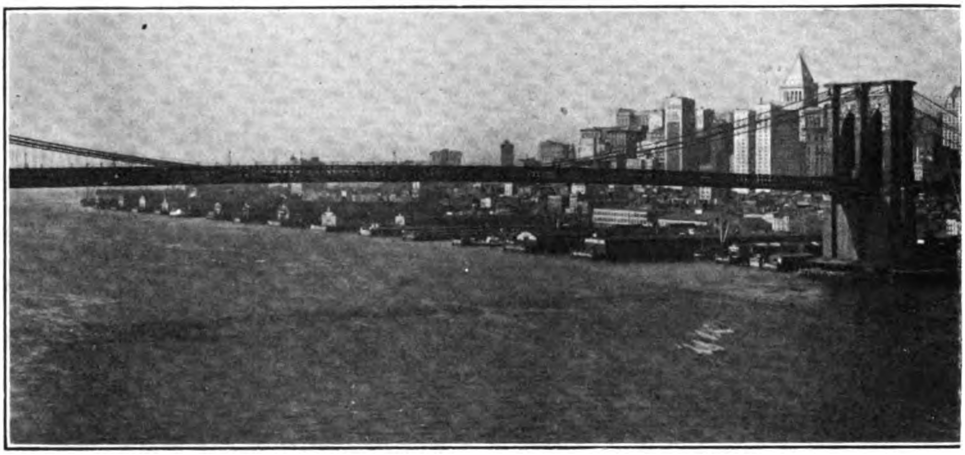
As the Half-Moon rounded the Battery and swept toward the mouth of the river which Henry Hudson had crossed the ocean to name, he and his lieutenants discussed real estate and its possibilities.

"Right over there where you see that Indian brandishing his tomahawk," said the chief of the expedition, pointing to the future corner of Broadway and Barclay street, "there's going to be a big building. But there's got to be something big to go in it—something that will match."

Whatever discussion there may have been regarding the matter, the question was settled several hundred years afterward, or to be more exact, in May, 1913, when the Marconi Wireless Telegraph Company of America established headquarters on the eighteenth floor of the Woolworth Building. The establishment of the Marconi Company's offices in the building marked the physical union of two big institutions—one the highest business structure in the world, and the other the headquarters for an organization which transmits wireless messages to all parts of the world.

As history is being made to-day in the world of wireless by the Marconi organization, so was it made by the early settlers of Manhattan on the site of the building where the company has its home. Not by the wildest stretch of their imaginations, however, could the Dutch and English adventurers of the years gone by conceive that in the neighborhood of where they built their hastily-thrown together huts would be located the offices of an enterprise which sends messages through the air. In the early days of New York there was a recreation park on or immediately adjacent to where the Woolworth Building now stands. Nearby was the meeting place of citizens who gathered to express their indignation at the passage of the Stamp Act, and at another time an old-fashioned mansion, the haunt of cultured men of the times, covered a part of the territory occupied by the big building.

The building which the Marconi Company selected as its home has so many unique features that thousands of persons visit it daily. The mere statement that it is 780 feet in heighth and has fifty-five stories does not convey its full



From where the graceful span of the Brooklyn Bridge crosses the

significance till the visitor goes to the top of the tower and looks down upon a new world of wonders. In the streets below the pedestrians resemble dwarfs, while the big ocean liners in bay and river seem small and commonplace. Just how near the clouds one is able to get by ascending to the highest point of the structure can be better realized when the observer takes into account the fact that the Metropolitan Tower, which reaches so far skyward that it constantly attracts attention from crowds farther north, is but 700 feet in height and the Singer building a giant structure in the neighborhood of the Woolworth, measures 612 feet from the sidewalk to its roof.

The tower is the highest point of the Woolworth Building, but the main structure has twenty-nine stories and is 385 feet above the level of the street. Included in the main building are 30,200,000 cubic feet. There is no lack of rentable office space, twenty-seven acres being at the disposal of tenants. The elevators, twenty-eight in number, and the corridors take up about thirteen acres. After the builders had finished work on the structure they realized what an enormous task they had accomplished. It was estimated that there are more than 3,000 exterior windows in the building and that in furnishing the structure more than forty-three miles of plumbing pipes were used. Materials used in making the building what it is to-day included 53,000 pounds of bronze and iron hardware, 3,000 hollow steel doors, twelve miles of marble trim, twelve miles of slate base, 20,000 cubic yards of sand, 15,000 yards of broken stone, 7,500 tons of exterior architectural terra cotta, 28,000 tons of hollow tile, 28,000 tons of terra cotta partitions and 15,000 cubic yards of broken stone. One of the claims made for the building is that it is absolutely fire proof. The doors, partitions and trim are of steel, terra cotta and wire glass. No wood was used in the construction of the building. It is estimated that it houses between 7,000 and 10,000 tenants.

There are many things to interest the visitor to the building, and not least among them are the Marconi offices. Comment has been made on the fact that among the last objects passengers on outgoing steamships see are the offices of the Marconi Company and that the headquarters of the company first greets the view of long voyagers as they land from incoming vessels.

As the visitor steps into the main entrance to the Marconi offices he finds himself in a reception room. This room contains several mahogany tables on which can be found message blanks and memorandum pads. At a window opening off this room marconigrams are received for transmission to all parts of the world. On the right hand of the reception room is a telephone switchboard fitted with twenty-one lines for communication between the various departments and five trunk lines connecting with the outside.

river the Woolworth Building rises high above the city of skyscrapers

Opening off from the reception room is a large office in which may be seen a considerable number of men, all intent on the completion of some particular work. The first impression that a visitor receives when he enters this room is that he is in the midst of unusual activity. Yet the work is carried on so quietly and there is such an absence of confusion that he can hardly believe that here is the headquarters of an organization which is directing the vast business of transmitting wireless messages to various points on the globe.

On the right-hand side of the room are the men of the traffic department, where hands are on the pulse of everything that pertains to the telegraph staff both at sea and ashore. No detail is too small to escape them. It may interest you to know that if you ever feel disposed to "kick"

The Board Room where are held the meetings of the men who guide the destinies of the company.

A view of the main office, showing a portion of the traffic department.

about a marconigram, it is here your protest will be investigated and your complaint adjusted. Copies of all messages transmitted are kept on file and these enable the men to trace the reason for nondelivery, delay or overcharge, as the case may be. The charges for transmitting the message are always refunded when it is discovered that an error was made in sending or receiving it.

One of the important features of the work carried on by this department is the assignment and regulation of ship operators. Immediately after the ships on which they are employed reach port the men, in accordance with the rules of the company, make their reports. They are required to make a full statement of their traffic receipts and report any defects that they may have discovered in the wireless apparatus they have been operating. As a further safeguard, as each ship docks the apparatus is gone over by inspectors. When a defect is discovered the construction department details a man to overhaul the outfit.

The operator is also required to make a full report of any communications which he may have picked up while sitting at his apparatus throughout the entire voyage. This report is practically a diary of communication events not only aboard the ship on which the operator is detailed, but of all craft on the ocean during the voyage.

The rules of the company require each operator to report daily to the operating department while his ship is in port. This rule is enforced in order that he may be on hand if it becomes necessary to transfer him to another ship. On the day that his ship sails he must report for duty several hours before the time for the departure of the vessel. A list is made out of the supplies which he will need during the voyage, including message forms, abstract forms, official circulars, detectors, telephone headgear, and parts which it may be necessary to have for the apparatus. It is necessary for an inspector to indorse the request for a requisition before the more expen-

The office of the Vice-President and General Manager, overlooking the great shipping center of the port of New York.

The succession of piers stretching for miles along the Hudson and the buildings of the shipping district are in full view of the Marconi offices. At any hour of the day craft may be seen departing for all quarters of the globe.

sive apparatus can be obtained. To add to the efficiency of the service operators are compelled to report for duty on the vessels to which they have been assigned three hours before the time of sailing, and notify the department by telephone. With this department also lies the responsibility of ascertaining that all of the company's operators have government licenses in compliance with the law.

Opposite the men of the traffic department is the staff of the engineering department. Here are to be found some of the engineers and draughtsmen absorbed in the work of designing and constructing Marconi apparatus used both for government and commercial work. Much responsibility rests upon the shoulders of the men in this department at present, because of the detail involved in constructing the higher power stations which are to connect up two continents by wireless. Reports from engineers in charge of outside work are received each week. These tell of the progress which has been made in the various tasks to which the men have been detailed.

The auditing department is also contained in the spacious room that houses the traffic and engineering departments. To keep account of the large amount of receipts and expenditures in the maintenance of an institution like the Marconi Company involves much clerical work. The auditing department, however, has succeeded in establishing a system of accounting that effectively meets all the requirements of the company.

Windows on either side of the main office and the inner sanctums of the department heads afford an excellent view of the Hudson river, New Jersey shore and New York Bay. From these windows can be seen craft sailing to all quarters of the globe. Furnishings that are handsome and in good taste mark the appearance of the room.

At the extreme end of the room is the entrance to the office of the vice-president and general manager. The windows of this office overlook the great shipping center of the port of New York.

Opposite the office of the general manager is the director's room, where are held the meetings of the men who guide the destinies of the Marconi Company.

The heads of the contract, traffic and engineering departments are in offices which are reached just before the visitor arrives at the main entrance to the Marconi suite. These offices are connected with one another and with the main room.

Throughout all the offices may be seen pictures of the big ocean greyhounds, and here and there a portrait of the company's inspiring genius, Mr. Marconi.

At no time since its organization has the American Marconi Company been so prosperous as at the present day. The exceptional progress the company was making was reported interestingly by Mr. Bottomley at a recent meeting of the board. He mentioned that the majority of vessels were now fitted with rotary gap sets and that these and the auxiliary sets were giving extremely good service. That the Marconi system dominates throughout the merchant marine was shown in the fact that Lloyd's Register, 1913-14, gives 1,882 merchant vessels equipped with wireless, about three-quarters of that number, or 1,393, being Marconi installations.

Announcement was made of a new contract with the coastwise steamships of the Agwi Lines, under which 76 additional vessels will be wireless equipped and operated by the company. The estimated traffic receipts for the six months ending June 30 show a substantial increase over the preceding year.

Mr. Bottomley reported that "arrangements have been completed for the erection of a station at Miami, Fla. We have arranged that we shall have such accommodations as we may require, including a place to house our apparatus, also space to erect towers and a house for our operators at a nominal figure. The lease is now under consideration by the authorities at Miami, and we expect to have this signed within the next few days."

The importance of this station lies in the fact that it will break up the long stretch from Jacksonville to Key West, and will greatly facilitate the handling of messages. "In addition," observed Mr. Bottomley, "we shall be able to control a large portion of the business which has heretofore gone through the government station at Key West."

To supplement the ship to shore business it is expected that connection will be made between Nassau and Miami; negotiations are now in progress with the Nassau authorities.

The Engineering Dapartment has been busily engaged in supplying apparatus to the Navy, it was said, and the majority of business which has been offered by the government has been secured by the Marconi Company, even though in many cases its bid was not the lowest. During the last four months contracts for 13 sets of apparatus have been made and an expected award for several additional sets has just been received. A sample set for submarines has been made up and met with the approval of the Navy Department. There is an excellent chance that the company will secure an order for 35 of these sets. Two sets supplied to the Revenue Cutter Service have proved very satisfactory.

The Navy Department has also purchased two Marconi-Bellini-Tosi Direction Finder equipments and tests are soon to be made under the supervision of the company's inspector. Mr. Bottomley said that he looked upon this apparatus as one of the most important factors in wireless telegraphy and he anticipated a considerable demand for this apparatus.

It was announced that the traffic arrangements have been completed for the contract with the Norwegian Government and the message rates agreed upon were satisfactory to the traffic department and the Western Union. A location for the American station has been selected and the site will be acquired within a few days.

Further developments on the Pacific Coast were announced, notable among which is the erection of two stations in Alaska. A site has already been secured near Ketchikan and a 25-kilowatt set is being built for this station, which will probably be completed some time in the early spring.

An engineer's report on the work being done at the high power stations was read and satisfaction was expressed with the excellent progress made. Referring to the globe girdling chain of Marconi stations, Mr. Bottomley reported that "arrangements have been made whereby the stations in the Hawaiian Islands are to communicate with Japan; the erection of the station in Japan is to be proceeded with immediately."

PICTURES BY WIRELESS

Francisco de Bernocchi, a young Italian investigator, who has been working for five years in the endeavor, has at last succeeded in sending pictures by the Marconi wireless system. The inventor is but twenty-five years of age, and after getting his system in working order he subjected it to severe tests which were devised by a committee of scientific persons. Reports of the tests say that drawings, pictures and autographs were transmitted with fidelity.

It has been announced that $5,000 has been given to Columbia University by an anonymous donor for equipment for research in wireless telegraphy.

THE SHARE MARKET

New York, October 20.

Had it not been for a slight flurry near the close of to-day's session industrials in the outside security market would have shown even greater losses than at the end of the preceding week. As it was the activity came in time to permit the closing figures to reach the average level maintained during the early part of the month.

For no apparent reason the market has settled into a state of apathy. Only six industrial issues were traded on the curb to-day, in contrast to the active trading that marked the close of last month. Brokers are of the opinion that Marconi's are more than holding their own considering the state of the market, even if fractional declines are shown.

Bid and asked prices to-day:

American, 4⅜-4¾; Canadian, 2¼-2⅝; English, common, 18-19; English, preferred, 15-16.

HOW TO AVOID DOUBLE MESSAGE TOLLS

A complaint was lodged with the Marconi Wireless Telegraph Company recently by one of its customers that two fees were being collected on wireless dispatches addressed to passengers on ships approaching or leaving European ports. This case in point was cited as having occurred on the Imperator:

A passenger on that steamship received a message which had been sent from New York to Crookhaven by cable and thence by wireless to the Imperator. Notwithstanding that this dispatch was marked prepaid in New York, the addressee was called upon by the Imperator's wireless operator to pay an additional fee when delivery was made.

The Marconi Company explains how this can be avoided. All marconigrams addressed to steamers which must be reached through foreign cable points should be filed with the Marconi Wireless Telegraph Company proper. A code word is prefixed to the dispatch, and then it is returned to the telegraph companies for transmission to the station nearest the zone in which the steamer is sailing. Otherwise the addressee must pay the wireless tolls beyond the foreign cable point.

The charges assessed are based on a chart issued monthly by the Marconi Company. This chart shows the zones in which steamers equipped with wireless can be reached during voyage. The through rate would be the land line tolls, the cable tolls and then the wireless tolls to the steamer. For example, a prepaid message filed in Chicago for a steamer nearing Europe would be sent in care of the Marconi Company in New York. No additional charge is made for routing the dispatch this way. When the telegraph company handling the dispatch delivers it to the traffic department of the Marconi Company that company prefixes a code word to it and returns the dispatch to the telegraph company for transmission by cable to the station nearest the steamer. Unless this method is adopted, the addressee is required to pay the charges beyond the cable point.

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

IN the smoking room of the Ostentacia, three days westward bound across the Atlantic ferry, a tall gentleman with a notable forehead, side whiskers and an air of absorption was playing chess. One hundred and fifty nautical miles from the Ostentacia, steaming in the same direction and just about holding her own, was the Sparta. And in the smoking room of that vessel, a fat, baldheaded gentleman, his brow corrugated with lines of thought, studied another chess board and sent and received moves by way of the wireless house.

"Isn't this John Maglory, of Ragged Edge, Arizona?"

A thin, nervous man who disseminated an air of prosperity, had put the question. He addressed himself to one of the group that was watching the Ostentacia end of the long-distance chess game.

"Right you are, mister. Maglory's my handle, whereby to be known," was the answer. "Howdy do—say, wouldn't you call that plumb foolish now?" and Maglory, of Ragged Edge, nodded toward the thoughtful gentleman with the side whiskers. "He's been two days at that one game, off and on, and sometimes it's as much as two hours before he grabs a move out of the air and slips it across that dinky little board!"

A genial smile lit up the stranger's face and the searching eyes glimmered pleasantly.

"Now that the Hertzian waves have been broken to harness, Mr. Maglory," he remarked, "they're being used in all sorts of ways. My card."

"Tommy-rot!" snorted Maglory, looking at the square of pasteboard but addressing himself to the Hertzian waves. "There's a heap of flubdub about this wireless business. I'm not from Missouri, but you can gamble your spurs little old Ragged Edge is a 'show-me' town. Boys' play—that's all this telegraphing without wires amounts to. That loose-jointed cimiroon over yon," and he nodded toward the gentleman who hung so fervidly over the chessboard, "pans out about the only real color in the wireless game. It's a pastime for some people same's a tin whistle or a pewter soldier or a Noah's ark is to a kid. H'm!" as Maglory glanced at the card. "'William Sidney,' eh? Any relation to old Chet Sidney, the three-card jigger who used to skin the natives of San Simone?"

William Sidney had carefully studied Maglory at first, and then with a patient smile had borne with sentiments conceived in ignorance or prejudice; but there was a perceptible change in his manner when his connection with a sharper at monte was vaguely suggested.

"New York is my town, Mr. Maglory," he snapped, "and I've never been west of Chicago. And, so far as I know, I am the last of my own particular line of Sidneys. This person who skinned the San Simoners was nothing to me."

"Then rise up and sing praises!" said the Arizonian. "A man can't always help the crooked off-shoots of his family tree, and if yours has been pruned I allow you're playing in a heap of luck. Me, now, I've got a sister's son that's caused a pile of trouble. We ought to hitch, but his ways are such that we can't and don't. Jefferson P. Rance is the name." Maglory frowned heavily. "Sidney, if you ever run across that name or the upstart that bears it, just remember I can't help it because it represents a kin of the Maglorys'. I——"

The Arizonian broke off suddenly. The frown on his rugged face faded into a smile at once childlike and happy. A girl, lithe and graceful, was floating towards Maglory and Sidney through the smoke-laden room.

Sidney's stare was one of surprise and admiration. Her face was, indeed, calculated to arouse admiration, for her rounded cheek was purest olive in tint, and her hair, straying from under the silken shawl she had thrown over her head, was black and lustrous. Her eyes were Spanish—wide and dark.

She came straight to John Maglory, her every move marked with an airy freedom and independence which balked at convention, as a mustang balks at a wire fence.

"Uncle John," said the girl, "you go right now to your room and go to bed. I'll not come after you again."

"Shucks!" grinned Maglory. "Bonnie, don't you fret about me. I just want another hour."

"Eleven o'clock then, for this once!" A slim, white finger was lifted admonishingly and the dark eyes swerved covertly and with disapproval upon William Sidney. "If you're not in your stateroom by eleven I'll have something to say to you in the morning, that's all."

With a final look at Maglory the girl turned and vanished as quickly as she had appeared. The old man chuckled fondly.

"That's her," he remarked, "that's Bonanza. Arizona born and bred, Sidney, which shows what Arizona can do when she throws herself. Lord! But I don't reckon there are any more in the world like *her!*"

"Niece?" came tentatively from Sidney.

"Nope," was the response in a tone heavy with disappointment. "She calls me uncle just by way of being affectionate-like. We ain't any more kin', though, than what you and I are; but I couldn't think any more of Bonanza if she was my own girl."

"Queer name for a girl!"

"Don't you find any fault with that name!" bristled Maglory. "I gave it to her myself when she was too small to have a say in the matter, and more and more as she grows up I see how it fits. Know what a bonanza is?"

"It's a term applied to a gold mine that really produces gold, isn't it?"

"It's a name applied to a mine that produces so much gold it's a Class A, blue-ribbon winner! And that's what little Bonanza is. The way she holds the bit on Uncle John is right divertin', and the way Uncle John looks after her"—the square jaw snapped and the gray eyes gleamed—"is going to make her future plumb safe and happy.

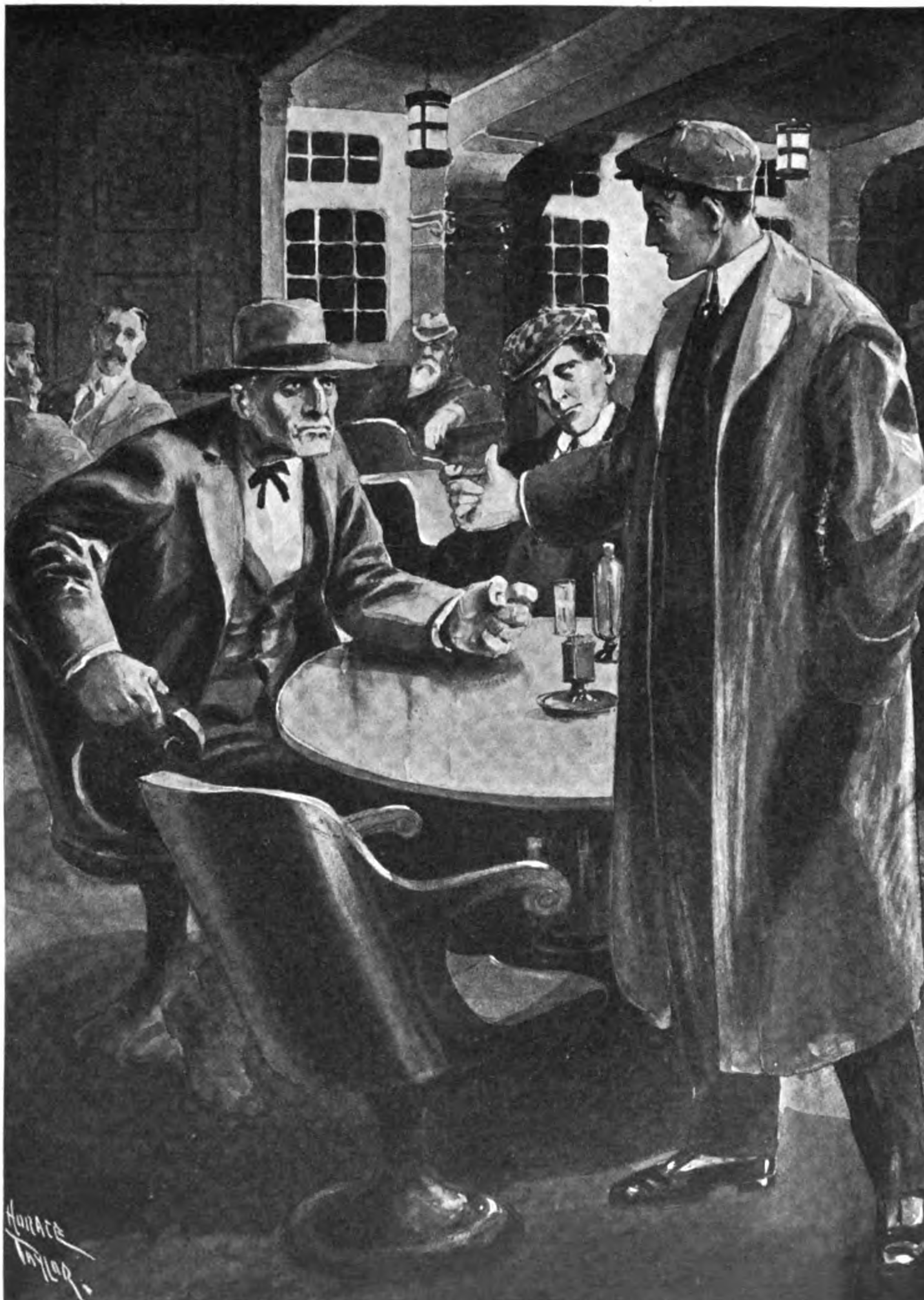
"Bonanza was two years old when she moved into Ragged Edge. Her father and mother brought her to the camp, but neither of 'em lasted long. Lungers, they were, and so poor their next meal was more or less of a gamble. I took to little Bonanza right from the start, and helped out her folks just because they were her folks, and when they hit the Long Trail I made it my business to look out for the kid.

"Hired a woman to come out from 'Frisco to start her off right, and she was brought up the best I knew how. Sent her to school, when she was old enough to go, and she was finished off in one of these high-up seminaries in Denver. I called her Bonanza because she was just about the biggest 'strike' I ever made in the Southwest.

"Father's name was Denbigh. He tuckered out in the hills, prospecting for a mine. Poor old fellow, he had hoped the climate would do big things for him and his wife, but they fell back on the climate too late. 'Most always it's that way. We hunted for Denbigh, and when we found him he was lying face down in as fine a blow-out of white quartz as you ever saw. That was all he left the girl—that claim and a tendency to the same ailment that carried him off. But the climate has taken the taint out of Bonanza's blood and she's as healthy and happy as an Injun squaw. As for that mine, I've been developing it for her, and I've got my hopes it will make her rich in her own right. I call the mine the Bonanza, but we're down a hundred feet without much of a showing—yet. Any day, though, good rock may be uncovered. I'm expecting it."

A glint had flared and faded in the eyes of Sidney. The talkative Maglory had not observed it.

"My friend," said Sidney, "my hobby in life is the long shot. I love to take a chance. Money is scarcely an object with me, and the story has its appeal.



"Don't let this man fool you. He's not taking a 'long shot,' as he calls it. There's no gamble about this move of his—he's playing a sure thing."

I am interested in Bonanza and her mine. Will you give me an option on the property for thirty days at fifty thousand dollars?"

The Arizonian stirred in his chair. Turning, he favored Willian Sidney with the whole of his attention.

"You've been in London?" he asked drily.

"Yes," the other nodded.

"Then you *sabe* I was trying to sell the mine to an English syndicate with big mineral holdings in Poco Tiempo Valley. Maybe you know that was the figure I asked them any they wouldn't have it?"

"I know that, too. And I know, furthermore, that your nephew, Jefferson P. Rance, blocked your plans. Mr. Maglory, pardon me for adverting to it, but I hear you have had reverses. You, from present indications, will have little to leave your ward, Bonanza. You are trying to make her future safe by letting some one else take the chance on that mine. Risks are my long suit. I will give you five thousand dollars for a thirty-day option on the mine at the figure named. And we can complete the deal right here."

The Arizonian seemed stunned. He aroused, however, to remark:

"Let's see your five thousand, Sidney. Only the cold cash talks between strangers, mind."

Sidney smiled and thrust a hand into his breast pocket. Before the hand could be withdrawn, a man started out of a corner of the smoking room, came forward and planted himself in front of Maglory.

"Tell him mañana, Uncle John!" he exclaimed. "He's stacking the cards on you."

CHAPTER II

John Maglory was sixty-two. He was big and square-built, and the gray in his hair matched the gray in his eyes. And there was steel in his make-up, finely tempered. Yet withal his good qualities he was strangely out of tune with the onward march of the world.

He had been among the first to pitch camp on the brink of Lost Horse Cañon, and to sluice for nuggets in the gravel banks below. His tent had given way to four adobe walls, and he had christened the settlement that grew up around him. "Ragged Edge" he had called it, which was decidedly appropriate, for it was ragged indeed, and on the edge of nowhere.

With the working out of the placerings, Ragged Edge gasped and all but expired. Then it secured a fresh lease of life with the discovery of rich lodes in the vicinity, and a modest if no more enduring prosperity came to the brink of Lost Horse Cañon.

Counting the Mexicans, there were fifty inhabitants in the town. Maglory felt crowded and moved over to San Simone. But San Simone grew, and when telephones and electric lights came into the place Maglory moved out—back to Ragged Edge again.

His primitive soul cried out against the refinements of civilization. He wanted the things he was used to, and he was headstrong and had a will of his own. The first automobile that popped and sputtered along the Lost Horse sickened his heart and sent him into the trackless hills for a week.

Now Ragged Edge was dying again, and this time for good. The fortunes of John Maglory were dying with the town. He had planned on leaving Bonanza all he had, but he could see plainly that in five years, if he lived that long, he would have nothing to leave the girl.

Blindly he had taken his ward and gone East, and even more blindly he had crossed the water to sell Bonanza's claim. He had failed. And only now, while returning to his own country, had rare good fortune thrown William Sidney across his path.

In the eleventh hour luck had blundered. Who was this that dared interfere with a business transaction which was to mean so much to Little Bonanza?

Maglory stared at the young man who had suddenly appeared before him. For a moment he seemed stupefied; then his gray eyes snapped and his red face whitened and hardened. Slowly he got to his feet. Unmindful of the place—all unsuited to the airing of domestic troubles—he shook his fist in the face of the man who confronted him.

"Jeff Rance," said he, "your being here is a surprise, but it's an eye-opener. You've been skulking around and camping on my trail. You've queered my work and double-crossed me, trying your best to beat Bonanza out of her rights. That's mean and low, and shames your Maglory blood. I told you a year ago I didn't want you around. Now you clear out and mind your own affairs or I'll forget you're my sister's son!"

Rance may have been twenty-five. He looked very little like a black sheep. In fact, if Maglory could have been set back forty years he would have borne a striking resemblance to his nephew.

In Rance were the same steady gray eyes, the same strong chin, the same finely molded lines of purpose and determination. He met the glance of the older man with firmness.

"You'd sell Bonanza's birth-right for a song," said he. "John Maglory, you're getting old and losing your grip. You're scared of shadows. You are a big-hearted, lovable old fool. Turn me down if you feel like it, kick me out, wash your hands of me, but while I live and breathe I'll stand between you and that claim of Bonanza's. You're not going to sell it!"

"Right to my face!" breathed Maglory, huskily. "You say all that right to my face! Rance, in about a minute I'll grab holt on you—I will, by cracky! You snake-in-the-grass . . . sidewinder . . . you would strike the hand that fed you. I——"

"Chop it. You talk too much," went on Rance, relentlessly. "You've been sitting here for half an hour, gabbling like an idiot to a perfect stranger—a man who's putting something over on you and——"

"Sir!" interrupted William Sidney, showing signs of temper.

"Don't try to play lame-duck with me," Rance flung in the stranger's teeth. "You received a wireless message this afternoon and that's why you're here. But I got one, too, and that's why *I'm* here. Uncle John," and Rance turned in desperate appeal to Maglory, "don't let this man fool you. He's not taking a 'long shot,' as he calls it. He knows what he's doing. There's no gamble about this move of his—he's playing a sure thing. Read that!"

Rance thrust a scrap of paper into Maglory's hands. The old man dropped his eyes mechanically and read:

> UNCOVERED FOOT VEIN HUNDRED DOLLAR ROCK. BIGGEST STRIKE THIS DISTRICT EVER HAD. BONANZA MINE REAL BONANZA. HEAD OFF YOUR UNCLE.

This was signed by Lafe Kennedy, foreman in charge of the work for Maglory. The old man stared.

"Where'd this come from?" he asked.

"From San Simone by telegraph and from South Wellfleet by wireless," answered Rance eagerly.

"Wireless!" Blistering contempt came from Maglory with the word. "I wouldn't believe wireless under oath. It's a chess and checker game, young man, and you can't phase me. Clear out of here, or I'll have one of the stewards throw you out." He turned to Sidney. "Where's that five thousand?" he demanded. "We'll do business."

An exclamation broke sharply from Rance and he advanced a step and dropped a hand on his uncle's arm. Maglory roughly threw off the hand. Rance, thoroughly enraged, started for William Sidney. A short scuffle ensued and, in answer to Sidney's frightened appeal for help, two stewards grabbed the young man and hustled him out of the cabin.

The long gentleman with the side-whiskers seemed greatly annoyed. Others in the room laughed, or looked scandalized, and presently returned to their talk or their card-playing.

A reading room steward entered with a marconigram for the gentleman at the chess-board. The latter read it, moved a piece in front of him and smiled.

"Here's where I give checkmate," said he, and sent a message of his own to the wireless house.

(*To be continued*)

A Few Sidelights on the Business History and Character of Edward J. Nally, Recently Appointed Vice-President and General Manager of the Marconi Company

EDWARD J. NALLY has been appointed general manager of the Marconi Wireless Telegraph Company of America; which is an occurrence of quite enough importance to have a chapter to itself in commercial history, the only kind of history that counts in these days of Peace Palaces and grape juice diplomacy. Besides, the Nallys have been making commercial history for a considerable period.

Some seventy-six years ago America, or more accurately that portion of it directly adjacent to a certain steamship pier, suspended work for a minute or two to nod and smile a welcome to a stranger. Quite an unusual procedure, some will say, in a country always too busy to get acquainted with next-door neighbors. But in this case the aforesaid smilers and nodders had little choice in the matter. Ordinarily the arrival of a mere slip of a colleen, clinging closely to the arm of a stalwart Irish lad scarcely out of his teens, would have passed unnoticed. The passengers lined up along the rail of that particular steamer, however, took good care that this didn't happen. Hats were tossed into the air, handkerchiefs waved and cheer after cheer arose to announce the arrival on these shores of "Handsome Patrick" Nally and his bride. Whereupon staid and sober citizens smiled their sympathy and understanding and immediately forgot all about it.

But not for long. Patrick Nally, fresh from Ireland and twenty-one, made them sit up and take notice. Philadelphians soon learned that one in their midst knew a thing or two about advanced commercial methods, and not so many years later St. Louis awoke to the fact that the city was a whole lot better off when Patrick Nally came, saw—and decided to settle there permanently. Nally prospered in the new country and became a considerable factor in the business world. He did many things of vital import in his day and generation; but what interests us most, he had the foresight to provide for the acceleration of the country's—and incidentally the world's—business after his time. For on April, 1859 he announced to his friends the entrance into the world of Edward J. Nally—destined to become the maker of men and builder of colossal business enterprises.

So, interesting and vital as were the early activities of the elder Nally, they must be left to some other biographer. For even in these days of big men and bigger deeds the announcement that Edward Julian Nally has come out of his brief retirement to prove what he can do in the way of making wireless telegraphy the most important and powerful adjunct to the transaction of the business of both hemispheres, overshadows a whole lot of things that might otherwise be occupying these pages. Practically every one in the world of wireless will want to know something about the man whom they have made general manager of the American Marconi Company, and incidentally vice-president, director and member of the Executive Board.

First of all, he is the man who put the Postal Telegraph Company on the map; that fact alone makes it a pretty safe prediction that the Marconi Company in America is going to make things hum.

What Mr. Nally doesn't know about the telegraph business hasn't yet been discovered. He has been connected with the wire telegraph service for thirty-eight years, starting as a messenger boy and working up to the vice-presidency and general managership of his company.

From messenger boy to general manager!

What a wonderful story lies behind that phrase! Thousands of young men and boys throughout the country have heard it, and thousands of backs have straightened as the sparkle of awakened ambition has come to the eyes of the respective owners. If for no other reason than this, the story of his struggles against disheartening odds and his rise to the very top notch of his chosen vocation is worth re-telling.

It has already been related that Mr. Nally's father had become a successful and influential citizen when the subject of our sketch was born. Yet through the vagaries of Fate, the qualities that had won him his place in the new world, the intangible somethings that prompted ship acquaintances of but a few days' standing to cheer him to the echo as he landed, were to be his son's only heritage. For shortly after the young man's arrival the elder Nally's health failed and a long succession of business reverses set in. Within a few years the fine structure of achievement so patiently builded was tottering on its foundations, and by the time the son he had hoped and planned so much for was able to run about, the absorbing problem of each day was to earn enough to feed the little family and to keep a roof over their heads.

Nothing but the bare necessities of life entered into young Nally's first impressions of the world; none of the advantages given to other boys came his way. Somehow his parents managed to give the boy one year's schooling. That was the only time he ever attended school for a full term. There were intermittent periods of attendance later, a total reaching perhaps two years.

At an almost incredible age the youngster's character manifested itself. Instinctively he realized that things weren't quite as they should be at home and he racked his little brain to find ways of getting a few pennies; for these very desirable and shiny objects seemed to have something to do with the situation. One of the means employed to this end by the resourceful little chap was to linger about the coal yards after school hours and wait for a wagon to start out with a load to deliver. He would trudge along after it, sometimes along miles of dusty roads, until it drew up before the house of the customer. Then he would make his presence known and volunteer his assistance in carrying in the load of coal. The few pennies given for his services were invariably turned over intact to the common household fund.

When he was eight years old his father's eyesight failed and young Nally went to work in a department store. He was employed as a cash boy at a salary of $13 a month. From this time until many years later his entire earnings, with the exception of his daily carfare, were cheerfully given toward maintaining the little home and family. When he reached his sixteenth year he became a Western Union messenger boy in St. Louis, and remained in the telegraph service continually from that time up until a few months ago.

Colonel Robert C. Clowry was then assistant superintendent of the Western Union in St. Louis. One day, shortly after Nally had donned his uniform, he drove up to the offices and seeing the boy just about to enter, called to him:

Both during and after business hours Mr. Nally is decidedly human, always approachable, affable and courteous.

"Here, young man, hold this horse for me!"

"Sorry, sir, can't do it," came the reply. "I am working for the Western Union, and all of my time must be given to my job." He of course didn't know who Colonel Clowry was then, and it is likely that the assistant superintendent dismissed the matter from his mind with but a momentary impression of the loyalty of one among many employees. It is interesting to note, however, that years afterward the boy who refused to hold his horse became the man's strongest business rival, respective heads of the two great corporations in the telegraph field.

During the three years he spent in the messenger service young Nally was the direct antithesis of the sleepy-eyed, slow-moving boy that cartoonists have pictured with more or less fidelity to type. Whenever any one wanted something done in a hurry, little "Ed" Nally was always called. In those days there were few elevators in buildings and telephones were just coming into use. Pneumatic tubes for sending press messages had not been introduced, and because of his fleet-footedness Nally was given the press route, carrying the Associated Press reports to the newspaper offices. Thus he became the only "all-night" messenger boy in St. Louis and had many exciting experiences.

One night he was given a message to deliver at the county insane asylum, away out on Rock Road, a lonely thoroughfare that ran through the suburbs of St. Louis. The locality was a dangerous one and was frequented by highwaymen, so the asylum clerk armed him with a lantern and a revolver for the return. Mr. Nally's own words best tell the story:

"With the lantern held in one of my trembling little hands and the revolver at full-cock where it rested in my pocket, I crept cautiously along in the direction of the city. After a time I began to feel a sense of security, for nothing had happened, and it struck me it would not be so very bad an episode if I should have a brush with one lone robber. The brush came, sure enough; but I regret to say that I did not rise to the full stature of the heroic role I had mapped out for myself. When I was called on suddenly to hold up my hands, I dropped on my knees, I believe. The two highwaymen took from me the revolver which had been forced upon me by the night clerk, together with all the change in my pockets. In my terror the weapon was wholly forgotten until the robber drew it from my coat!"

It has been said that young Nally's spirit of adventure came from reading stirring Indian and outlaw tales in dime novels. Nothing could be further from the truth. For it was about this time that Nally realized the handicap of his lack of early education and introduced a system of his own for acquiring knowledge. Whenever he felt puzzled he made a mental note of the matter and at the first opportunity he sought enlightenment from wiser persons or in books. There was an old book and print shop on Ninth avenue in St. Louis, and while the other boys were idling Nally could be found at odd moments drinking in the contents of the bookshelves. The quaint old proprietor, T. F. Townsend, took an interest in the boy and allowed him full run of the place; it was here that the fine efficient executive of to-day gained his first love of books and etchings and paved the way toward an education far beyond that of the average American business man. Out of this shop, too, came the first volumes of what to-day is a remarkable and intensely interesting private library,

The library in the Nally home at Ossining-on-the-Hudson; a room that reflects the many-sided personality of the owner. Here are gathered his choicest possessions, the books and prints of his early days, the later and rarer volumes and etchings, and innumerable souvenirs of his triumphs and discouragements throughout his business career.

books which for the most part were bought with the ten cents saved each day by walking to and from work.

In 1878 Nally was given a junior clerkship in Colonel Clowry's office, and later he held several other higher positions in the Western Union.

Then he went to Minneapolis, where he became superintendent for the Great Northwestern Telegraph Company. About this time the Western Union, under the leadership of Jay Gould, had what amounted to a telegraph monopoly. Business and brokerage houses began to need broader and better service and wildcat telegraph companies sprung up all over the country. At this juncture John W. Mackay, the world's most famous miner, invested his millions in the telegraph business and the new Postal Company, the only formidable rival of the Western Union, came into existence. That was in 1886; four years later Mr. Nally resigned his position in Minneapolis to become assistant general superintendent of the Postal in Chicago. Right from the beginning the new company became involved in a stormy rate war and it was left for the few men of experience, industry and integrity who had been gathered into the new company to create order from chaos. What was done is now commercial history and does not need repetition. The important tasks assigned to Edward J. Nally and his successful handling of them is clearly shown in his rapid rise in the service. Within a year he was made general superintendent; five years later he became vice-president, director and member of the executive committee with headquarters in New York. On April 11, 1907, his forty-eighth birthday, he became vice-president and general manager; which position he held up to his retirement four months ago. In thirty years he had progressed from a $13 a month job to one of the highest positions industry has to offer.

It was not to be expected that a big, broad, capable executive, still in the prime of life, would be allowed to remain out of the business world for long.

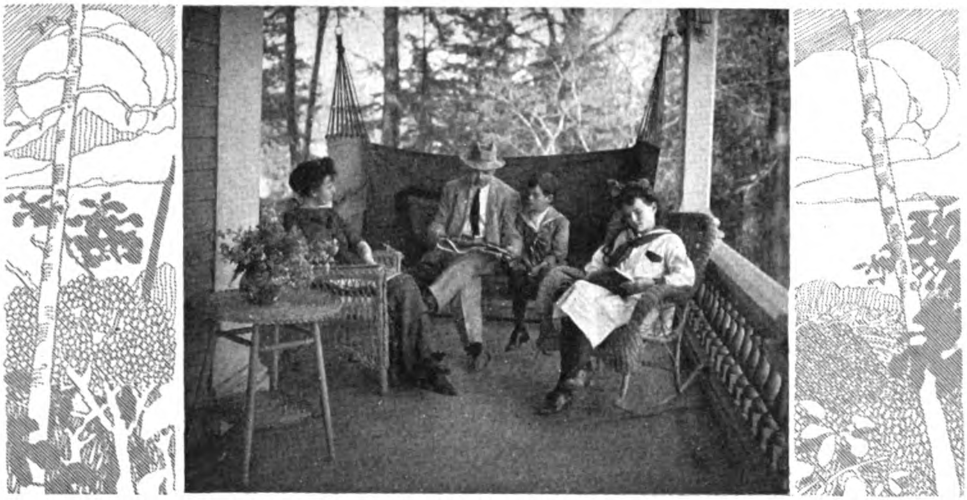
The enormous possibilities in wireless telegraphy appealed to him, and on October first, Mr. Nally heeded the call of the American Marconi Company and became its vice-president and general manager.

Mr. Nally's views on wireless give some hint of what may be expected in the way of its development under his direction. "I consider that the opportunities for constructive work are ideal, with wireless just on the threshold of its development," he said. "If there is one thing I prefer above others, it is creative work, and it seems to me that with the freedom of expression always associated with the building up of new enterprises, limitless fields of activity can be created. Wireless communication appeals strongly to my imagination and I feel the greatest enthusiasm in becoming associated with man's greatest achievement. Marconi's marvelous invention is making history. What more could a man desire than the opportunity to participate in, and perhaps influence to a degree, the epoch-making incidents of his day and generation?"

Concentration, monumental energy and squareness in dealing with employees are the keynotes of this man's character. He is a firm believer in rewarding conscientious effort and each individual working under him is constantly under his observation. "Lack of concentration of purpose and energy," says Mr. Nally, "appears to me the main obstacle which prevents the young men of to-day from 'carrying the message to Garcia.' The man who is paid fifty dollars a month and earns what he gets and no more, is the man who sticks in a fifty-dollar position and is not advanced on the pay-roll. On the other hand, the employee who draws only fifty dollars but works as if he were being paid eighty dollars is invariably the one to be chosen for promotion to the eighty-dollar place.

"Jealousy of holidays and off-hours indicates in an employee the presence of the microbe of failure. The men who are given to signing petitions and round robins also betray the same defect. They petition for opportunities instead of making them."

And Mr. Nally is the living embodiment of the advice he gives. To his determination early in life to take the world as it came, without shrinking or flinching, to face the hardships of a commercial career, incidental fatigue and discourage-



Essentially a home-loving man, the Marconi executive takes the greatest interest in making it a most attractive recreation spot for himself and his family.

ment with fortitude and indifference, he gives the credit for his rise to the top of the heap.

Both during and after business hours he is essentially a human being. Always approachable, affable and courteous to those who have something to say, he is ever in close touch with the pulse of the organization he dominates. Mr. Nally has none of the aloofness of the average corporation official; his staff is to him a great big family, all working toward a common end, and he sees that full credit and assistance are given where deserved.

A demonstration of how universally he is beloved of employees was given on the occasion of his marriage to Miss Lee Warren Redd, of Lexington, Ky., in 1897. Hundreds of congratulatory telegrams poured in from all parts of the country and scores of gifts, of all descriptions, each one pulsating with the sincerest well wishes of the giver, were showered upon the assistant general superintendent and his bride. And each advancing step in his career has been marked by tangible evidences, collective and individual, of the high estem in which his co-workers hold him.

Like all men of inordinate capacity and dynamic personality in business, his home reflects an atmosphere of orderliness in relaxation. Located on one of the highest points about Ossining-on-the-Hudson, the house commands a sweeping view of the river and the Palisades beyond, an ideal spot for the idling hours of the man of many interests. Here he has gathered about him his choicest possessions, the books and prints of the early days, the later and rarer volumes and etchings, and innumerable souvenirs of his triumphs and discouragements throughout his business career. Essentially a home-loving man, Mr. Nally takes the greatest interest in making it a most attractive recreation spot for himself and his two children, devoting many hours of consultation with Mrs. Nally, whose love of Nature and keen appreciation of decorative values finds a responsive chord in his many-sided personality. Yet with his numberless activities, Mr. Nally finds time to assist in important civic betterment work and to further the interests of a few carefully selected clubs.

Edward Julian Nally is a distinct acquisition to the ranks of wireless workers, and the Marconi Company is particularly fortunate in securing the services of one of the ablest men in the telegraph field. He looks upon the annihilation of space by wireless as the greatest of modern triumphs; and if the spirit and verve with which he entered into his new field of activity is any indication, commercial wireless is going to take some mighty big steps forward during the coming year.

LIQUIDATING COMPANY READY TO COMPLETE STOCK TRANSFERS

Early in October, the Wireless Liquidating Company sent out a notice to stockholders, requesting that proxies be signed and returned before November 17, when a meeting will be held to pass resolutions for the distribution of the stock of the American Marconi Company among holders of Liquidating stock.

The letter, which is over the signatures of Arthur P. West, George L. Fox, Alfred A. DuBan, George W. Whiteside and R. M. Owen, states: We are now about ready to distribute the Marconi stock, and we hope to be able to pay a small cash dividend in addition thereto. But such a distribution cannot be made without the approval of two-thirds of the stockholders of the Liquidating Company given at a regular meeting of stockholders. A meeting to pass on that question has been called." The circular adds: "If we can distribute the stock of the Marconi Company in the shape of stock (instead of selling it and distributing the proceeds), a course which we believe is earnestly desired by our stockholders, each holder of five shares of Liquidating stock will receive at least two shares of the Marconi Stock. Reference is made to the suits pending against the heirs of Christopher C. Wilson, and it is intimated that if certain claims which have been filed with the receivers appointed are expunged the distribution may be on a two-to-one basis instead of including a cash dividend.

It is purposed at the meeting of stockholders on November 17, that holders of the Wireless Liquidating shares shall also pass upon a resolution authorizing the directors of the Liquidating Company to appoint a trustee who will issue scrip for fractional Marconi shares. The directors assert: "One of the most difficult problems with which we have to contend in winding up the affairs of the Liquidating Company, is the question of distributing fractions of shares. That is to say, some stockholders of the Liquidating Company may be entitled, for instance, to two and one-fifth Marconi shares. The Marconi Company does not issue fractional shares; and it is our purpose to distribute to such stockholders two shares of Marconi stock, and, if the stockholders approve, to deposit the remaining shares representing such and similar fractional interests with a trustee who will issue scrip to our stockholders for their various fractions of the stock of the Marconi Wireless Telegraph Company of America, such scrip to be exchangeable for regular stock certificates in the Marconi Wireless Telegraph Company of America, whenever it is presented to the trustee, in amounts equal to a full share or shares of the Marconi Wireless Telegraph Company of America. This will enable stockholders to sell or buy fractions of shares so as to make their respective holdings even shares."

The Wireless Liquidating Company announces that "after the payment of the debts of the Marconi Company and the expenses of administration, there remains on hand sufficient money to enable the Liquidating Company to acquire the 140,000 Marconi shares free and clear of all indebtedness." Also, that "none of the members of the Reorganization Committee received compensation for their services out of the funds of the stockholders, some of them even refusing reimbursement of their out-of pocket expenses." The same applies to the officers or directors of the Liquidating Company, excepting the secretary, who receives a nominal salary.

The circular asked holders of Liquidating shares who favor the prompt distribution of Marconi Stock to attend the meeting or send in their proxies promptly. Those who do not comply with this request will be practically voting against the proposed distribution. Attention was called to the fact that under the New York Law the Company cannot proceed to distribute its assets until two-thirds of all the outstanding stock has voted to do so.

Mention was also made of the action brought by Joseph B. Witherbee and the Court's decision in favor of the Liquiding Company.

Shareholders Indorse Goldschmidt Purchase

FOLLOWING a speech made by Godfrey Isaacs at a meeting of the English Marconi Company, held in London on October 3, the shareholders approved the action of the directors in authorizing an increase in capital of £500,000 (about $2,500,000) in ordinary shares for the purpose of obtaining an interest in the Cie. Universelle de Telegraphie et Telephonie sans Fil of France. The French company controls the rights to the Goldschmidt wireless inventions throughout the world except in the interior of Germany. Mr. Isaacs, who is managing director of the Marconi Company, said that it was not yet known whether Goldschmidt's continuous wave system was capable of sustained long distance service, or whether it was superior to the non-continuous wave system. He declared that the Marconi Company would work the two systems together in various kinds of weather and adopt for use whichever one showed up to the greater advantage.

The Purpose of the Meeting

Mr. Isaacs' speech follows:

"This meeting has been convened, as the circular which you have received has informed you, for the purpose of submitting to you a resolution authorizing the increase of the company's capital by the creation of a further 500,000 ordinary shares of £1 each to rank pari passu with the existing 750,000 ordinary shares, except as regards dividends declared for the period of the current year.

"If this resolution be passed, as I have no doubt it will, and subsequently confirmed at the further meeting to be held for that purpose on the 20th instant, it is the intention, as you have been informed by the circular, to make an immediate issue of 250,000 of the shares and offer them to the shareholders at the price of £3-5-0 per share. Of the remaining 250,000 shares, part will be issued for cash in connection with the arrangements which have been made with respect to the shares to be acquired in the Cie. Universelle de Telegraphie et Telephonie sans Fil of France, and the balance for the present will remain unissued.

Revenue Continually Increasing

"I do not suppose for one moment that the recommendation to increase the company's capital will have come as any surprise to the shareholders, for it is very general knowledge that wireless telegraphy has become a very important industry not only in this country and in Europe, but in very nearly every country in the world. It is, in our opinion, destined to play a very important part indeed in the future telegraphic business of the world, and shareholders are aware that the policy of this company aims at conducting that telegraphic business for its own account wherever it may be possible.

"Considerable progress has been made in that direction in recent times and a number of important concessions have been secured, which will provide to the company the means of organizing telegraphic services with some of the busiest commercial centers of the world. Negotiations are pending with other countries and we have every reason to believe that they will be brought to a satisfactory conclusion in the very near future.

"To fulfil the terms of the concessions and create such telegraph services a number of stations have to be built, requiring a substantial expenditure. As each station is opened and a satisfactory telegraphic service conducted, for which I think we can safely rely upon our scientific advisers and engineers, an additional important, regular, and I think there is every reason to expect, a continuously increasing revenue, will accrue to the company.

"Additional and cheaper means of communication between all the busy centers of the world, together with the ever increasing commerce, should add very considerably to the sum which is today expended upon the world's telegraph messages. I think I am right in saying that the money expended yearly for telegraphic communications across the seas is already sufficient to pay satisfactory dividends upon a capitalization which I believe exceeds £100,000,000 sterling, independently of the increase which may be reasonably expected through the advent of wireless telegraphy and the general development of the world's trade; and when we shall have completed the work which lies before us, and secured, if only a small share, of the telegraph business, it should prove sufficient to enable us to earn substantial dividends upon which I think we shall be able then to regard with our million and a half sterling as a very moderate capitalization considerating the extensive telegraph routes which we shall control.

"Given efficient management of our company's affairs during the next two or three years, I am confident we shall then find that we own one of the biggest and most important industries in the world, capable of holding its own against any competition and furnishing remunerative return to those who have supplied the capital and aided in the creation of an enterprise carrying the name of one with whom we are all proud to be associated.

"You will have learned also from the circular sent to you that we are acquiring a large number of shares in the Cie. Universelle de Telegraphie et Telephonie sans Fil, which company owns the rights throughout the world, with the exception of the interior of Germany, of Dr. Goldschmidt's high frequency alternator, and his other wireless patents. I wish to say a word or two to you with reference to these arrangements in order that there may be no misunderstanding.

Did Not Fear Goldschmidt Competition

"The Cie. Universelle de Telegraphie et Telephonie sans Fil is a company registered in France with a subscribed capital of 10,000,000 francs in 100,000 shares of 100 francs each, and 100,000 parts beneficiaries or founder shares which participate in the profits to the extent of 45 per cent, thus making the capital equal to nearly 20,000,000 francs or £800,000. This capital was subscribed by a few important and very influential persons, who wield considerable power in certain countries abroad. Their board is composed of men of eminence and ability in France, Germany and this country, and their support of the Goldschmidt system, no matter what might be its merits, and upon this subject I shall have a word or two to say later, represented a serious menace to our programme in certain countries; we did not fear their competition, but we were anxious that they should not prevent or delay our obtaining certain concessions to which we attached importance. The company is in possession of some 7,500,000 francs or £300,000 in liquid capital and therefore in this respect also carried no small weight in the foreign countries to which I have referred.

Should Secure All French Business

"From every point of view, and in using these words I mean to cover something more than the interests of our company, it appeared to your directors to be of the utmost importance that we should assure the telegraph services which are embraced in our programme becoming an English enterprise under the control and direction of an English company. These are some of the considerations which induced us to make the arrangements we have made with the Compagnie Universelle de Telegraphie et Telephonie sans Fil.

"We are satisfied with the conditions we have obtained and believe we have entered into transactions which will prove beneficial to the company.

"All the shares in the Cie. Universelle et Telegraphie et Telephonie sans Fil which were previously held in Germany pass into our hands and all the German directors retire from the board—a consideration of no small importance in France and one which we hope will enable the Cie. Universelle, which will also probably hold the Marconi long-distance license for France and the French Colonies, to secure the whole of the important business in wireless telegraphy which is comprised in the programme of the French Government.

"It is probable that the Goldschmidt patents for the rest of the world will become the property of the Marconi Company. Now with regard to the Goldschmidt high frequency alternator, this is an extremely clever machine for the generation of continuous waves; it has been erected in a station near Hanover which Mr. Marconi, one of his ablest engineers and I visited a few weeks back. There is great merit in the invention, and Professor Goldschmidt is no doubt a very able engineer. But it should be understood that he has not invented and does not claim to have invented a system of wireless telegraphy, but a machine for the generation and utilization of continuous waves.

"The station in Hanover is well designed and of great promise; it has succeeded in sending across the Atlantic signals and even messages—but as we have told you on frequent occasions there is a great difference between sending signals and messages and conducting a continuous telegraphic commercial service—and the Hanoverian station, in our opinion, without the assistance, experience and patents of the Marconi Company, is still a long way from being able to conduct such a service.

Credit for Goldschmidt

"In saying this I do not want to be understood to be taking from Professor Goldschmidt one whit of the merit to which he is entitled; on the contrary, his are are the only methods other than those of the Marconi Company, of which we have any knowledge, which, in our opinion, have any prospect of success. But it is natural that a long period of tests, experiments and further inventions would be as necessary with Professor Goldschmidt as they were with Commendatore Marconi.

"However, there were many considerations which caused us to make the arrangements we have, some of which I have already referred to. There is one about which I must say a few words.

"We have had, as you know, a Select Committee of the House Commons and an Advisory Committee composed of scientific men. That committee reported that the Marconi Company alone was able to carry out the Government work at the present moment, but it nevertheless spoke of Professor Goldschmidt's machine in words which would have served the Cie. Universelle as a certificate with any foreign Government and consequently provide the means of seriously impeding, if not damaging, this company's programme.

Messages Not Received at Tuckerton

"It would have been little or no satisfaction to us to see the Cie. Universelle obtain a contract or a concession abroad, and fail two or three years later to fulfill it; for even though it fell subsequently to us to carry out it would not have compensated us for the delay or the prejudice we should have suffered meantime.

"These are considerations of importance which obtain to-day, but in a very short time, we hope, they will no longer exist; the important foundations of our business will have been securely laid and no interference with our programme can then arise.

"It has been sated that one of the reasons which induced us to enter into this transaction was that the station at Hanover had succeeded in transmitting wireless messages to Tuckerton, U. S. A., at a regular rate of 100 words per minute for hours at a stretch. There is not an atom of foundation for that statement, for no better reason than that the Hanoverian station has not done anything of the kind, nor anything approaching it. It has also been said by a paper, which is usually more accurate in its statements, that Lord Parker's committee reported that the future is likely to belong to continuous waves, which is the Goldschmidt and not the Marconi system; whereas what in fact the committee reported was that the only continuous wave machine which they had seen tried with success over the long distances was the Marconi continuous wave machine.

"A good deal more has been written upon this subject, mainly with the object of attacking the Government in connection with the contract for the Imperial stations, but these are matters which do not concern us; they are political and the Marconi Company has no politics. But when the public is told, as one paper has told them, that the nation's interests have been sacrificed, I for one protest, for it would seem to me that the course we have taken will prove to be of very marked advantage to the nation, and that for the following reasons:

"We do not know, and nobody yet knows, whether continuous waves will be able to do a continuous long-distance commercial service. If they can, will they prove superior in any way to the non-continuous waves? Those who have had no experience with long-distance wireless telegraphy may be willing to express their opinions, but Mr. Marconi and his engineers who have had such experience decline to express themselves. Before doing so they wish to see what we are about to do, viz.: work the continuous and non-continuous waves side by side across the Atlantic and compare them at all times and in all weathers. Similarly we shall be able to test the Goldschmidt continuous wave machine and compare it in every respect with the Marconi continuous wave machine.

Has Choice of Methods Now

"If the continuous wave proves to be superior to the non-continuous, we shall be in a position to decide which of the two machines is the better; we shall preserve an absolutely open mind and adopt whichever offers the greater advantage and Mr. Marconi will be the first to insist upon that. Should the Goldschmidt machine prove the better, the nation will have the benefit of it under the contract with our company without any extra cost and without having run any risk. Had the arrangement which we have entered into not been made the government would not have had the opportunity of such a comparative test; but if it had, does anybody suppose that if the superiority proved to be with the Goldschmidt machine, that the German and French interests would have been willing to furnish it on any better terms, if as good, as those entered into with this company? The Government has dealt with an English company; if the foreign machine proves of advantage, the government still gets the benefit of it through an English company. Is that how the nation's interests have been sacrificed?

"And again, if the Goldschmidt machine proves to be of the value that some contend and markedly superior, as it pleases others to say, to the Marconi machine, the commercial wireless telegraph business of the world would have been in the hands of foreign companies, whereas by our arrangements they will be in the control of an English company. Is that a sacrifice of the nation?

"I will say no more upon that subject—I hope I have said enough to convince you that whether the Marconi continuous wave machine, or the Goldschmidt continuous wave machine, or the combination of the two, proves the best in wireless telegraphy, the Marconi Company will possess them and under the contract the nation will have the benefit of them.

"Ladies and gentlemen, I trust you will approve the course we have taken and pass the resolution which the chairman will submit to you. It may interest shareholders to know that 2,303 shareholders, representing 275,657 shares, have signified their approval and sent us their proxies."

Subscriptions to the new issue of stock will be received by the Marconi Wireless Telegraph Company of America. Full particulars will be found in an announcement published in our advertising columns

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AN HONOR POSTPONED

A Rome correspondent writes: "Recently it was announced that Mr. Marconi was to receive the honor of elevation to the position of Senator. The king himself expressed approval of the step to show appeciation of Mr. Marconi's achievements. When the distinguished inventor was visiting His Majesty at San Rossore a few days ago the King congratulated him on the approaching event.

"'But,' said Mr. Marconi, 'I am not yet forty years of age, and therefore am not qualified.'

"Alas, he was right. Under the Italian Constitutional law no one is eligible for a senatorship until he has reached that age. The King is said to have expressed some surprise that his Ministers had not made the necessary simple inquiry before putting Mr. Marconi's name forward for the coveted honor. The inventor will now have to wait until next year. He was born on April 25, 1874. The plan to honor Mr. Marconi was proposed on the initiative of Premier Giolitti."

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D., R.E.
Instructor in Radio Engineering, the College of the City of New York

ARTICLE II

Dealing with the conditions encountered in radio telegraph transmitters, the author describes a high-voltage Wheatstone bridge for the measurement of capacity at high voltages and radio frequencies. The principle is shown and a detailed description of the complete apparatus is given.

A substitution method for the measurement of the capacity of condensers such as are used in radio telegraph receiving apparatus is fully described.

THE capacity of a condenser, as measured by the method outlined in the first article of this series, is strictly applicable only when the condenser is used at low voltages and audio frequencies. But, as is well known, condensers are very frequently employed in circuits where both the voltage and frequency attain very high values, and it therefore is desirable to measure their capacity under such conditions also.

8.—MEASUREMENT OF CAPACITY AT HIGH VOLTAGES AND RADIO FREQUENCIES, USING THE WHEATSTONE BRIDGE METHOD.

(a) *Arrangement of the Apparatus.*—The method involves the use of high voltages and radio frequencies in a Wheatstone Bridge. The simplest form of generator is therefore a spark gap coupled to an oscillatory circuit. In Figures 5 and 6, E is the spark gap. Connected across this gap are two circuits, L_1 C'_n and L_2 C_x. Each of these consists of an inductance and a capacity; and therefore each time there is a breakdown of the spark gap, free alternating currents (usually called, "damped oscillations") pass through each of these circuits. If the Geissler tube F be connected across the terminals C and D of the condensers, it will be found that (under certain conditions which will be given below), it is possible to keep the tube dark by adjusting one of the capacities, C'_n to a particular value. For all other values of C_n the tube glows brightly. The inductances L_1 and L_2 may now be reversed in position relative to their respective capacities, and by altering C'_n (the original value of C_n for which the tube did not glow), a new value, C''_n, can be found for which no discharge passes through the tube. From the quantities C'_n and C''_n it is easily possible to calculate the unknown capacity C_x. The second arrangement of L_1 and L_2 is shown in the right-hand portion of Figure 5.

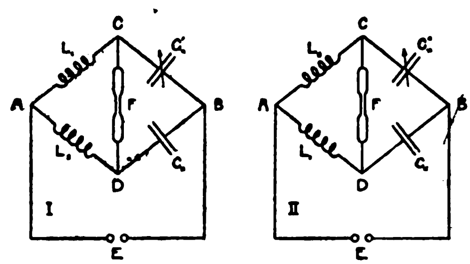


Fig. 5

The actual arrangement of the apparatus (together with certain convenient additional measuring instruments and protective appliances) is shown in Figure 6. This diagram is of further interest, because it shows a method of arranging alternator, transformer, and spark gap which will be frequently used hereafter. G is an alternator, current from which flows in turn through the regulating reactance ("choke coil") S, the primary of the transformer K, the switch or transmitting key J, and the fuse I. Since the voltages in the secondary of the transformer K rise to high values, and since (because of the presence of the spark gap E and the oscillatory circuits) radio frequency alternating voltages will be present between the terminals of its secondary winding, it is necessary to protect the alternator G against the effect of these radio frequency high voltages, in case of a breakdown of the winding insulation of the transformer. This is satisfactorily done by connecting the large condensers H across the terminals of the primary winding. The condenser are in series and their middle point is connected directly to the frame of the transformer. To protect the secondary winding against excessive voltages, the protective spark gap R is directly connected across the terminals of the secondary. R is set to such separation of the sparking surfaces, that, before the secondary winding insulation breaks down, there is a discharge across the gap. It will be found that most transformers are already provided with such a protective gap. However, if this is not the case, the proper separation of the 1 cm. diameter brass balls of the gap for a 5,000 volt transformer is about 1.0 mm., for a 10,000 volt transformer about 2.5 mm., for a 15,000 volt transformer 4.2 mm., and for a 20,000 volt transformer 6.0 mm.

An electrostatic voltmeter V was a non-essential portion of the equipment, but served as a convenient means of rapidly determining the voltage at which the condenser capacities were measured. E is the main discharge gap, N a normal or standard variable condenser arranged for high voltages. P is the unknown condenser, F the Geissler tube, L and M are copper helix, high voltage inductances, and Q is a double pole double throw switch permitting a rapid reversal of the inductance bridge arms.

In the experiment as performed, G was a source of 110 volt 60 cycle current, the reactance S consisted of 80 turns of No. 14 wire about 25 cm. to the turn, wound on a rectangular cross-section iron core and with taps every four turns. Its inductance was 0.036 henry (measured at 500 cycles and 1 ampere). The condensers H were each 2.0 μf Western Electric 21-D condensers and the circuit was fused for 10 amperes. The transformer was a 1.5 K.W. 60 cycle, 20,000 volt, closed core transformer with adjustable magnetic leak-

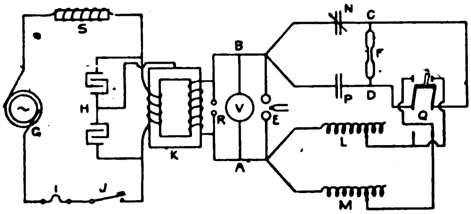


Fig. 6

age. An extra protective gap, R, was of the usual micrometer-screw-adjustment type. The electrostatic voltmeter was a 0-10,000 volt Kohl instrument. The standard condenser was a parallel plate condenser in oil. It had 8 fixed sections which could be connected in parallel readily, and one variable section for fine adjustment. Its total capacity was 0.00491 μf. The unknown capacity was a copper on glass Leyden jar, P. The Geissler tube employed should contain one of the following gases: neon, helium, carbon dioxid, or hydrogen; these gases being distinguished by their low dielectric strength and a consequent high sensitiveness of the tube as an indicator. The inductances consisted of 31 turns of 0.5″ x 0.0625″ flat copper strip wound edgewise on a series of slotted rubber rods. Outside diameter was 8.75″ and the space between turns (clear) was 0.1875″. The total inductance of each helix was 128 μh (microhenrys). The switch Q was for moderately high voltages, and mounted on a marble base, but high insulation is not particularly necessary at this point because, when the bridge is balanced there is no potential difference across the terminals of N and P.

The entire apparatus is shown in Figure 7. To the left can be seen a hot wire ammeter for measuring the transformer primary current, if desired; a control switch, the reactance S, the transformer, and the spark gap. The gap is air-cooled, one of the electrodes (of

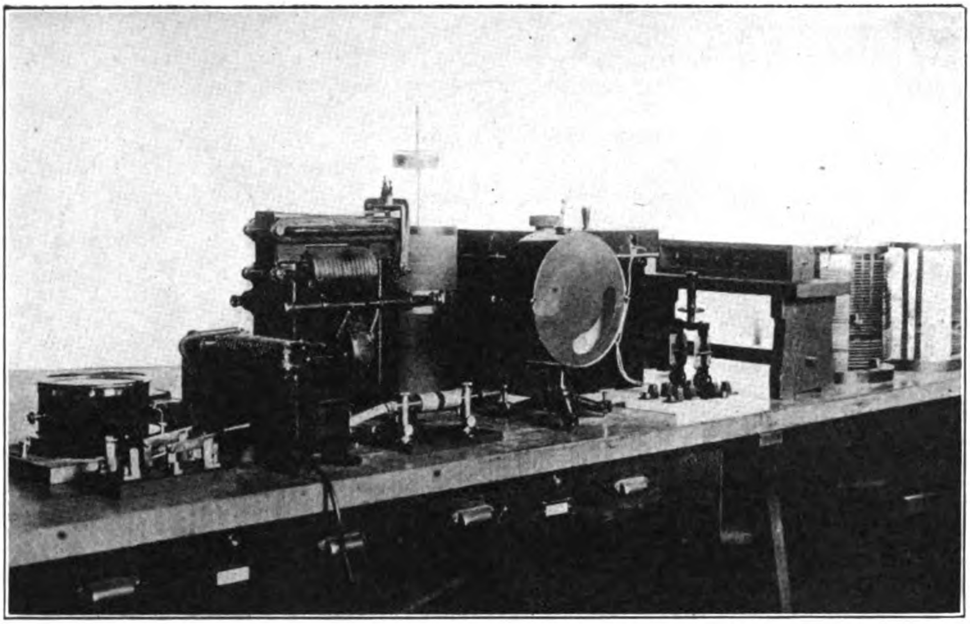


Fig. 7

zinc) being perforated, the other solid. Compressed air is supplied to the gap, and passes out radially between the sparking surfaces. Such cooling adds to the regularity of operation. Passing to the right in the illustration, the electrostaic voltmeter and the reversing switch are seen standing before the standard oil condenser. The Geissler tube is mounted in a recessed blackened box, which acts as a shadow frame. At the extreme right are the two bridge arm inductances.

(b) *Theory of the Method.*—Suppose that the breakdown voltage of the gap is E_m. The discharge phenomena are then somewhat as follows:

(1) Both condensers C_x and C_n are charged to the same voltage, E_m.

(2) The gap becomes conductive, and of fairly low resistance.

(3) The terminal voltages across the condensers diminishes similarly to a free alternating current ("damped oscillation"), being represented by an expression of the form

$$e = E_m \epsilon^{-at} \sin \omega t \qquad (24)$$

where e is the potential difference at the terminals of the condenser at the end of the time t, E_m is (very nearly) the maximum and initial potential difference, ϵ is the base of the system of natural logarithms, and ω is the angular velocity (2π times the frequency of alternation).

It is well known that the damping factor, a, is given by

$$a = \frac{R}{2L} \qquad (25)$$

where R is the radio frequency resistance of either of the oscillatory circuits, and L is its inductance. Furthermore,

$$\omega = \frac{1}{\sqrt{LC}} \qquad (26)$$

where L and C are the inductance and capacity of the same circuit.

If the alternations of voltage across the terminals of each of the condensers are to keep in step (which is the necessary condition that the Geissler tube shall not light up), it is evident that the damping factors and angular velocities of each of the circuits $C'_n L_1$ and $C_x L_2$ shall be equal. The first condition is not as important as the second, and will be appreciably fulfilled if the inductances used are of proper dimensions and do not differ markedly in value.

The second condition leads to the following equation:

$$L_1 C'_n = L_2 C_x.$$

If, after reversing the connections of L_1 and L_2, the Geissler tube is again darkened when the value of C_n is C_n'', we have similarly

$$L_2 C''_n = L_1 C_x.$$

From the last two equations L_1 and L_2 can be eliminated, and the value of C_x is found to be

$$C_x = \sqrt{C'_n C''_n} \quad (27)$$

So that C_x can be directly calculated. The method here outlined is similar to that used in weighing on a false-arm scales.

(c) *Procedure.*—From 0.2 to 1.0 K.W. transformer input are employed, and the voltage at which the measurement is to be made is regulated by adjusting the separation of the spark gap surfaces. If the capacities to be measured are fairly large, it will be necessary to increase the transformer input for a given voltage. The inductances are arranged so that they vary by 10 or 20%, and the glow in the tube disappears at a certain adjustment of C_n. The room should not be very brilliantly illuminated for accurate measurement. The key, J, is best a heavy sending key, because, if the current is kept on very long when the bridge is not balanced, the vacuum tube may be overheated. The true balance point must be found by taking the mean of the two positions above and below it at which the tube just begins to glow. The reason for this is that it takes a certain voltage to cause *any* glow in the tube.

(d) *Errors of the Experiment, their Elimination; and Probable Accuracy.*—The inductance and capacity of the connections in the bridge arms should be small, which can be attained to a satisfactory extent by having such leads short and widely separated. Brush loss in the unknown condenser will cause an apparent increase of capacity, which should not be allowed for, because it will also be present when such a condenser is in actual use.

The results of a typical experiment are as follows:

Connection I. Tube begins to glow for following values of C_n: 2 fixed sections + (170° ± 5°) on variable section = 0.00238 ± 0.00001 μf., and at 2 fixed sections + (90° ± 5°) on variable section = 0.00219 ± 0.00001 μf.

The mean value = C'_n = 0.00228 ± 0.00002 μf.

Connection II. Tube begins to glow for following values of C_n: 3 fixed sections + (130° ± 5°) on variable section = 0.00272 ± 0.00001 μf., and at 3 fixed sections + (50° ± 5°) on variable section = 0.00250 ± 0.00001 μf.

The mean value = C''_n = 0.00261 ± 0.00002 μf.

Unknown capacity = $C_x = \sqrt{C'_n C''_n}$ = 0.00244 ± 0.00001 μf.

Accuracy = 0.5%.

We frequently desire to use condensers in receiving circuits and in wave meters. The capacity of such condensers should be measured by the next method.

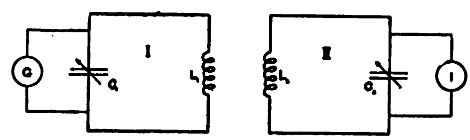


Fig. 8

9.—MEASUREMENT OF CAPACITY AT RADIO FREQUENCIES AND LOW VOLTAGE BY THE RESONANCE METHOD.

(a) *Theory of the Method.*—In Figure 8, consider the circuits I and II. Circuit I consists of the inductance L_1, the capacity C_1, and some form of gap discharger (such as a spark gap or buzzer break) G. By means of G, the condenser C_1 is charged, and during its period of discharge, free alternating currents ("damped oscillations") are present in the circuit I. The circuit II is inductively coupled to I by means of the inductance L_2. Connected across its capacity, C_2, is the indicator I. This indicator may be, for example, a detector and telephone, or a detector and galvanometer. We wish to know under what conditions of adjustment of secondary and primary circuits the response of the indicator in the secondary circuit shall be a maximum. Such a condition is called resonance. Bjerknes has shown that, if the two circuits are *very loosely* coupled, the condition for maximum response of the secondary indicator is equality of the natural periods of the circuits. We shall consider this matter at considerable length under Measurements of Wave Length.

Suppose that the condenser C_2 is unknown. We may adjust the primary condenser and inductance, and the secondary inductance, until finally the maximum indication is obtained in the secondary. We then replace the unknown condenser by a variable standard condenser C_n, and by varying C_n again obtain the greatest indication. Obviously, the last value of the standard condenser is that of the unknown capacity, since each brings the secondary resonance with the primary. (Except for the rare case of strong overtones in the exciting circuit.)

(b) *Arrangement and Description of the Apparatus.*—In Figure 9 is shown a complete wiring diagram of the apparatus. The primary circuit, I, consists of a fixed coupling inductance L_1, and extra tuning variable inductance L'_1, and the capacity C_1, also variable. The circuit is excited from the buzzer E, G which is fed by current which passes through the regulating resistance D, and the two inductance L_1 and L'_1. An appropriate resistance F is shunted across the break point of the buzzer. It contributes to the regularity of action of the buzzer, and, by partly preventing the break, causes wave trains of small damping in the primary circuit. The secondary circuit, II, consists of the fixed coupling inductance L_2, the variable tuning inductance L'_2, and either the standard variable condenser C_n or the unknown condenser C_x. Across the terminals of the condenser are connected the detector H and the telephone J. For the telephone an appropriate galvanometer may be substituted. If it is desired to heighten the sensitiveness of the indicator circuit, a small auxiliary voltage obtained from a potentiometer circuit and applied at the terminals of most crystal detectors will increase the response. And a small "telephone condenser" (of about 0.02 μf) connected across the telephone will also be found of advantage. Usually neither of these devices is necessary.

The actual apparatus employed for the experiment was as follows: B was a 10 volt storage battery, D a slider resistance of maximum 11 ohms. The buzzer was the smallest size "Eco" buzzer. F was a 4-ohm non-inductive resistance, being part of a usual resistance box. The capacity C_1 was an aluminum plate, variable, air condenser. L_1 was a standard inductance of value 190 μh. (microhenrys). It was not

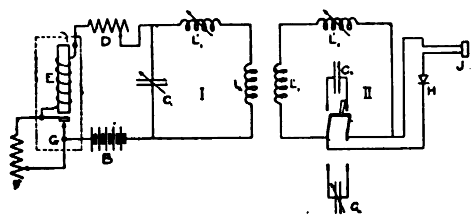


Fig. 9

found necessary to use L_2. The maximum value of C_1 was 0.00199 μf. In the secondary circuit, L'_2 was not found necessary (for the particular capacity measured), and L_2 was 192 μh. (The calculation of these inductances can be most easily accomplished by Nagaoka's formula and tables as given in the Bulletin of the Bureau of Standards, Vol. 8, No. 1, entitled, "Formulas and Tables for the Calculation of Mutual and Self-Induction" (Revised). The standard condenser was a variable 0.00497 μf. rotary plate air condenser, and the unknown capacity was a smaller variable air condenser. The detector H was a crystal detector of the "Pyron type, and the telephone receiver was a 2,000-ohm double head-band one. When it was desired to replace the telephone by a galvanometer, a Hartmann & Braun galvanometer of 325 ohms resistance and having a figure of merit of 9 $(10)^{-7}$ amperes per degree deflection was used. This galvanometer was robust and easily portable. Not all buzzers were found to be equally satisfactory. They can best be chosen by trial. If it is desired to use a slightly more powerful source instead of the buzzer, a small induction coil and spark gap of the usual type may be employed.

The actual appearance of the apparatus is shown in Figure 10. At the left of the photograph are seen the en-

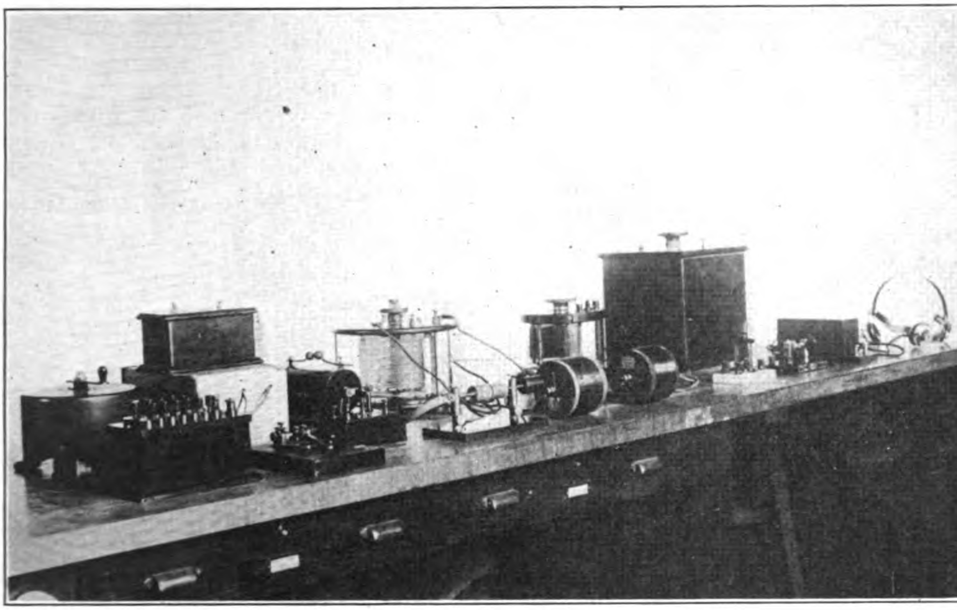


Fig. 10

closed buzzer with a small induction coil standing on it and a second induction coil beside it. Surrounding it are the regulating resistances D and F and a control key. The three condensers are shown in the background, and in front of them a spark gap (which may be used with the induction coils, if desired), the coupling inductances L_1 and L_2, the reversing switch for known and unknown condensers, the crystal detector, the portable galvanometer, and the telephone receivers.

(c) *Procedure.*—Adjust the buzzer so that it operates steadily with a clear tone. The resistance across the contact G should be *small,* say a few ohms. Of course, the smaller this resistance, the greater will be the current required to operate the buzzer. Each time the buzzer contact opens, the current through the inductances of circuit I will be rapidly changed and a free alternating current will be present in this circuit. Couple L_1 and L_2 closely, and, with the unknown condenser in circuit II, tune circuit I by varying L_1, C_1, and (if necessary) L'_1 until a loud note is heard in the receivers. It may be necessary to adjust the detector a number of times before trying a new setting. If the values of the various inductances and capacities are roughly known, time can be saved by bringing them to an adjustment such that

$$(L_1 + L'_1)\ C_1 = (L_2 + L'_2)\ C_2.$$

This is the condition for equality of natural periods (approximately); without considering the influence of buzzer and detector circuits).

Coils L_1 and L_2 are then to be separated until the coupling is so loose that a sound is heard in the telephone *practically only at one setting* of C_1. The coupling is not sufficiently loose unless further separation of L_1 and L_2 makes no difference in the resonance setting of C_1. Leaving C_1 at its final adjustment, replace C_x by C_n, and vary C_n until resonance is again obtained. When C_n is finally adjusted, its value is that of C_x. For accurate work, the whole process should be repeated several times. When the galvanometer is used instead of the telephone, more accurate work is generally possible. For extremely accurate measurements using the galvanometer a series of galvanometer readings for various values of C_1 should be made, and these readings must be duplicated when C_x is replaced by C_n. For more rapid work, only the maximum readings in the two cases need be duplicated.

(d) *Errors of the Measurement, their Elimination; and Probable Accuracy.*—Unless the detector and telephone are sufficiently sensitive, and the currents in the primary sufficiently powerful, it may happen that the coupling of the circuits necessary for easy observation is too close. The remedy for this condition is obviously to increase primary power and detector sensitiveness. When using the galvanometer, it must be remembered that the constancy of the alternating current produced by that device is not greater than about 5%. For greater constancy, special vibrating wire interrupters or a combination of transformers and small quenched spark gaps must be employed.

With the apparatus described above the following results were obtained:

Using the telephone as indicator: Setting of C_n for resonance

$= 105° \pm 1°$.

Accuracy = 1%.

Using the galvanometer and taking complete sets of readings, setting for resonance was $120.7° \pm 0.5°$. (Mean of 20 readings.)

Accuracy = 0.5%.

(For reference, it may be stated that at the same time the wave length was 865 meters, and the sum of decrements of primary and secondary circuits was 0.205. The methods of measuring these will be given hereafter.)

This is the second article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The third will appear in an early issue.

NAVAL "FANS" RECEIVE SCORES

The United States aerial "news service," whereby officers and men on United States warships far out at sea are kept informed each night of the baseball scores and other items of interest, has proved a great success.

Reports to the Navy Department from the battleship Illinois, which has returned to home waters with a big party of midshipmen, declare that the reports were picked up readily by the vessel when it was 2,175 nautical miles out at sea from the navy's powerful station at Arlington, Va., and 2,610 miles distant from the station at Key West. The battleship also reported intercepting wireless messages from European stations.

KOLSTER ADDRESSES RADIO MEN

In an interesting paper, entitled "The Effects of Distributed Capacity of Coils Used in Radio Telegraphic Circuits," read before a recent meeting of the Institute of Radio Engineers by Frederick Kolster, of the United States Bureau of Standards, important phenomena taking place in radiotelegraphic circuits is discussed. The results had been experimentally proven. It was clearly observed:

1—A single layer coil such as used in wavemeters and receiving tuners may have considerable effective distributed capacity. Two methods were described for determining the capacity.

2—This effective distributed capacity has the properties of a condenser in shunt to a tuning inductance. It may therefore be represented by an imaginary condenser (Fig. 1).

Or may be expressed by an equivalent loop circuit.

3—Under experiment a coil with a natural period of 260 meters, an inductance of 1.5 milli-henrys, the effective capacity (due to the imaginary condenser in shunt) totaled .000013 microfarad.

4—The inductance of such a coil apparently changes with the frequency or wave lengths, as was proven by curves.

5—Unused turns of the loading coil in the receiving tuner (Fig. 2), or any tuning coil having distributed capacity, may act as a coupled oscillatory circuit to the used portions of the coil. The coil will therefore respond to two frequencies.

6—The radio frequency resistance of coils with appreciable distributed capacity is found in practice to be higher for some frequencies than that calculated from the well-known formulæ. This may be particularly explained by the distributed capacity of the circuit if the circuit can be considered as an equivalent loop circuit.

The apparent resistance of such a coil may be expressed by the following equation:

$$R' = \frac{R}{R^2 C^2 \omega^2 + (L C \omega^2 - 1)^2}$$

where,

R = the calculated radio frequency resistance.
L = the inductance.
C = the condenser in parallel.

The results of experimental observations were shown, there being considerable difference between the apparent and the actual resistance.

7—The so-called untuned or aperiodic circuit (Fig. 3) may in reality not be so at all, due to the imaginary condenser (effective capacity) in shunt. This coil may have a distinct natural time period and respond more readily to that frequency. This was experimentally proven. A co-ordination of results indicates:

A—The importance of taking into consideration the capacity effects in coils or circuits designed for calibration purposes, and in particular in circuits of large inductance and small capacity.

B—Inductance coils for radio frequency circuits should be designed to have minimum capacity as well as minimum resistance. It is unfortunate that the best design for one of these requirements is not the best design for the other.

C—Coils with "deadended" turns should not be used even though the turns not in use are metallically disconnected from the circuit. They should be entirely out of the fields of the active turns.

D—Coils in so-called untuned detector circuits should be particularly designed to have minimum capacity, or else for each short range of wave-lengths a separate coil should be used having a natural period best adapted to this range.

E—In wavemeter circuits coils having distributed capacity should not be partly inside and outside the instrument. They should be connected directly to the variable condenser, for then the main effect of the distributed capacity will be merely a small addition to the capacity of the variable condenser.

Without doubt, much of the peculiar phenomena sometimes observed in receiving tuners has been accounted for. In a discussion following the reading of the paper, Dr. Goldsmith, of the agreed that the effects observed were undoubtedly true when the inductance is reasonably localized and the capacity not extremely great, but it could not hold good for radiative antennæ. Valid reasons were given.

Several methods for the elimination of the effects of distributed capacity

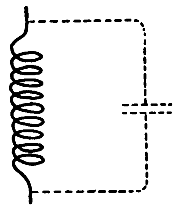


FIG 1

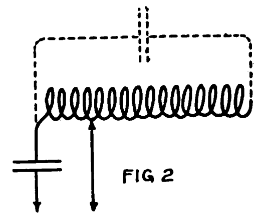


FIG 2

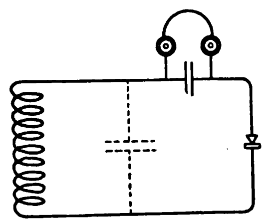


FIG 3

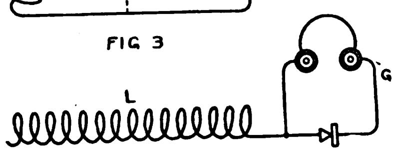


FIG 4

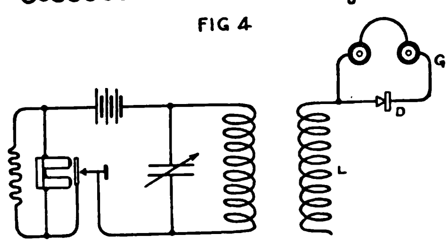


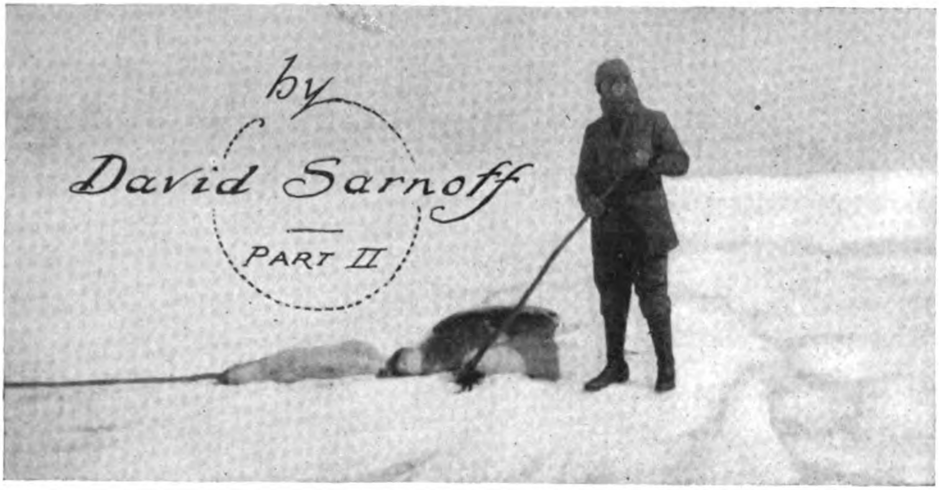
FIG 5

were suggested by members, but none might be reasonably applied to commercial practice.

An interesting feature of the discussion was a method for determining the natural period of a coil as per Fig. 4, in which D is a rectifying detector, G a galvanometer or head phones. L the coil under test.

L may be excited either by very loose coupling to a quenched spark circuit or, as was promulgated by an engineer of the Marconi Company, may be excited by a wavemeter in turn excited by an aperiodic buzzer (Fig. 5).

My Trip to the Icefields



The Captain's Story

THE doctor and I were unmercifully joked regarding our trip across ice and our ducking. In fact I felt like a young "tenderfoot" who had tried and failed to give an exhibition of bareback riding before a crowd of cowboys in the West. The jocular remarks uttered at our expense, however, were good-natured, and I consoled myself with the reflection that I was obtaining real Arctic experience.

I had intended to relate in this article something about the dramatic part the ethereal waves played in a series of incidents that came to my attention while I was on my trip up North. But recently I found my fingers fairly itching to set down on paper a story of the ice fields that is quite as graphic a portrayal of life as something on a motion picture screen. So I am going to ask you to transport yourself from your cushioned chair beside the fire in your library and take a seat beside me in the captain's cabin of the sealing vessel Beothic, wedged in among the ice floes of the North. It will be necessary for you to do so, figuratively speaking, in order to appreciate the story which I am about to relate.

Opposite me sat the commander of the steamship—a big, burly figure of a man who stolidly smoked his pipe and replied to my remarks for the most part in monosyllables and grunts. For days I had been trying on various occasions in a small way to persuade him to tell me something of himself and his life. In supplying me with information about routine matters he was courteous enough, but when the conversation touched on topics foreign to these he shut his mouth as tight as the proverbial clam.

We were alone in the cabin after the evening meal. Outside the wind moaned dismally and the thousand and one sounds that fill a ship broke the silence. A friend of mine who scribbles for a living had told me that every man has at least one good story to tell. It seemed to me that my companion ought to be able to gratify my desire for a yarn. I was formulating in my mind a speech designed to set spinning the wheels which would fabric a tale when——

"You want me to tell somethin'?" he asked.

I nodded, wondering what had prompted him to make the offer. It must have been that he was in a mood for story-telling and wanted to unburden his mind. This, then, is the captain's yarn, told as best I can remember it, in his own crude English:

"Five years ago I came up here in a big ship with a big crew—maybe ninety or a hundred men. I was going to make the big kill and get many sealskins. We started just like we came on this trip—with many folks on the shore waving hands and tellin' good-bye. I felt very happy. But I didn't know what would happen. You never know what happens up here."

He paused a few minutes and seemed deep in thought. I was impatient for the story. After he had puffed at his pipe till it was going to his satisfaction, he continued.

"That's one reason I didn't want 'Gene—that's my brother—to go along. It was the first trip he made to the ice fields. But he was a boy who liked to travel 'round. He was 'bout eighteen—a big boy, 'most as big as me. Every time I came back from my seal trips he teased me to take him along next time. His mother said no and I said no, but after a time she gave up and let him come. The day we left she stayed on the shore and waved her hands and cried. Before the boy came aboard she said to me, 'Take care of him,' and I promised.

"We had a good trip and good weather as we steamed on up North. When we got where I knew there are many seals, I sent men out from the ship, one crowd in one place and some another, to kill the seals. Then the ships sailed on, expectin' to pick up the men when it had left others on the ice.

"My brother, he went in the first crowd. I told him to be careful, not to fall through the holes in the ice an' to work hard. He left the ship, singin' and laughin', and all I said to him didn't count, as near as I could figure out.

"This was early in the mornin'. As we went on up North the ice got thicker and we couldn't go so fast. After a while the ship got wedged in between the floes so tight that she couldn't move and I wouldn't go no farther. I wanted to go back and get ready to pick up my men. Then I saw somethin' away off in the sky that made me shiver—no, not with cold, but because I am scared. I saw once before that thing in the sky and knew it meant a big storm. You don't know what a big storm is up here, Coni man, till you get in one.

"Well, there we was wedged in so tight in the ice that we couldn't budge, though I tried everything I could think of to get away. An' while I was realizin' that the storm was comin' it broke and the snow began to fall. Pretty soon it was like a great blanket that shut out everythin' in sight—you couldn't see nothin' but a mass of white flakes. Knowin' how desperate the plight of my men on the ice was, I set a charge of dynamite under the floes that was holdin' the ship, and for five minutes we was free and movin'. Then we got wedged in again.

"All the time I kept the foghorn blowin' and sent up rockets to tell the poor fellows on the ice where we was. Finally, along late in the afternoon, some of 'em reached the ship. They had heard the horn and felt their way through the snow till they found us. But forty-eight of my crew was still missin' and with 'em was my brother.

"Night came on and we was still jammed hard and fast in the ice. Again we tried dynamite, but no sooner would we get free from the floes than we'd get caught again. Now, danger don't mean a whole lot to me, but I couldn't help thinkin' of that boy. It sorta took away my nerve. I thought of gettin' the men to form a searchin' party and lookin' for the missing ones, but I knew that would be throwin' away more lives. All I could do was to keep the horn blowin' and hope that the snow would stop."

The captain halted in his narrative to get up from his chair and walk across the cabin. The memory of what he had passed through was apparently still with him. Finally he resumed his story.

"There wasn't no sleep for me that night. In the mornin' the snow was still fallin' and it was colder than ever. Some of the men volunteered to go in search of the others on the ice, and four of 'em started out. They was only gone half an hour. Then they come back, tired and discouraged after bein' buffeted about by the wind. They saw it was no use tryin' to get anywhere in the storm and was thankful to get back to the ship alive.

"The end of another day and night saw us still locked in the ice. Again a rescue party started across the ice, but we could see a row of figures stretched out on the ice. They were our men—all of 'em dead. Some had died of starvation and others of cold. But my brother 'Gene wasn't among 'em.

"What had become of him I didn't know. He had, I reckoned, wandered off from the others and had gone through a hole in the ice into the water, or was buried under the snow. While I was walkin' the deck with gloomy thoughts in my head, the lookout in the crow's nest shouted that he saw an object movin' slowly along the ice ahead of us. My heart began beatin'

Ice figures largely in the Newfoundland sealers' scheme of living, and is used in much the same manner as we employ highways. In this picture the crew for the expedition are seen coming right up to the vessel's side, carrying their raiment and equipment on sleds.

turned back after goin' a short distance. And for what seemed like a month to me, but was only another night and a day, the snow continued to come down.

"On the mornin' of the fourth day that we had been locked in, the storm stopped and I set to work in earnest to get the ship free.

"It took us many long hours, dynamitin' and choppin', before we could move. Then, as fast as we could get through the floes, we steamed toward the place where my brother and the others had been left. Pretty soon we came to a place where from the deck quick-like, and one of the mates turned to me with some words of encouragement and hope. But I wouldn't listen to him. I was too fearful of bein' disappointed. Over the side of the vessel and onto the ice I went with my men at my heels.

"Sure enough there was somethin' crawlin' along, but whether it was man or animal I couldn't be sure of. We quickened our speed and finally came to the figure which, sure enough, was my brother. But I thought at first I had found him only to have him die. He was half dead from cold and hunger, an' it took days of careful nursin' before he could tell us how he had escaped the death of the others.

"Did you ever get so hungry, mister, that you felt as if you'd like to eat the skin your boots are made of? Did you ever get so cold that you didn't have no feelin' left and just wanted to walk away and find a place alone to die in? That's the way it was with those men who were stranded on the ice. Some of 'em was brave enough, too. At first they took an encouragin' look at things because they thought the ship was comin' along every minute. But when it didn't come and they looked things in the face and thought of the long night and the sufferin' they would have to go through, a lot of 'em lost heart.

"But that first night, while the men had a hard time keepin' warm enough to be kept alive, wasn't much to talk about compared to what came later. All through that night they kept warm by huddlin' close together and burrowin' into the snow. There wasn't much talkin'. All of 'em was savin' their strength. A few of 'em prayed, my brother said.

"In the mornin' the sufferin' from hunger began. They had killed a few seals, and one of the old men in the crowd made his breakfast off the meat from one of the animals. It wasn't easy to force the food down, but the others ate seal meat, too. Some of 'em couldn't do it and they was the ones that got to feelin' weak before the others. And all the time they kept a lookout for the ship. We was too far off for 'em to hear our horn, and so they kept on waitin' and waitin'.

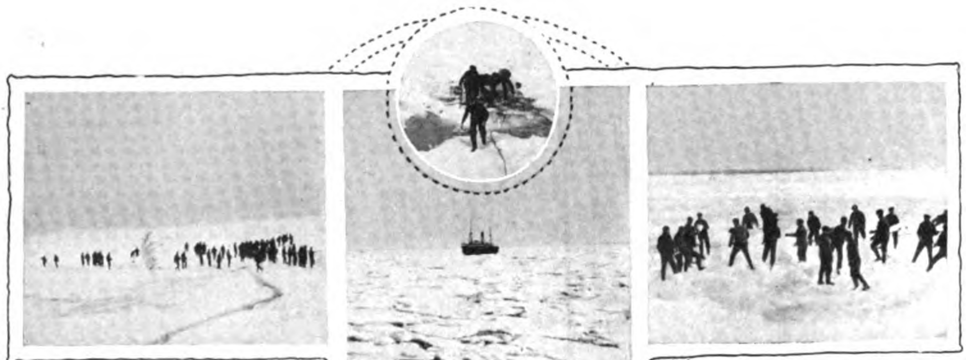
"Toward night some of the men got to actin' strange. One big feller, who couldn't stomach the seal meat, suddenly broke out into crazy talk and ran away into the storm before any one could stop him. A few of the others started mutterin', about tryin' to reach the ship; but they didn't have the nerve to leave the others just then. As darkness came on, my brother and some of the men got together all the seal pelts they could find and used 'em as coverings. But these wasn't enough protection from the cold, and when daylight got around again two of the men was found frozen to death.

"All of 'em was sufferin' so by them that they didn't know quite what they was doin'. 'Gene and another man was desperate and made up their minds to reach the ship, no matter what happened to 'em. So, not payin' any attention to the others, who didn't want 'em to go, they started off together. On and on they plodded for hours. My brother, bein' young and strong, stood things better than his companion, who, after he had tramped till late in the afternoon, fell down in the snow and couldn't get strength enough to go any further. For a long time my brother worked over him, tryin' to get him on his feet. But it wasn't no use and he had had to leave him there to die.

"All that night 'Gene walked and walked. Once he fell down in the snow and felt that sleepy feelin' comin' over him. But he knew that meant freezin' to death, so he 'roused himself up and kept goin'. I don't know how far he walked, but part of the time he musta been goin' around in a circle. Toward the end, he said, his mind probably went back on him pretty bad, because he'd think he saw the lights of the ship in front of him. Then he'd run forward and look and look, but he wouldn't see nothin' but the snow. Once he thought he heard some one shouting', too, and he spent a lot o' time, runnin' here and there. After a while he found out he had been fooled by the cryin' of a seal.

After a long and arduous day's work the sealers return, dragging the pelts across broken ice and gaping holes, impassable to the average man.

"He didn't know when the night ended nor when the daylight came. The last thing he remembered anythin' about at all was fightin' off that sleepy feelin' that was comin' over him all the time. But when we reached him he was crawlin' along on his hands and knees, so I reckon we got there just about in time to save his life."



As a climax to his story the captain took me on deck and introduced me to his brother, who was a member of the Beothic's crew. I could relate many other details of the story—how the captain recovered the bodies of all his men who met death and the sorrow and grief among the relatives and friends of the victims. But I have set down only the facts which impressed me the most.

In the small picture on the upper left hand the men are alternately dynamiting the heavy floes and pulling the vessel through the ice. At the extreme right they are bringing in chunks of ice for drinking water supply. The salt is extracted in an evaporator. At the bottom, sealers are seen boarding the moving vessel as tons of ice break up right under their feet.

I went to sleep late that night, dreaming of hairbreadth escapes from death on the ice. The steady bump, bump, of the ice cakes against the sides of the vessel added a touch of realism to my dream. Early in the morning I was awakened by the heavy trampling of many feet on the deck, and hurriedly dressed to find that we were in the habitation of a number of young seals, or "white coats" as they are called by the hunters.

When I arrived on deck I found that many of the ship's company had scattered over the ice, where they were rapidly increasing the death rate among the "white coats." It may be of interest to the readers of THE WIRELESS AGE to know that a seal hunting expedition is generally divided into groups of twenty or twenty-five men who, under the direction of a leader known as the "master of watch," use gaffs and knives to end the lives of their quarry. For a time I stood on the deck and watched the men as they laid low the "white coats" with blows from the gaffs, removing the pelts from the animals with jack knives and placing the skins on sheets of ice. A flag of the ship was placed on top of each pile of pelts to indicate ownership.

So interested did I become in the work of the seal hunters that I resolved to take part in it. Once on the ice it took me only a short time to discover a "white coat" that was by its mother's side. Always on the alert for danger, the mother attempted to draw her offspring into a hole in the ice—a "bobbin' hole," as it is called—when the saw me approach. Failing in this, she re-treated to a place of safety and left the "white coat" at my mercy. The little animal appeared so helpless that I hesitated for several minutes before striking it with my gaff. Then the shouts and cries of the seal hunters, who yelled, "Hit 'em, Coni-man, dem don't bite," spurred me to raise my gaff and strike. One blow killed the creature, and I removed its pelt with my knife. Emboldened by my first success in sealing, I selected other victims among the animals and in a short time I had killed a dozen of the creatures.

In two days the crew of the Beothic succeeded in obtaining 2,400 seal skins. I sent this news by wireless by way of Belle Isle to the owners of the vessel, and received in reply by the same means a message of congratulation which seemed to gratify the captain considerably. While I was communicating with other vessels and giving them information regarding our luck in sealing and the conditions of the weather, the captain's son, a man about thirty years old, came into the wireless cabin. At that moment Belle Isle began calling "MXB-MXB-S" which, translated, meant that a message had been received at that station for transmission to the Beothic. The wireless contained the news that a boy had been born to the wife of the man who was standing at my side.

He had been somewhat skeptical regarding messages of the air heretofore, but when he received the marconigram from his home he changed his opinion. In the captain's cabin that evening a supper was given to celebrate the arrival of the baby, and wireless came in for much favorable mention.

The wonders of radio communication were again demonstrated a few hours afterward when I received a message from a vessel 100 miles away to the effect that one of her crew was suffering from an internal illness. The message described in detail the symptoms of the sufferer and I showed it to the physician aboard the Beothic. He sent a message in which he advised a course of treatment and told of simple remedies to be administered. Another ship picked up this message and as a result several requests for medical advice came to the Beothic from various parts of the ocean.

This is the second in a series of articles by Mr. Sarnoff relating his experiences in the Arctic regions. The third will appear in an early issue.

WIRELESS DEFEATS DEATH

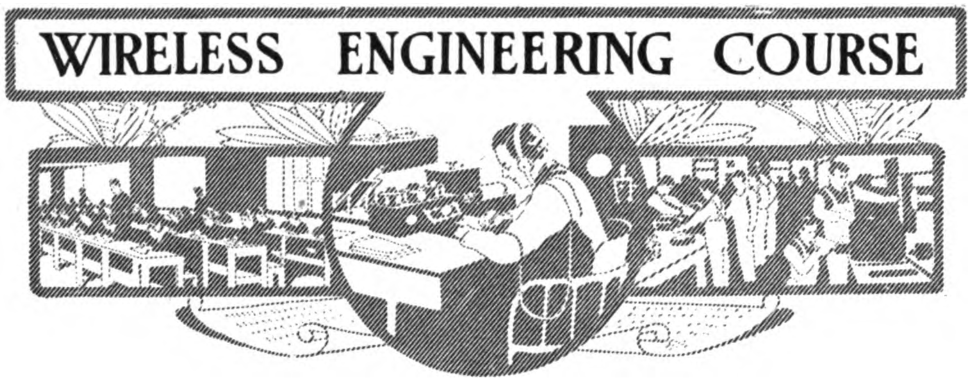
Wireless telegraphy helped F. M. Chamberlain, a naturalist in the United States Bureau of Fisheries, win a race against death that extended from the Arctic regions to his home in Oakland, Cal. While in the frozen North, Chamberlain was taken ill with "galloping consumption." His physician said there was only one hope for him—to reach a warm Southern climate—and that he had one chance in 10,000,000 of reaching California alive.

Washington was appealed to and ordered the government wireless stations in Alaska to flash messages all over the Northern seas for a government vessel to rush to Chamberlain's assistance. One wireless message was picked up by a revenue cutter, which hastened to the sick man.

Then the race for life began. Knot by knot the cutter steamed nearer to the warm South air. The engineer used every trick in his "kit" to hurry the vessel. Oil-soaked fuel gained an extra knot and careful nursing of the engines gained another.

When the harbor lights of Seattle hove in view, the question arose as to whether Chamberlain should be left there or be brought to Oakland. It was decided to bring him to Oakland, and never did railroad men speed a train from Seattle to San Francisco as that train was rushed.

By a prearranged plan of the Marconi Wireless Telegraph Company, every ship with wireless apparatus, sailing the Pacific ocean, dipped her flag Friday, September 26, in honor of the anniversary of Balboa's discovery.



By H. SHOEMAKER
Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER XI

Electrical Oscillations

TO clearly understand why oscillations are produced by the discharge of a condenser, we must fully comprehend the nature of the forces involved. The process is as follows: First, energy is stored up in electrostatic or potential form, in the condenser K (Fig. 45). The plates of the condenser are at a difference of potential, and there is a tendency to come to the same potential. This cannot be accomplished unless the plates are connected together. The condenser is capable of storing energy in potential form in the same manner as a water tank at an elevation is capable of storing water, which in turn possesses energy by virtue of its position or elevation above the earth. If the water is allowed to flow from the tank to the earth, then it will be able to do work, and its energy is said to be kinetic. Kinetic energy is the energy a body possesses by virtue of its motion. In the case of the circuit shown in Fig. 45, electro potential energy stored in condenser K is equal to one-half the capacity of K times the maximum voltage squared; or

$$E = \frac{K V^2}{2} \qquad (7)$$

When the condenser discharges through the inductance L (Fig. 45), a current flows through the inductance which builds up a magnetic field. In building up this magnetic field energy is required. This energy is kinetic in form, as it is the energy of the motion of the charge of the condenser.

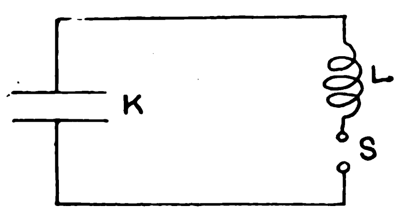


Fig 45

When the current starts to flow through the inductance it is retarded or held back by the magnetic field produced through the inductance; but when the current has reached its maximum, it has imparted all its energy to the magnetic field and it starts falling in value. The magnetic field then starts to collapse, thus causing the current to continue to flow. This energy stored up in the inductance is equal to that stored in the condenser less the loss due to the resistance of the circuit.

This magnetic energy being forced

back into the condenser causes its potential to rise, but in the opposite direction. As soon as the magnetic energy is converted into electro potential energy, the process repeats itself, until all the energy is lost due to the resistance of the circuit.

The magnetic energy can be expressed by:

$$E = \frac{L\ I^2}{2} \qquad (8)$$

Where L is the inductance and I the maximum current value.

Equation 7 is the expression for the electrostatic energy, or energy in potential form, while equation 8 is the expressions for the magnetic energy or energy in kinetic from. As $\frac{K\ V^2}{2}$ and $\frac{L\ I^2}{2}$ are both expressions for energy and they are equal, in the case of the oscillating circuit we can put:

$$\frac{K\ V^2}{2} = \frac{L\ I^2}{2} \text{ or } K\ V^2 = L\ I^2 \qquad (9)$$

It is to be remembered that V is the maximum voltage and I the maximum current.

The above equation is not strictly true, as it does not take into account the loss due to the resistance of the circuit. This loss is $R\ I_1^2$ where R is the resistance of the circuit and I_1 the effective current or (root mean square value) per each semi-oscillation. We can then say that for each semi-oscillation:

$$K\ V^2 = L\ I^2 - R\ I_1^2$$

$\frac{K\ V^2}{2}$ is the total energy of each wave train and is expressed in watts when K is in farads and V in volts. If we multiply $\frac{K\ V^2}{2}$ by the number of wave trains per second we will have the total energy used. If N is the number of wave trains per second and W the watts, then

$$W = \frac{N\ K\ V^2}{2}$$

Thus, if the condenser K (Fig. 45) is charged and discharged 100 times per second to a potential of 10,000 volts, then

$$W = \frac{100 \times K \times (10{,}000)^2}{2}$$

If K = .010 microfarad, or 10^{-8} farads, then

$$W = \frac{100 \times 10^{-8} \times (10{,}000)^2}{2}$$

or

$$\frac{10^2 \times 10^{-8} \times 10^8}{2} = \frac{10^2}{2} = 50$$

If N was 200 instead of 100, then W would equal 100 watts. It will therefore be seen that the energy is proportional to the number of times the condenser is charged and discharged. The energy of discharge is equal to that of the charge, and if it discharges back into the charging circuit there will not be any energy used except that lost by the resistance of the charging circuit. If, however, the condenser is discharged through the inductance and spark gap, so that oscillations are set up, then this energy is so changed in character that it cannot pass back into the charging circuit, and must therefore be dissipated or used up in the form of electrical oscillations.

The rate at which energy is dissipated or used up in the oscillation circuit is enormous, as will be seen from the following example:

If the condenser is charged 100 times

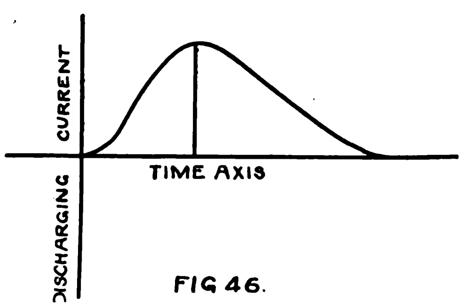


FIG 46.

per second and discharged after each charge, we can say the time required to charge the condenser is approximately 1/200 of a second. If the capacity is .010 M.F. and the voltage 10,000 volts, then

$$W = \frac{10^{-8} \times 10^{8}}{2} = \frac{1}{2}$$

The energy of each charge is therefore ½ watt. Now, if the oscillation produced by the discharge has a frequency of one million (10^6) and there are 10 complete oscillations before they die out, then this ½ watt is dissipated in ten one millionths of a second, or 10^{-5} seconds, and the rate at which energy is being dissipated or used is

$$\frac{1}{10^{-5}} \times \frac{1}{2} \text{ or } \frac{10^5}{2} = 50{,}000 \text{ watts to}$$

maintain these oscillations in a continuous manner.

The above is not strictly true, as the effect of damping has not been considered, but it will serve to illustrate the fact that a great amount of energy is employed for short times in the oscillations.

In practice the condenser is charged from the secondary of an alternating-current transformer, and the condenser will be charged twice for each period. If the frequency is 60 cycles, then the condenser will be charged 120 times per second. The voltage of each charge will be the maximum voltage, or 1.41 times the effective voltage. If the spark gap is adjusted to the proper length, then the condenser will discharge through the oscillating circuit at each maximum voltage, or twice per cycle. If the gap is short, then there may be several discharges per half cycle. It will therefore be seen that the spark gap plays a very important part in the production of electrical oscillations. It must be constructed so as to act uniformly and continuously. After each discharge it should recover it's insulating properties before the condenser starts to charge again. With low frequencies of the order of 100 cycles or less, an ordinary spark gap comprising two metallic terminals separated by the proper distance can be used. If the frequency is higher, then some means for cooling or aiding the gap to recover its insulating properties must be used. This can be accomplished by means of an air blast directed across the gap in such a manner that it will remove the heated gases. Rotary gaps are also used which cause the spark to take place between different sets of terminals, so that the same gap is not used for two successive discharges. Numerous forms of spark gaps have come into use, all of which are designed to produce regular and uniform discharges.

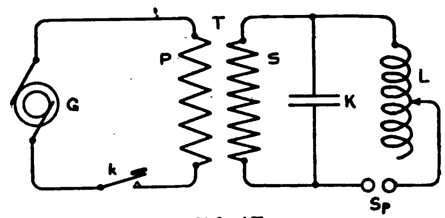


FIG 47

By making the inductance of the oscillating circuit variable, the frequency of the oscillations can be varied at will over wide ranges. This could also be accomplished by varying the capacity of the condenser, but in practice this condenser must be adjusted to the transformer secondary or the secondary adjusted to the condenser, and therefore cannot be varied without varying the secondary of the transformer. In theory, the inductance of the transformer secondary, the capacity of the condenser and the frequency should be so related that

$$L = \frac{1}{p^2 K} \text{ where } p = 2\pi n.$$

In practice this relation must be modified, as the discharge of the condenser at the maximum potential of the secondary causes the energy to be suddenly removed from the circuit, which upsets the resonant relation which would otherwise exist. The secondary of the transformer is therefore adjusted to the condenser while the oscillating circuit is operating.

Fig. 47 is an elementary diagram of circuits used in the production of electrical oscillations. G is an alternating current generator, P is the primary of the transformer T, which is connected to the generator through the key or switch. This switch or key serves to control the oscillations when used for telegraph purposes. S is the secondary of the transformer T, and is connected to the condenser K. This is called the charging circuit.

One terminal of the condenser K is connected to one terminal of the variable inductance L; the adjustable terminal of the inductance is connected to one spark gap terminal, the other spark gap terminal being connected to the other terminal of the condenser.

This constitutes the oscillating circuit, and to distinguish it from other oscillating circuits used in wireless apparatus, and because it is used to excite or produce oscillations in other circuits, it is called the exciting circuit.

Fig. 48 shows two oscillating circuits in inductive relation, the one to the left being the exciting circuit, which is producing the oscillations. The circuit to the right consists of the condenser K_1, the inductance L_1, and an ammeter foı high frequncy currents. The inductance L_1 is brought into inductive relation to the inductance L so that the ammeter indicates a current flow. If either L_1 or K_1 is varied the ammeter will show a variation of current in the circuit and will be a maximum with a certain adjustment.

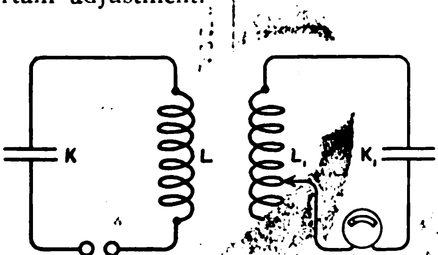


FIG 48.

After maximum is obtained, any increase or decrease of either L_1 or K_1 will cause a decrease of current. The condition for this maximum current is that $L_1 \times K_1$ must equal $L \times K$. The two circuits are then said to be in resonance.

This property of two circuits is used to great advantage in wireless telegraphy, as will later appear.

(To be continued)

This course commenced in The Marconigraph, issue of December, 1912. *Copies of previous lessons may be secured. Address Technical Department,* THE WIRELESS AGE.

ERRATA

In the chapter of the Wireless Engineering Course published in the October number of THE WIRELESS AGE, equation No. 2 on page 64, second column, should have read:

$$2\pi n = \frac{\sqrt{1}}{KL}, \text{ or } n = \frac{1}{2\pi \sqrt{LK}}.$$

The words attached to figure 46 on page 65, the same number, should have read, "discharging current" instead of "discharging circuit."

The equation on page 66, second column, reading $m = \frac{3.935 = \delta}{\delta}$, should have read

$$m = \frac{3.935 - \delta}{\delta}.$$

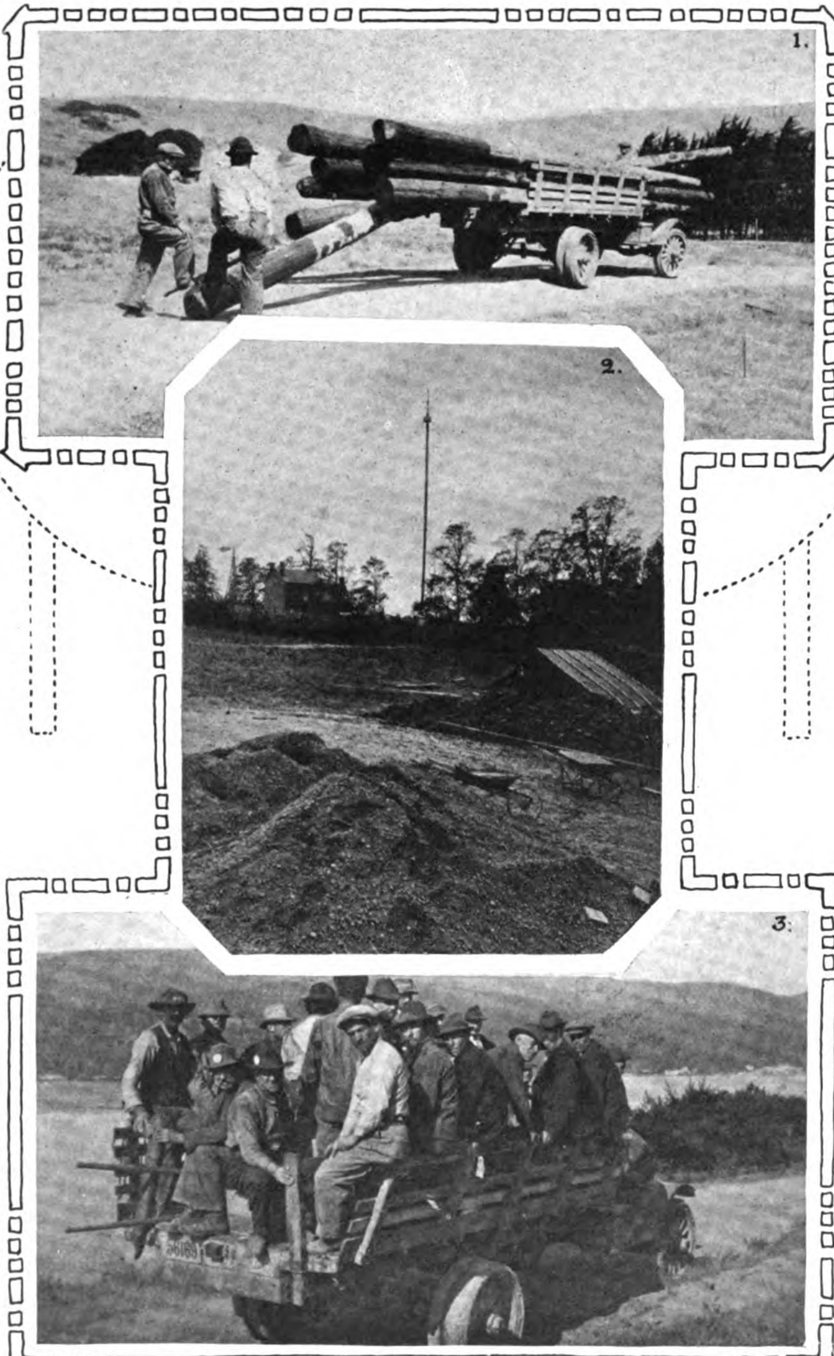
INSTALLATION IN CATHEDRAL

A wireless outfit in the Cathedral of Florence has its antennæ entirely within the edifice. Messages have been received by the Cathedral station from Nordeich, Germany, Toulon, France, and the Eiffel Tower. Despite the fact that it is necessary for the wireless waves to pass through several thick walls in order to reach the apparatus, the messages were distinct.

Three wires, which make up the antennæ, are stretched from the inside of the cupola to a pillar in the interior of the Cathedral and the apparatus is grounded on a lightning rod which ends in a well in one of the walls. It is likely that much of the electrical energy from the messages received is intercepted and carried to the earth by the lightning rods on the cupola. The Cathedral operators have not attempted to send messages from the antennæ within the edifice.

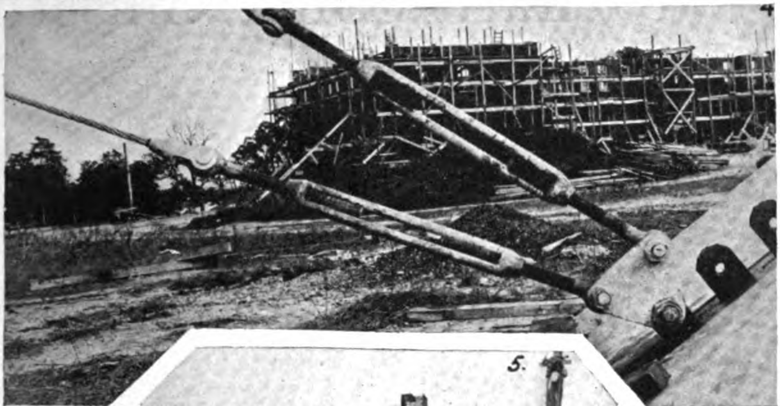
Herbert M. Weeks, a wireless telegrapher in the service of the United States government, died in the Naval Hospital in Brooklyn, N. Y., on Sept. 18.

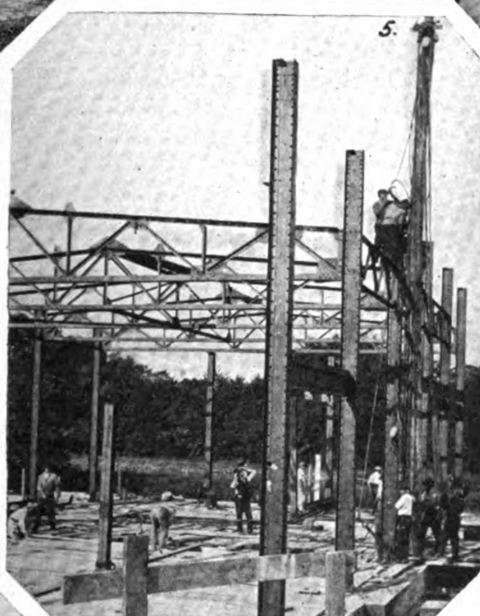
What the Kodak Recorded



1. *Distributing poles for the operating land line by which the receiving unit automatically controls the sending apparatus.* 2. *One of the masts for the Belmar station as it reached the half-way mark. Two others, or three out of the six, are now half completed.* 3. *A typical group of workmen en route to daily tasks. A number of motor trucks have been acquired by the Marconi Company for transporting labor and materials.*

at the High-Power Stations





4. *A good illustration of the simple and effective manner in which the guy cables of the masts are secured to the concrete anchorage blocks. Each cable is capable of sustaining a pull of 80,000 pounds. One wing of the Belmar hotel building appears in the background.* 5. *A close view of the structural steel work for the New Brunswick power house.* 6. *Three visitors to the Belmar site, scheduled for a trip to the interior on Thanksgiving Day.*

How to Earn Some Christmas Money

"OH shucks! This Christmas thing's played out. I call it tommy rot to go about spending money every December just because there is a day in that month that we call Christmas. Santa Claus, hanging up stockings, the Kris Kringle yip—it's nothing but a delusion and I can't stand for it any more."

These remarks were uttered by a middle-aged man of prosperous appearance who puffed vigorously at a cigar in the smoking compartment of a Pullman speeding from New York to Chicago. The man with the pipe opposite the speaker took it upon himself to answer.

"Delusion," he repeated slowly. "Yes, I suppose it is."

The other man nodded.

"Of course it is," he said. "This is an age when you've got to see things as they are all the time and it's a dangerous thing to encourage delusions—they're liable to interfere with business."

"What was the happiest time of your life?" said the man with the pipe. "Your boyhood period, made up of as it must have been of make-believe and Christmas, fairy tales and delusions—or were you better pleased with yourself and things when you got to piling up money?"

"I've outgrown those kid things," answered the man with the cigar.

"Suppose you have outgrown them," was the reply. "There are others who haven't, and it's a good thing to keep that Christmas delusion alive."

THE WIRELESS AGE shares the sentiments of the man with the youthful spirit. It believes that Christmas is an excellent institution and to encourage the Kris Kringle spirit it has planned to start a prize contest. It is a contest that will be open to every one. Young readers of the magazine will have as much chance to win as those of mature years.

What in your opinion would be the best wireless messages to send from a vessel at sea to land and from land to a vessel at sea on Christmas day? To the reader writing the best examples of messages THE WIRELESS AGE will give a prize of $1, or a year's subscription to the magazine. The messages should be mailed in time to reach THE WIRELESS AGE not later than December 10. The winner of the prize will be notified regarding the result of the contest in time for him to use the cash or the subscription to the magazine for a Christmas gift if he wishes to do so.

The messages should not exceed fifty words and it is desirable to have them written legibly in ink on one side of the paper. Competitors should send two messages, one to be sent from a vessel to land, and another to be sent from land to vessel.

There was a happy ending to a love story in a marconigram which a man of wealth received one Christmas day from a comic opera star while she was on a steamship in mid-ocean en route to London. The man, who had accumulated a fortune in the West, had pleaded with the singer to marry him. She declined to give him an answer and sailed away leaving him in doubt. While he was spending the gloomiest Christmas of his life in a hotel in New York he received a wireless message from the girl containing one word, "Yes." It sent him scurrying to a steamship pier to catch a vessel which was just about to depart for England.

THE WIRELESS AGE wants to obtain your idea of the most appropriate wireless messages to be transmitted on Christmas day. Imagine that you are aboard a steamship at sea on the day devoted to the presentation and reception of gifts. What kind of a communication would you send to your relatives or friends on land? On the other hand, picture yourself at your home ashore and a member of your family or a friend on a vessel at sea. The messages which you believe would be most gladly welcomed are the one that will be likely to win a prize. Address, Contest Department.

CHAPTER V

Oil Condensers—Operators in the Marconi service should have a thorough understanding of the assembly of the standard oil condenser. This is an absolute necessity, as occasionally a plate may be punctured making it necessary to dismantle the unit.

The operator should first note the difference between a "right" and "left" condenser plate. A "right" plate is one (when held with both hands in front of the operator) where the connecting "tab" nearest him issues from the upper right-hand side of the plate. A "left" plate is one where the "tab" issues from the upper left-hand corner.

These are clearly shown in the lower left-hand corner of Fig. 9. In assembling the condenser, when considering two plates, the inside tab of the left-hand plate is connected to the inside tab of the right-hand plate. The entire unit consisting of 36 plates is shown in detail in the upper portion of the sketch. In each bank 12 plates are connected in parallel, forming a unit, and the three units are connected in series.

A separating plate of thick, heavy glass is placed between the units as indicated. While the glass plates are shown in the drawing as being separated, they are in reality pressed closely together.

A safety gap is placed across each unit as shown in the sketch. These protect the condenser from a break-down should the spark gap be abnormally widened by the operator.

During assembly one complete unit of 12 plates is set up, with alternate left and right plates connected together. The 12 plates are then tied together by a strip of canvas known as "condenser tape." These plates may easily be lifted by means of the canvas tape and carefully lowered into the oil. The three units are then connected up in series as shown in the drawing.

Those tabs issuing from a single unit are connected to a binding post on the underside of the wooden cover of the condenser by means of a clamp. Connections between the units are made on the surface of the lid of the cover by a brass rod, which also carries the safety spark discharge points. The condenser completely assembled is shown in the lower right-hand corner of the sketch.

Locating a Punctured Plate—Should one of the plates be punctured the entire unit will be "short-circuited" and the whole set rendered practically inoperative.

To locate a punctured plate the primary voltage is reduced from 500 to about 240 volts, the cover is removed from the condenser rack, the connecting tabs disconnected from the binding posts and the units electrically separated from one another. The secondary terminals of the transformer are directly applied to each unit, the transmitting key is depressed and the punctured plate is noted by a spark discharge passing through the fracture.

When the punctured plate is located, by studying the assembly in figure 9 closely, the operator will note that if but one glass plate is removed from a single unit of 12, and the unit reassembled, *that* unit will be short-circuited, because two

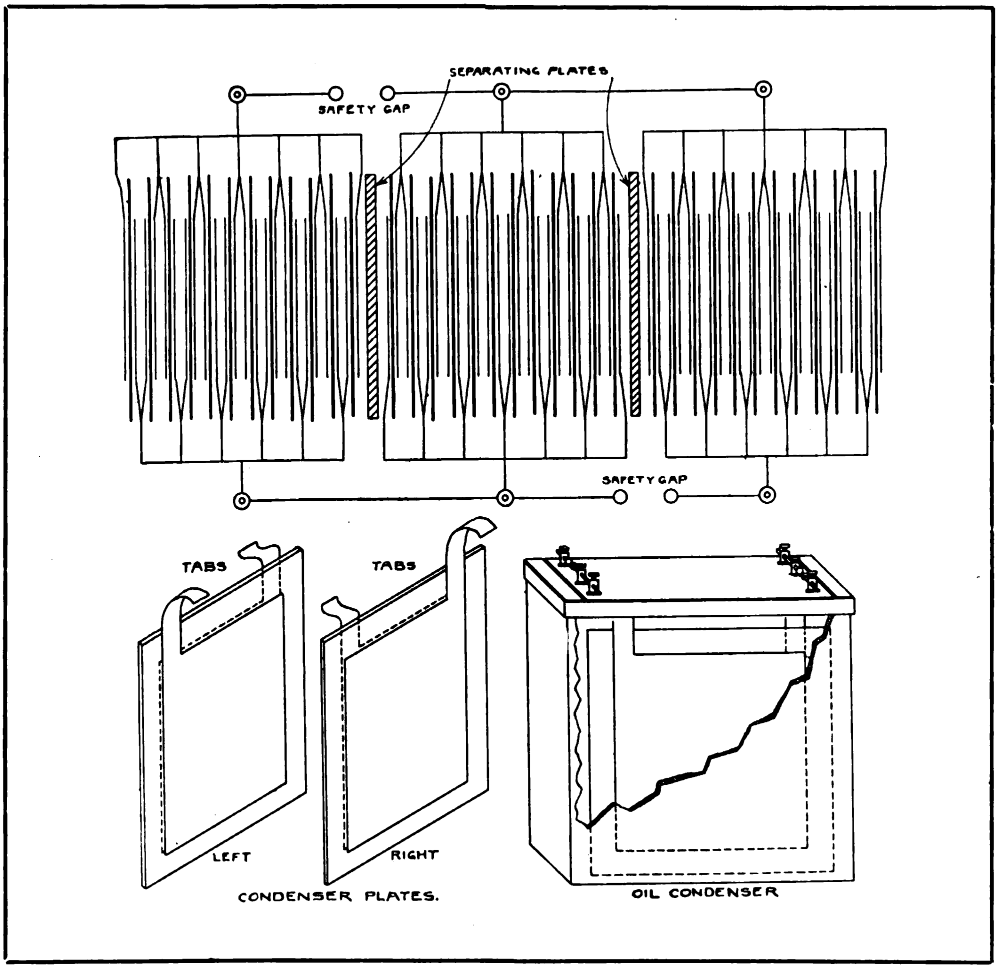


Fig. 9

plates of opposite polarity will be in direct contact.

The punctured plate should be replaced by a spare plate furnished with each equipment, making sure it is replaced by the proper type of plate (right or left).

In case there are no spare plates aboard the ship, and it is necessary to remove two plates, the good plate may be placed at either end of the unit and connected in for use.

During the assembly and after the final connections are made, operators should take particular care to see when the lid is dropped into place that the connecting tabs of two different units do not come in contact with one another, for if they should these units will be "short-circuited" and the condenser again made inoperative. A careful study of Fig. 9 will enable any operator to dismantle and assemble the oil-immersed condenser with little difficulty.

Condenser Combinations—Operators in the Marconi service should always be prepared to remedy an unexpected breakdown. For while it is true that, generally speaking, very little difficulty is experienced with wireless telegraph sets at sea, occasional accidents or injury to the apparatus may occur.

In Marconi radio sets equipped with copper-plated Leyden jars, it will be found that the 1-K. W. sets contain 12 copper-plated Leyden jars divided into two units of six each; that is, there are six jars in parallel in each unit, and the two units are connected in series. According to the formula, the capacity of condensers in parallel is:

$$C = C_1 + C_2 + C_3 \qquad (1).$$

Therefore, if the set of jars is connected in parallel, the capacity of each jar averaging .003 M. F., the total capacity will be:

$$12 \times .003 \text{ M. F.} = .036 \text{ M. F.}$$

Since, however, the jars are connected in series-parallel, the capacity is given by another formula:

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}} \qquad (2).$$

In the case cited, since there are six jars in each unit the capacity of each unit will be 6 × .003 M. F. = .018 M. F., and according to the formula (No. 2) the combined capacity of the unit

$$C = \frac{1}{\frac{1}{.018} + \frac{1}{.018}} = \frac{1}{\frac{2}{.018}} =$$

$$1 \times \frac{.018}{2} = .009 \text{ M. F.}$$

Therefore the combined capacity is .009 M. F.

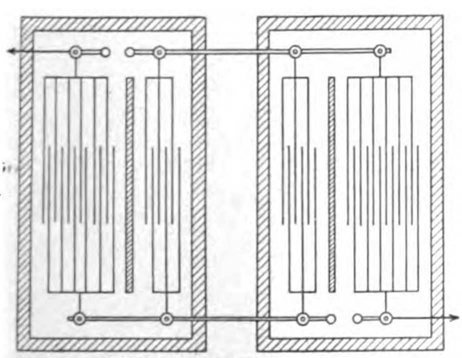


Fig. 10

Suppose, for example, five of the jars should be punctured or break down; it is evident there are insufficient jars remaining to allow the use of a series-parallel connection. It will then be found that three jars in parallel will give a capacity equal to twelve jars connected in series parallel, that is:

$$C = .003 + .003 + .003 = .009 \text{ M. F.}$$

Since the resultant capacity is of the same value as that secured previously (i. e., by the series-parallel connection), the wave length of the closed oscillatory circuit remains unchanged, but as a matter of safety the length of the spark gap should be reduced and the primary voltage cut down to prevent an abnormal strain on the condenser. The practical use of the formulæ given can be readily seen.

Let us consider, as an example, the oil condensers employed in connection with the 240-cycle disc discharger sets. In this set the condenser consists of 3 banks of glass plates in series, each bank consisting of 12 plates in parallel. Suppose breakage should occur—for example, say 18 were broken. Since but 18 plates remain, it is evident that there is an insufficient number on hand to permit the use of three banks in series. It is then to be determined what number of plates in parallel will give the same capacity in microfarads as 36 plates connected in series-parallel (in the regular manner). We may calculate the number of plates required by the formula (No. 2). Substituting for values of C the number of plates, N, then,

$$N = \frac{1}{\frac{1}{12} + \frac{1}{12} + \frac{1}{12}} =$$

$$1 \times \frac{12}{3} = 4 \text{ plates}$$

Since 18 plates are available, it will be of advantage to connect two banks in series, but it must not be forgotten that we desire the equivalent capacity of four plates in parallel; and since by the formula the capacity of two equal condensers in series gives a resultant capacity of one-half of one, it will be evident with such an arrangement that four times more plates are required than when one unit in parallel alone is used; consequently 16 of the 18 plates are necessary, 8 in parallel in each unit, and two units in series. This may be readily proven by the student from formula No. 2.

The Effect of Series-Parallel Connec-

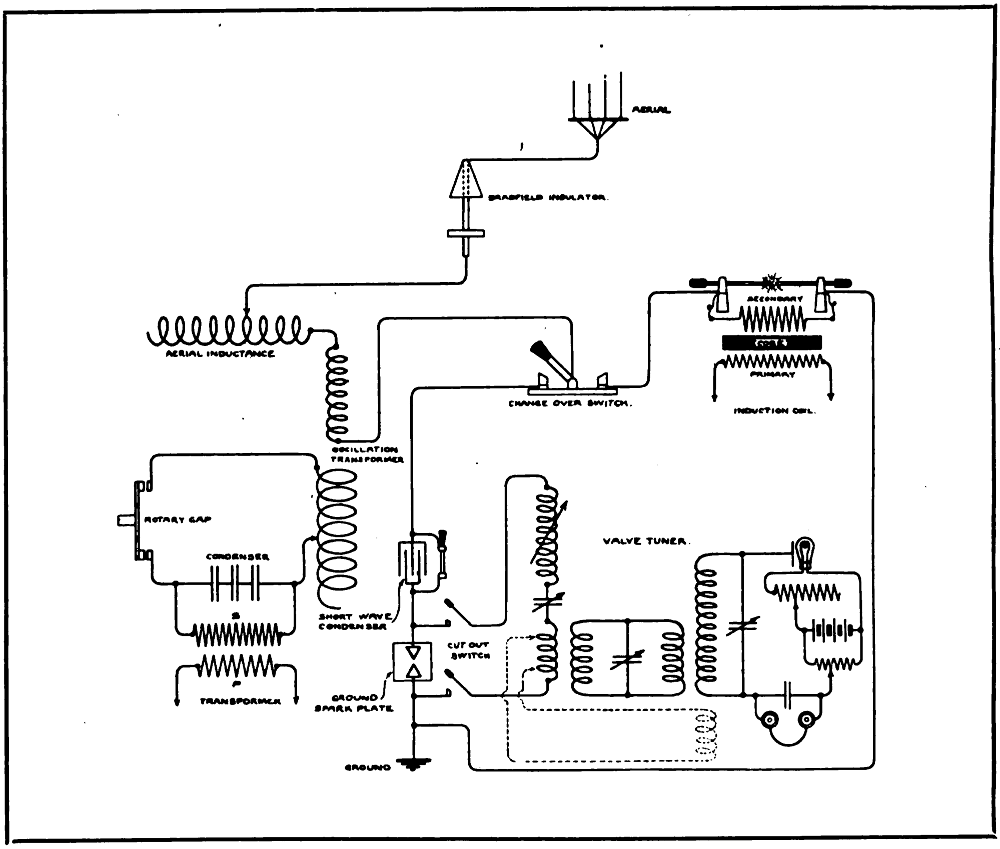


Fig. 11

tion—If the secondary voltage is 15,000, as it generally is in the 240-cycle sets, then, when three condenser units connected in series are employed, the potential on each unit is reduced to 5,000 volts. If but two units are connected in series, the potential strain is increased to 7,500 volts per unit. The operator will find, in case of emergency, that this connection may be employed with little fear of break-down, provided the primary voltage is slightly reduced; nor under these conditions will the range of the set be materially decreased.

Suppose, as a further example, that all plates in the condenser tank should be punctured; the operator may meet the emergency by removing the short-wave condenser from the open oscillatory circuit. This condenser consists of four plates connected in series, each of which has approximately the same capacity as one plate of the oil condenser. The operator will then remove the four plates from their rack, connect them in parallel, place them in the closed oscillation circuit, using the same length lead as formerly employed with the standard condenser; the set may then be operated as before. This, however, must be done with a considerably reduced primary voltage.

By carefully applying the formula supplied, any number of combinations of Leyden jars or glass plates may be used to give the capacity of the original unit and the set may then be operated in emergencies as before.

Fig. 10 shows diagramatically two condenser tanks occasionally found in the Marconi service. Each tank contains 18 plates, one unit of 12 in parallel and a second unit of 6 plates in parallel. Since three banks in series are required, it will be observed that 6 plates of one tank are connected in parallel to six plates of the second tank, finally making three units of 12 plates in series.

Auxiliary Sets—A recent regulation issued by the Department of Commerce, based on the London convention's determinations, requires all auxiliary sets to be operated on a wave length of 600 meters. It has been the custom to operate the auxiliary sets at the natural wave length of the antenna.

Since plain aerial connection (i. e., direction excitation) is employed in these sets, no difficulties are realized in the matter of coupling. The open circuits, as adjusted for the power transmitter, is already set at a wave length of 600 meters, making it necessary only to connect the spark gap of the auxiliary set in series with the open circuit.

This is accomplished by means of a

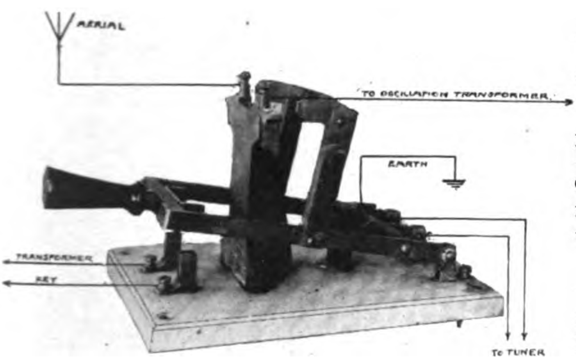


Fig. 12

single-blade double-throw switch as in Fig. 11. When this switch is thrown to the left the power set is connected for transmitting; when thrown to the right the power set is disconnected and the spark gap of the auxiliary set is connected directly in series with the open circuit. The operator should not fail to observe that when transmitting with the auxiliary set this switch must be thrown to the left in order to connect in the receiving apparatus. (This applies only to installations employing the valve tuner in connection with the ground spark plate.)

Elimination of Anchor Gaps—The oscillation transformers of all radio transmitters are now adjusted for a very loose coupling. Since this results in considerable reduction of potentials in the antenna, it has been found desirable (in the United type of transmitter) to eliminate the anchor spark gap, thus doing away with the destructive effects of unnecessary resistance and decreasing the decrement of the radiated waves.

This desirable feature is now accomplished by means of an attachment to the United type antenna switch. By reference to the photograph, Fig. 12, it will be observed that, when the switch is depressed (placed in the sending position) a special copper bar, A connects contact C to D. D, in turn, is connected to the secondary of the transmitting oscillation transformer, while C is connected to the antenna.

When the handle of the switch is raised, A B breaks connection between C and D, and C is then connected to blade E. Blade E is in turn connected to the receiving tuner. The positions of C and D connections may be reversed, making sure that the connection from the knife blade (underneath the aerial switch) is at the same time reversed.

New Method of Connection for Type D Tuners—The use of the loop aerial has been discontinued; therefore a single deck insulator now meets the requirements and but one lead from the antenna to the receiving apparatus is necessary.

On ships equipped with type D tuners, this change may result in a decrease of receiving range for the longer wave lengths, because when the inductance of the open and closed circuits is increased for the longer values the coupling is abnormally increased, seriously affecting the factor of efficiency.

On the shorter wave lengths the connections shown in Fig. 13 may be employed. The right-hand binding post,

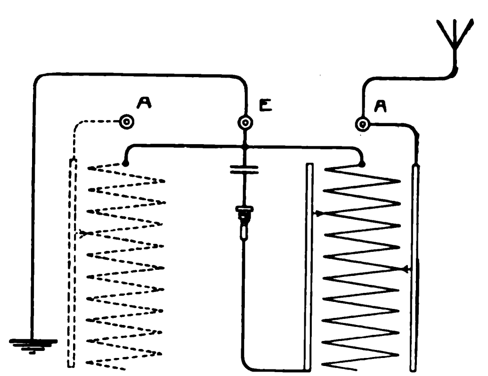


Fig. 13

marked A, is connected to the lead-in from the antenna (through the aerial

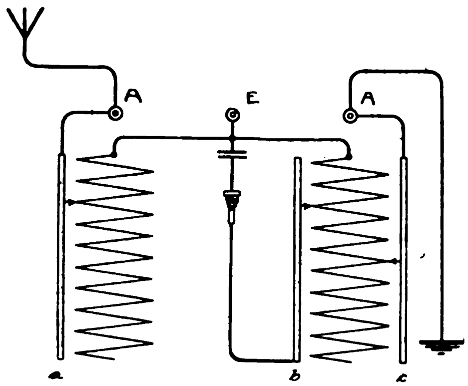


Fig. 14

changeover switch). The left-hand tuning coil is then out of the circuit.

If it is desired to receive the longer wave lengths with increased efficiency, considerable benefit may be derived by the connection in Fig. 14. The left-hand coil then becomes the aerial tuning inductance for the right-hand coil.

If loose coupling is desired, the inductance in use under slider C is decreased in value and its equivalent added in the left-hand coil by means of slider A; thus the mutual inductance in the right-hand tuning coil (the coupling coil) is reduced, and therefore the percentage of coupling decreased.

(*To be continued*)

HE BET A NICKEL WE WOULDN'T PRINT THIS

Mr. A. Hagen, who hails from Duluth, Minn., takes exception to the article which appeared in the September *Marconigraph,* headed "Naval Reserves Pleased with Set."

Mr. Hagen's trouble seems to be confined to misdirected credit, for, according to his statement, Mr. Zucks, who, we were assured, served as operator on the United States steamship Gopher during a recent manœuvre, was presumably swabbing the decks at the time.

Now it appears that Mr. Hagen was in charge of the wireless equipment on this trip, and he rises to remark that the distance worked during the daytime with a Marconi 1-kilowatt set was 125 miles, which he considers very good work on the Great Lakes.

Our interesting correspondent informs us that Bark Bay is 50 miles from Duluth and 125 miles from Calumet, which statement we accept without even looking at the atlas.

Mr. Hagen closes by offering to bet us a nickel that we wouldn't print his side of the story. Mr. Hagen loses, not because we need the money, but because we are strong on facts.

SERVICE ITEMS

Arrangements have been made for the marriage of Miss Myra Morrill, of Wallingford, Conn., and Nugent H. Slaughter, manager of the Marconi Trans-Pacific station at Honolulu. Miss Morrill sailed from San Francisco for Honolulu on October 22, and will be married on her arrival. She and Mr. Slaughter met more than a year ago on an ocean steamship while they were bound for Europe.

Miss Laura Ricker and J. B. Duffy were married at the home of the bride's parents, Mr. and Mrs. Josiah Ricker, in Midvale, N. J., on October 23. Mr. Duffy is assistant to E. T. Edwards, manager of the operating department of the Marconi Company.

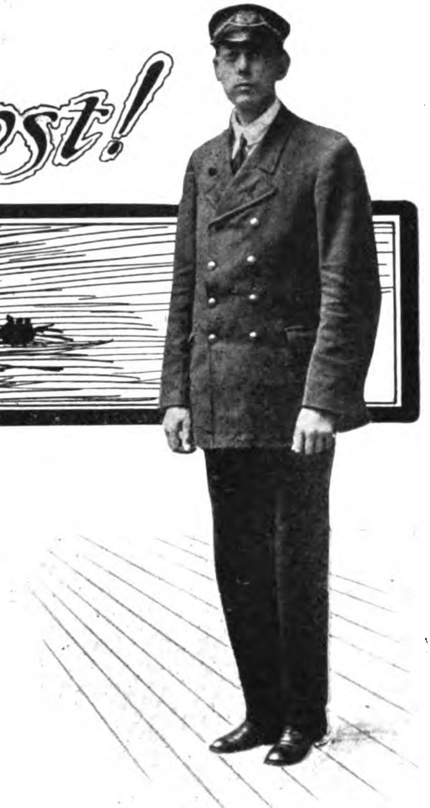
Miss Lillian Coffin, of Siaconsett, Mass., and M. C. Tierney, operator at the Marconi station in that place, were married on October 23.

Miss Hannah A. Demerest, of New York City, and J. E. Hudson, inspector for the Marconi Company, were married on September 23.

Mr. and Mrs. James Reoch, of Macfarlane Park, Fla., have announced the marriage of their daughter, Miss Elizabeth McIntosh Reoch, to Robert Irving Young on October 6. Mr. Young is manager of the Marconi station at Tampa.

U. P. Kent, operator at the Marconi wireless station at Cape May, N. J., has been promoted to the managership of the Jacksonville (Fla.) station in place of W. R. Byrd.

No Lives Lost!



How Robert Emanuel, Unsung Hero of the Wireless Key, Saved the Lives of All Those Aboard the British Steamship Templemore and Stood by the Captain When All the Others had Gone to Safety from the Raging Flames.

"IT was Hades, that's all."

This was the terse statement of Captain Isaac H. Jones, master of the British steamship Templemore, which was burned at sea 800 miles east of the Virginia Capes, in describing the scene aboard the vessel while he and his men were fighting the flames that finally drove them to take refuge in small boats. Again the wireless operator figured as one of the chief actors in a drama of the sea. On this occasion Robert Emanuel worked by candle-light in the wireless house on the burning vessel to send out the S. O. S. call which resulted in the rescue of fifty-four men. The survivors were brought to Baltimore, Md., by the steamship Arcadia, of the Hamburg-American line, which picked them up. The Templemore was destroyed by the flames. Fire started on the Templemore on the night of September 29. The story of how those aboard the ship, all of whom consisted of its officers and crew, were saved, was told as follows by Captain Jones:

"Sorry as I am to have lost my ship, I saved my men, and that was a great accomplishment. Not a soul was lost, but what we had to endure nobody will ever be able to understand.

"We were 800 miles east of the Virginia Capes at half-past eleven o'clock at night, when my chief engineer, Louis Green, came to the bridge and said he smelled smoke near his stateroom.

"I went aft with him, and soon we saw fire coming from the hatch just back of the engineroom. It was the hold where cotton was stored, and it is my belief that the fire was caused by spontaneous combustion. I ordered the hold flooded by means of the fire-fighting apparatus which we had in every part of the ship, and, besides, two powerful streams of water were sent into the ventilators just above the burning cotton.

"Our experience in the small boats was the worst of all. A storm was raging, and when the rain was not soaking our clothing the wind was nearly upsetting our slender craft."

"Green thought the fire was under control within ten minutes after it was discovered, but I told him we had better be cautious. All hands were ordered on deck, about half the crew having turned in several hours before.

"Within twenty minutes after Green reported to me on the bridge, the fire reached the oil and lumber, which was stored next to the cotton, and an explosion shook the vessel from end to end. I saw that we were in a desperate situation and ordered the Marconi operator to send out an 'S. O. S.'

"Word came at ten minutes to midnight that the Arcadia, fifty miles away, had heard our call and was coming at full speed to pick us up. Still we fought the blaze, my men appearing unmindful of the danger, and prepared to stay as long as I desired.

"The fire reached the engineroom so quickly that the steering gear was put out of commission five minutes after the fire began. The pumps were still working, however, and we managed to keep the blaze away from the wireless operator's room and the bridge until nearly one o'clock. Finally, Robert Emanuel, the Marconi man, reported that the lights were out in his room.

"He ordered candles lighted and kept in communication with the Arcadia for fifteen minutes longer.

"I saw we had done the best we could, and three boats were lowered. No man left the ship until he received instructions to do so from me. I have never heard of men who behaved so admirably under such trying conditions. It was a few minutes after one o'clock when I left the ship.

"Our experience in the small boats was the worst of all. A storm was raging and when the rain was not soaking our clothing the wind was nearly upsetting our slender craft. Under such conditions we managed to keep our boat's head to the wind until ten minutes to four o'clock, when the Arcadia came up. Many of the crew were seasick and exhausted. Some were too weak to walk and had to be lifted out of the boats.

"When the Arcadia started toward Baltimore the Templemore was aflame from bow to stern."

The appearance of the Templemore's crew attested the harrowing experiences through which they had passed. Their faces bore marks of the battle they had waged against the flames and one of the mates had his arm in a sling. Captain Jones had lost his cap and wore one which had been given him by Captain George Boldt, commander of the Arcadia.

The Marconi operator, Emanuel, and Captain Jones were the last to leave the Templemore.

"I had just finished taking down press from Arlington," said Emanuel, in telling about the fire, "when the captain came to me and told me to send out at once a distress signal. Immediately I sent out S. O. S. which was answered by the Hamburg-American liner Arcadia. We exchanged ships' positions and found them to be within fifty miles range of each other. I then told the Arcadia that fire had broken out and to hurry up and come as quickly as possible. The Arcadia answered, 'Coming full steam, we will be with you soon.' I kept in communication with her until twelve o'clock on the power set. She then called me up again and said that she could not see our rockets, but was making all haste. The distance between the two vessels was then about thirty-five miles.

"Then the ship's dynamo went out of commission and I put on the accumulators. I then worked the auxiliary set by the light of a candle which was given me by the chief steward. The captain and I were the only two left on board, and I used the accumulators at short intervals. At no time did they show signs of weakening, and in fact the whole outfit was in perfect condition and operated very successfully. The smoke was becoming dense in the wireless cabin and the flames were spreading, so the captain compelled me to leave the cabin with him. We had to leave so quickly that I was unable to save any of my effects and could carry away only what I was wearing."

Emanuel's first S. O. S. call was answered by Alfred Freeman, wireless operator aboard the Arcadia. While Emanuel sent messages giving the position of the burning ship, Freeman replied with words of encouragement. The assistant wireless operator on the Templemore was J. H. Miller.

The value of the Templemore and her cargo is estimated at $700,000.

S.O.S. EFFECTS ANOTHER RESCUE

For the second time within less than two months wireless telegraphy has saved passengers and crews of vessels owned by the Pacific Coast Steamship Company from finding graves along the Western coast. On August 17 the steamship State of California struck an uncharted rock in Gambier Bay and sank after Donald Perkins, the wireless operator aboard, had sent out the S. O. S. call which resulted in the rescue of a considerable number of her passengers and men. On the night of October 3 the steamship Spokane went ashore on the beach off Cape Lazo, B. C., and her wireless man brought to the aid of those on board the freighter La Touche. The rescue ship found the survivors of the Spokane in lifeboats and took them aboard.

Cape Lazo is 100 miles north of Victoria. The coast in this section is extremely dangerous.

The first call for assistance sent out by the Marconi operator on the Spokane following her last mishap gave the regular distress signal, S. O. S., and was followed by a brief message:

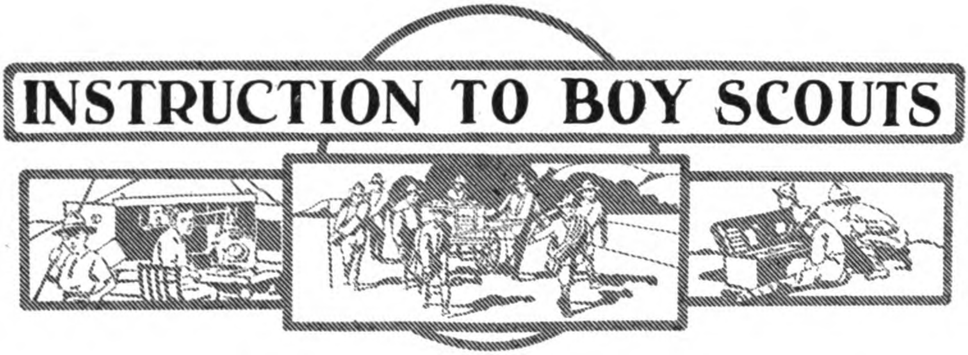
"Sinking fast. Rush help."

Several steamers heard the call. The freighter La Touche, of the same line, announced that she was nearest to Cape Lazo, but in order that there might be no lack of assistance the steamships Dolphin, Minnesota and Alki followed La Touche.

At half past ten o'clock, a few hours after the distress signal had gone forth, La Touche reached the scene of the wreck. The work of transferring the occupants of the life boats to the freighter began fifteen minutes later.

The Spokane was a vessel of 2,056 tons net, 4,000 gross tonnage, 270 feet long, schooner-rigged, and had triple-expansion engine developing 2,000 horsepower. She was built at the Union Iron Works, San Francisco, in 1902, for the Pacific Coast Company.

She left Ketchikan, Alaska, her last American port of call, with 108 passengers aboard. At Prince Rupert she picked up a dozen more. As cargo the vessel carried 16,000 cases of canned salmon and about 100 tons of fresh fish.



By A. B. COLE

CHAPTER II

Batteries for Wireless Telegraph Use

THE simple primary cell illustrated in Fig. 3 would not be satisfactory for operating wireless spark cells, because its E. M. F. would diminish rapidly in actual service. This drop in E. M. F. is due to the formation of small bubbles of hydrogen gas upon the surface of the carbon, or negative electrode, caused by the chemical action of the cell. This gas accumulates until the entire surface of the carbon plate is covered with it, when practically no current can be drawn from the cell, on account of the high resistance of the hydrogen bubbles, which are an insulator. When the negative electrode becomes covered with a film of hydrogen gas it is said to be *polarized*.

All practical cells provide some means of eliminating the hydrogen. In many types of cell some material is placed in or around the negative electrode to absorb the gas as quickly as it is formed. This material is known as a *depolarizer*.

DRY CELLS.—The general construction of a dry cell is shown in Fig. 7. (A) is a zinc cylinder in close contact with an inner cylinder of a special variety of blotting paper, which is saturated with a mixture of salammoniac and other chemicals which retain moisture. Inside the paper cylinder (B) and around the carbon plate (C) a quantity of manganese dioxide and powdered carbon is very tightly packed. The top of the cell is then sealed to prevent access of air by pouring in hot asphaltum.

A dry cell is not actually dry, since the paper cylinder (B) must be moist if the cell is to operate. As soon as one of these cells dries out it will no longer

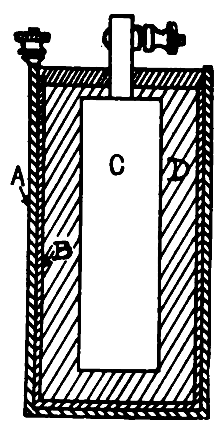


Fig. 7.—Construction of a Dry Cell

give current. Dry cells are made, however, which will not dry out for a year or more if not used. The E. M. F. of any ordinary dry cell is 1.5 volts, and this does not depend upon the size of the cell. The E. M. F. of a large cell will be the same as that of a small one, but the ampere hour output will, of course, be greater.

Experimenters should not attempt to build dry cells for practical purposes, since considerable experience is required and since the use of special machinery to pack the depolarizer is necessary to produce a good cell.

Not more than three-quarter ampere should be drawn from the regular size dry cell for any considerable length of time, as the use of a greater current will cause the cell to polarize, with a consequent drop in E. M. F.

Dry cells have the remarkable characteristic that, if allowed to stand idle for a time, they will recuperate and the E. M. F. will return to almost its original value. For this reason they are especially adapted to intermittent service. Dry cells are the most satisfactory kind for field work, since they have no loose liquids to spill, and can be readily packed in quite a small space. The weight of the average cell of regular size is about two pounds.

THE FULLER CELL.—The Fuller cell is especially useful in station outfits, and is not portable. The E. M. F. is close to two volts per cell, and a large current may be taken from it for a con-

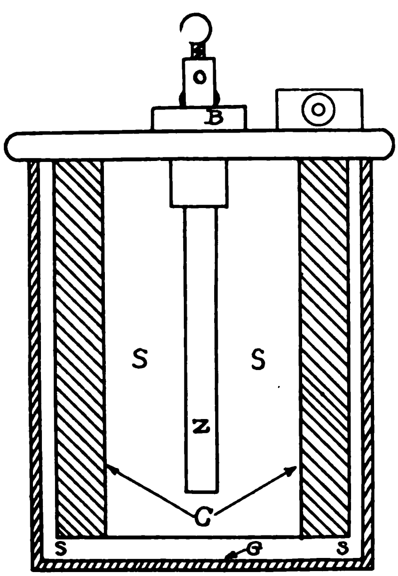


Fig. 8.—Simple Fuller Cell

siderable length of time with a small drop of E. M. F. The simplest type of this cell for wireless purposes is made from an ordinary carbon cylinder cell, such as is used for doorbell work. This cell consists of a carbon cylinder (C) set in a glass jar (G), the cylinder having a hole at the top into which a porcelain bushing is fitted. The bushing (B) holds the zinc rod (Z) in place. The solution or electrolyte (S) contained in the jar is composed of the following chemicals: 2 pounds of sulphuric acid, dissolved in 3 quarts water; 1 pound bichromate of potash, dissolved in 1½ quarts water.

The acid *must* be poured *slowly* into the water, never the water into the acid, on account of the high temperature which the mixture will have. If the water were poured into the acid the mixture would become very hot and splash. Remember that the acid or solution will burn its way through any kind of cloth and will burn the skin. If any should come in contact with the skin it should be washed off immediately with cold water.

After the acid solution has been slowly made and allowed to cool off, the bichromate solution may be poured into it. This solution should be made by breaking the bichromate into small pieces before attempting to dissolve them. This will save considerable time.

The zinc rod should be amalgamated by rubbing it with mercury until it is entirely coated with it, as otherwise the acid solution would dissolve the zinc at an excessive rate.

The zinc should be withdrawn from the solution as soon as the cell is no longer required. This preserves it from the action of the acid.

This type of cell gives excellent results in operating the spark coils of wireless stations and in other work requiring a high E. M. F. and large current. It has the disadvantage of employing acid in its solution, which will damage almost any material with which it may come in contact, and for this reason the cell must be carefully handled to prevent spilling. It is one of the best cells for wireless use, however, and no equally powerful cell has been invented employing an acid solution.

The storage cell is a type which is in general use for operating the spark coils of wireless equipment. Its normal E. M. F. is high, about 2 volts, and a much larger current can be taken from it without injury, even in the small sizes, than from a dry cell.

When a storage cell has been exhausted, it may be renewed, or "Recharged," by proper connection with a source of current, such as an electric lighting circuit or a dynamo.

Fig. 9 illustrates a complete commercial storage cell in a glass jar.

The capacity of a storage cell is measured by the number of amperes which it will deliver for a certain length of time before it becomes exhausted. This length of time is 8 hours for any size cell of the type to be described. The cell shown in the cut is rated as having a capacity of 15

Fig. 9.—Small Storage Cell

ampere hours, that is, it will deliver 1⅞ amperes for 8 hours. The charging rate is the same as that of discharge. If a storage cell is allowed to discharge in less time than 8 hours, that is, to deliver a greater current than the normal for a shorter time, the plates are likely to be injured. Thus, it will be possible to take 3 amperes for about 5 hours, at the risk of injuring the cell, or ½ ampere for 30 hours. At this rate the cell will have a very long life.

The form of one type of electrode or plate of a storage cell is illustrated in Fig. 10. This plate is a casting of lead having spaces into which the "paste" is set. In Fig. 11 we show a mould for casting the plates. It is made from a block of wood, cut out with a small chisel to give the proper shape to the plates. All the wood which is cut out is that which forms the plate itself when the hot lead is poured into the mould, and the small projections which are left form the spaces or holes in the plate which serve to hold the active material or "paste." The projections are ¼ inch wide and ⅜ inch long, and are spaced apart

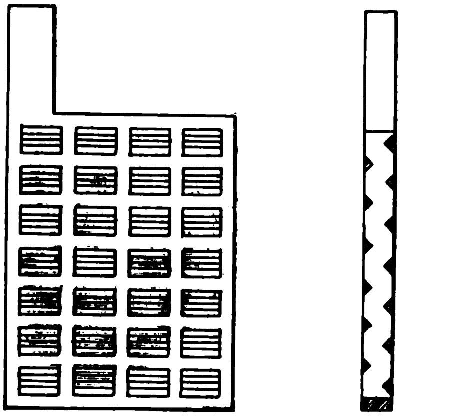


Fig. 10.—Plate of Storage Cell

about ¼ inch. The oblong piece at the top of the plate is called the "lug," and serves as an electrical connection with the plate when the cell is assembled. The lug projects above the acid solution.

A good grade of lead should be employed in casting the plates. This may be obtained from a local hardware or plumbing store. The mould should be protected from the hot lead by rubbing chalk thoroughly over its surface. This will also assist in the easy removal of the plates from the mould. As soon as the casting cools sufficiently to become strong, the mould should be turned upside down, and the casting will fall out. If the casting is allowed to cool off too much, it will be a more difficult matter to remove it. A little experimenting will serve to show the proper time for removal. Three cells should be made to operate a one-inch spark coil, or four cells for a two-inch coil.

After the castings of the plates have become cold, the spaces are to be filled with the paste, which is made of a mixture of red lead and sulphuric acid, or litharge (lead monoxide) and sulphuric acid, depending upon whether the plate is to be a positive or a negative. The acid for the mixture is about 20% acid and 80% water. Only sufficient is used to make the paste moist. The red lead and litharge can be obtained from a hardware or drug store. After the paste is set in place it should be allowed to dry thoroughly, when it will become hard.

A negative and a positive plate are then placed in a glass jar and are separated by a thin strip of wood. A dilute acid solution consisting of 25% sulphuric acid and 75% water is then poured slowly into the jar, and the cell is ready to be charged. In commercial practice, one more negative than positive plate is used, but in a small experimental cell it is better for the beginner to use

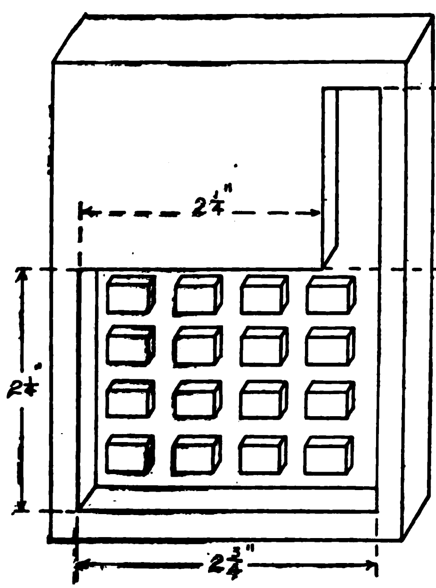


Fig. 11.—Mold for Plate

one of each, as there will be less chance of making mistakes, and the cell will give good results.

Where the cells are designed for portable use, a strip of hard rubber is made to fit around the lugs inside the top of the jar, and then the top of the cell is filled with asphaltum, which is used in the tops of dry cells. A hole is left through the sealing compound to the acid solution so that the gases formed during the process of charging the cell may escape.

CHARGING THE CELL.—The finished cell is to be charged from a source of direct current. Alternating current will not do, unless changed to direct by a rectifier.

Usually, the best method of recharging is afforded by a direct current lighting circuit. The proper method of connection is shown in Fig. 12, (L) represents one 32-candlepower *carbon filament* lamp.

The positive wire of the supply circuit *must* be connected to the positive pole of the battery of cells. A simple way of determining which is the posi-

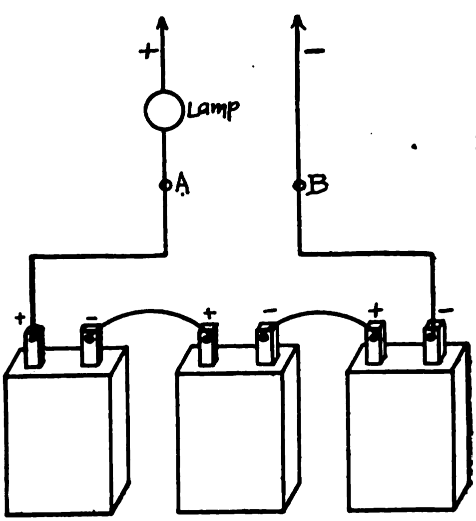


Fig. 12.—Charging Diagram

tive wire is to insert both in a glass of water containing a small quantity of common salt. The wire at which most bubbles appear in the solution is the *negative*. To make this test, use the wires so that the current must first pass through the lamp before entering the solution, by taking the wires from the points (A) and (B) shown in the diagram. Under no circumstances take the wires directly from the lamp socket, since by so doing considerable trouble may result.

The operator should attempt to always charge and discharge storage cells at not more than the normal rate. After the cell has been charged, the positive plate will turn a dark brown color, and the negative will become a light gray.

Storage cells should not be allowed to stand in a discharged condition, but should be recharged immediately to prevent *sulphation,* which is caused by the action of the acid solution upon the plates when in a discharged condtion.

Care should be exercised in handling the cells not to allow any of the acid to some in contact with cloth, as the acid would attack it rapidly, leaving a bright red mark. Such marks, or drops of acid on the cloth, should be washed at once with strong soap and water.

One method of recharging storage cells, where a direct current lighting circuit is not available, is to connect a large number of old dry cells in multiple series as explained a little later on. A set made up of 24 dry cells arranged 6 in series, four in parallel, will give fair results in charging three storage cells. If four storage cells are to be charged, 32 dry cells should be used in sets of 8 in series, four in parallel. The dry cells can be obtained from almost any garage, where the old ones are taken out of automobiles.

In charging storage cells in this way, always connect the carbon, or positive terminal of the set of dry cells, to the positive terminal of the battery of storage cells.

METHODS OF CONNECTING CELLS.—Any number of cells of any type may be connected in several different ways, depending upon the character of the work required of them. One of these is known as the *series* method of connection, and is illustrated in Fig. 13, which shows three dry cells connected in this way. The positive pole or the carbon of the first is connected to the negative pole or zinc of the second, the positive of the second

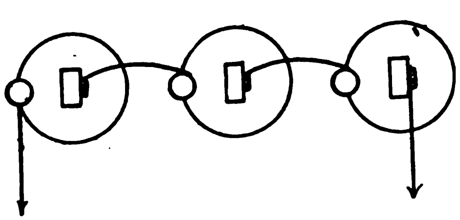


Fig. 13.—*Cells in Series*

to the negative of the third, and so on. The remaining poles, the zinc of the first, and the carbon of the last, are taken as terminals of the battery of cells thereby formed.

This method of connection corresponds to arranging three tanks of water as shown in Fig. 14. The water pressure in this case will be the sum of the pressures of the individual tanks. In the same way the total E. M. F. of the electric battery will be the sum of those of the separate cells. If each cell has an E. M. F. of 1.5 volts, the total E. M. F. of a battery of three connected in series will be three times 1.5 or 4.5 volts, and the same rule will apply to any number of cells arranged in this way.

It will be readily understood that a battery of cells arranged in series will

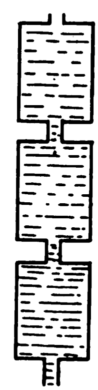


Fig. 14.—*Tanks in Series*

be capable of delivering only, as a total, at this pressure, the quantity or volume of current which any one of the cells would deliver, just as in the hydraulic system the quantity of the water at the total pressure will be that of any one tank, for as soon as the upper tank becomes empty, the pressure is reduced to that of only two tanks. Only similar cells should be connected in series if best results are desired, for a poor cell will impede the flow of current of the others.

MULTIPLE OR PARALLEL CONNECTION.—The method of connecting cells in multiple or parallel is illustrated in Fig. 15. All the positive poles are joined together by means of one wire, and all the negative poles are connected by another wire. These wires form the terminals of the battery.

The result of multiple connection is shown by the hydraulic system in Fig. 16. The pressure at the lower end of the outlet is equal to that of any one tank, but the total volume which the system can deliver is the sum of the capacities of all tanks. In like manner, the E. M. F. of three cells connected in multiple is equal to that of one cell, but the total volume of current which may be drawn will be the sum of those of the three cells.

Only cells of the same E. M. F. may be connected in multiple, for otherwise those of higher E. M. F. would force current against the others, just as in the hydraulic system the levels of the water in the several tanks must be the same.

MULTIPLE SERIES CONNECTION.—When cells are connected in a combination of both the multiple and series methods, they are said to be connected in "multiple series." Fig. 17 shows this method of connection applied to dry cells, although any type of cells may be arranged in this way, provided they are all of the same kind and size. This method comprises several batteries of cells in series, the series sets being connected in multiple.

This combination has the E. M. F. of any one of the series sets, and also the total current output of the number of sets which are connected in multiple. It has been found by actual test that two sets of dry cells connected in multiple series have three times the life of a single set, and three sets connected in this way may have from four to five times the life of a single set under ordinary conditions of use.

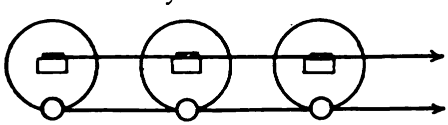


Fig. 15.—Cells in Multiple

Thus, if each cell of the battery illustrated in Fig. 17 has an E. M. F. of 1.5 volts and a total output of 25 ampere hours, the battery would have an E. M. F. of four times this quantity, or 6 volts, and since three series sets are connected in multiple, the total current output would be from four to five times 25 ampere hours, or about 115 ampere hours. In this arrangement, only 1/3 of the total current is taken from any one of the series sets, which results in much greater life of the individual cells.

If dry cells are employed to operate the spark coils of wireless telegraph sets, the multiple series method of connection is strongly recommended, for while the initial expense of the battery will be greater, the service obtained per dollar expended will be much greater, and the outfits will do better work on account of the low internal resistance of the battery so formed.

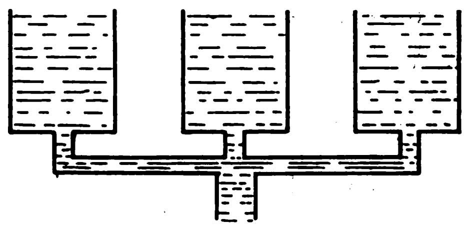


Fig. 16.—Tanks in Multiple

The diagram in Fig. 17 illustrates the proper method of connection for dry cells to operate a one-inch spark coil.

Chapter III

Magnets and Magnetism.

Since magnets and magnetism play very important parts in the operation of wireless telegraph equipment, a knowledge of the laws and actions is essential to an understanding of wireless apparatus.

A piece of iron or steel which has the power of attracting other bodies of these materials is said to be a *magnet* and to have *magnetic* properties. Any piece of iron or steel may be made magnetic by several methods. If a bar of steel is rubbed over one end of a magnet, it will be found to have become a magnet itself. It may retain its magnetism for a considerable period of time, in which case it is said to be a permanent magnet. A bar of soft iron will retain its magnetic properties for only a short time, and for this reason all permanent magnets are made of steel.

There are several kinds of permanent magnets, of which the bar and horseshoe types are most generally used.

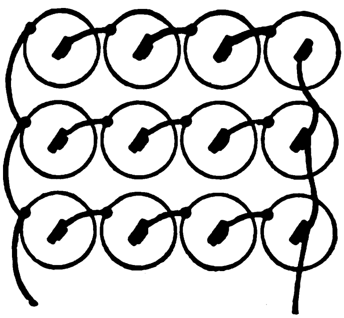


Fig. 17.—Cells in Multiple Series

They are given these names on account of their shapes, which are shown in Fig. 18.

MAGNETIC FIELD OF FORCE.—If a quantity of iron filing are placed upon a flat piece of paper, held immediately above a horseshoe magnet, and the paper is tapped lightly, it will be found that the filings arrange themselves illustrated in Fig. 19, which shows that most of them remain between the ends of the horseshoe.

If the same process is followed with a bar magnet, the final arrangement will be as shown in Fig. 20. The ends of the magnets, near which most of the filings come to rest, and where the

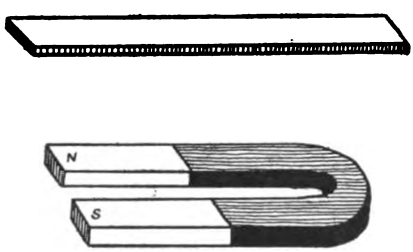


Fig. 18.—Bar and Horseshoe Magnets

greatest magnetism is manifest, are known as the *poles* of the magnet. One is called the North pole, and the other the South pole, since if a bar magnet is suspended from a very light thread from its center its North pole would, in time, point toward the North magnetic pole of the earth.

The paths along which the filings arrange themselves in the above experiment are known as the *magnetic lines of force,* or simply the lines of force,

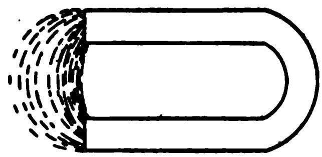


Fig. 19.—Field of Horseshoe Magnet

of the magnets. The space in which the filings are effected by the magnet is termed the *magnetic field* of the magnet. Lines of force are only imaginary lines, but the idea is useful in understanding the actions of magnets.

ELECTROMAGNETS.—If a coil of insulated wire is wound around a bar of soft iron, and a current of electricity is caused to flow around the coil, the bar

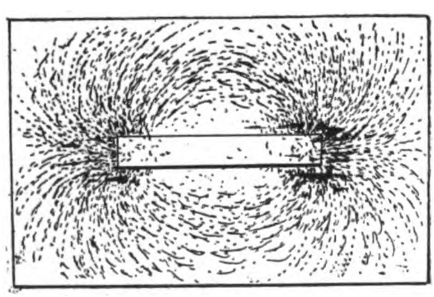


Fig. 20.—Field of Bar Magnet

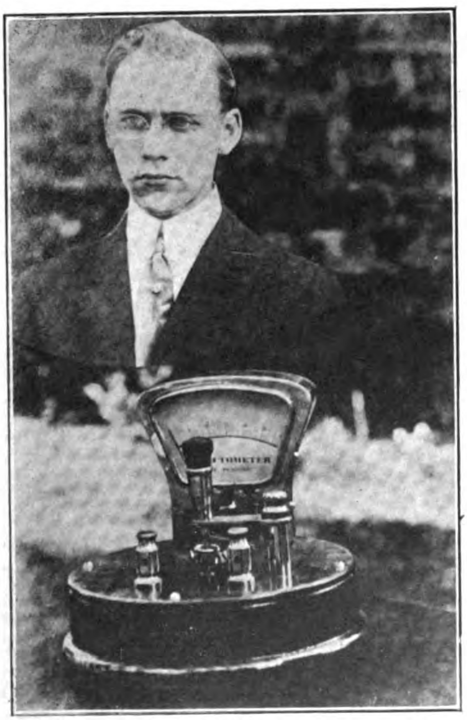
will show all the magnetic properties of a permanent magnet while the current continues to flow, but immediately upon the cessation of the current it will return to its original condition. If a bar of steel were used instead of soft iron, it would continue to act as a magnet after the current had ceased to flow. The magnet formed by winding the wire around the bar of soft iron is called an *electromagnet.*

This is the second installment of instruction for Boy Scouts. The third lesson by Mr. Cole will appear in an early issue.

AMATEUR CLUB NEWS

In his efforts to improve wireless telegraphy, Arthur G. Carlson, of North Easton, Mass., has invented a detectometer, which has been given a test at a Government station, as well as on an ocean liner. The results have been very gratifying. With the device, it is claimed, Carlson can always be positive of receiving a message at the time it is sent.

He has arranged a meter or scale where a pointer reads the adjustment. At a certain position on the meter messages can be recorded loudly and distinctly. Any electrical disturbance will move the needle so that it becomes apparent at once that the adjustment is not right.



Arthur G. Carlson and His Detectometer

Carlson was born in North Easton, August 19, 1894. He attended the grammar schools in North Easton, and this year was graduated from the Oliver Ames High school, where he installed a wireless outfit. He has received messages from as great a distance as 2,500 miles.

The atmosphere over Milwaukee, Wis., will be a jungle of wireless "flashes" between seven and eight o'clock every night before long. This is the hour when, under the law, amateurs will have the air to themselves for wireless messages, and the Y. M. C. A. boys' department has organized the city's young wireless enthusiasts into a club to promote the building and operating of radio apparatus.

A wireless specialist from the engineering school will move his outfit to the boys' building, where it will be installed in the skylight room on the second floor. The 150-foot Y. M. C. A. chimney will serve to bear the antennæ by means of which the flashes will be snatched out of the atmosphere and conducted down to the receiving apparatus, to be translated into the dots and dashes of the telegraphic code. The class is in two sections, and two meetings will be held each week to give the members instruction in wireless telegraphy.

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By Wm. H. Priess, R. E.

ARTICLE II

Multiplication

23. In arithmetic multiplication is the simple process of taking one member as many times as there are units and fractions of a unit in the second number. Usually the multiplier and multiplicand are whole integers, positive, and of the first degree. On the other hand, algebraic multiplication generally consists of a multiplier and a multiplicand, comprising several terms. These terms may be positive or negative, and of various powers. Thus, besides the process of finding the product of two positive numbers of the first degree, we must also deal with quantities which may consist of many positive or negative terms of a higher power than unity.

24. *Multiplication is an abbreviated process of addition or subtraction. It consists in adding or subtracting one quantity as many times as there are units and fractions of a unit in the second quantity.*

Instead of writing,

$$+a+a+a+a$$

we may simplify and condense this expression, by using the algebraic multiplication form,

$$4 \times a \text{ or } 4a;$$

and instead of

$$-a-a-a-a$$

we may write

$$-4 \times a \text{ or } -4a$$

By $a \times b$ is meant that a is to be added as many times as there are units in b. If $b = 5$

$$a \times b = 5a$$

Law of Signs

25. In regard to the sign of the product, it naturally depends upon the sign of the multiplier (whether we are adding or subtracting), and likewise upon the multiplicand (whether the quantities we are adding or subtracting are positive or negative quantities). If we examine the following four possible combinations of signs,

$$+4 \times (+a) = +a+a+a+a = +4a$$
$$+4 \times (-a) = -a-a-a-a = -4a$$
$$-4 \times (+a) = -a-a-a-a = -4a$$
$$-4 \times (-a) = +a+a+a+a = +4a$$

we find that the multiplication of two quantities *each* of which is +, or —, terminates in a + product; while the result of multiplying two quantities of different signs, one of which is + and the other —, is a — product. This is known as the law of signs. *Briefly stated, like signs produce a positive, unlike signs a negative product.*

A practical physical illustration of the actuality of this statement may be found in the character of the work done, when a charge of positive or negative electricity placed in an electric field, is moved in the direction of the field (lines of electric force) or against that direction. In Figure 2 the parallel lines represent the electric field, having the direction shown by the arrow tips, and for the sake of simplicity it is assumed to be parallel uniform, and of unit intensity. The distance d in the direction of the field is called $-d$, and in the opposite direction $+d$. In (a), the positive charge $+q$ is placed in the field, and in (b), the negative charge $-q$ is likewise placed in the field. Arrows placed on the charges indicate the directions that the charges tend to move. If a body is acted on by a force, and moves against that force, *work is done on that body*, i. e., it can itself do work because of its displacement. *This work is positive*, for if the body is released it will return to its original position, and deliver up the energy that has just been given to it. If a body is acted on by a force, and moves in the direction which the force urges it, *the body does work*, i. e., the body will drag an object to its new position. *This work is negative*, for we must expend positive work to return the body to its original position. This discussion may be applied to the case now being considered. The work required

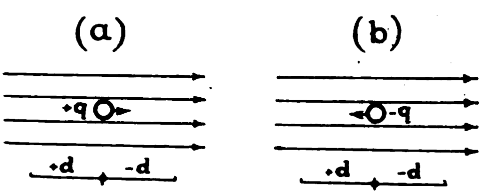


Fig. 2

to move an electric charge *q*, a distance *d* parallel to a uniform electric field of unit intensity, in which the charge is placed, is equal (regardless of the sign) to the product of the distance and the charge. In this case

$$\text{Work} = qd.$$

A positive electric charge tends to move in the direction of the field which surrounds it. Therefore, if [diagram (a)] we move the charge $+ q$, a distance $+ d$, we *do work on the charge*, which according to the previous explanations is positive, and equal to $+ q\, d$. If we move the charge $+ q$, a distance $- d$, the *charge does work*, and from the same reasoning, the work is negative and equal to $- q\, d$. If on the other hand [diagram (b)] we move the charge $- q$, *a* distance $+ d$, the charge moving in the direction the forces urges it, *does work*. The resultant work, is therefore negative, and equal to $- q\, d$. To move the charge $- q$ a distance $- d$, we must *do work on it;* this work being performed on the charge is positive and equal to $+ q\, d$. These results can be placed in the following table,

$$\text{Force} \times \text{Distance} = \text{Work}$$
$$+ q \times + d = + W$$
$$+ q \times - d = - W$$
$$- q \times + d = - W$$
$$- q \times - d = + W$$

It is to be understood that the above results do not originate from mathematics, but are the result of trial, confirmed by laboratory and mathematical experience.

Index Law

26. *When the same letter appears in both the multiplier and the multiplicand, its product is expressed by the sum of the indices of that letter.* For since

$$a^3 = a \times a \times a$$
and $$a^2 = a \times a$$
$$a^3 \times a^2 = a \times a \times a \quad \times a \times a = a^5 = a^{3+}$$

Keeping in mind the fact that the multiplier and multiplicand can be interchanged without altering the product, we then have all the information necessary to perform the function of multiplying two expressions.

Multiplication of Expressions

27. In the example $(a + b)\, c$, each term of the multiplicand must be multiplied by c;

$$(a + b)c = ac + bc.$$

It is convenient to enclose an expression in a parenthesis ( ), when we wish to indicate that it is to be treated as a factor of the product.

In the example $(a + b)\ (e - f)$, the apparent complexity of the problem may be made to vanish by substituting a letter—for instance *g*—for the multiplier $(e - f)$. The example then reduces to $(a + b)\ g$, which has the simple solution,

$$(a + b)g = ag + bg.$$

Substituting for g its value $(e - f)$, we have

$$ag + bg = a(e - f) + b(e - f);$$

which reduces to

$$ae - af + be - bf.$$

In short, to multiply one expression by another, we multiply each term of the multiplier by each term of the multiplicand, giving every letter its proper index, and writing the answer as the sum of the partial products, which partial products are preceded by their correct signs. It is readily seen that if terms contain coefficients, the partial products will also contain coefficients, which do not remain in the answer as factors, but are multiplied out to form the new coefficients.

$$(3a^2b - 4bc^2)(ab^2 + 3c^2) = 3a^3b^3 + 9a^2bc^2 - 4ab^3c^2 - 12bc^4.$$

Arrangement of Work

28. In multiplying two expressions we arrange each according to the descending powers of some letter, and write them in rows one under the other. Then multiply each term of the upper row by each term of the lower row, arranging the partial products in rows with like terms in columns. The addition of these partial products, evolves the required answer.

Multiply $(2ab + 3a^2 - b + b^2)$
by $(a^2 - b^2 + 2ab)$

Arrange both expressions according to the decending powers of some letter (for instance *a*) in horizontal rows, ana follow rules laid down above.

$$\begin{array}{l} 3a^2+2ab-b+b^2 \\ a^2+2ab-b^2 \\ \hline 3a^4+2a^3b-a^2b+a^2b^2 \\ \quad +6a^3b \qquad +4a^2b^2-2ab^2+2ab^3 \\ \qquad\qquad -3a^2b^2 \qquad -2ab^3+b^3-b^4 \\ \hline 3a^4+8a^3b-a^2b+2a^2b^2-2ab^2 \qquad +b^3-b^4 \end{array}$$

29. Of special interest are the three following and often recurring cases, that are well to memorize.

(a) The square of the sum of two quantities,

$$(a + b)^2 = (a + b)(a + b) = a^2 + 2ab + b^2.$$

(b) The square of the difference of two quantities,

$$(a - b)^2 = (a - b)(a - b) = a^2 - 2ab + b^2.$$

(c) The product of the sum and difference of two quantities,

$$(a + b)(a - b) = a^2 - b^2.$$

30. In the circuit illustrated in Figure 3, a battery (B), in series with a generator (G), supplies a difference of potential across the condenser bank (C_1, C_2), when the series key (K) is closed. The condenser forms an element of the oscillating circuit consisting of the disc discharger (D), and the inductance L. It is required to find (a) The energy stored up in the condenser bank, at each charge, if the voltage of the battery is V_1 volts, the voltage of the generator V_2 volts, and the capacity of the condenser units C_1 and C_2 microfarads (μ f. s.) respectively; (b) The rate of input into the oscillating circuit if the disc discharger produces a spark frequency of *n* per second. The energy stored up in a condenser is expressed by the equation

$$J = \frac{1}{2,000,000} CV^2 \text{ joules,}$$

or replacing $\frac{1}{1,000,000}$ by 10^{-6},

$$J = \tfrac{1}{2}CV^2 \times 10^{-6} \text{ joules} \qquad (1)$$

where C is in μ fs., and V is in volts.

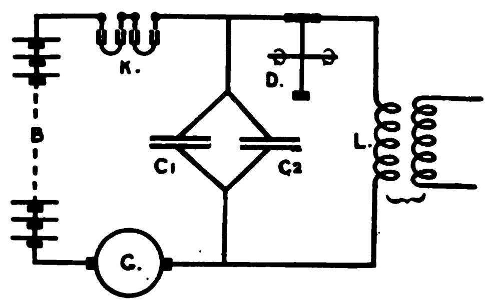


Fig. 3

A *joule* is that amount of energy expended in a second, when a current of one ampere passes through a resistance of one ohm. The *rate of input* is the number of joules a second delivered to a circuit, and is expressed in terms of *watts*. A watt corresponds to an input rate of one joule a second. In the case under consideration, since there are J joules expended each time the condenser is charged, and as we have n charges a second, then,

$$W = nJ \text{ watts,} \qquad (2)$$

or from (1)

$$W = \tfrac{1}{2}nCV^2 \times 10^{-6} \text{ watts.}$$

Substituting for V_1 in equation (1), its value ($V_1 + V_2$), and for C, its value ($C_1 + C_2$), the expression for the energy in the condenser may be written

$$\begin{aligned} J &= \tfrac{1}{2}(C_1 + C_2)(V_1 + V_2)^2 \times 10^{-6} \text{ joules} \\ &= \tfrac{1}{2}(C_1 + C_2)(V_1^2 + 2V_1V_2 + V_2^2) \times 10^{-6} \text{ joules} \\ &= \tfrac{1}{2}(C_1V_1^2 + 2C_1V_1V_2 + C_1V_2^2 + C_2V_1^2 + 2C_2V_1V_2 + C_2V_2^2) \times 10^{-6} \text{ joules.} \end{aligned}$$

The rate of input from equation (2) is

$$W = nJ = \tfrac{1}{2}n(C_1 + C_2)(V_1 + V_2)^2 \text{ watts.}$$

If $V_1 = V_2$, and $C_1 = C_2$, then

$$J = 4C_1V_1^2 \times 10^{-6} \text{ joules,}$$
$$W = 4nC_1V_1^2 \times 10^{-6} \text{ watts.}$$

Further if $V_1 = 5{,}000$ volts, $C_1 = .002\ \mu$ f. and $n = 1{,}000$

$$J = 4 \times .002 \times (5000)^2 \times 10^{-6} = 0.2 \text{ joules}$$
$$W = 4 \times 1000 \times .002 \times (5000)^2 \times 10^{-6} = 200 \text{ watts.}$$

The high-power Marconi stations successfully employ this principle in transacting commercial business.

Division

31. In multiplication two factors were given, and we were required to find their product. In division we are given one factor and a product; the problem being to find the other factor. Division is therefore the inverse of multiplication. It is evident that a law of signs and indices must enter the discussion. This is found to be the case.

Sign Law

32. As in multiplication, so in division, *like signs produce a positive, unlike signs a negative quotient.*

For since $(+a) \times (+b) = +c$, therefore $\frac{+c}{+b} = +a$.

For since $(+a) \times (-b) = -c$, therefore $\frac{-c}{-b} = +a$.

For since $(-a) \times (+b) = -c$, therefore $\frac{-c}{+b} = -a$.

For since $(-a) \times (-b) = +c$, therefore $\frac{+c}{-b} = -a$.

Index Law

33. *When the same letter appears in the division and the dividend, its quotient is expressed by that letter, raised to a power equal to the difference obtained by subtracting the index of the divisor, from the index of the dividend.*

$$\frac{a^5}{a^2} = a^3 \times \frac{a^2}{a^2} = a^3 = a^{5-2}$$

If the index of the division is greater than the index of the dividend, the answer is a fraction.

$$\frac{a^5}{a^7} = \frac{a^5}{a^5} \times \frac{1}{a^2} = \frac{1}{a^2}$$

According to the rule, the difference of the indices is —2. Therefore, to make the rule general, we must interpret a quantity with a negative index as the equivalent of a fraction, the numerator of which is unity, and the denominator of which is that quantity raised to the corresponding positive index.

$$a^{-3} = \frac{1}{a^3}$$

$$a^2b \times {}^{-2} = \frac{a^2b}{x^2}$$

If the difference of the indices is zero, the result is unity, and the letter disappears from the quotient (being replaced by $+1$).

$$a^3b^2c^2 \div a^2b^3c^2 = a^{3-2}b^{2-3}c^{2-2} = \frac{a}{b}$$

Keeping the additional fact in mind, that multiplications and divisions can be performed in any order, the reader has at his disposal enough information to perform directly, simple algebraic division.

Division of an Expression by a Term

34. In dividing the expression $(a + b)$ by c, we divide each term of the dividend $(a + b)$, by the divisor c.

$$\frac{(a + b)}{c} = \frac{a}{c} + \frac{b}{c}$$

From inspection of the example,

$$\frac{a^2b + 3c^2d - 2a^3b^4c}{2a^2bc} = \frac{1}{2c} + \frac{3cd}{2a^2b} - ab^3$$

we may formulate the rule for the division of an expression by a term. To divide an expression by a term, divide every term of the dividend by the divisor, giving each letter its proper index, and each term its proper sign, writing the answer as the algebraic sum of *the partial products.*

Division of an Expression by an Expression

35. In dividing one expression by another, the process is a roundabout one; resolving itself into the problem of finding one factor, giving the other factor and the product. It is best understood by taking a solved problem and working back so as to obtain the method.

$$(a+b)(b^2+a^2+2ab) = 3ab^2+a^3+3a^2b+b^3$$

Let it be required to find the quotient of $3ab^2 + a^3 + 3a^2b + b^3$ is the dividend, and $(a + b)$ the divisor. The answer is obviously $(b^2 + a^2 +$

2 a b). Rearrange the terms according to the descending powers of the letter a, and write the equation in the following form,

$$(a+b)a^2 + (a+b)2ab + (a+b)b^2 = a^3 + 3a^2b + 3ab^2 + b^3$$

Then it is evident that the first term in the dividend a^3 (containing the highest power in a), is made up of the product of a^2 and the divisor $(a+b)$. Perform this multiplication, and subtract the product from each side of the equation. Multiplying and subtracting (indicated by cancellation),

$$\cancel{a^3} + \cancel{a^2b} + (a+b)\,2ab + (a+b)\,b^2 = \cancel{a^3} + \cancel{a^2b} + 2a^2b + 3ab^2 + b^3.$$

a^2 is then the first term of the quotient. It is clear that $2\,a^2\,b$ (the term containing highest power of a in the remainder) is obtained through the product of the divisor $(a+b)$ and $2\,a\,b$. Performing this multiplication and subtracting the product obtained from each side,

$$2\cancel{a^2b} + 2\cancel{ab^2} + (a+b)\,b^2 = 2\cancel{a^2b} + 2\cancel{ab^2} + ab^2 + b^3$$

the term 2 a b forms the second term of the quotient. It is apparent that the remainder $(ab^2 + b^3)$ is the product of b^2 and the divisor $(a+b)$. If we multiply the divisor $(a+b)$ by b^2, and subtract its product from both sides, the remainder disappears. Therefore b^2 is the third and last term of the quotient. The process may be written in the following form,

$$\begin{array}{r|l}
 & a^2 + 2ab + b^2 \\ \hline
a+b & a^3 + 3a^2b + 3ab^2 + b^3 \\
 & a^3 + a^2b \\ \hline
 & \quad 2a^2b + 3ab^2 + b^3 \\
 & \quad 2a^2b + 2ab^2 \\ \hline
 & \qquad ab^2 + b^3 \\
 & \qquad ab^2 + b^3 \\ \hline
 & \qquad\qquad 0
\end{array}$$

From the example we have just examined, it is seen that four steps are required in division.

(1) *Arrange the terms of the divisor and dividend according to the descending powers of some common letter.*

(2) *Divide the first term of the dividend by the first term of the divisor; this gives the first term of the quotient.*

(3) *Multiply each term in the divisor by the term in the quotient we have just obtained, and subtract the resulting product from the dividend.*

(4) *Consider the remainder as a new dividend and repeat the process.*

If after dividing we find a remainder that does not contain the divisor, we write the answer as the sum of the terms we have obtained in the quotient; to this we add a fraction, the numerator of which is the remainder, and the denominator the divisor. Actual divisions are seldom performed in engineering problems because of the labor involved. Other methods are employed for approximation, which (in radio work) permit the use of an error of 0.5%, instead of the ordinary engineering error of 0.1%.

Simple Equations

36. *An equation is simple if it contains but one unknown quantity, and that quantity appears with the same index, throughout the equation.* This is by far the most common form of equation that the radio worker meets. For example, calculations of inductance, capacity and resistance, as well as combinations of the above for solutions for wave length and decrement, appear in the form of simple equations. The solution of such an equation consists in finding a value of the unknown quantity, that will reduce the equation to an identity, or an equation all terms of which contain nothing but known quantities.

Solution of Simple Equations

37. There are four axioms upon which the solution of all algebraic equations depend. These the reader may verify, by trying them on an identity consisting, of the sums or differences of integers. In an equation:

(1) *Equals added to equals, the sums are equal;*

(2) *Equals subtracted from equals, the differences are equal;*

(3) *Equals multiplied by equals, the products are equal;*

(4) *Equals divided by equals, the quotients are equal.*

We may illustrate the solution of a simple equation by the following example.

$$\frac{a\times + b - c}{d + e} = g$$

From (3) $a\times + b - c = (d + e)g$

From (1) $a\times + b = (d + e)g + c$

From (2) $a\times = (d + e)g + c - d$

From (4) $$\times = \frac{(d + e)g + c - d}{a}$$

This is the answer required, for we have as a result an equation, one side of which contains x alone (or the unknown quantity), the other side nothing but known quantities. If the index of the unknown quantity were other than unity it can be reduced to unity by performing the inverse operation of that indicated by the index on both sides of the equation.

If $y^2 = a$

then $y = \sqrt{a}$.

and if $\sqrt[3]{z} = b$

then $3 = b^3$.

This is the second in a series of articles on mathematics by Mr. Priess. The third will appear in an early issue.

ERRATA

In the October issue of THE WIRELESS AGE the figures in the article on Elementary Engineering Mathematics, page 36, second column, following the phrase, "coefficients of the terms in the vertical rows," should have read as follows:

$$+ 2a^2 + 3ab + 7b^2.$$
$$- 4a^2 + ab + 4b^2 + 3c^2.$$
$$+ 6a^2 + b^2 - 9c^2.$$
$$\overline{+ 4a^2 + 4ab + 12b^2 - 6c^2.}$$

On page 37, second column, in the same article, the expression "(currents in circuits A and B)," should have read, "currents in circuits A and C."

CAPTAIN BULLARD ABROAD

Captain W. H. G. Bullard, superintendent of the United States Naval Radio Service, sailed from New York on the Kaiser Wilhelm der Grosse on October 14. He will attend the International Conference on Safety at Sea to be held in London November 12, being one of the delegates of the United States recently appointed by the President.

GERMANY CURBS WIRLESS ACTIVITIES

Germany has taken decisive steps toward regulating the activities of amateur wireless operators in that country. The law of Germany now reads that private stations may be erected only on condition that the government shall have the privilege at any time of ordering their demolition.

The law was promulgated by the post-office and interior departments of Germany.

DELEGATES TO SEA SAFETY CONFERENCE

The following have been appointed by President Wilson to represent the United States at the International Conference on Safety at Sea, to be held in London on November 12:

Representative J. W. Alexander, of Missouri, chairman of the Committee on Merchant Marine; Senators Fletcher, of Florida, and Burton, of Ohio; E. T. Chamberlain, of New York, Commissioner of Navigation; Capt. E. P. Bertholf, of New Jersey, revenue cutter service; Rear Admiral Washington L. Capps, U. S. N.; Capt. Geo. F. Cooper, hydrographer of the United States navy; Captain W. H. A. Bullard, superintendent of the United States Naval Radio Service; Homer L. Ferguson, of North Carolina, general manager Newport News Shipbuilding and Dry Dock Company; Albert Gilbert Smith, of New York, vice-president of the New York and Cuba Steamship Company; Andrew Furuseth, of California, head of the Seamen's Union, and George Uhler, supervising inspector general of the Steamboat Inspection Service.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

C. F. J., Brooklyn, N. Y., sends us a circuit diagram of his receiving apparatus and inquires why he is not able to receive at distances of from 1,000 to 1,500 miles, as different magazines state he should be able to do. He also sends us a description of his equipment.

Ans.—Looking over your sketch we find you are using an inefficient hookup, and therefore you experience a decrease in range. We show in Fig. 1 a satisfactory hookup of the apparatus you have on hand.

Your diagram shows two fixed condensers in series with the galena detector. Taking into consideration the capacity for which these condensers are generally constructed, the resultant capacity will be too small. Note that we have connected the headphones around the fixed condenser; this gives increased strength of signals. The variable condenser which you have in shunt with the primary we have connected in shunt with the secondary. Do not be guided solely by statements made in magazines regarding the distances which ought to be covered with a given equipment. There are so many variable factors entering the case that no one can accurately prognosticate your range in advance. Keep in mind the fact that inefficiencies in receiving do not lie wholly in the apparatus, but may be largely governed by conditions external to the antenna.

* * *

L. A. V., New Orleans, La., says:

I note that you state on page 472, in the July issue of the *Marconigraph*, that a 60-cycle current is composed of 120 alternations per second, two alternations constituting a cycle; A. P. Morgan's book, "Wireless Telegraph Construction for Amateurs," gives the following definition for a cycle: Cycle—the full period of reversal of an alternating current; a 60-cycle current is one making 60 complete reversals per second.

I should be very thankful to you if you would explain this to me, as there seems to be a mistake somewhere.

Ans.—Mr. Morgan's statement, as well as ours, is correct. If you will pick up any elementary book on alternating currents, the first thing to meet your gaze will be a sine curve. We cannot give you a complete course of instruction in alternating current work, but, briefly, a sine curve is a graphic illustration in terms of trigonometry of the rise and fall of a complete cycle of alternating current. It gives instantaneous values of current during a complete reversal, and if you will note these books carefully you will see that the upper part of the curve is positive and the lower part negative. In other words, the upper half represents the values of current from the point of origin around the circuit and back again; the lower half represents the reverse condition; meaning that during one cycle the current flows around the circuit first one way and then in the opposite direction. Therefore a cycle is composed of two alternations. This matter is fully explained in the "Wireless Engineering Course," by H. Shoemaker, in the February issue of the *Marconigraph*. Back numbers can be secured by addressing the The Wireless Age.

(2) Please give me a good explanation regarding how to draw a wave curve to be used in connection with a wave meter to tell the wave length.

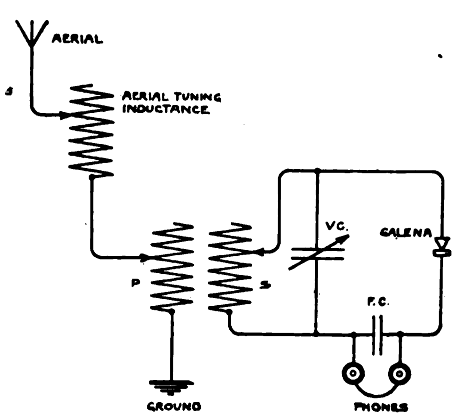


FIG 1

Ans.—In the January and February issues of the *Marconigraph*, in the Wireless Engineering Course, by H. Shoemaker, you will find a disquisition on co-ordinate geometry which will tell you what you want to know. You must understand that it is not necessary to plot a curve of the calibration of a wave meter, but you might mark the wave length direct on the wave meter scale. There is no reason why this cannot be done.

Briefly, a curve is plotted as follows: Suppose you are calibrating a wave meter having a variable condenser, and the scale of the condenser has a range of from 0 deg. to 500 deg., the wave meter being calibrated against a known source. For purposes of illustration, let us say that when the pointer of the variable condenser (the wave meter being calibrated) is placed at various positions on the variable condenser scale the following readings are obtained (from the calibrated meter):

Degrees on Condenser Scale Wave Meter Under Calibration.	Wave Length in Meters of Standard.
5	110
10	204
15	292
20	347
25	407
30	458

The values of wave length lying between these condenser readings mav be secured by plotting a curve on cross-section paper as in Fig. 2.

By a proper selection of the divisions on the paper we may divide the vertical lines into condenser readings and the horizontal lines into wave length.

Taking the first tabulation, 5= 110, we proceed along the vertical lines corresponding to 110 meters until we meet the horizontal line corresponding to condenser reading 5 and at the intersection of the two lines we place a dot or cross. For the remainder of the values in the table the points are located on the cross-section paper in the same manner. After the series of points are properly located, a line is drawn common to all.

Readings of wave length between the points of calibration may now be had (by reference to the curve). Taking the curve in Fig. 2, suppose the wave meter indicated resonance at degree 23 of the condenser scale, the horizontal line corresponding to 23 meets vertical line 385 on the curve; the wave length reading therefore is 385 meters.

(3) How can a wave meter be calibrated with one that is already calibrated?

Ans.—This may be accomplished as in Fig. 3-A and B. Wave meter A, the standard is excited by a buzzer circuit, as shown; the magnets of the buzzer are shunted by a condenser of 2 mfds. capacity. When the buzzer is in operation wave meter A becomes a transmitter, sending out oscillations of a definite frequency. If wave meter B (the one of unknown calibration) is placed in inductive relation to A, it will absorb energy from A and will be in resonance with A at whatever point the condenser (of B) gives the loudest sound in the headphones. The coupling between L and L^1 should be kept as loose as is consistent with strength of signals.

For calibration, condenser C of wave meter A is then set at some definite wave length. The crystal of wave meter B is adjusted for sensitiveness and C^1 is varied until maximum response is procured from A. At the particular point at which C^1 is set, wave meter B obviously has the same wave length as wave meter A. Thus, a series of readings may be made on C and corresponding reading found on C^1; hence the calibration of the wave meter.

(4) What is the inductance of the following coil—wound on a tube, outside diameter 4 5/16 inches, length 4 1/16 inches, consisting of 53 turns of No. 18 bell wire D. C. C.[1]?

Ans.—The inductance of the coil is quite closely 41,200 centimeters.

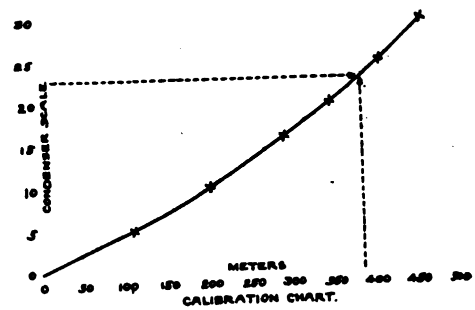


FIG 2

(5) What would be the lowest and highest wave length to which the inductance mentioned in connection with a variable condenser of .0008 and .0004 mfds. capacity could tune to?

Ans.—At .004 mfds. capacity the wave length would be 762 meters; with .0008 mfds. in shunt with this inductance the wave lengh would be 342 meters.

* * *

W. J. C., St. Louis, Mo., asks:

Please give me names of makers of 500-cycle generators. I want a 120-watt generator, like that used in army scout work; the generator to be self-excited. I have written a number of manufacturers, but cannot locate the maker.

Ans.—Communicate with the Holtzer Cabot Manufacturing Co. for the 120-watt generator, 500 cycles.

* * *

B. S., Wilmington, N. C., asks:

(1) Is a pipe driven 10 feet in the earth a good ground for lightning only; if not, what would effect the purpose?

Ans.—If the pipe is driven in moist earth it may be considered as a fair connection for lightning discharges. We prefer, however, a zinc or copper plate buried in moist earth. A copper connection being brought to the surface, a plate 6 x 6 feet is sufficient.

(2) My wave length is about 250 meters using only a spark coil, condenser and gap; please give size of series condenser and oscillation transformer, with instructions how to make and use them to keep my wave length under 200 meters. My aerial has five wires 70 feet long with 80 feet "leadins"; the coil runs on six dry cells, using about eight volts.

Ans.—You will find helpful hints regarding the solution of the problem in the article in this issue of THE WIRELESS AGE entitled "A 200-Meter Amateur Set." As regards the series condenser, if we knew the exact capacity of your antenna we could answer your question very accurately. We do not know the spread or size of the wires, but can give you a calculation based on an aerial (80 by 70 feet) having four wires separated 2 feet. This will approximate the conditions of your stations.

A flat top antenna having four wires 70 feet in length and 80 feet from the earth will have a capacity of .00033 mfds. — inductance 65669 chms., and therefore a wave length of 277 + meters. To be reduced to a period of 200 meters the antenna should have a capacity of .000171 mfds. It will therefore require a condenser in series having a capacity of .000357 mfds.

The series condenser, then, may consist of a single plate of glass, 8 by 8½ inches, having foil on both sides of 5 by 5½ inches. This is calculated on the basis of the dielectric constant of glass being 7; as you have no facilities for making these calculations it is likely that you will have to vary the size of the foil. You will find, however, that our data fairly approximate the conditions and will be very nearly correct to reduce your antenna to a wave length of 200 meters.

* * *

H. D. J., Richmond, Cal. (S. S. Ascunsion), writes as follows: The other day I had an argument with the chief engineer about a generator. He said, "If a generator is put in vacuum it will not generate, as the machine will burn up immediately," He also said that "If there is no air around the machine it will not generate, as it is the movement of air which causes the current to be generated, the particles of air being charged with electricity."

My side of the argument was that the machine would generate no matter where it is located; electricity is supposed to be a movement of the ether; and if some means are at hand to cool the machine and overcome the heat caused by friction at the bearings it will generate in vacuum as well as in the open air.

Ans.—Electricity is not produced by friction between air and the dynamo armature, but is due to the fact that the armature wires are cutting through magnetic lines of force; this will take place in vacua as well as in air. The problem presents another possible condition; you should understand that partial vacuum is a better conductor than air at ordinary pressures. If, for example, a high potential generator (say 6,000 to 8,000 volts) were placed in vacuum there might be considerable conductance leakage. On the other hand, perfect vacuum (an impossible condition) has infinite insulation qualities and no conductance leakage would occur. Under these conditions the generator can perform its functions quite as well as in air, if not better, at least as far as generation of electricity is concerned.

(2) I should like information on the Marconi high frequency sets, with the rotary gap on the shaft of the motor-generator. I note that when a distant transmitting station is sending, and after the machine attains its maximum speed, the spark is not so loud as it is during some periods of speeding up and stopping. It seems to me that the gap is run at a speed which is too high to get maximum efficiency. The spark seems to be much louder before the machine gets to the maximum speed. I would like to know if this set would not do better work if the machine were run at a lower speed. I have noticed this on several sets when we were a few hundrd miles away.

Ans.—We have noticed the same effect. While it is true that the ordinary telephone receivers used in wireless telegraph communication are more responsive to currents of high frequency (300 to 500 cycles), yet with a given power and as compared with a lower frequency, say 60 cycles, the oscillations given off by the transmitter are of less amplitude.

In the case of the signals being received at any station, you have a factor other than the headphones to consider. You must also take into account the effect of the amplitude of the oscillations on the energy rectified by the crystal. In the particular case in point it is more than likely that at a particular speed (lower than the normal speed, as you say) the current input into the transformer will considerably increase in value, thereby increasing the amplitude of the oscillations given off by the antenna and therefore the stronger signals; the greater amplitude may also be due to the decrease in frequency, as previously explained. At slower speeds the signals undoubtedly may be somewhat louder, but if the set were reduced to such speeds it would make of non-effect the idea of design, viz., a high spark note giving increased range during static or atmospherics.

* * *

V. P., Richmond, Ind., asks:

Could you kindly inform me how to make a good 2 mfd. condenser for a kick back preventer?

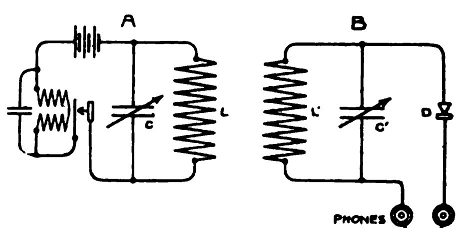


FIG 3

Ans.—These condensers are made by separating two very long sheets of tin foil by a thin strip of paraffine paper. Both pieces of foil are also covered with paraffine paper. The entire arrangement is then wound up in a lump and sealed in a metal can with hot paraffine, connection having been made to both coatings. You will find it much cheaper to purchase one of these condensers than to construct it. They may be secured from any telephone company.

(2) What is the best size of wire to use on your sending apparatus, i. e., on the primary leads and on the secondary leads? I thought high tension cable might be all right for the secondary terminals, but I deemed it best to secure advice.

Ans.—Primary leads of the transformer should be wired up with No. 13, D. B. R. C.; secondary leads (from trnasformer to condenser) use high tension cable. Condensers to spark gap and helix not less than No. 8 R. B. R. C. wire.

* * *

J. E. F., Brooklyn, asks:

Is the Marconi multiple tuner used in transatlantic working? If not, why?

Ans.—Yes, we understand it is.

(2) Is the magnetic detector necessary in the operation of the valve tuner, or can a mineral or valve detector be used with as good results or better than with the magnetic detector?

Ans.—The valve tuner is primarily designed for use in connection with the magnetic detector, but will work equally well with crystal detectors. It will not give such good results with the oscillation valve, as the inductance in the detector circuit is of insufficient value.

(3). Kindly give me the wave length of the following aerial: 112 feet long; 30 feet high at one end, 40 feet at the other; four wires 1½ feet apart; ground lead 15 feet long; aerial wire No. 14 B. S.; aluminum wire; ground lead No. 16; B. S. copper; lead in 50 feet.

Ans.—The wave length of your antenna is approximately 250 meters.

* * *

W. C. M., Bushnell, Ill., says:

My transmitter consists of 1 K. W. Worts-McKisson closed core transformer; secondary voltage of 20,000 Halcun rotary spark gap; oscillation transformer, upright type, of No. 2 aluminum wire; coils 12 inches in diameter, 7 turns in primary and 15 turns in secondary; aerial, four copper wires (No. 12) 2 feet apart, 70 feet long, 50 feet high at one end, 40 feet at lower end; lead in 60 feet long, No. 4 copper, 40 feet long to four No. 12 wires brought down from aerial; ground No. 4 copper, 50 feet long to city water mains; also four copper rods, ¼ inch, 6 feet long in bottom of cellar; instruments located in attic on second floor. Condenser is fifteen 2-quart fruit jars, set in zinc tank surrounded by salt solution, also jars filled with same and boiled linseed oil, 1 inch deep over top.

I have a Murdock condenser unit in aerial circuit to reduce wave length. By using all condenser and all turns in oscillation transformer secondary and one turn in primary close coupled, ground on bottom wire of secondary, I get an ammeter reading of 1.5 amp. ammeter in series with aerial. Why don't I get better reading? To add inductance in aerial lead or take out any, only lowers reading. Taking off one or more jars of condenser only lowers reading and my wave length is too high or apparently so. My leads are of copper ribbon ½ inch wide and doubled, leads from condenser to gap and oscillation transformer only 20 inches long; my transformer will only draw 600 watts. Please tell me what to do to make this set comply with regulations, also give directions for making what I may need.

Ans.—We have printed this inquiry in full, as it clearly indicates the "haze" existing about the average amateur station with regard to a 200-meter adjustment of their equipment to comply with the United States regulations.

We suggest that you read carefully the article appearing in this issue of THE WIRELESS AGE, entitled "A 200-Meter Amateur Set." We have no doubt but that your circuits are out of proportion, and consequently the reading in the antenna is only 1.5 amps. However, with this set at its most efficient adjustment you should not expect more than 3 amps., roughly. The natural wave length of your aerial is approximately 210 meters. When you add to this fifteen turns of the secondary you probably boost the wave length to 350 meters, which surely does not comply with the law. Not knowing the capacity of your antenna or series condenser, we cannot calculate the latter's effect on the wave length.

You will need to cut down your antenna so that it has a natural period of 160 or 170 meters; then by the addition of a few turns in the secondary of the oscillation transformer you will arrive at a wave length of 200 meters. Your condenser capacity is apparently too large for 200 meters. If we knew the thickness of the glass we could calculate, very roughly, the capacity. Better see the article in this issue of THE WIRELESS AGE; build a condenser this size or reduce the number of jars in your hydro-condenser. Your 1 K. W. transformer is quite correct for the condenser described in the article referred to, provided you connect a reactance coil in series with the primary of the transformer.

At a frequency of 60 cycles, using a condenser the corect size for 200 meters, your transformer will not draw 1 K. W. The limit you can use and still protect the condenser from puncture will be about 4 K. W.

* * *

M. W., Holly, Mich.:

Regarding the spreaders, separate your aerial wires 2 feet. As you are using eight wires you will need spreaders 14 feet in length. Have them made of well-grained spruce, 3 inches in diameter at the center, tapering to 2 inches at the end.

Your receiving hook-up is all right. You should receive up to 100 miles in daylight, and after dark you may hear up to 1,000 miles.

* * *

S. W. T., Beverly, Mass., asks:

Will you kindly tell me where I can purchase a copy of the *Naval Manual of Wireless Telegraphy for* 1911?

Ans.—Write the secretary and treasurer of the Naval Institute, Annapolis, Md.

THE WIRELESS AGE

DECEMBER, 1913

IN OUR OPINION

FOR the man who has really tried, there can be no more radiant period of the year than that which brings it to a close. What if some things have not come out the way they should have? And what if you failed to secure the recognition you so earnestly sought and diligently worked for? You've got another chance, haven't you?

Why This Is the Most Radiant Period in the Year

Of course you have; and a far better one.

Perhaps you feel that all the painstaking effort of Nineteen Thirteen has brought you nothing. In fact, you seem to have lost out somewhere.

You haven't. You may have gained nothing but experience—but you will find that very experience invaluable in the coming year.

There is only one type of man for whom nothing can be done. That's the fellow who says, "I have nothing to look forward to." He has lost step with the procession; he has forgotten the one big secret of life. For to-morrow is bound to be more wonderful than to-day and we have a right to expect greater things of the universe, greater discoveries, greater inventions, greater conquests over nature, fuller recognition of man's genius and power.

Life is truly great when hope and expectancy are the breath in a man's nostrils. Every obstacle can be surmounted, wrongs can be redressed and foes can be conquered. The trail of human energy and application is full of fresh opportunities, hidden forces, glad surprises. The unexpected is always that which comes to pass. No one can foretell what a day, a month, or a year will bring and, great as we are, not one among us can peek behind the curtain that hides the secrets of the coming year.

Expect greater things of yourself. There is not a single soul among us who dares to claim that he is all he might be. There are plenty of good things to go round, and the man who is looking forward is the one that will see the opportunities first.

NOW that the Thanksgiving turkey has been enjoyed in the inverse ratio with the quantity consumed, we are in the midst of the greatest of all periods of expectation. Christmas is coming, the graduation day of the school of expectancy in which the Almighty develops and trains the powers of the soul.

Christmas, the Graduation Day in the School of Expectancy

To everyone, Christmas is the most glorious holiday in the year. It is the children's day, memories of which flit around them as a butterfly hovers about a flower. Rich in faith and hope and expectation, for months the knowledge that Christmas is coming has caused the child heart to sing, and the unpicturable loveliness of the little ones' delight has awakened the best that is in us.

Radiant beams of this glorious festival come to us out of the mists of the future, and we are happy; at least all of us who love children are, and the rest don't matter. This day brings its lesson, through the children. Can it be that those very children, too, can teach us something?

Let us examine the child philosophy. Children have a genius for anticipating. They are always climbing over the fences of the present and running out across the fields of to-morrow. No time is lost in anticipation of the dismal and dark. They run ahead and gather up only the things that shine. We who are older gradually fall into the habit of looking forward to squalls and pitfalls. We forget the sunshine, and the mountain peak we have scaled. We frighten ourselves with thoughts of things that might possibly happen. It is not so with the child. Yesterday is of small importance. To-morrow is his paradise. Coming events dazzle him, and it is thus that he enjoys a blessing before and when it arrives.

Can there be any doubt that this is the secret of all happiness?

Encouraging the Expectation that Our Dearest Dreams Will Come True

THE great Teacher placed a little child in the midst of his disciples, saying: "Of such is the Kingdom of Heaven." And it was His habit to keep the disciples' eyes on the future. As wonders were revealed to them, they were further thrilled by hearing: "Ye shall see greater things than these." And when they were astonished by miracles they were assured: "Greater things than these shall ye do." When they exulted in their success they learned of their relationship to a world whose glories man cannot now conceive. He himself had the heart of a child. He was always looking ahead. When darkness was immediately ahead, He looked through it into the light.

And as the child brings the lesson, so, too, does the day. A thousand years of expectancy preceded the first Christmas. Through centuries the eyes of the Hebrews were fixed on the future. Their burden was to be lightened by the advent of a man and they patiently bided their time. While other nations habitually looked backward, they placed the golden age in front of them. From the Greeks and Romans we learn that history began with an age of gold, was followed by an age of silver, which in time gave way to an age of bronze, to be succeeded by an age of iron. But the Hebrews saw the golden time ahead of them; it is reflected in their literature, in their unmatchable strength of character. Time and again they were trampled in the dust by hostile empires, but never was their vision of brighter days to come dimmed nor confidence in their ideal lost.

And at last the Christ child was born.

Thus was the heart's habit of looking forward stamped with Heaven's approval. Christmas is a day redolent with memories and rich in significance, for it encourages us to expect the fulfillment of our dearest dreams.

There is a lot for you in the Christmas spirit. Particularly if you are easily discouraged.

AT a time when "Peace on Earth, Good Will Toward Men" is echoing in all hearts, it seems fitting that humanity's debt to one of its fellow men should receive its proper recognition.

Woeful Failure in Appreciation of a Priceless Gift

Nothing in life is dearer than life itself. Through the wizardry of one man the lives of thousands of humans have been saved from frightful deaths in the past few weeks. Faint whispers for help have come to the ears of men in ships ploughing through the great solitudes of the sea and they have gone to the aid of their stricken comrades. We who have suffered the loss of dear ones and have known the aching void left in our souls through such loss, cannot fail to appreciate what this means. As a writer in our greatly esteemed contemporary, the London Graphic, puts it: "There are surely few people who will not agree with Mr. Godfrey Isaacs, when he expressed his surprise that all nations do not join together to give some sort of recognition to Marconi, to whom they are all indebted."

And what have we done? A bronze tablet from a small group of individuals, two or three honorary degrees from universities and a few scattered words of praise not unmixed with undeserved criticism. The Saviour conferred on mankind, through this indefatigable worker, the greatest boon since civilization began. And we have failed woefully in our appreciation of the priceless gift.

As the writer we have referred to says: "The public imagination is stirred only by sensational tragedies like those of the Titanic and the Volturno, when ships actually doomed have sent out despairing messages. But not a month passes without some vessel being warned of imminent peril by wireless words, and dodging death in the nick of time. It is impossible to estimate the number of lives which have escaped from the perils of shipwreck owing to the genius and heroic energy of this inventor. In the Atlantic alone nearly 3,000 people have been saved by timely assistance brought to them by means of wireless, and in other seas there are many captains who have cause to bless the day when their ships were equipped with this life-saving apparatus. The highways of the sea are strewn with derelicts and the western portion of the North Atlantic is a great danger zone from this cause; but in one year 131 messages were sent from coast stations to passing ships warning them of these floating perils, and vessels proceeding on the North and South Atlantic routes report to each other when any derelict is sighted. No charge is made to anyone in connection with the ship-to-ship reports, which are treated by the Marconi Company as masters' service messages, and the extension of wireless telegraphy in the mercantile marine has been an additional means of safeguarding life."

The Averting of Tragedy a Daily Occurrence

AN incident which occurred in the early days of the Marconi system, when it was ridiculed by skeptics, is mentioned; a striking proof of its value even then. The lighthouse keeper of the Lizard received a message from a fog-bound ship out at sea, stating that the captain believed himself to be in the neighborhood of the Lizard, and asking that if the message was "received" the powerful fog-horns might be blown. This was done, and shortly afterwards a big German liner which had been making straight for the rocks altered her course and proceeded up the Channel.

This is only one of hundreds of similar instances. It has been mentioned because it was one of the earliest; since then wireless warnings that have averted disaster have become an everyday occurrence.

Think that over. Every day in the year wireless telegraphy—Marconi's wireless telegraphy—is saving hundreds of lives!

"It is no wonder," says the Graphic, "that realizing the immense advantage of carrying wireless on board, the Executive Committee of the National Sailors' and Firemen's Union have decided to consult their members as to whether they will be prepared on and after May 1st next to refuse to engage on any ocean-going cargo vessels not equipped with wireless."

A Christmas Thought for the Thoughtful

THE men who are actively engaged in commercial wireless unconsciously pay tribute to Marconi, its inspiring genius. In their everyday work they show by devotion to duty and loyalty to those under their care what this greatest humanitarian agency means to them. The general public, though, will probably never realize their obligation until they have experienced the thrill that comes from receiving a message that has winged its way through the ether. A layman describes the sensation thus: "Listening to the high shrill note of those electric sparks, I heard the new voice of science which speaks across the world, the voice which sends a cry of distress from a wreck in the loneliness of a storm-tossed sea. And while I listened to these stabbing sparks, my imagination paid a tribute to the genius of Marconi, who has given a new glory to the name of science."

Some day all of us will realize fully what this means and proper and fitting expression of our gratitude will be given.

It is not to be expected that this will happen right away; but it can not be doubted that on Christmas day millions of thoughtful persons will spend a few moments in reflection on the great blessing the Saviour has given us through one of his servants.

THE EDITOR.

THE VOLTURNO DISASTER

A remarkable photograph taken from the deck of one of the rescuing ships, showing the Volturno burning in mid-ocean and the violent sea that was running

Photos., Underwood & Underwood

HIS ship afire in mid-ocean with seas so high that life-saving apparatus and small boats were valueless; flames menacing the lives of hundreds of persons, and each minute bringing nearer the time when the waters would reach out for their prey—these were the conditions which confronted the master of a craft who relied upon a wireless appeal for succor. And his faith in the ethereal waves was justified. For while those aboard the doomed vessel were counting the hours that lay between them and death, a fleet of ships, summoned by the magic of wireless telegraphy, came from out of the dreary wastes to rescue the unfortunates.

The immigrant ship Volturno, ablaze from stem to stern, in a terrific storm in the Atlantic, about 450 miles east of Newfoundland, on Thursday, October 9, sent a wireless call over the ocean for help. Several steamships answered the summons and, following their arrival, 521 of her passengers and crew were saved. The others, numbering 136, lost their lives when the heavy seas smashed the burning craft's lifeboats against her sides and spilled their human freight into the water.

Replete with deeds of heroism and daring is this latest story of a sea disaster. And while the rescuing ships, bearing the survivors of the Volturno and the tale of how she was destroyed were racing to ports on both sides of the Atlantic, the wireless crackled the news to land, many hours in advance of their arrival. Accounts of the manner in which the wireless operators aboard the Volturno, Walter Seddon and Christopher Pennington, conducted themselves in the times of stress, placed them in an excellent light. Pennington performed his duties courageously while menaced by peril, and escaped from the vessel by leaping into the sea. Seddon was an occupant of the last boat to leave the doomed craft.

Commanded by Captain Francis Inch, the Volturno was bound from Rotterdam to New York via Halifax. She was an Uranium line boat, well equipped with life-saving and fire-extinguishing apparatus. The scene of the tragedy was approximately 700 miles northeast of where the Titanic sank.

For more than twenty hours the rescuing ships that had turned about when the S. O. S. call reached them, cruised around the Volturno, unable to give aid because of the dangers of wind and wave. It was not until Friday morning that they were able to transfer those among the Volturno's passengers who had not lost their lives when the lifeboats were wrecked. And it was a matter of only a few hours at the last that meant the difference between life and death to the frightened folk who had been driven aft by the flames and who had about given up all hope of reaching safety.

Chief Marconi Operator Seddon and the Volturno's mascot. This man stuck to his post for seventeen hours after the fire started, leaving in the last boat with his captain.

On Thursday night, as it fell dark, the 5,000 passengers on the ships that had come up to rescue the Volturno's people had one of the most remarkable experiences that ever fell to those who sail the sea. They saw a great ship burning in the center of a fleet, impotent to help. The flames leaping from the Volturno illuminated the mountainous waves that daunted the rescuing vessels. All around were steamships ablaze with light, whose people heard the cries of the Volturno's passengers and were powerless to give aid. Early Friday morning, the weather having moderated, these ships were able to lower small boats and take off the Volturno's passengers.

Had it not been for the great storm that made the launching of small boats a desperate venture, it is likely that few, if any, of the Volturno's passengers would have been drowned. For the wireless served again in time of need and the ships that were summoned would have without doubt picked up the small craft. The Volturno was well equipped with apparatus for life saving, but no seamanship or courage could overcome the fury of the storm.

The Volturno had been battered by wind and sea for a day or two before the fire started. She had been struggling along through heavy seas and combating such weather as is most feared by navigators when they think of broken shafts, of fire, or of other dangerous accidents. The explosion which caused the fire occurred early on Thursday morning. Seddon and Pennington, the Volturno's wireless men, were immediately ordered to send out the S. O. S. call. While Captain Inch and his officers were fighting the flames forward and trying to calm the steerage, the two young men in the wireless room were reaching out over the sea, knowing that numerous ships were within a few hundred miles.

The Carmania, eastbound, was the first to pick up the call. The Cunarder was only seventy-eight miles from the burning ship when Captain Barr learned that there was work waiting for his men. The Carmania was running under her usual speed, but Captain Barr ordered his engineers to crowd on steam and proceed as rapidly as possible. A double force of stokers was put to work and their efforts gave the ship twenty knots.

Reaching the Volturno about noon, Captain Barr realized at a glance the desperate situation of the folk on the other vessel. The immigrant boat was entirely ablaze at the bow. She was pointed with the wind in an effort to keep the flames from making their way aft and was making little or no headway. Great waves were breaking over her.

The gale was terrific, and there seemed little chance for a lifeboat, but Captain Barr, moved no doubt by the plight of the Volturno's people, directed First Officer Gardner to make an attempt to reach the vessel. The lowering of the boat was accomplished only after extraordinary efforts. Time after time the sea prevented the boat from being dropped. Several times the first officer and the lifeboat crew were nearly drowned. Finally Gardner got his boat away from the Carmania and attempted to make progress toward the Volturno. It was an unavailing fight. Oars were broken or torn from the hands of the crew. The first officer and his men struggled for two hours to reach the Volturno and were finally conquered. Captain Barr saw that it was utterly hopeless to attempt a transfer by means of small boats.

He tried another plan, manœuvring the big Cunarder to the lee of the burning ship and attempting to get near enough to cast life lines. He managed to get within 100 feet or so of the Volturno's stern, but it was impossible to get a line to the ship or to devise any plan that would result in taking off the passengers. The Carmania's people could see hundreds of the immigrants crowded aft on the Volturno. These unfortunates were terribly frightened and made pathetic appeals to be saved. There was nothing that could be done then. The only hope lay in a possible abatement of the storm.

Then the other ships that had caught the wireless appeal began to show on the horizon and to loom near. First of all was the North German Lloyd, Grosser Kurfuerst, which came up in the late afternoon. The big German boat tried Captain Barr's tactics of lowering a small boat and of fighting it out with the storm, but it was useless. No amount of courage or determination could get a lifeboat anywhere near the Volturno. The German sailors were recalled to their ship after their boat had been nearly capsized.

In the meantime, the wireless operators on the Carmania had never ceased sending out appeals, and hour by hour the Carmania got word that more ships were approaching. Presently the Red Star, Kroonland, showed in sight, and then as the hours passed there came in turn the freighter Seydlitz, bound for Bremen and the Far East; La Touraine, the fast French liner, bound for Havre; the Minneapolis, the Rappahannock, the Czar, the Narragansett and the Devonian.

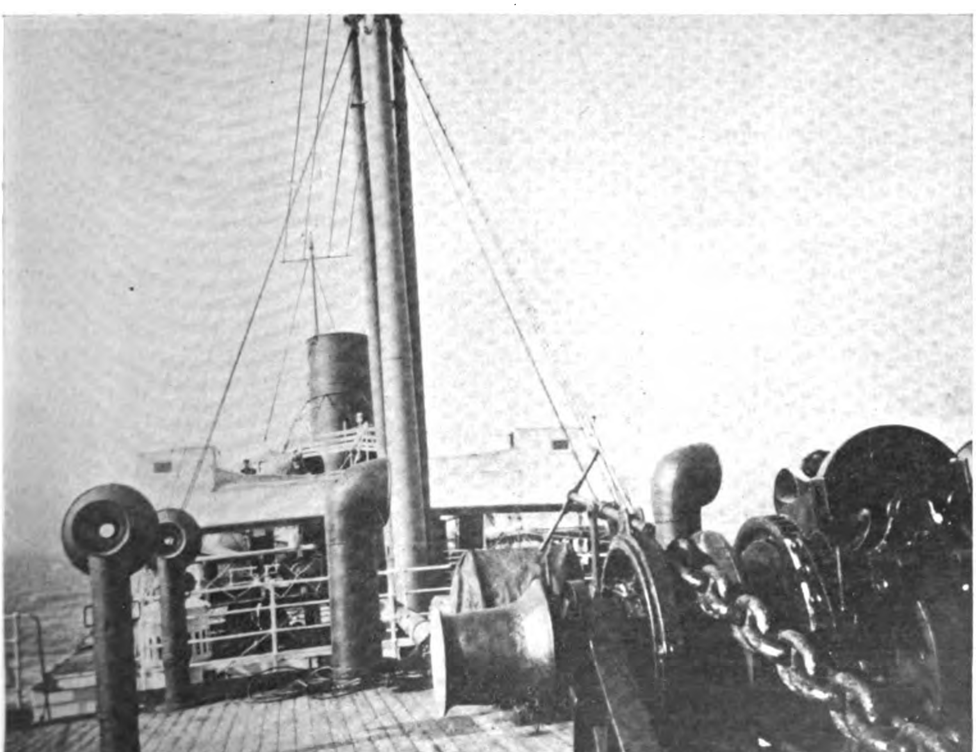
The peril of the Volturno's passengers was so apparent to all of the commanders that each ship as it approached the position of the blazing vessel tried the desperate expedient of lowering the small boats. Most of the ships were near enough by dusk to see that the fire was working aft steadily and that the immigrants on the Volturno had very little chance for life unless a miracle was wrought or the sea became calm.

The rescuing vessels manœuvred carefully to keep out of each other's way, no small problem for big ships gathered closely in a North Atlantic blow. When night came and the red flames from the Volturno were clearly visible to the passengers and crews of the ships standing by, the gale moderated a little. The Grosser Kurfuerst dropped another boat and this time the oarsmen were able to make more of a fight. But in the end they gained nothing and had to return to their ship.

As the night increased, the Volturno was a spectacle of fearful fascination. The whole scene was as though a brilliantly illuminated city had settled upon the face of the ocean. The rescuing ships, bright with their electric lights, hovered as near as they dared to the vessel that was afire. The noise of the storm was so great that those who listened could make little of what was occurring aboard the Volturno. Occasionally they heard cries which might have meant anything besides appeals for rescue. There was no knowing whether Captain Inch and his officers were fighting a panic as well as fire. No situation of greater suspense or more trying to seamen or passengers could be imagined.

The Kroonland, La Touraine, the Carmania and the other ships kept the water as light as possible, sweeping the ocean with searchlights, casting overboard lighted buoys and waste soaked with oil. There was a chance that some of the Volturno's people had jumped into the sea or had escaped drowning when the lifeboats were smashed.

Occasionally, word came from the burning ship by wireless. One message was encouraging. It said that the fire, for some reason, had slackened a little and was not spreading aft rapidly. It also contained the information that the flames had reached the boilers and the engine room and that the steam pumps and dynamos were out of commission. The operator said that he had been obliged to use reserve batteries for his wireless. A final call for help was sent out from the Volturno at nine o'clock. It read: "For God's sake help us, or we perish." Later on in the night, people on the Carmania heard a cry from the water. The Cunarder swept her searchlights over the water and soon distinguished a man who was being tossed by the waves. How to rescue him was a problem. A sailor volunteered to let himself be lowered into the water. A line was attached to his waist and he let himself overboard, taking the chance that a wave might dash him against the Carmania's side. Stout swimming brought him within reach of the man who had called for help. He was one of the Vol-



This view of the deck of the Volturno was made by Captain Inch on the trip previous to the ill-fated one. In the background is shown the bow of the vessel where the fire broke out, sending the frantic-stricken passengers to seek safety in the immediate foreground, or stern of the ship.

turno's steerage passengers who wore a life belt. He had either jumped from the ship or had managed to keep afloat when the four lifeboats were destroyed.

Other cries were heard during the night, but the searchlights could locate no one. They who cried out perished miserably, with ships, as brilliant as summer hotels, standing all around them.

The storm continued throughout the night, but toward dawn the wind decreased and the sea began to get smoother. Nine steamships were around the Volturno at daybreak. These were the Carmania, the Kroonland, La Touraine, the Grosser Kurfuerst, the Minneapolis, the Seydlitz, the Rappahannock, the Devonian and the New York, a tank ship. Soon afterward, the Czar and the oil tank ship Narragansett arrived. The latter came up at full speed and took a position slightly to the windward of the Volturno. She began at once to pour oil on the sea, using two large lines of hose which sprayed oil for a considerable distance in the neighborhood of the stern of the Volturno.

The arrival of the Naragansett proved to be of immense assistance. The oil calmed the seas immediately about the stern of the burning ship so that the small boats from the rescuing fleet could approach closely. It was still a perilous undertaking, but the use of oil went far toward minimizing the risk of capsizing lifeboats.

Dozens of lifeboats from the rescuing fleet manœuvred about the stern of the Volturno, awaiting their turn to take off passengers. Captain Inch and the Volturno's officers rigged life lines at the stern of their ship and sent down these lines women and children first of all. Then the men of the passenger list were lowered into the small boats, and finally the crew and the officers abandoned the ship. The work of rescue was completed at nine o'clock in the morning. The task was accomplished with splendid courage and discipline, the officers of the Volturno managing to maintain good order among the terrified passengers.

Seddon and Pennington, wireless operators on the Volturno, were among those who sought refuge on the Kroonland. These men were directly responsible for saving the lives of all those on the burned steamship.

Seddon stuck to his post for seventeen hours after the fire started. He went in the last boat with Captain Inch. A brief, but graphic, story of the Volturno tragedy is told in a wireless message sent by Seddon from the Kroonland, in part as follows:

"Steamer Kroonland, Oct. 16.—Volturno was found on fire 6.55 A. M., October 9, latitude 34.51 west. Mr. Pennington, my assistant, was on watch when Captain Inch gave orders to send out distress signals. This was done immediately, and we called the Carmania, Seydlitz, Grosser Kurfuerst individually.

"The Seydlitz answered immediately after we finished calling. We gave them our position, and he replied that he was coming under forced draught to our aid. Just as Pennington finished giving our position for the Seydlitz, I reached the wireless room and got into communication with the Carmania. I gave Captain Barr our position and his reply was: 'Coming all speed. Now fifty-nine miles from you and hope to reach you at three o'clock (Greenwich time).'

"After giving Carmania position, the Grosser Kurfuerst answered and said he was coming all speed. Great difficulty was experienced in receiving owing to occasional earthing of aerials through leads coming into connection with water tanks on deck.

"This was caused by sagging of aerial owing to foremast supports giving way. After some time, we managed to get the mast propped; then leads were altered to the right position. No more earthing took place, and signals were quite O. K.

"We were further hampered, however, by the rolling of the ship, which was so great that it was almost impossible to send at times. I requested the Carmania to send out calls, which she did. About half an hour later I was in communication with the Kroonland, which was 108 miles distant. I gave him our position and he replied: 'Cheer up, old man! We are coming all speed to your rescue.'

"The Seydlitz came alongside of us to windward at 5 o'clock, and half-an-hour later the Grosser Kurfuerst reached us. The Carmania at this time was about ten miles distant to the southward, cruising in search of our missing boats, which left the ship when fire broke.

"On request, the Carmania returned immediately. All this time I was in continuous communication with all the ships around us and received prompt replies from all of them."

The destruction of the aerial having made further work for Pennington impossible, Captain Inch ordered him to leave the ship. This was about midnight. The only way that Pennington saw to escape was to leap into the sea, and he did so. It was a jump of twenty feet.

"I went down so far that I didn't care whether I was coming up or not," said the operator. He was hauled aboard one of the Kroonland's boats unconscious. Seddon and Pennington were brought to New York after they had been rescued. They were anxious to reach England, however, and left New York before they could be found and asked to relate the full details of their experiences.

There were others besides the wireless men who showed that they were made of heroic mettle, and among these is Edward Lloyd, second officer of the Volturno. Unassuming and quiet, but a giant in physical strength, he rose to the awful occasion that confronted the officers of the doomed vessel from the time the cry of fire was first sounded. He checked the flames long enough for the rescue ships to arrive by chopping holes in the deck of the Volturno and pouring water into the hold; he made it possible for the wireless calls for aid to be sent by climbing aloft and repairing the burned out wireless antenna, and, above all, when the succoring ships stood by not daring to put their small boats into the angry seas, he launched a mere cockleshell of a craft and jumped into it to prove that lifeboats would live in the tossing water.

C. J. Pennington, second, and W. Seddon, chief operator. When the aerial was destroyed Captain Inch ordered Pennington to leave the ship. He leaped into the sea and was later picked up unconscious by one of the Kroonland's lifeboats.

"It was my watch below and I was asleep at seven o'clock on Thursday morning," he said, "when I was awakened by the alarm of fire being sounded by the ringing of the ship's bell. I rushed up to my post on the bridge and found Captain Inch and the first and fourth officers there.

"Just as I reached the bridge, the flames shot up from the forward part of the ship to a height of sixty feet. There did not appear to be any explosion, but a tremendous spout of flame instead. It caught the entire watch asleep below in the forepart of the ship, and every soul there must have been instantly burned to death. That was the first flame seen, as the alarm had been sounded at the sight of smoke.

"What started the blaze no one will ever know. It couldn't have resulted from a cigarette, as the hatches had been battened down.

"Captain Inch at once gave orders to man the lifeboats, despite the gale and high seas. Nos. 1 and 4 boats, in charge of the first and fourth officers, were made ready with their regular crews, and a large number of passengers, mostly women, who were nearest, were directed to get into them. The boats were then lowered away, but the instant they struck the water they were smashed against the ship's side. Half-a-dozen boats in all were lowered and smashed in the same way. Then Captain Inch saw that it was useless to attempt to put more boats out.

"All the boats were strong and in good order, but they broke into bits against the iron plates of the Volturno, and sank.

"The captain ordered the passengers all mustered aft in charge of the second steward, the chief steward having gone down with the first boat. Then he ordered most of the crew forward to fight the fire.

"I had already gone forward and, with a heavy chisel and a sledge hammer, had broken through the iron and wood of the deck so that hose could be thrust into the hold. We soon had every hose aboard the ship playing into the blaze. One gush of flame caught Captain Inch, who was in the thick of the battle, and nearly blinded him.

"The passengers, huddled aft, were screaming, praying and singing hymns. The stewards passed among them, endeavoring to quiet their fears by telling them the fire would be out in a short time and serving out food. All of the members of the crew knew that the ship was doomed, and yet they behaved nobly.

"The engineers were all at their posts, and only came up from the engine room for reliefs when they could stay there no longer on account of the intense heat. The third engineer stayed at the engines with fire all around him. Even his coat and hat were burned. The ship was kept going under full speed, with her helm hard up to allow for fighting the flames from the weather side.

"At nine o'clock in the morning the fire had been fought down, but, of course, it was not under control. However, we had checked it enough, as was proved later, to make the after part of the ship livable until aid came.

"The bridge by this time had become unbearable. The flames had swept the ship from bow to smoke stack. At half-past eleven o'clock in the morning, the fire had burned the ratlines on the foremast, and the mast itself, with the aerials of the wireless, was in danger of coming down.

"I climbed aloft up the steel shroud, and after twenty minutes' work succeeded in lashing the mast. The shroud had become so hot that my hands were burned, and the moment I had fastened the aerials securely with tackle, the halyards and the block on the mast they were reefed to blazed up.

"In another minute our wireless apparatus would have gone. By this time my hands were blistered so I could not retain my hold on the shroud and I fell to the deck, landing on a liferaft ,spraining my back and bruising my head. But it was no time for aches or pains, and I went below, remaining there until 4.30 P. M., when the fire reached the bunkers.

"Then, of course, the steam gave out, and our pumps became useless. The steam steering gear was also put out of commission. With four men, I went aft and rigged up the hand gear so as to still keep the helm hard up.

"Our wireless operators kept at their posts continuously, sending the S. O. S. signals and notifying the other ships that were steaming to our aid of the state of affairs aboard. Toward the last, the operators used their storage batteries.

"We could not put over any more of our boats as the rope gear had all been burned, and we could not launch them. Captain Inch then went to the wireless operators and had messages sent to the other ships, begging them to take off our passengers and never mind the crew. They replied that they had tried their best, but that the sea was too heavy. Besides the Carmania, other ships had arrived by this time.

"Captain Inch remarked that if we could only launch a boat we would set an example and convince the other ships that they could do so, and that, besides, it would encourage our passengers. We had a small boat, and I asked him to let me use it. I had it rigged up with tackle and swung over the lee side amidships.

"Captain Inch did not order any of the crew into it. It was then half-past five o'clock in the afternoon, and dark. A stoker and a steward came up and, seeing what was going on, volunteered to make the trip with me. Then two sailors jumped forward to go.

"As the boat was lowered, I slipped down the falls with the four men, and we cast off. It was a two-mile pull to the Grosser Kurfuerst, the nearest of the rescue ships.

"The fire had burned the ratlines on the foremast, and the mast itself, with the aerials of the wireless, was in danger of coming down. I climbed aloft up the steel shroud, and after twenty minutes' work succeeded in lashing the mast. In another minute our wireless apparatus would have gone."—Second Officer Lloyd.

"Before I left the Volturno, I took an electric flashlight with a storage battery, and said to Captain Inch:

"'I'll flash the light repeatedly. If you miss it you'll know we've gone down, and, for God's sake, don't send the passengers after me in the other boats. If I can't live in this sea, they can't, either!'

"All five of us in the boat pulled on the oars for all our lives were worth. The seas washed over us and we filled with water rapidly. After three-quarters of an hour we managed to get under the lee of the Grosser Kurfuerst, and her men lowered tackle and two rope ladders for us.

"The men with me grabbed the ladders and I caught the tackle and held on. We were all drawn up, and that instant our small boat, which was full of water, sank underneath our feet.

"My first thought was of the flash and I called out to the men on the Grosser Kurfuerst to flash a light back to the Volturno. Captain Inch must have caught the signal, for her wireless began again appealing frantically to have her passengers taken off.

"It was about this time an explosion came on the Volturno, and the Grosser Kurfuerst immediately put over boats. The men in them pulled against the sea, as the Volturno was to windward. Then other ships about the Volturno began to put out boats."

Captain Spangenberg, of the Grosser Kurfuerst, said that he brought his ship so close to the Volturno when he first arrived at the scene of the disaster that he could shout to Captain Inch and hear him answer.

"Inch called to me to come up on his lee side," said Captain Spangenberg, "and I managed to get within about 500 feet of his vessel. That was as close as I dared go.

" 'Lower your boats and we will throw you a line,' Captain Inch called to me. In order to do this successfully it would have been necessary for me to approach even closer to the Volturno than I then was, and this I was unwilling to do. There was then a full gale on, and the seas were very high. I had 2,100 persons on board my vessel, and I could not afford to risk their safety in any circumstances. It was a decided risk to remain even so close as I then was, but I determined to make a try at getting a line to the Volturno and ordered the crew to get the projectile guns ready.

"It was my idea to throw a projectile aboard the burning vessel, but by the time we were ready the seas were so high that we were rolling badly and the Volturno was shifting her position constantly. Her decks were crowded with people, and as there was a heavy wind I was afraid that the projectiles might go in among the huddled passengers, in which event many might have been killed or injured; so I was compelled to give up this idea.

"It was clear to me that, come what might, we would have to launch the boats if we were to do anything for the Volturno. So I issued a call for volunteers, and I am proud to say that a hundred

There were others besides the wireless men who showed they were made of heroic mettle, and among these is Edward Lloyd, second officer of the Volturno. A giant in physical strength, he made it possible for the wireless appeals to be sent by climbing aloft and repairing the aerial when it burnt away.

men of the ship stepped forward, eager to risk their lives.

"Just as it began to get dark, we had two boat crews ready, and were preparing to launch the first boat, when we received a wireless message from the Volturno which ran, as I recall it: 'We are launching our last boat and will try to get it over to you. Try to watch it. When you see a small light dancing on the waves, come as near as you can and pick up the boat.'

"This was the boat in which Second Officer Lloyd came to us with four men. The little light which he carried was a small electric flashlight. We got the men safely on board the Grosser Kurfuerst, and Lloyd came to me at once. He said that the seas were too high for rescue work and that it would be foolhardy to expose my men to useless danger at that time. He said that Captain Inch hoped to keep the fire down till daybreak, at which time conditions might be better.

"Inch sent a message to me, saying, that in the event of a great explosion, or his vessel breaking up and sinking, he wanted us to stand by and pick up as many as we could. He said that all of the passengers had been provided with lifebelts and if the seas subsided even slightly, he had hopes that most of them could be saved.

"We decided to follow Inch's advice, and I began working my vessel around on the weather side, hoping to be able to get closer. Then, at nine o'clock, came the great explosion. The whole forepart of the Volturno was torn out and the flames shot high into the air. We of the Grosser Kurfuerst decided that the time for action had come. Our volunteers were all ready and waiting and they piled into the boats."

Captain Inch, the young commander of the Volturno, had interesting details of the disaster to tell. He does not look within five years of the thirty-six to which he confesses.

"The loss of our lifeboats, following the discovery of the fire, is, of course, the saddest chapter in the awful story," he said. "It was my first duty to order these boats provisioned and made ready for launching, and the disaster that followed the dropping, or the attempt to drop, them into the seas indicates better than any words of mine the kind of weather the Volturno faced that day. The first boat to be launched was in command of Chief Officer Miller. It struck the water and immediately seas engulfed it, and it was capsized and all in it were lost. The second boat was lowered under the command of poor Langsell, the fourth officer. In it were about forty persons, I should say. The boat got away from the ship and was not seen again.

"The third boat, commanded by Boatswain Suderstrohm, was lowered and had about fifty of the steerage passengers in it. As it struck the water, the tossing Volturno made a deep dip forward and a giant sea swept the boat under the liner's stern. When she settled back she sat upon the little craft, crushed it like an eggshell, and everybody in it was lost except the boatswain, who dived out. On coming up, he caught hold of the tackle that was dangling from the ship's stern and was pulled back on board. No man ever looked death closer in the face than he did.

"I forgot to say that Miller's boat, after it capsized, righted itself, and we saw several of those who had been in it, among them Miller and a seaman, trying to get back. Whether they succeeded and what became of them we shall probably never know.

"At that time, I did not think the Volturno would last much more than an hour, so fierce were the flames that were eating their way through the vitals of the ship. But we did not launch any more boats, for Pennington, the Marconi operator, told me that the Carmania had caught our signal and was speeding to our aid."

Captain Inch described the scene on the Volturno just after he had been told that fire had started on the ship. Forward and abaft the forecastle the flames formed a wall forty feet in height.

"While I was looking over the ship," the captain said, "one of my men came up out of the forecastle. His face was burned badly and, as he staggered toward me, I caught him in my arms and asked him where he had been. He answered: 'I am just out of the forecastle, and there are four men burning to death in there.' It was all too true.

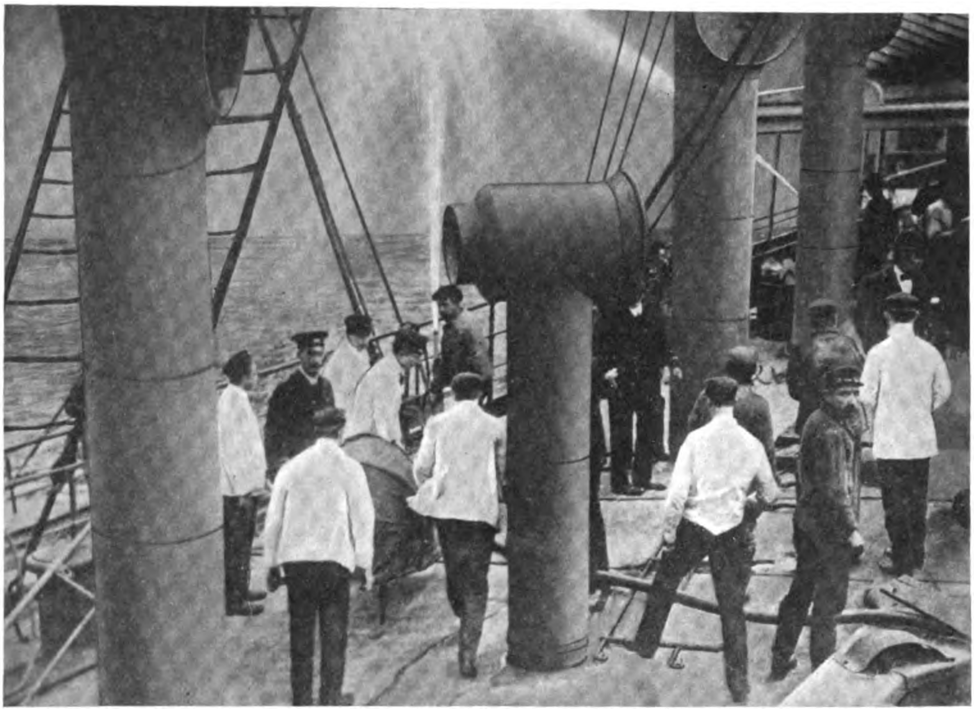
"At this time the operators were sending out the S. O. S. signal, and as I looked about the ship I felt that we were doomed. Then followed a series of explosions, the origin of which I have not been able to determine. There were three of them, and the last was by far the worst. It was a terrific detonation and completely wrecked the saloon, and everything seemed to collapse.

"Pennington, the second wireless man, came to me and I told him to go back and keep S. O. S. going while I got the ship's position. All this time the crew were getting the boats ready for launching, and the explosions were following one after another."

While Pennington was sending out his call for aid, another explosion occurred, putting the compass out of commission. Just after the explosion, Captain Inch related, Pennington came to him and said that the Carmania was on her way to give assistance.

"When Pennington brought this cheering information," declared the Volturno's commander, "we had launched the boats under Miller and Langsell and Lauderstrohm. I ordered that no more lifeboats be launched. It was almost impossible for a boat to live in those heavy seas."

Extracts from the log of Captain Barr, of the Carmania, throw considerable light upon the difficulties which confronted the rescuing ships. The log reads in part as follows:



That the Volturno was well equipped with fire extinguishing apparatus, and that the men were skilled in its use, is evidenced by this actual photograph of fire drill at sea aboard the vessel. When the equipment could not check the raging flame and her commander relied upon a wireless appeal for aid—and won.

"It seemed a hopeless task to get a boat to her [the Volturno], but I resolved to try one, and sent the first officer, Mr. F. Gardner, away with eight men. The boat got away well enough, but was in difficulties as soon as she got from under our lee. I had advised Gardner that whether he got any people or not he would have to pull clear, keep head to sea, and trust me to pick him up. His boat was already turned over, so that he lost all oars but three, and only by using his sea anchor and bailing did he keep afloat. He could not reach the Volturno.

"I tried to short-turn the ship, but she would not look at it, so I had to make a bold sweep to windward and drop down on him. It was two hours before we got him alongside again. Meanwhile, at about 1.15 (P. M.), I marconied Volturno: 'Cannot take people off by boat, too much sea. If you cannot hold fire and must abandon will keep close to windward. If time will run to windward and look for your boats. Suggest lifeline and belts if necessary.' He consented to my looking for his boats, asking me not to go too far. At 3.10 P. M., we sighted the German steamer, Seydlitz, and marconied to him: 'Am going northwest ten miles to look for boats. Will you stand by Volturno? Will return.' I ran about eight miles, seeing only three buoyancy tanks as of broken boats, and was recalled by an urgent signal from the Volturno, whereupon I returned full speed.

"I had held a consultation of officers, inviting suggestions, and the chief officer advised dropping rafts under his lee. I agreed to this and marconied to Volturno: 'Will run to leeward and drop some rafts; try to get them. Can you move engines? The ship drives fast and must go to windward to pick up.' This message he received. On my return I found that the Grosser Kurfuerst had arrived and that the Seydlitz was picking up his boat to windward of the Volturno, after, apparently, an experience similar to our own. At 4.33 P. M. I stopped close on the Volturno's lee and dropped six life rafts. He could not, apparently, move his engines, and they drove past ahead of him. Meanwhile, I backed and got my bow within about 100 feet of his stern and he tried to float life buoys to me. His idea was to run a rope between the ships and haul the boats back and forth. It would have been quite impossible in such a heavy sea.

"Until the weather moderated there was no hope of doing anything with the boats, and other steamers were arriving, so at 7 P. M. I sent a message to all ships: 'Have tried a boat and dropped rafts, cannot do more under existing conditions. This ship hard to manœuvre. If any suggestion or attempts, will keep clear.' I thought it wise to do this not to hamper the efforts of others. I did not think he could last till morning, in which case, if it came as a last resource to trust to lifelines and lifebelts, I was in position to drive down on him with lifelines fore and aft, ladders over, side well lighted with clusters, and searchlights going. I was careful not to blind other ships with it and use it to pick up boats, lighting up the Volturno occasionally to see what was happening. This position I maintained through the night; was about half-a-mile distant, but could not get closer, as about ten steamers were all close together."

Captain Barr's log relates how the other steamships asked the Carmania to use her searchlights to look out for the boats which they had sent to the Volturno, and of his compliance with the request. He states that "from where I lay could not fetch the Volturno, so none [boats] were sent, and I could not get closer without upsetting the whole scheme."

The Volturno disaster marks the third occasion in which wireless telegraphy has saved a large number of lives at sea. Without the wireless the world would not have known of the collision between the Republic and the Florida off Nantucket lightship, on January 23, 1909, for many hours, perhaps for many days. As it was, news of the Republic's peril reached the Baltic in ten minutes, and the world knew within four hours that only eight lives had been lost and the rest of those on board transferred to the rescuing steamship.

The second occasion was the loss of the Titanic, a year and a half ago, when the operator stuck to his post, calling for help until the very moment the ill-fated craft sank. In that disaster 1,475 lives were lost, but 705 lives were saved by the steamers called to the aid of the Titanic by the wireless flashes.

In addition to the Titanic and Volturno disasters, there have been many wrecks of less magnitude where the survivors have owed their lives to Marconi wireless.

The Engineering Measurements of Radio Telegraphy

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ARTICLE III

In this issue a second method for the measurement of capacities at radio frequencies and high voltages by the resonance method is described. It is followed by a desciption of an extremely accurate method for obtaining the effective or the absolute capacity of a condenser similar to that employed in the receiving apparatus in a radio station.

CONDENSERS are frequently employed where radio frequency currents of high voltage pass through them. Instances of such use are found in the secondary or primary circuits of the usual radio station, and also in the series condensers which are occasionally inserted in an antenna to permit radiation at short wave lengths. When a condenser is to be used for such a purpose, its capacity should be measured by the following method:

10. *Measurement of Capacity at Radio Frequencies and High Voltage by the Resonance Method.*

(*a*) *Theory of the Method.*—The theory of the following method is exactly the same as that of the method given in Section 9 for the equivalent measurement of capacity at radio frequencies and *low* voltages. It may, however, be added that, since high voltages are to be developed in the secondary of two coupled circuits by means of resonance effects, it becomes essential that the energy in the primary circuit shall be fairly large, the voltage reasonably high, and that the secondary circuit shall have the minimum possible decrement. That is, the secondary circuit shall be so constructed that its equivalent ohmic resistance at radio frequencies shall be as small as possible. The practical methods of securing this result will be given below. It is also desirable to keep the primary damping quite low.

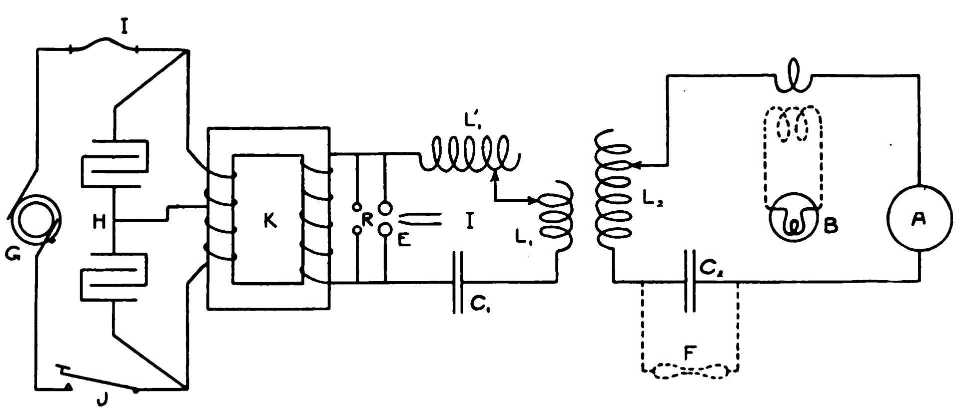


Fig. 11

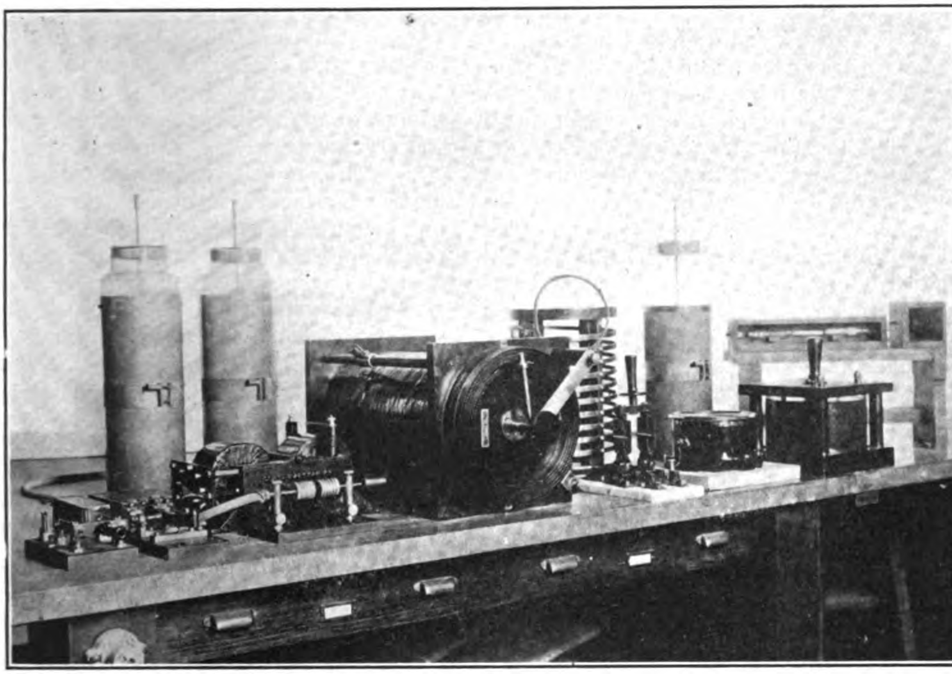


Fig. 12

(*b*) ***Arrangement and Description of the Apparatus.***—The arrangement of the apparatus is shown in Figure 11. Here G is an alternator, which supplies energy to the primary circuit of the transformer K. The fuse I and the condensers H are protective devices, used exactly as described in Section 8a. The switch or key J controls the primary current. In the particular transformer used the primary current could be varied in a number of steps by tapping off different numbers of primary turns. Across the secondary of the transformer, the protective gap R was permanently attached. E was a zinc air-cooled spark gap. The primary circuit, I, consisted of the capacity C_1, the tuning inductance L_1', and the variable coupling inductance L_1. The secondary circuit, II, consisted of the variable inductance L_2 (which was coupled to L_1), the capacity C_2, which may be either a known capacity, C_n, or an unknown capacity, C_x, and whatever indicating device was used. Thus the ammeter H might be inserted directly in the circuit. Or a small lamp might be inserted in place of the ammeter. Or the Geissler tube, F, might be placed across the terminals of C_2. It is to be noted that low-resistance devices which require considerable current for their operation should be placed directly in the circuit. Hot wire ammeters and lamps are such devices. However, large-resistance indicators, which are dependent on the presence of high voltages for their operation, should be connected across the terminals of the condenser C_2. The reason for these arrangements is obvious.

The actual appearance of the apparatus is shown in Figure 12. To the left are seen the key and transmitting switch J, the condensers H, and, directly behind one another, the compressed-air-cooled spark gap, the high tension transformer, and the Leyden jar condenser C_1. In the transformer the switch for tapping off primary sections, the primary and secondary coils, and the protective gap are all clearly visible. In the center is seen the inductive coupler L_1L_2. L_1 is the continuously variable spiral inductance to the front, and L_2 is the helix behind it. The helix can be varied a turn at a time. To the right, and back of a high-tension switch (the purpose of which will be mentioned below) is the continuously variable helix inductance, L_1'. At the extreme right are seen the hot-wire ammeter, the standard condenser C_n, the unknown Leyden jar condenser C_x, the small lamp indicator and the Geissler tube indicator. Both the latter are mounted in shadow boxes to permit of their use in fairly well lit rooms. The high tension switch referred to above may be used to permit a rapid change from C_x to C_n, but, unless one has a switch of proven high insulation, it is better to change from C_x to C_n by actually shifting the connections.

The details of the apparatus were as follows: G was a large 110-volt 60-cycle generator, I a 5-ampere fuse, J a heavy transmitting key especially adapted for large currents. The condensers, H, were, as before, 2 μf Western Electric No. 21-D condensers. The transformer chosen for the experiment was a 0.5-K.W. 8,000-volt closed core one. It was used at about half power. Five transformers of different types have been tried for the experiment, and by suitably varying the primary current and the capacity load C_1, any of them proved available for the measurement. The primary capacity consisted of two Leyden jars in parallel. (Their combined capacity was 0.00641 μf.) The primary inductance L_1' consisted of 10.4 turns of 3/8" x 1/16" copper strip wound flat on the surface of a cylinder of diameter 7.5". The separate turns were held in place by screws on rubber rods. The inductance of the helix was 10 μh. The inductance L_1 consisted of 5.8 turns of 1" wide thin copper strip wound in a spiral, outer diameter 9", 3/16" between turns. A sliding contact, capable of moving outward radially on its supporting bar, made it possible to vary the inductance readily. The total inductance of the spiral was 6 μh; and a somewhat larger inductance could be used to advantage in its place. The secondary inductance L_2 consisted of 26.8 turns of thin flat copper strip, 1/4" wide, wound flat on the surface of a cylinder of diameter 8", with 3/16" between adjacent turns. Its total inductance was 72 μh. The standard capacity C_n was a variable rotary plate condenser with oil dielectric, maximum capacity being 0.00200 μf. The ammeter was a 5-ampere hot-band ammeter, of resistance 0.20 ohm. The indicating lamp was a 3.5-volt tungsten flash lamp. And the Geissler tube contained carbon dioxid.

(*c*) *Procedure.*—First of all, it is desirable to adjust the various inductances and capacities so that $(L_1 + L_1')C_1 = L_2C_2$, at least approximately. The unknown capacity is inserted as C_2, and the primary varied until the maximum reading is obtained in the indicator in the secondary circuit. It may be necessary to vary the secondary inductance as well, or even to insert an auxiliary inductance in the secondary circuit if the unknown capacity is quite small. In case there is excessive sparking at the key J, a 2 μf condenser of the same type as H should be placed across the key terminals. And it should be remembered that *extreme care should be taken to avoid touching any circuit unless the main switch* I *is open.* Considerable handling of these circuits tends to breed a carelessness which may easily have serious results. After the point of maximum secondary indication is reached, the standard condenser C_n is inserted in place of C_x. C_n is then varied, keeping the other inductances and capacities constant until the maximum reading is again obtained. Care must be taken that the observations with C_x and C_n are not taken at different frequencies; that is, at the different coupling waves which are always produced in such coupled circuits.

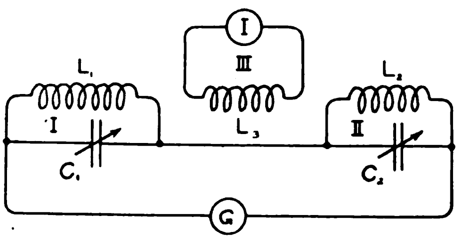


Fig. 13

It is, unfortunately, not always feasible to couple very loosely and yet keep the high voltages necessary in the secondary circuit. It it were possible, the coupling waves would be avoided. However, it is usually possible to find two points where the indicator shows a maximum as C_n is varied. In general, that point at which the indicator reads nearest to the value given when C_x was in circuit is the one to be chosen. Unless C_n and C_x are similar

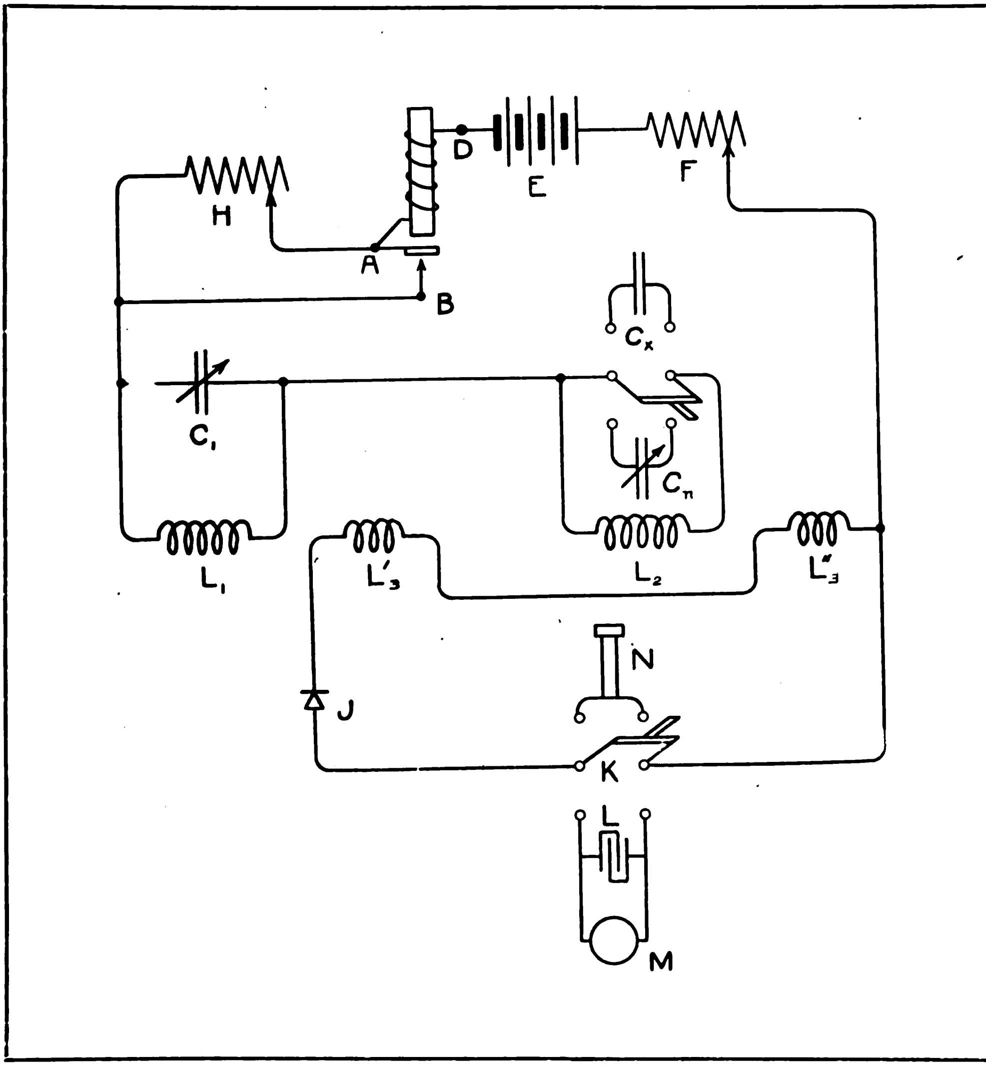


Fig. 14

condensers with the same dielectric, it is unlikely that the resonant readings of the indicator will be quite the same for both C_n and C_x even when the correct wave is being used in both cases. The difference of the readings gives a clue to the relative losses in the two condensers in question, which fact will be applied in a later measurement. If loose coupling and a single wave in the secondary can be obtained, so much the better. The final value of C_n, which is obtained at the corresponding maximum reading, is equal to the value of C_x. It is usually advisable to find the value of C_n at which the maximum reading is obtained by taking points on opposite sides of the correct value, such that the readings of the indicator are equal for those points. This is particularly desirable when a scale indicator—*e. g.,* an ammeter—is used. The mean of the values of the capacities corresponding to these points on C_n is taken as the value of C_x. It is to be remembered that these points should not lie more than a few per cent at most from the maximum, otherwise lack of symmetry of the resonance curve will disadvantageously influence the accuracy of the results.

If the voltage used is very high, it is well to place in series with the Geissler tube indicator a very high resistance (say several megohms), made up compactly in the form of a graphite rod. If the current values in the circuit are so high that the lamp form of indicator would be burned out, it can be shunted by a thin copper wire, the diameter and length of which are most easily found by trial.

In using a hot-wire ammeter in this measurement, particularly when high accuracy is desired, it is necessary to make sure that the readings of the ammeter are independent of the frequency of the current flowing through it. This can be ascertained by any of the methods given hereafter for calibrating such instruments. However, any of the better modern hot-wire or hot-band instruments will be found sufficiently accurate for this particular measurement.

(*d*) *Errors of the Method; their Elimination and Probable Accuracy.*—Unless the spark gap is operating properly, it will be impossible to obtain results of any value by this method. If a quenched spark gap with the appropriate auxiliary transformer and closed circuit are available, they should be used. Failing that, a zinc gap, the faces of which are quite parallel, and which is cooled by a jet of compressed air is desirable. If no great amount of power is being passed through the gap, a fan blower will suffice for cooling. In every case the transformer primary current and the capacity load C_1 must be so regulated that a steady, violent, sharply crackling spark is obtained. The reddish, less noisy, arc-like discharge which is obtained when the above conditions are not fulfilled is useless for precision measurements.

The results of a typical experiment with the apparatus described are here given:

Using an ammeter as indicator:

$$C_x = 168.5° \pm 0.3° \text{ on } C_n = 0.0019° \pm 0.000004\ \mu f.$$

Accuracy of measurement = 0.2%.

Using a lamp indicator. (The lamp was connected to an inductance of 19 μh, consisting of 16.8 turns of No. 14 single lamp cord on a core 8.6 cm. in diameter. Around this inductance was wound loosely a single turn of the secondary circuit, thus coupling the lamp

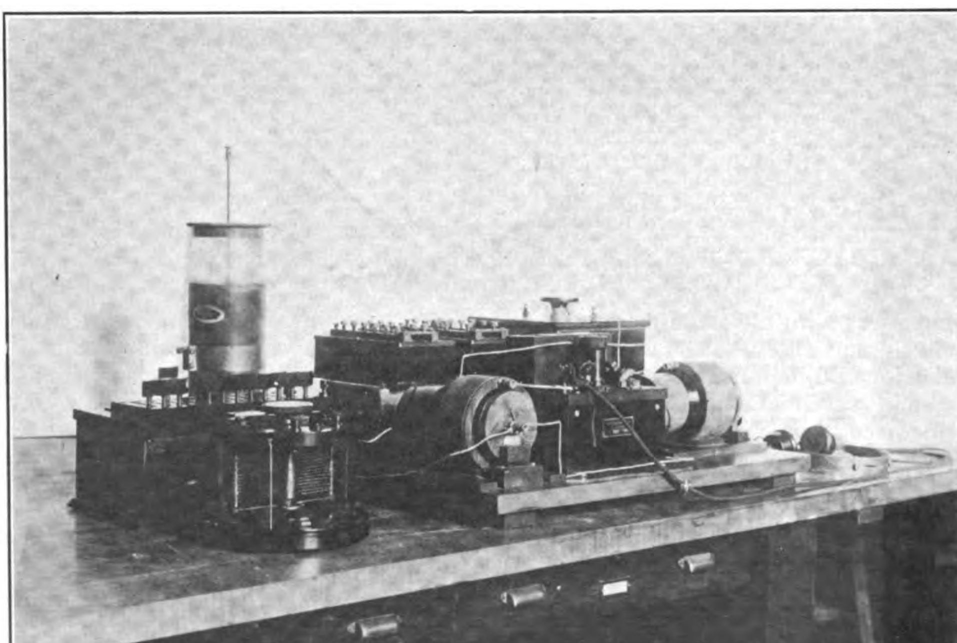


Fig. 15

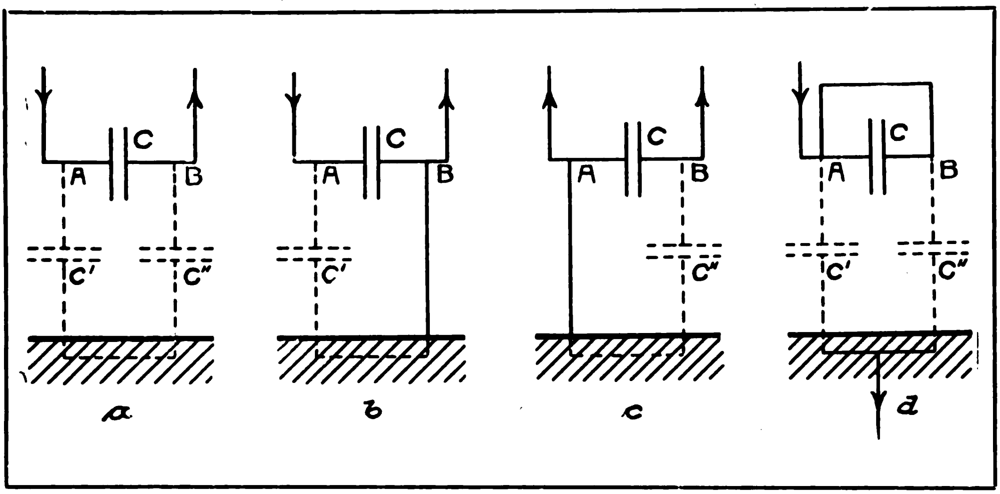


Fig. 16

inductively to that circuit. This was necessary because otherwise the current through the lamp would have been excessive.)

$C_x = 169.0° \pm 1.0°$ on C_n

Accuracy of measurement = 0.5%.

Using a Geissler tube indicator:

$C_x = 166.° \pm 3.°$ on C_n.

Accuracy of measurement = 1.5%.

It may be mentioned that the wave length at which the measurements were performed was 422 meters, that the current through the unknown capacity was 4.25 amperes, and that the secondary decrement (using the ammeter indicator) was very small, namely, 0.012.

Among the preceding methods of measuring capacity, one of those suitable for measuring capacities at radio frequencies was a null method using the telephone as an indicator. Null methods, that is, those where readings are obtained by *zero* deflection of a galvanometer or *silence* in a telephone, are generally preferable to those involving the use of maximum deflections. The reason for this is that the results of null method measurements are less likely to be affected by small variations in the energy supplied by the source of current. The silence point is independent of the strength of the source, though, of course, the ease of finding is is not entirely so. The following null method of measuring capacities is very convenient in practice and can readily be made one of extreme precision.

11. *Measurement of Capacity at Radio Frequencies and Low Voltages, by the Opposition Method.* (This method is due to Dr. George Seibt, and can be readily adapted to high voltage measurements.)

(*a*) *Theory of the Method.*—In Figure 13, suppose that G is a device which at regular intervals charges the condensers C_1 and C_2 to a certain potential. Suppose, further, that $C_1 = C_2$ and that $L_1 = L_2$. As the condensers discharge, the current values in the circuits I and II will be the same throughout the entire discharge, provided that the resistances of these circuits are also equal (an easy condition to fulfill). The circuit III consists of the inductance L_3 connected to the indicator of radio frequency electrical energy I. The circuit III is coupled to both I and II but in such a way that the currents induced by I in III are in the opposite direction to those produced in III by II. Under these circumstances, nothing will be shown by the indicator. If, however, either C_1 or C_2 be altered, a reading will immediately be shown by the indicator.

If, then, we replace C_2, which may be an unknown condenser, by a variable standard condenser, and again adjust C_2 till there is no indication of I, we obtain the value of the unknown capacity directly.

(*b*) *Arrangement and Description of the Apparatus.*—Figure 14 is the circuit diagram of the actual apparatus. A, B and D are the three binding posts of a high-pitch buzzer, arranged exactly as in several of the preceding measurements, in a sound-proof box. The current supplied by the battery E is controlled by the adjustable resistance F. The second adjustable resistance H may be shunted across either A and B, or B and D. Its purpose is to prevent the heavy sparking at the buzzer contact point caused by the inductance of the buzzer electro-magnet. L_1C_1 and L_2C_2 are circuits I and II respectively, exactly as in Figure 3. The inductance L_3 of Figure 13 is divided into two equal portions, L_3' and L_3'', which are coupled respectively to L_1 and L_2 in the manner indicated; that is, so that the induced electromotive forces and resulting currents tend to neutralize. J is a crystal detector, K a double-pole, double-throw switch, N a telephone receiver, M a galvanometer, and L a large auxiliary condenser across the galvanometer terminals.

In the apparatus as actually used, the buzzer was an "Eco" buzzer, the battery voltage was 10, F was 20 ohms, and H was 40 ohms. Both the resistances used were non-inductive, though this is not strictly necessary. L_1 and L_2 were constructed as follows: Each was made up of 63 turns of No. 18 double-silk-covered wire, total length of winding 11.1 cm., diameter of core 8.9 cm. The inductance was approximately 390 μh. C_1 was an 0.005 μf rotary plate variable air condenser, and C_2 was either one of a number of standard calibrated variable condensers, or the unknown capacity. L_3' and L_3'' were both constructed as follows: 60 turns of No. 24 double-cotton-covered wire were wound on a core 12.3 cm. in diameter. The axial length of winding was 6 cm., and the approximate inductance was 490 μh. The detector J was a tellurium-galena contact, and proved quite reliable in use. To prevent deterioration of the crystals through moisture and dust, the entire detector was enclosed in a hard rubber protecting case with means for adjusting the contact pressure from the outside. The telephone was a 3,000 ohm Western Electric No. 145-W, double, head-band receiver. The galvanometer M was a Hartmann & Braun instrument, resistance 325 ohms, sensitiveness $1° = 9\,(10)^{-7}$ amperes. The condenser N was 1 μf. The various coils of the two inductive couplings could, to advantage, be made of heavier wire or, best of all, of litzendraht, or multiply stranded wire. This is desirable if extreme precision of measurement is required.

The apparatus itself is shown in Figure 15. To the left in the foreground are seen the two standard condensers which were used. Back of them is an unknown capacity which was to be measured. The two inductive couplers, mounted at right angles on their base, are shown in the center. Between them stands the box supporting the enclosed detector and the galvanometer, and containing the condenser L. Back of these are the exciting buzzer, the resistance boxes H and F, and the condenser C_1.

(*d*) *Errors of the Method, their Elimination; and Probable Accuracy.*—It is evident that the wave length at which any given condenser may be measured for capacity is not variable with this type of apparatus. For the inductance L_2 practically determines, together with that capacity, the period of circuit. Only by having the inductances L_1 and L_2 simultaneously variable can this objection be overcome. The accuracy of the measurement is diminished if one of the condensers C_1 or C_2 is subject to large dielectric losses, because of the resulting difference in damping of the circuits L_1C_1 and L_2C_2. For extremely accurate work by this method, these circuits must be excited by a source of forced or sustained alternating current (such as Poulsen arc), and the capacities of each of the plate systems to ground must be considered. We will examine this latter effect in some detail. In Figure 16a, the effective capacity of the condenser, the terminals of which are A and B, is measured, and found to be C_e. The capacity of the left-hand plate system to ground is represented by the condenser C', and the capacity of the right-hand plate system to ground by the condenser C''. If C is the true capacity between the plate systems, the apparent or effective capacity as measured between A and B will be (by equation (10) of the first article of this series)

$$C_e = C + \frac{C' C''}{C' + C''} \qquad (28)$$

Suppose terminal B to be connected to ground, and the new value of the apparent capacity between A and B to be C_1. Then, obviously

$$C_1 = C' + C$$

If terminal A is connected to ground, and the apparent capacity between A and B is C_2, we have

$$C_2 = C'' + C$$

And, finally, if terminals A and B are connected to each other, and the capacity between A and ground is found to be C_3,

$$C_3 = C' + C''.$$

We readily obtain the true value of the capacity between the plate systems from the three last equations, namely:

$$C = (C_1 + C_2 - C_3)/2 \qquad (29)$$

Under usual conditions of working, we are, however, interested solely in the effective capacity, C_e, which can be directly measured. For reasons which are now clear, it is desirable that the standard condenser shall be enclosed in a grounded metal case so that its capacity is independent of the presence of conducting bodies in its vicinity.

As examples of actual measurements by the Seibt method, the following are given:

1. Unknown capacity, 0.00389 μf.
   Telephone indicator, accuracy 0.2 per cent.
   Galvanometer indicator, accuracy 0.5 per cent.
2. Unknown capacity, 0.00101 μf.
   Telephone indicator, accuracy 0.2 per cent.
   Galvanometer indicator, accuracy 0.3 per cent.

This is the third article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The fourth will appear in an early issue.

PLANS WAR ON OFFENDERS

William B. Terrell, wireless telegraphy inspector, has announced that a vigorous campaign looking toward the arrest of all unlicensed wireless operators will be started.

"There are probably fifteen hundred unlicensed operators in my district, which comprises Long Island, Staten Island, Northern New Jersey and all the territory between New York City and Albany," he said. "When we have obtained what we consider sufficient evidence in each case we will proceed against the owners of the stations in the criminal courts in New York State and in New Jersey.

"This is a serious matter. Many times when one of these unlicensed stations is in conversation with a legitimate land station another operator may be trying to 'raise' the station with whom the unlicensed operator is in communication.

"Frequently the unlicensed station gets into communication with a ship at sea and this we consider a menace to navigation, because it interferes with that particular ship receiving messages from other ships or calls for help.

"We have also received complaints from the United States navy. Officials at the Brooklyn Navy Yard have been interfered with repeatedly in their communications with war vessels in the waters of the vicinity.

"Not alone will we cause the arrest of these amateurs, but we intend to seize their apparatus."

SEAMEN FAVOR SHIP EQUIPMENTS

The executive council of the National Sailors and Firemen's Union at an emergency meeting held recently in London, decided to take a ballot of the members of the union on the question whether they were prepared to refuse, after May 1, 1914, to ship on board any ocean-going craft not equipped with wireless telegraphy. The council expressed the opinion that much loss of life on cargo boats could be avoided if they were equipped with wireless telegraphy, which could be done at a cost of about $2,000 a year for each vessel. The council proposes to invite the seamen of other nations to join in the movement.

Bouquets and ~~Boulders~~

THE WIRELESS AGE is one of the best all around magazines that I have ever read. If you continue to publish as good a periodical you may rely upon my renewal.

D. T. C., *Massachusetts.*

* * *

I am a regular subscriber to your magazine and derive much pleasure from it.

G. B. S., *New York.*

* * *

I am delighted with your magazine. I think it will be of great value, not only to the amateur operator, but to the professional as well. I should say that it is just what every wireless fellow ought to have and appreciate. I gave up subscriptions to other magazines for one to THE WIRELESS AGE.

J. P. S., *New Jersey.*

* * *

I enjoy every page; will always take THE WIRELESS AGE.

A. B. H., *California.*

* * *

I liked your magazine from the start; it has been better every number; I like interesting and practical articles on all subjects—that is why I subscribed.

G. J. G., *Nebraska.*

* * *

I am enthusiastic. You have no competitors with a magazine like this. It is exactly what the amateur and professional operators alike are itching for.

J. E. D., *Pennsylvania.*

* * *

THE WIRELESS AGE, judging from the first issue, is quite an improvement over the Marconigraph, although I never had occasion to find fault in any way with the latter.

F. G. E., *New Jersey.*

* * *

The best magazine published on radio subjects.

L. S. B., *Massachusetts.*

* * *

Your wireless magazine was brought to my notice in a Fessenden wireless station—which I thought was a mighty good recommendation. Your magazine seemed to take the field with a great deal of speed.

H. R. F., Jr., *Massachusetts.*

* * *

I find it a magazine that is worth double its value.

C. H. C., *New Jersey.*

* * *

Find much to interest me.

M. E. J., *California.*

* * *

Very interesting as well as very useful.

A. R. M., *New York.*

* * *

You are to be congratulated upon getting out THE WIRELESS AGE. I think it is the best thing in wireless magazines, either American or foreign.

C. H. S., *Wisconsin.*

* * *

Such articles as "The Engineering Measurements of Radio Telegraphy" and "Electrical Oscillations" are just what I have been looking for, but could not get in convenient form anywhere. I hope you continue to have such articles in subsequent numbers, as this is just where most amateurs stop and that is what they need. I am sure your magazine will be gratefully received and be a great success if it continues to be anything like the one at hand.

R. W. P., *Rhode Island.*

* * *

It's well for all concerned in wireless work that you are doing so much to keep up interest in this valuable art. The October number was extremely interesting and you are covering a field that is inadequately covered by the other periodicals.

C. H. S., *Pennsylvania.*

* * *

My interest in wireless has been lagging, except from a scientific side, which will always interest me; but when I read your magazine I felt a great desire to get my set working again, and I will.

E. L., *Pennsylvania.*

Hawaii High Power Link in the Mid-Pacific

Some observations by a Marconi Engineer.

IT seems odd that the site of the largest wireless duplex station which the Marconi Wireless Telegraph Company of America is building should be located on an island, approximately four times the size of the five boroughs of Greater New York, in the middle of the Pacific Ocean. This is explained, however, by the fact that the plant will work in both directions, necessitating the employment of a considerable number of men.

The Island of Oahu, on which the station is located, is the third in size of the Hawaiian group, and comprises about 600 square miles of volcanic and coral rock. All of the islands were formed by volcanic disturbances, and on some the volcanoes are still active. On Oahu, however, they have long since been extinct; in fact we defied old Koko Head by running our receiving aerial up its side and sinking the tail anchor far down in the crater.

History in Oahu has been made quickly, for the story of the progress on the island, since Captain Cook discovered the Hawaiian group in 1778 to the present day, is full of human interest. The story runs from native chiefs to kings, from kings to an independent republic, and from that to a territory of the United States. The country has developed fast and the end is not yet, for with the opening of the Panama Canal the importance of the harbors will be greatly increased; the direct wireless communication with the United States and Japan will also be a big factor in its commercial growth.

No country in the world has so much commerce in proportion to its population. This is largely due to the fact that practically all the industries on the island consist of cultivating sugar, pineapple, and coffee plantations. The country naturally turns to the United States for all of its manufactured articles. Most of the lumber and all of the fuel is imported. The greater number of the plantations are along the coast and in the valleys, the interior of the island being wild and mountainous and little adapted for any industry except cattle raising. A railroad runs from Honolulu nearly around the island and reaches all the large plantations. There is telegraph communication between the various points in Hawaii and, since March, 1901, the islands of the group have been connected by Marconi wireless.

Practically all of the transportation of material for the two stations has been from New York by way of the American-Hawaiian Steamship Line to Port of Mexico, across the Isthmus of Tehuantepec, and thence by boat to Honolulu.

A panoramic view of the buildings in course of erection at Marshalls, Cal., where residences of the engineers, which the picture shows to be nearly complete, are located about from the

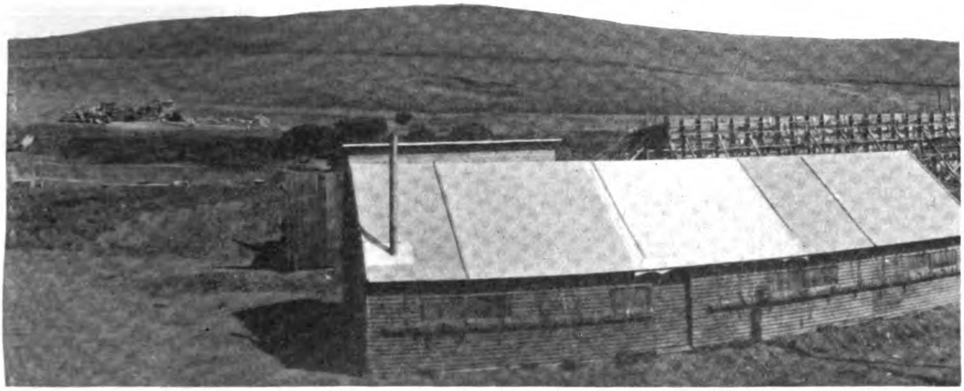
This trip takes about five or six weeks. A little time can be saved by sending material across country to San Francisco or Seattle and then by boat to Honolulu. The cost, however, of sending material by this route is prohibitive for all machinery or other large parts. All structural steel and machinery is sent by way of New York. Cement and lumber is sent from California.

Koko Head, the southeastern end of the island, has been selected for the site of the receiving station, and Kahuku Point, which is located on the northern corner, about thirty-five miles away, has been determined upon as the location for the receiving station. The latter site was selected chiefly because of its proximity to the railroad. All of the oil fuel necessary for the operation of the 1,500 horse power plant will be brought from California by boat and then by cars to our storage tanks.

Koko Head is about ten miles east of Honolulu and has the distinction of being the dryest point on the island. The moisture, borne along by the northeasterly trades, is not precipitated at this end of Oahu because of the narrowness of the land and the absence of any considerable elevation. As a result of the absence of water, the land in this corner of the island is undeveloped and is used only for cattle grazing. Even the poor beasts, however, get little nourishment from the scanty surface growths, and often perish from need of something beside the salt or brackish water obtainable. The roads about Koko Head are not remarkable for their good surfaces or durability. An excellent road runs from Honolulu to Kaimuki, a suburb snugly located in the Divide, at the back of the military reservation at Diamond Head. From Kaimuki the road dips down into the valley, which is covered with algeroba bean trees, and leads to the shore, which it skirts until the Kuapa fish pond is reached. The good road ends at Kaimuki and from there on the thoroughfare becomes gradually worse until it reaches a point near the fish pond, where it becomes a mere surface trail.

Our site is on the other, or eastern side of the pond, where the ground slopes upward slowly to the hogsback formation on which Koko Crater and Koko Head are excrescences. There were two ways of getting around the pond; the first one held nothing good and the other was good for nothing. The trail around the northern side of the pond is long and rough, while that around by the sea front is only passable at low tide, and has dangerous quicksands to be avoided.

The transportation of material to this site was a problem requiring careful consideration. We had the choice of carting the material by the road or shipping it by boat and unloading it upon the beach. When we inquired about the feasibility of the latter plan, we were unable to find ship owners or captains who were familiar with the channel said to exist in the coral reef protecting the bay which fronted the beach; nor did we find any



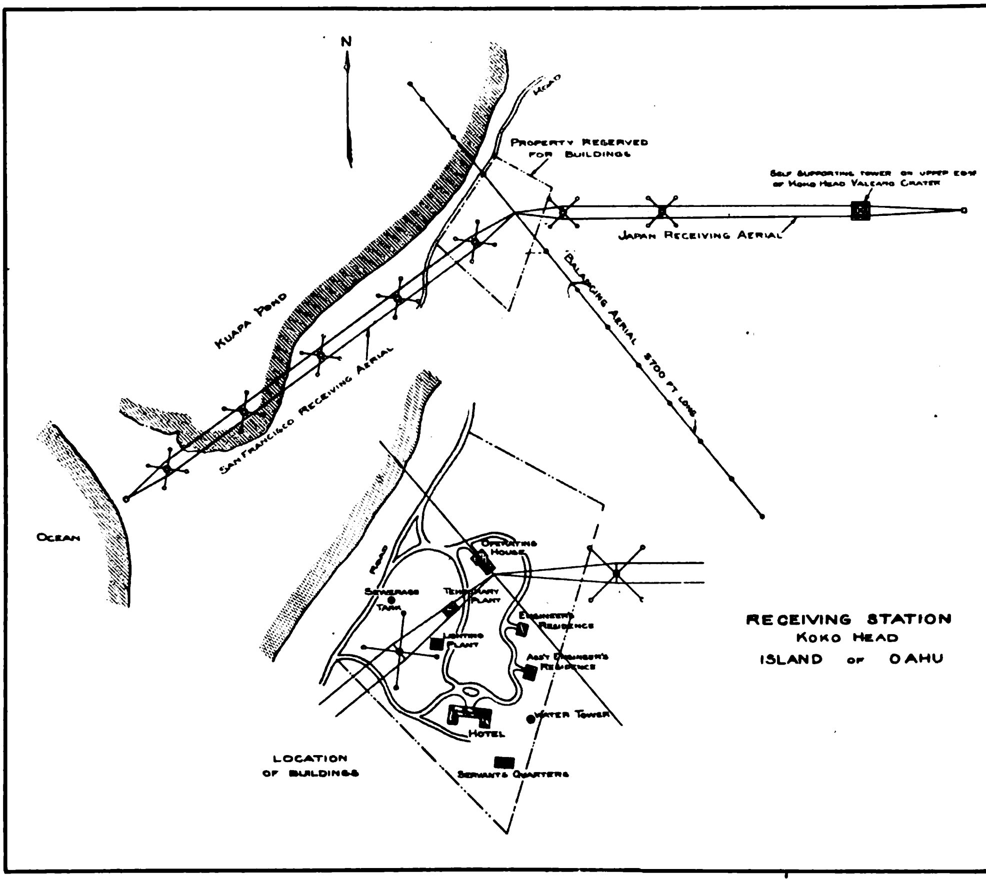
messages crossing the Pacific from Honolulu will be received. The large hotel and the 300 yards south of the line of the aerial; the operating building being nearly a ffth of a mile other structures.

owners of craft who cared to risk sending a barge across the passage without careful investigation. We finally enlisted the services of a Kanaka, who made his living by fishing in the bay. He showed us the channel, which was roughly "S" shaped, zigzagging through the ridges in the reef where the waves broke, with comparatively smooth water between. We were told that at high tide the depth of the channel was six feet.

After both methods of transporting the material had been considered, it was decided to attempt the task by the sea route. Accordingly a consignment of steel was placed on a small coasting steamer, the Molokai, commanded by a Hawaiian who had earned a reputation for skill in manœuvring his boat in and out of the numerous difficult landings to be met with around the island. A barge and a launch accompanied the steamer; the steamer could not get over the bar and we planned to unload the material on to the barge and have the latter towed ashore by the launch.

On the morning of the day appointed for the task, the steamer was off the reef in a choppy sea, with an off-shore breeze blowing. The barge was loaded with chains, ropes, tackle and gear for use in hauling the heavier pieces of material ashore. On top of these were placed steel cylinders for the mast and the mast erection cage. When the barge, handled by two Japanese sailors, was fully loaded it drew about four feet of water. A line was passed to the men on the launch, and after this had been made fast the trip to the shore began. The Kanaka fisherman, who was in charge of the launch, watched his opportunity and shot the craft through the first line of breakers so skillfully that very little water was shipped. As the barge approached the reef, the Japanese sailors, in order to avoid the drenching shower of spray, climbed into the wooden erection cage. The Kanaka fisherman was not so successful in negotiating the second line of breakers, for two big combers rolled over the barge, and it sank just before it cleared the reef.

The launch slipped the cable and turned to rescue the sailors in the erection cage, which floated away when the barge sank. The wind was off shore and it drove the cage again and again on to the reef, moving it continually westward and away from the channel. For two hours the launch stood by, trying to get near enough to rescue the men, but without success. They were comparatively safe, however, and ducked into the shelter of the cage whenever a big wave broke over it. After it became apparent that the men could not be rescued by the launch, the fisherman's canoe was obtained and paddled near the reef where the cage had drifted. After much buffeting and bobbing about, the cage finally became wedged in the reef at a point where the Japanese sailors were able to get out and wade through the water to the canoe, which eventually brought them to shore, very cold and suffering from



exposure. They were sent to the steamer with an order for hot coffee and a rest.

While the rescue was being effected, a whale boat had been lowered from the steamer and some material placed in it. The launch towed the small boat over the reef successfully, and the remainder of the consignment was unloaded in this manner without further mishap. About a week later the cage was picked up off Diamond Head, showing little evidence of its rough usage on the reefs and, with practically no repairs, it was put into service at the station.

This experience in transportation demonstrated that the sea route was neither safe nor speedy and consequently the greater part of the material has been hauled to the site by road.

While the experiment of carrying the material by water was under way, transportation by road was given a trial. The first loads started from Honolulu soon after midnight, and before Kaimuki was reached rain began to fall. It was not anticipated that there would be rain in the Koko Head district, and the caravan proceeded. When it reached the shore the rain was falling as only a tropical rain can fall. The road, which was built of red clay mud, softened and became so slippery that the wagons could not be kept in a straight course, the rear wheels slipping off to one side wherever the surface of the thoroughfare sloped. Material fell from the wagons, parts of harness broke and wheels were put out of commission as a result of the bad roads.

This was discouraging enough, but more trouble came when the caravan started along the trail around the pond. That part of the road not constructed of rough rocks was soft and muddy; the surface of the thoroughfare was seldom level, and consequently the wagons slid sideways. One of the vehicles slid off the road toward the pond, and was brought to a stop by trees, one being in front and the other behind the wagon. Considerable delay followed before it was again placed on the road. After shifting most of the loads and doubling up on the teams, the material was finally brought piecemeal to the site. The most serious mishap that occurred during the trip was a broken axle.

We have improved the roads considerably by regrading and building bridges over the pond. Most of the trucking is now being done by automobile, which insures a better and cheaper means of hauling than that given by horse-drawn vehicles.

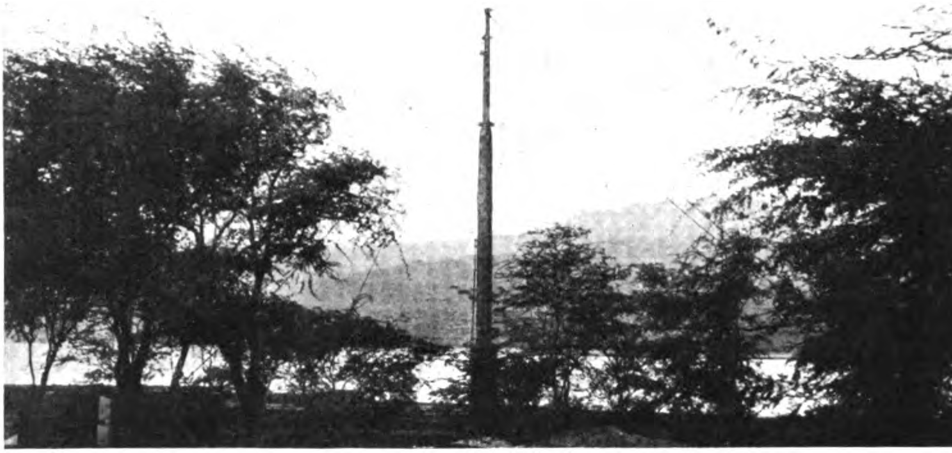
There has been more rain in the district than we anticipated, several heavy storms having taken place since we began the construction work. On one occasion the rain fall was so great that the camp was in danger of being washed away. The encampment is laid out on a slope to the pond, and whenever a rainfall of any proportions takes place the water pours over the incline in small torrents.

The inadequate water supply has given us much trouble. It was found easy to obtain well water, but it ran about forty grains of salt to the gallon, which destroyed its value for drinking purposes. After scouring the nearby hills in search of a water supply, we decided to distill all our water used for domestic purposes.

The sand required for concrete is drawn up from the beach and, although it is somewhat salty, makes a good quality of concrete. In order to obtain stone, it was necessary for us to open a quarry of our own; some distance away we found a good quality of volcanic trap rock, which is blasted out and run through a crusher.

The map of our Koko Head property gives a very good idea of the layout of the station. From the operating house as a center, the San Francisco aerial extends southwestward, carried on five 330-foot masts, to an anchorage on the beach. The Japan aerial extends from the operating house almost due east. The first two masts are of the standard sectional type, four hundred and thirty feet high; the first is on level ground and the second is on a hillside. From this point the aerial makes a long span of over

From disheartening experience transportation of materials to Koko Head by the sea route has proven neither safe nor speedy. Consequently the greater part of the material has been hauled to the site by road. When this was first tried in the midst of a tropical downpour the wagons slid sideways off the muddy roads and the material finally had to be brought piecemeal to its destination. The roads have been improved by regrading and the bridge shown in the photograph has been built across the pond.



Starting work on mast No. 3 at Koko Head. This station is located at the southeastern end of Oahu Island, Hawaii, about ten miles east of Honolulu. All of the islands were formed by volcanic disturbances, and on some the volcanoes are still active. On Oahu, however, they have long since become extinct; in fact, we defied old Koko Head by running our receiving aerial up its side and sinking the tail of the anchor far down in the crater.

2,000 feet to the top edge of Koko Head, at an elevation of 1,194 feet above the sea level; here there is not room enough to erect a sectional mast, only about forty square feet being available for a self-supporting structural tower, 150 feet high. The tail end anchorage is far down on the inside of the crater. The balancing aerial, which is employed in both sets of antennae, is on self-supporting towers, each of which is one hundred feet high. The only difficulty in erecting these is due to the fact that two of them and the anchorage are located in the fish pond and it was necessary to sink caissons in order to lay the foundations. It was also necessary to sink a caisson to lay the foundation for the fourth mast of the San Francisco aerial.

The receiving station is so far from any town that it has been planned by the J. G. White Engineering Corporation as a community complete in itself, possessing water supply, sewerage and lighting systems. Progress in the construction of the buildings is being held back, pending the arrival of shipments of structural steel for roofing. The construction work on the buildings is similar to that on the stations in California. The buildings will be of steel and concrete, roofed with tile.

The transmitting station at Kahuku can be reached either by road or by rail. The railroad, starting from Honolulu, runs around by way of the western shore of the island past Pearl Harbor, where the government is building a great naval base; a spur track runs from the main line to the Naval Reservation. After leaving the harbor the line runs inland and passes over sugar and sisal plantations; at Waimaualo the road turns northerly and reaches the shore, which it follows to the most western point, Kaena Point. This is a picturesque spot, the line being built along the face of the cliff around the point; the sea dashes against the rocks, sending so much salt water and spray over the track that it is necessary to keep the rails painted.

As the line sweeps northeastward, the coral shelf protecting the foothills broadens until at Kahuku it is over a mile wide; it is on this flat coral shelf that our power station is being erected. The railroad ends at Kahuka; it was built for the benefit of the sugar plantations and is a narrow gauge road.

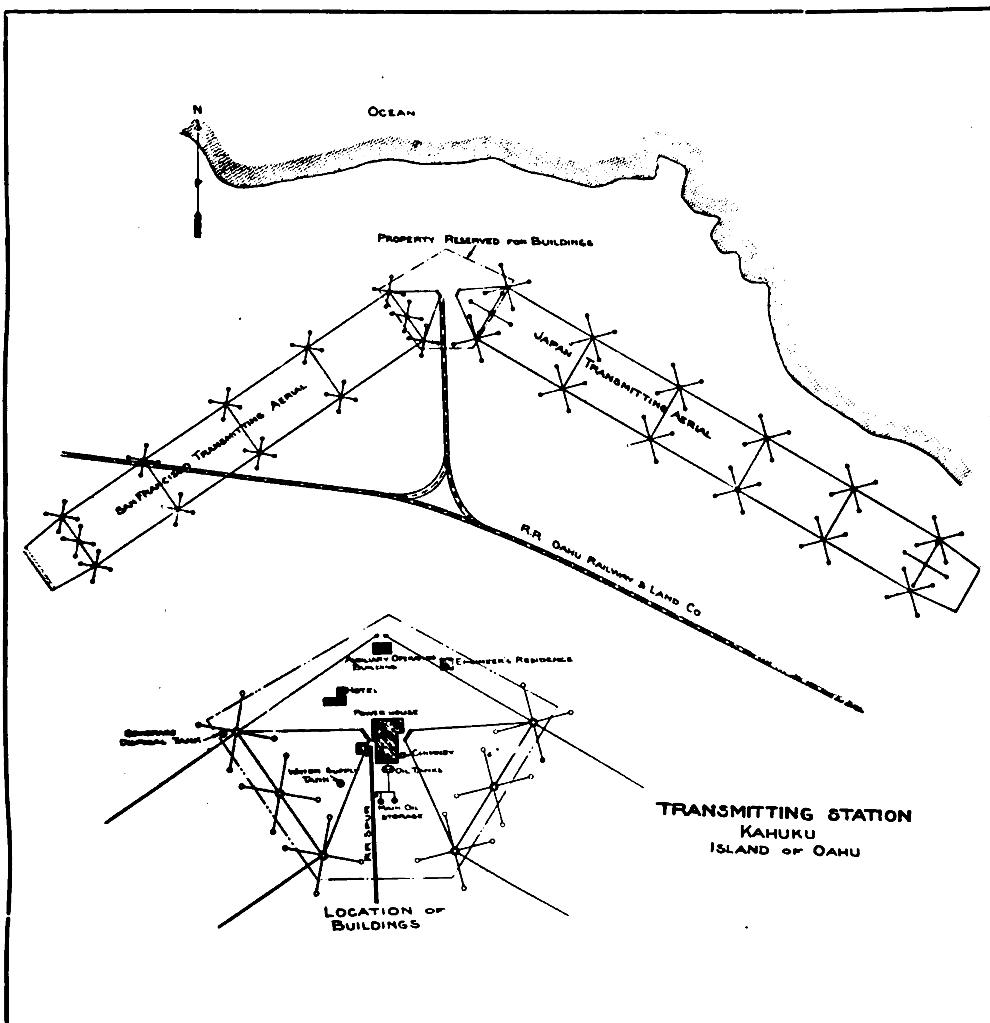
There are two wagon roads which may be followed from Honolulu to Kahuku.

One runs around by the eastern side of the island; the other runs past the Naval Reservation, cuts across the island to the northern shore and follows the railroad to the station.

The construction work at Kahuka presents no particular engineering difficulties. The chief point of interest lies in the size of the entire station.

From the power house as a center, the San Franscico transmitting aerial extends southwestward, supported by twelve masts 325 feet high; the Japan aerial extends to the southeast supported by fourteen masts, 475 feet high. These masts are the largest that have yet been constructed on the Marconi system of sectional cylinders. The power house will consist of boiler room, engine room and condenser room. The boilers are oil-fired and will feed three 500 horse-power turbines, which drive the special alternators and Marconi disc dischargers. The condenser room will accommodate 768 large oil type tank condensers.

The prevailing winds at Kahuku are from the northeast and the breeze is almost continuous: it is always laden with salt spray, so that it behooves us to use every precaution to prevent the masts and stays from rusting. In order to guard against damage from rust it will be necessary to keep a force of riggers busy applying paint to the metal work.



TRANSMITTING STATION
KAHUKU
ISLAND OF OAHU

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November.—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London had met with no success. On the steamship he meets William Sidney, who offers to buy an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against accepting Sidney's proposition. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property.

CHAPTER III

THE little cabin where the wireless operator slept and did his work—sleeping quarters, sitting-room and office, all rolled into one—was located on the deck-house in the after part of the ship. Ordinarily, passengers were not allowed access to it; but then, neither were first-cabin passengers allowed aft to the second-cabin deck, nor the second cabiners to mingle with first-class passengers. These rules had been broken and were to be broken again that night on the Ostentacia.

Rules and regulations mattered little to Jefferson P. Rance. A fortune was at stake and a refractory uncle was to be brought to time. Besides, the inspiration for Rance's endeavors were the dark, lustrous eyes of the Only Girl in the World.

For Bonanza he had crossed the water; had done his utmost to smash the ill-considered plans of Uncle John Maglory; for her he had first come under Uncle John's displeasure and learned something of the injustice that leaves a smart and a heart-ache; and for her he would continue to fight, flinging his love as a gage at the feet of Fate.

His name was on the second-cabin passenger list. The present state of his finances made this necessary. And through making a virtue of necessity, he had been able to watch William Sidney, and to keep his presence aboard a secret from Uncle John.

This night, however, he had ventured out of bounds. The exigencies of the moment had led him to hurl caution to the winds. Now the truth was out and Uncle John had foolishly defied him and virtually sold Bonanza's birthright for the proverbial mess of pottage. Fifty thousand dollars for a mine with a foot vein of hundred-dollar rock! *A twelve-inch* vein! And true fissures, like that of the Bonanza, increased in value as the digging went down. That mine might easily be worth half a million!

Rance was sick at heart and discouraged. What under heaven had got into John Maglory? If he wanted to be a troglodyte, and keep his narrow little world somewhere in the Stone Age, what right had he to deny Bonanza Denbigh all the substantial benefits of civilization and progress?

Maglory, in an ugly temper, had sneered at the authenticity and questioned the statements of a message by wireless. It was that message of hope regarding the mine, caught out of the air by the man in the wireless house, that had led Maglory to shake his fist in the face of fortune and to run headlong into folly. That, and a pretty rage aroused by the unexpected meeting with his nephew.

But William Sidney had no more than an option. True, he had paid heavily for a chance to buy the mine in thirty days for fifty thousand dollars, and something like a cataclysm would be necessary to free the property; yet in mining affairs cataclysms often occur by chance, or may be invented. With what sort of a flood could Rance overwhelm the resourceful Sidney and save the Bonanza Mine for its namesake?

An entertainment was holding the attention of passengers in the second cabin. Music came faintly to Rance's ears as he sought his stateroom. He thought long and earnestly, and finally he wrote a message in a code long since arranged between himself and Lafe Kennedy. He looked at his watch. It was eleven o'clock. Resolutely he left the stateroom and climbed the ladder to the wireless house.

It would be better to give that message personally into the hands of the operator.

Johnnie Clendenning, the operator, had cleaned up a dozen messages and left his post temporarily. It was his wont, when there was no business pressing, to raid the second-cabin galley to the extent of one ham sandwich.

Rance rapped on the door. There was no answer. He did not rap a second time, but opened the door and walked in. He was there a moment later when Clendenning arrived, munching at his bread and ham.

"No visitors allowed in here," said the operator. "Captain's orders."

"I know," answered Rance, with a pleasant smile and a glance from the gray eyes that held a friendly gleam, "but I wanted to give you a message."

Clendenning had laid aside his sandwich for a moment to adjust his tuner. He would soon be getting the press news, for which the ship had subscribed, and the important SP would presently come to him out of the depths of the night.

He bade Rance a significant good-night as he took the message and reached for the switch handle. Rance passed to the door, paused there and turned back.

"I wonder if Mr. Sidney, Mr. William Sidney, has sent a message this evening?" he queried.

The operator smiled. "Search me," he answered slangily. "I've sent a number of messages to-night, but there are some things I can't remember." Then he nodded and Rance went out. "A trifle nosey!" commented Clendenning to himself, "but he appears to be an on-the-level sort of chap and I rather like him. Why the deuce is this William Sidney bothering him?"

But the operator had no time for speculations. The call he was expecting came to him and for several minutes he was more than busy.

Rance descended to the deck, hesitated a moment and then passed slowly along the side of the after deck-house to the end of the ship. Here there was a bench and he paused, drawing a quick breath. In the half gloom could be seen a slender, closely-cloaked figure sitting on the bench, leaning back against the end of the deck-house with an air of patient weariness.

The Atlantic was like a pond. The moon cast silvery beams across the wavelets. The rumble of the engines sounded faint and far-away, and the churning waters under the vessel's stern lisped softly as they bubbled far out into the flashing wake.

Rance walked quickly to the bench, seated himself and passed a protecting arm about the slender figure.

"Bonnie," he whispered, "I told you not to do this again! If Uncle John knew——"

"But Uncle John won't know," came the answer. "He is in bed and asleep. And oh, Jeff, I just *had* to see you once more. You were expecting me, weren't you?" There was a suspicion of laughter in her voice.

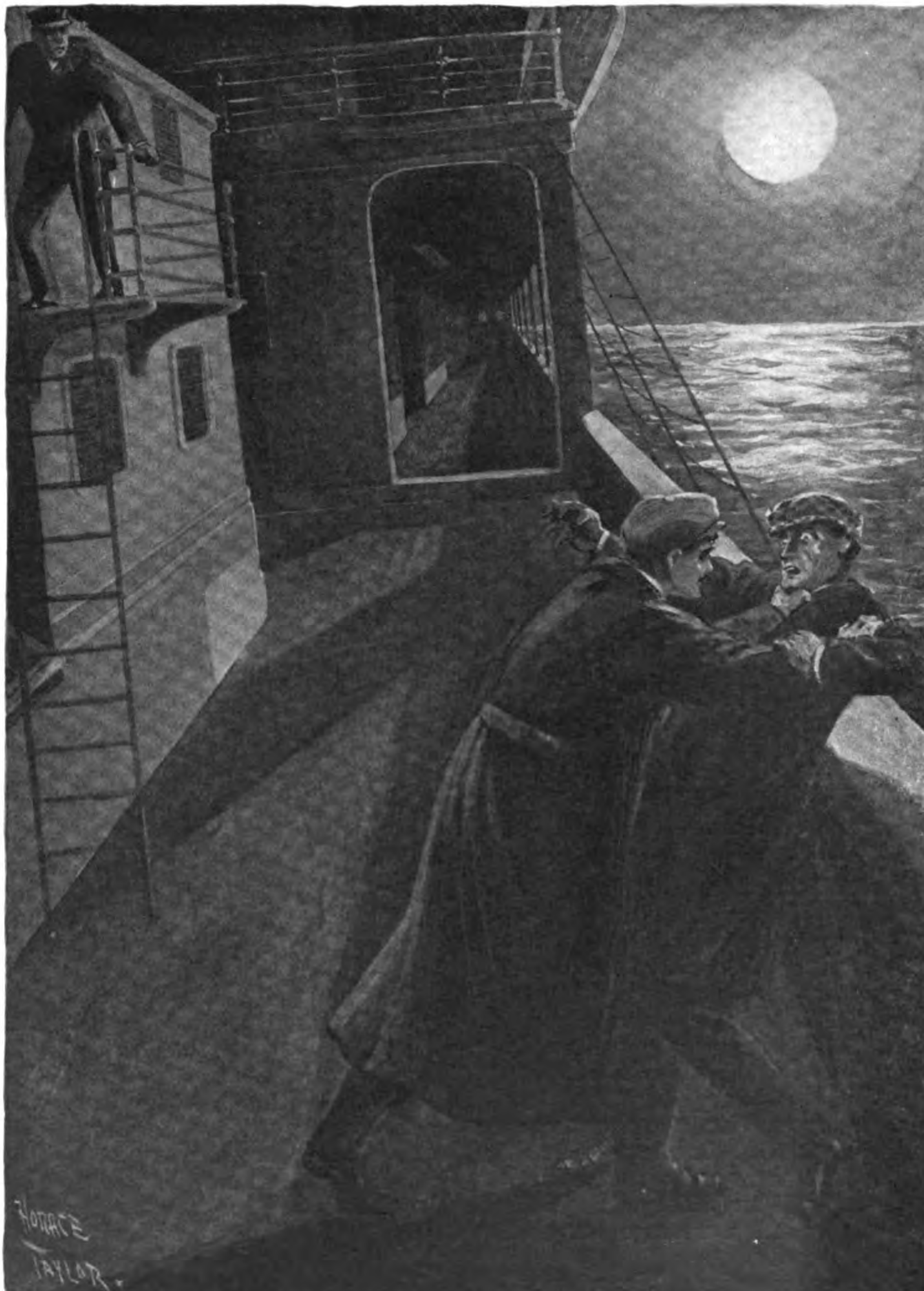
"Why do you think I was expecting you?" Rance asked, as he swayed closer to her.

"Because you are here, yourself."

Rance chuckled. "Well, if you pin me down, I'll have to admit that I was hoping against hope—and hoping where I shouldn't. It is really too bad that you should be taking all these chances, dearest. There would be an explosion if Uncle John ever learned of your bribing the second-cabin stewardess and stealing away to meet the outlaw and the black sheep of the family."

Two white hands fluttered to the arm with which Rance was pulling the cloak more securely about the slight figure.

"Jeff, dear, don't!" breathed the girl. "I won't have you call yourself names. You have tried to do a lot for me, and I know how generous and good you are,



He leaped forward and gripped Sidney's throat. "You'll talk about Miss Denbigh, will you?" he breathed.

even if Uncle John doesn't. Some day everything will be different."

"Some day!" repeated Rance, with a tinge of bitterness. "When? The day I marry you out of hand, and in spite of Uncle John! That will happen, dear, and it will not be pleasant for Uncle John, nor make a friend of him, believe me!"

"You must make a friend of him before that."

"How? Not by sacrificing your interests!"

"They are already sacrificed, if you want to call it that. But we have five thousand dollars and, in thirty days, will have forty-five thousand dollars more. Mr. Sidney does not seem to be such a sharper, after all, Jeff."

"That's not a tenth part of what you ought to have!" exclaimed Rance, hotly.

"Oh, Jeff, please be satisfied!" begged the girl. "Don't antagonize Uncle John any further. Can I forget," a note of sadness creeping into her voice, "that I am the one who came between you and your uncle?"

"You are not the one!" he declared vehemently. "He thinks me a rake and a gambler, a ne'er-do-well, and a whole lot of other things that allow me not the shadow of a right to take you for my own. Only by proving to him that I am not what he thinks can I overrule his objections to the rest of it. But in favor or out, as long as I live and breathe, Bonnie, I am going to do what I can to save that mine for you."

Bonanza sighed helplessly. She was caught between love and duty to Uncle John, almost a second father to her, and the wealth of love she cherished for Rance. There seemed to be nothing she could do to make peace between those whom she held dearest.

"Surely, Jeff," she murmured, "you will have to give it up now! Sidney has his option. It will be only a month until he has the mine."

"I have sent a message to Kennedy," was the slow response. "Perhaps, in a few days, Sidney won't be so anxious to buy the mine. It is just possible, too, that he will be willing to lose the five thousand dollars and forfeit his option."

"What have you done, Jeff?"

A step on the deck caught Rance's attention. He glanced around hurriedly and saw a dark figure emerging from the shadows on the starboard side of the deck-house. The figure paused, peered for a moment at the two on the bench, and then moved on to the rail at the ship's stern.

Rance withdrew his arm from Bonanza's shoulders. His body stiffened.

"You had better go now," he whispered in the girl's ear. "And don't come again, Bonnie. When we meet next time, let it be at Ragged Edge."

The girl did not move. "That man is William Sidney!" she murmured, tensely. "What's he doing here?"

"Please go before he recognizes you," insisted Rance. "Maybe it is too late for that already, but there is still a chance."

Sidney stood at the rail, gazing lazily into the bubbling wake of the steamer. Rance swiftly pressed his lips to the girl's, almost lifted her to her feet and walked a little way forward with her.

"Did you have an appointment with him?" insisted the girl in a frightened voice. "Has he come to meet you?"

"I had no appointment with him, but the opportunity for a talk is too good to be passed over."

The menacing ring in Rance's voice alarmed Bonanza.

"Talk with him, Jeff," she said, "but hold your temper. I know you better than you know yourself, and all the mines in the world could not make up to me the loss of an atom of my faith in you. Remember that!"

She turned from him and moved away through the shadows. A blur of light showed suddenly above her as the door of the wireless house opened and closed. Clendenning was coming out to take the air on top of the deck-house before turning in. It was a habit with Clendenning.

CHAPTER IV.

"Ah, Mr. Rance. An unexpected pleasure, I assure you. Sorry if I interrupted a tête-à-tête. I am in this part of the ship entirely by chance."

Rance had approached and taken his place beside Sidney at the rail.

"I wonder," he observed.

"Wonder?" echoed William Sidney, with just the suggestion of a chuckle. "Good word that, and appropriate. It is a wonderful night, almost anybody might wonder—about many things."

"I was wondering," continued Rance quietly, "whether you are really here by chance, or whether some deck-hand might not have suggested——"

"You do me wrong," the other interrupted, calmly. "In fact, Rance, you seem rather given to questioning my motives. I am sorry. Really, my boy, I should like to be a friend of yours."

"You can be no friend of mine, Sidney. When it comes to friends, I do my own picking and choosing. And another thing. It isn't necessary for you to hem and haw, and side-step with me, not for a holy minute. I had your measure before you ever left Denver for London. Your brother Chet, out in San Simone, helped me to it."

"I have no brother Chet out in San Simone," said Sidney, coldly.

"Down around Ragged Edge we call a spade a spade," went on Rance, calmly, "and I'll throw your character on the screen for a minute just to prove that I know you lie. You were——"

"Be careful, young man!" Sidney drew himself up close to the rail and his eyes gleamed in the shadow of his hat brim. "You are talking to a gentleman, Rance, and not to a yellow dog of your own stripe."

The words came hot and insolent, and Arizona friends of the man at whom they were aimed would have been surprised at the way he took them. He laughed under his breath.

"I'm talking to a clever pirate," proceeded Rance, "a man who sails the seas of commerce and loots and scuttles every honest craft that is not too heavily armed. Guile is your trump card, and you never sit in a game without a table hold-out, or the choice of the pack up your sleeve. Now, my fine gentleman, listen to this. You're a wild-catter, a shark, a two-faced juniper, and you would stick up a stage or snake a game of faro—if you could do it safely. You think you've got your claws on the Bonanza Mine and that you can rob a woman by playing upon the prejudices and weakness of John Maglory. But you've forgotten one thing, and that is that you have to figure me in your calculations. I'm in this game with both feet! Get me?"

Rance swung on his heel. He would have walked away and left Sidney scowling in the moonlight had not a quick hand reached out and stayed him.

"You say you have my measure, Rance," said Sidney, his voice tremulous with anger. "How about yourself? I know a thing or two, and it comes mostly from your uncle, who ought to know. What have you ever done that is a credit to you? Just where do you get off in this little game of sterling integrity and high-minded virtue? Don't call the kettle black, Rance. It's not healthy."

Rance, usually quick tempered, held himself well in hand.

"My uncle is misinformed," he returned, "and what you have learned about me is wide of the truth. Even at that I don't think you have learned a whole lot. You went to London to queer the deal John Maglory was trying to put across. So did I. When I discovered what your purpose was, I was content to let you carry it out. You seemed to have influence where I had none at all, so you succeeded where I should probably have failed. You were working to get the Bonanza Mine into your hands, and you have played your cards well. You think you have cozened and thimble-rigged Maglory—but he's not the only one you have to fight. Pretty soon you are going to hear from me. If you have that option in your pocket, Sidney, you might as well turn it over and save yourself trouble. I'll see to it that you get back the five thousand dollars."

"I was born to trouble as the sparks fly upward," said Sidney, laughing unpleasantly, "so make your little play, Rance, whenever you get good and ready. Against your uncle's wishes you continue making love to Miss Denbigh. She has been meeting you here at the dead of night, after first making sure that Maglory was asleep in his stateroom. A nice sort of man you are to put a girl up to such tricks and—hands off!"

Rance's temper had leaped beyond control. Mention of Bonanza, by this man in such a way, had spurred him to fury. He leaped forward and gripped Sidney's throat.

"You'll talk about Miss Denbigh, will you?" he breathed. "You worm! She is the girl you are trying to rob, and her name on your lips is an insult!" The strong fingers closed tighter. "I've half a mind to toss you over this rail—you and your crooked option! It would be an accident at sea and no one the wiser. If I am all that you say, my fine gentleman, what is to prevent?"

Steadily Rance bent the other backward over the rail. An abyss yawned at the steamer's stern, with a thrashing screw and a bubbling cauldron at its bottom. Sidney fought with desperation. The minutes passed. Then one hand, groping wildly, found and jerked into sight a revolver.

Clendenning was watching the quarrel from the roof of the deck-house. He descended swiftly, as the climax approached, and now ran along the side of the house and hurled himself into the struggle. With one hand he caught Rance, and with the other he disarmed Sidney.

"That will be about all of this," said he sharply. "Now break away!"

(*To be continued*)

SEVEN NEW CLASSES OF MESSAGES ADMITTED INTO SERVICE

Seven new classes of wireless messages have been admitted into the radiotelegraphic service in the United States, the president of this country having signed the proclamation promulgating the London International Radiotelegraphic Convention. The order applying to the new classes of messages went into effect September 1, 1913. The convention also placed the control of wireless communication within the range of any coast station in the hands of the latter, and stipulated that vessels should not communicate with one another if the messages interfered with the operation of the land equipment.

The new classes of messages are as follow: Messages with the answers prepaid; messages calling for the repetition of messages (for verification); special delivery messages; messages to the delivered by mail; multiple messages; messages calling for the date and hour of the transmission of other messages from coast stations to vessels, and paid service messages.

The regulations of the convention provide that the sender of a message can prepay a reply of not less than ten words via American coast stations. He will be charged for the forwarding expenses for the reply message on the minimum basis of ten words.

The receiver of a reply prepaid message is given a voucher equal in value to the amount prepaid for the reply. The voucher is good for six weeks only. The receiver of a reply prepaid message is not bound to send a reply to the sender of the original communication, but may apply the value of his voucher to the payment of any wireless dispatch.

For the purpose of verification the sender of a message may have it repeated at each station during transmission by paying the ordinary charge, plus one quarter.

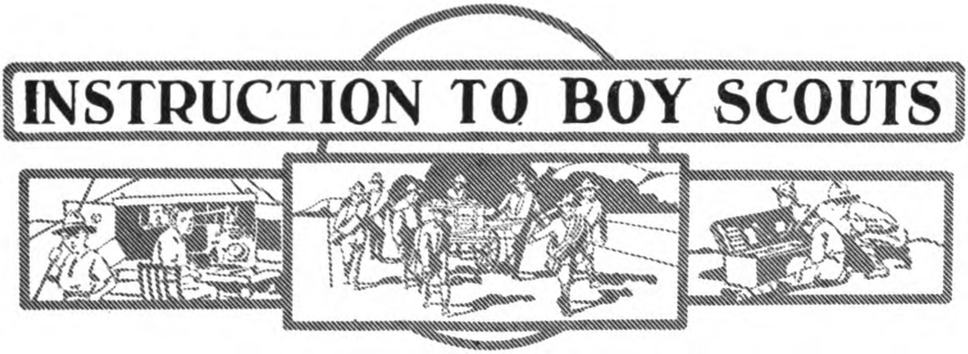
Special delivery messages are dispatches which call for delivery beyond the limits of a telegraph office. These messages, the Convention stipulates, should be accepted only in cases where the charge for special delivery is paid by the addressee.

Messages to be delivered by mail should be sent by post by the coast stations receiving them. In some cases it may be necessary to forward by land line and then by mail.

A multiple message is one addressed either to several persons, or to one person at several addresses. This kind of a message is not recognized by the land lines in the United States, which charge for it as so many different communications.

Notifications, in response to messages calling for the time of transmission of other communications, will be sent either by telegraph or mail at the option of the sender. If telegraphic notification is requested, the sender of the message will be charged for a five word telegram.

Service messages may be exchanged only between stations. They will be sent at the request of the sender of a commercial message and charged for at regular rates. They will be sent to rectify or complete addresses and texts, or to cancel messages.



By A. B. COLE

CHAPTER IV

Electromagnetic Induction

IF a bar magnet is plunged into a hollow coil of insulated wire, a galvanometer or a telephone receiver connected to the ends of the coil will indicate that an electric current is flowing through it, but only while the magnet is moving. If the magnet is allowed to remain stationary within the coil, no current flows. When the magnet is withdrawn from the coil, the current again flows around the latter, but in the opposite direction to the original current. The current is the result of the E. M. F. generated in the coil by the lines of force of the magnet cutting the convolutions of wire while it is in motion. The value of the E. M. F., developed in this way, will be in direct proproportion to the rate at which the magnet moves; that is, to the rate at which the lines of force cut the coil.

This current is called an ***induced current,*** and is said to be generated by ***induction.***

If, in the experiment mentioned, the coil and bar magnet wire were sufficiently large, it would be a difficult matter to plunge the magnet into the center of the coil, and an equally hard task to withdraw it suddenly, for the currents induced in the coil would flow in such a direction as to either repel or attract the magnet. They would tend in consequence to prevent any change in the number of magnetic lines of force passing through it.

The same general effect would be produced if an electromagnet were substituted for the bar magnet. If the electromagnet were placed inside the coil and did not move, no current would flow around the convolutions of the hollow

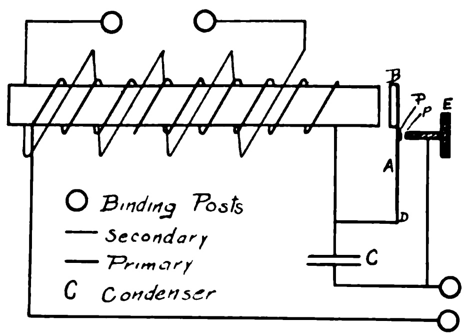


Fig. 21.—Diagram of Spark Coil

coil; but if the electromagnet were suddenly demagnetized, by breaking the circuit supplying it with current, a current would be induced in the hollow coil at the instant that the circuit was broken. If the circuit were again completed, another current would be induced in the hollow or outer coil, in the opposite direction to that of the preceding induced current. The currents induced under these circumstances are due to a change in the number of lines of force passing through the outer coil, as in the original experiment; for when the electromagnet is demagnetized, the number of lines quickly falls to zero, and when the circuit is again completed, they increase quickly from zero to maximum.

The E. M. F. induced in the outer coil will depend upon the *rate* at which the number of lines of force changes, and this in turn is dependent upon the rate at which the circuit of the electromagnet is broken and completed. The combination of an electromagnet whose circuit may be broken and completed many times per second, around which a coil of insulated wire is placed, is termed an induction or spark coil.

SPARK COILS.—Fig. 21 shows a diagram of connection for the parts of a spark coil. The electromagnet, which has a core made up of a bundle of soft iron wires, is termed the *primary* winding and the outer coil is known as the *secondary* winding.

In practice, the purpose of using a spark coil is to obtain a very high E. M. F. at the terminals of the secondary winding, and for this reason the coil is made of many convolutions of wire, which is generally of small diameter in order to reduce expense of wire. The primary consists of comparatively few turns of heavy wire.

The device which alternately breaks and completes, or "makes" the primary circuit, is known as the *interrupter*. This consists of a steel spring (A), having a platinum contact point (P). It is fastened at one end at (D) and the other end, which is free to vibrate, has a disk of iron (B) secured to it. The disk is known as the *armature* of the interrupter, and is placed before one end of the core. An adjusting screw (E) having a platinum contact point (p) is arranged so that its pressure on the point (P) may be varied at will.

When the coil is connected to a battery, the core becomes magnetized, and the disk (B) is drawn toward it. This breaks the connection between (P) and (p), and the core loses its magnetic properties. The tension of spring (A) then brings (B) back to its original position and the primary circuit is again completed, when the same operation is again repeated. The spring (A), therefore, continues to vibrate as long as current is supplied to the coil.

A condenser (C) is connected between the vibrator spring and the adjusting screw, and serves to permit the core to become demagnetized rapidly when the connection betwen (P) and (p) is broken, by allowing the momentary current thereby induced in the primary to discharge through itself. This results in the generation of a high E. M. F. in the secondary winding. The condenser also reduces excessive sparking between the contact points.

Spark coils, since they are portable and convenient, are used in radio outfits designed for field work.

TRANSFORMERS.—The principles of electromagnetic induction also apply to transformers, the purpose of which is likewise to develop high voutage currents. Transformers, however, unlike induction coils, operate directly from alternating current lighting or power circuits and require no interrupter of any kind. An alternating current is one which reverses its direction of flow periodically, and the average alternating current supplied for lighting purposes does this 7,200 times per minute. This is known as a 60-cycle alternating current.

The reversals of direction of flow accomplish the same result as the interrupter of the spark coil, for they cause the number of lines of force of any electromagnet connected to the circuit to change continually.

While some wireless transformers have cores similar in shape to those of induction coils, the great majority of those used by experimenters have what are

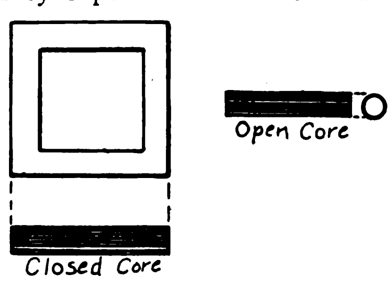


Fig. 22.—Open and Closed Cores

known as "closed" cores. These are rectangular in shape and are built of many sheets of soft iron. The type of core constructed of a bundle of iron wires is called an "open" core.

The shapes of these cores are illustrated in Fig. 22. In a transformer the primary is wound on one side or "leg" of the core, and the secondary is placed on the opposite leg. The secondary is generally wound in sections, or "pies," so that in case of breakdown in this winding the damaged section may be removed readily and the winding repaired without removing all of the wire.

Transformers are chiefly used in stationary radio sets.

Chapter V

Spark Coil Construction

The spark coil dimensions given in this chapter are those of coils which have been successfully built and used.

The 1-inch coil is the most popular size among amateur experimenters, as it consumes less current than the larger sizes and will give satisfactory service in transmitting messages up to five or six miles in connection with the average aerial. While it will not cover this distance in connection with a small aerial used in field work, it will be found suitable for general use; and to increase its range it is simply necessary to use a longer or higher aerial.

The spark coil is rated as a 1-inch coil because it will give a steady spark 1 inch in length when operated on 6 new dry cells or a 6-volt storage battery, if it is carefully built. The first item for consideration is the core, which is made up of a bundle of soft iron wires. This wire can be obtained from almost any hardware dealer. No. 18 wire may be used for the purpose, although smaller wire will do. Larger wire should not be used. A cardboard tube ½ inch in inside diameter with a wall 1/16 of an inch thick and a length of 5¼ inches is first made; this is filled with the iron wires cut to a length of 5¾ inches. The wires should be packed in closely, so that when finished the core is practically a solid rod composed of many wires. One half-inch of the core should project from one end of the tube.

Two layers of empire cloth are now wound around the cardboard tube and the primary winding of two layers of No. 18 D. C. C. magnet wire is wound evenly over this. The total number of primary turns will be close to 170. Care must be taken to wind the wire evenly. After the primary is completed it should be boiled in paraffine until thoroughly impregnated.

When dry, the primary is covered with

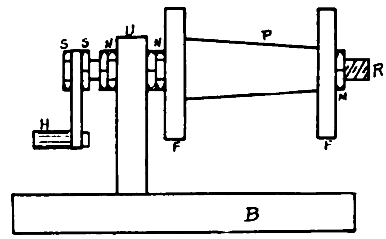


Fig. 23.—Winder for Sections

six layers of empire cloth, to insulate it from the secondary winding.

The secondary winding is made in two sections. The simplest method of constructing the sections is to use a hand magnet winder, similar to that shown in Fig. 23, unless a lathe can be used. The base (B) may be made of wood. A threaded metal rod (R) passes through a block of wood (U) mounted on the base as shown, and a handle (H), made in any convenient way, is attached to it by two nuts (S). Two pairs of nuts (N) on the rod prevent side motion. The spool (P) may be made of wood and should be tapered slightly so that the sections when formed may be removed easily. Two round wooden flanges (F) are turned out to hold the sections in place while the wire is being wound on. The removable flange at the right of the drawing is held on the rod by a nut (M) so that when it is removed the section can be taken off.

The length of each of the secondary sections is 1¾ inches, and the distance between the flanges should be the same.

The secondary wire is No. 38 enameled. About 12 ounces will be required if it is wound very evenly, as it must be if the coil is to give a full 1-inch spark. A layer of this paper of good quality is placed on the spool (P). Then a layer of wire is wound over the paper. Another layer of paper is placed over the wire, and a second layer of wire is wound over the paper. This process is continued until the section has a diameter of

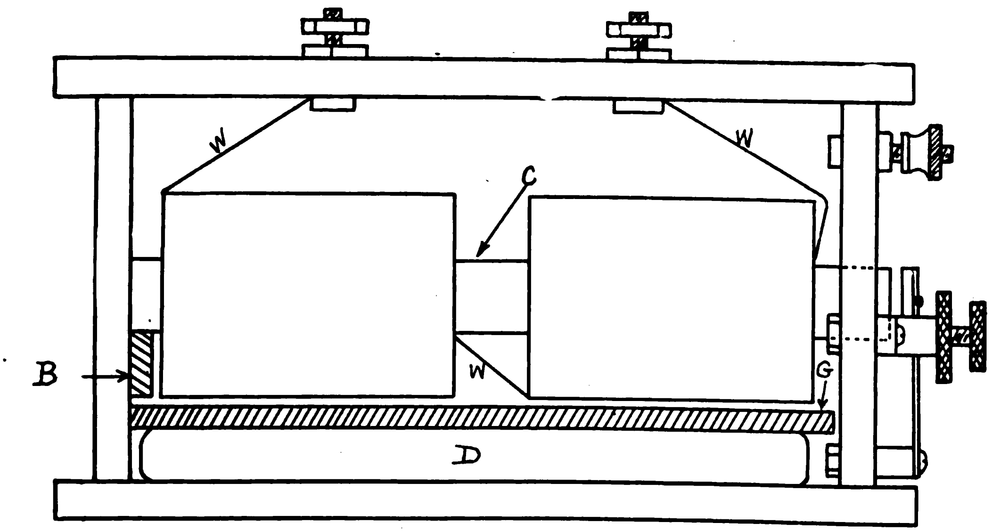


Fig. 24.—Arrangement of Coil Parts

1¾ inches. There should be a margin of paper projecting at each end of the winding of ¼ inch, and consequently the layers of wire will be 1¼ inches long.

When the sections are finished they should be immersed in melted paraffine for at least one hour. Unless all the air is driven out and replaced by paraffine, it is likely that the coil will break down where an air bubble remains.

After the sections have been removed from the paraffine and cooled they will be practically solid. They should then be slipped over the completed primary and connected together so that the current induced in the secondary wires will flow in the same direction in both sections. The coils should be placed on the completed primary as shown in Fig. 24, so that the end of the wire of the secondary section nearer the vibrator is the inner end, not the outer; it is desirable to have the low voltage end of the secondary at this part of the coil.

Fig. 24 illustrates the disposition of the parts of the coil in the case, which may be made of wood. (W) represents the wires connecting the secondary sections together and to the binding posts on the top of the coil case. The condenser, shown at (D), is now made by rolling sheets of tin foil, separated by paper sheets, to form a flat condenser about ⅜ of an inch thick, 3 inches wide and 6 inches long.

A sheet of thin paper of good quality, 6 inches by 86 inches, is placed on a table. A sheet of tin foil, 5 inches by 80 inches, is placed over it so that there is a margin of paper ½ inch wide on each side of the tin foil. Another sheet of paper of the same size as the first is then laid over the tin foil sheet and a second sheet of tin foil is placed over this. A third sheet of paper is placed over the second sheet of tin foil. The condenser formed in this way is rolled up to give the approximate dimensions mentioned. A short piece of insulated wire leads out from each of the two tin foil sheets and serves as terminals for the condenser.

The completed condenser should now be tested to find out whether the sheets of tin foil are in contact with each other. This is done by connecting a battery of one or two cells in series with it and a buzzer or a small incandescent lamp. If the sheets are in contact the buzzer or lamp will operate. If this be the case the condenser must be taken apart and the trouble located. If a good grade of paper is used no difficuty should be experienced from this source.

The completed condenser should be placed in hot paraffine for a short time and allowed to cool. It may then be laid in the bottom of the coil case and covered by a sheet of glass (G), 6½ inches by 3 inches. The glass is to prevent the secondary current from jumping to the condenser.

As illustrated in Fig. 24, the core passes through one end of the coil case and projects outside about ⅛ inch, so that it will be close to the interrupter. The other end of the core is supported by a wood block (B) which may be nailed to the wall of the case.

This coil operates best in connection with an interrupter of medium speed. For those who wish to build their own interrupters, we have illustrated the details of construction in Fig. 25, but it is more satisfactory to buy one. An interrupter is somewhat difficult to make, and the success of the coil depends largely upon it.

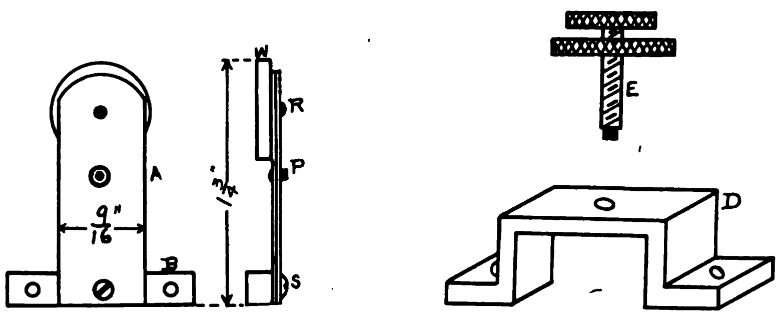


Fig. 25.—Interrupter Parts

The spring (A) is made of two strips of steel of the dimensions given. A rivet (R) passes through both and also the iron disk (W), which is 1/16 of an inch thick and ⅝ of an inch in diameter. The strip nearer the disk is free to move about 1/64 of an inch on the rivet, but the other strip is secured to the rivet and moves with it. The platinum point (P), which is ⅛ of an inch in diameter and ⅛ of an inch thick, is soldered to the strip nearer the disk (W) and passes through a hole 3/16 of an inch in diameter in the other strip.

A hole is drilled in both strips at the lower ends so that they may be secured to a brass block (B) by means of a screw (S). A brass adjusting screw (E) with a platinum point ⅛ of an inch in diameter and ⅛ of an inch thick is threaded to pass through a brass bridge (D). The completed interrupter is fastened to the coil case with screws, so that the disk (W) is directly in front of the end of the core, which projects slightly from the end of the case. The method of connecting the various parts of the coil is shown in Fig. 21.

In order to be certain that the secondary sections are properly connected, the coil should be tested on a 6-volt battery. If the spark produced is the full length, the sections are connected correctly. If the spark obtained is too short, one of the secondary sections should be reversed on the core and then the full spark should be produced.

For those who wish to build larger coils to operate over greater distances than those possible with a 1-inch coil, we give the following dimensions of coils which have actually been built:

COIL DIMENSIONS

In. Coil	In. A	In. B	No. C	D	No. E	Lb. F	In. G	In. H	I
2	7	⅝	18	184	36	...	2¼	5¼	1,400
3	8	¾	16	208	36	1½	3	6	2,000

A—Length of Core.
B—Diameter of Core.
C—Size of Primary Wire (D. C. C.).
D—Number of Primary Turns.
E—Size of Secondary Wire.
F—Weight of Secondary Wire (Enameled).
G—Approx. Diameter of Secondary.
H—Distance between Coil Heads.
I—Total No. of Square Inches of Foil in Condenser.

The larger coils are built in the same way as the 1-inch coil, but special care must be taken to well insulate the primary from the core and the secondary from the primary.

This is the third installment of instruction for Boy Scouts. The fourth lesson by Mr. Cole will appear in an early issue.

How to Conduct a Radio Club

By E. E. BUTCHER

This is the first article of a series telling how to conduct a radio club. Amateur club members will find these articles of inestimable value, and if the suggestions given are followed out they will lead to excellent results. Experimenters will be taught how to carry on practical work in wireless telegraphy, and full directions for carrying out interesting club-room demonstrations will be advanced. The series has been planned with the idea of eliminating the time ordinarily lost at meetings and to instruct the members as to the proper methods of conducting tests of universal value, as well as the very essential parliamentary procedure. The publishers are anxious to make this series an addition of priceless value to the literature of the wireless art, and suggestions from readers will be heartily welcomed.

THE United States of America has justly been called the birthplace of amateur radio telegraphy. In an effort to aid in the maintenance of this prestige, THE WIRELESS AGE has decided to assist youthful experimenters in founding and forming their radio clubs.

While a large number of these organizations already exist, it has been the writer's personal experience that many are not run to the best advantage. The affairs of the organizations have been conducted more or less loosely, the attendance has been irregular, and an air of hilarity, which is not conducive to serious thought, pervaded the meetings. The meetings of a radio club can be made intensely interesting, for there is no amateur "hobby" which will stimulate interest for research in scientific work like that of wireless telegraphy. It is the constant progressiveness of the art and its new applications that make it interesting.

A radio club should be conducted on serious, dignified lines. It should be educational, instructive and productive of advancement, for it is quite possible that some of its members will in time become radio engineers, and they will never regret the preliminary training which they received from the amateur organization. It is somewhat to be regretted that progress in the art has been prevented by a lack of interest and undefined principle. It is fortunate, however, that it is not too late to make amends. While the foregoing criticism is merited, in justice to the American amateur it must be said that in no country in the universe have youthful experimenters advanced to the point reached by the boys in the United States of America.

If you enter any amateur station today, what do you find? The most modern and improved types of sets in the world, including receiving equipment which is equal to that on a first-class battleship. Complete 500-cycle quenched spark transmitting sets have been found, which, while they cannot be considered marvelous when compared to other types of apparatus, are generally believed to be beyond the pocketbook of the average amateur. A number of amateurs are not getting the best results possible out of their radio equipments. This is quite evident from the communications constantly received by THE WIRELESS AGE.

It is the purpose of this article to outline the method of procedure to be followed in forming a radio club. It is to be followed by a series of articles describing experiments of interest to radio clubs in general. It is purposed also to keep these clubs informed on everything of interest to them relating to the latest and best developments in experimental raido telegraphy.

Generally speaking, it is not difficult for the amateurs in a given locality to get in touch with one another, for as soon as a new arrival erects a station and begins using the ether he is immediately communicated with by others in his vicinity. Names and addresses are readily ascertained in any city and it is a simple matter to start an organization.

How to Get Together

If in any city a radio organization has not already been formed, two or three amateurs should meet and forward a communication to a prominent magazine, inviting all the amateurs in their vicinity who desire to join a radio club, to open up correspondence. A short time afterward a circular letter should be sent to all responsive amateurs, indicating the date and location at which the first meeting of the club is to be held.

The following brief outline for the formation of the temporary organization in a general way represents the parliamentary procedure in general practice, boiled down to suit the needs of the amateurs. The outline of the constitution for a radio club has been made as brief as possible, but nothing essential has been omitted.

No reference has been made to by-laws. They are in reality amendments to the constitution and may be supplied from time to time at the business meetings of the club. Amendments generally refer to the actions of committees, enlarging or diminishing their powers, etc.

Temporary Organization

At the first meeting a temporary organization should be formed. This is a preliminary step to a permanent organization.

At the first meeting of the temporary organization, the presiding officer, known as the chairman, should be elected. Since, of course, none has been appointed, one of the amateurs present should rise and suggest that some person present be named to preside. Generally a quick vote is taken, and if the majority agree on a certain individual he may be considered as elected and should immediately take the presiding officer's chair. This appointment should be given preferably to one of those sending out the original circular letter to the amateurs. Those at the meeting should be guided in their selection of a chairman by his knowledge of parliamentary law.

The chairman should be supported by a recording officer, whom he may appoint directly. The recording officer is known as the secretary for the temporary organization. He should make a complete record of the proceedings of the meeting.

The chairman should then call the meeting to order. He should deliver a brief address, stating the reasons for which the meeting has been called, and invite a general discussion of the subject from those present.

An amateur should rise, addressing the chairman (if he is not known he should give his name). He is given full opportunity to state his views clearly—the possibilities and impossibilities of the enterprise under consideration and the general advantage of taking active steps towards forming a club. In this way all those at the meeting will be able to express their views regarding the subject.

If the consensus of opinion indicates that an organization is desired, it is in order for one person present to present a resolution which, for example, may be as follows:

Amateur addresses the chair: "Mr. Chairman."

The chairman acknowledges his right to the floor by calling his name: "Mr. Smith."

Mr. Smith, to the chair: "It seems to be the general desire of those present tonight that immediate steps be taken for the formation of a permanently organized radio club. I therefore propose that active steps be taken at once for the formation of a radio club among the amateurs of this city."

The chairman repeats the motion to the audience, and says: "The motion is now open for discussion."

If no discussion arises and no objection is offered, the chairman says:

(1) "All those in favor of the resolution respond by saying aye."

(2) "All those of a contrary mind say nay."

If the ayes and nays are about equal a vote by count should be taken for a definite decision.

Several committees may now be appointed. It is often customary to first appoint a Resolutions Committee. The members of this committee may be appointed directly by the chair or, if those present so desire, by a general vote.

It is the duty of the Resolutions Committee to draw up a definite statement, placing in form of a series of resolutions the general desires of the founders of the organization. The committee may withdraw from the meeting in order to decide upon the form in which the resolutions are to be put to the chair, and then ask that they be acted upon by those present in the regular manner.

A second committee, to be known as the Nominations Committee, may be formed. The members of this committee are appointed by the chair if those present at the meeting so desire. It is the duty of the Nominations Committee to suggest or to place before the meeting, for nomination, the names of amateurs for election as officers of the permanent organization.

A third committee, to be known as the Rules and Regulations Committee, should be appointed. It is the duty of this committee to take active steps to draft a constitution and by-laws for the permanent organization.

Before the permanent organization is founded, a fourth committee should be formed to determine the eligibility for membership of those at the temporary meeting. The committee may have full power to investigate and determine in whatever way it sees fit whether or not those who wish to join are eligible.

It is understood, of course, that the committee will express the general desires of those originally forming the radio club. As a suggestion, no one should be allowed to join the club as a full member who has not been actively connected with amateur radio telegraphy for at least one year. It should be further stipulated that in order to be eligible for full membership the applicant must be thoroughly familiar with the United States laws pertaining to amateur radio telegraphy. (Copies of these rules and regulations can be secured from the Department of Commerce and Labor, Washington, D. C., or the district radio inspectors.)

All committee reports must be presented to the chair for reading by the recording officer. It is then in order for some one to present a motion for adoption or acceptance of the report of the committee. When a motion is offered by a person present it must be seconded by another in the audience. After it has been seconded a vote should be taken to determine the general sentiment of those present.

Permanent Organization

Generally speaking, it is advisable that the meeting of the temporary organization be held first and the appointment of committees made as suggested.

The affairs of the permanent organization can be handled at a second meeting. This will give the various committees sufficient time to carry on their deliberations properly. It is, however, possible to effect the entire organization at one meeting, although better results will be obtained if the founding of the permanent organization is postponed to a later date.

When the permanent organization is to be effected, the various committees previously mentioned should report to the chairman. Usually the chairman of each committee reads his report before the entire assembly and the chairman of the temporary organization requests that action be taken.

The membership committee should offer its report first. It should name those eligible to membership in the club, and a general vote of all present should be taken. If there are any present who are not eligible to membership they should leave before further business is taken up.

The Rules and Regulations committee should report next, stating clearly the constitution for the club. An outline of a constitution suited to general needs follows:

Article I

Sec. (1). The name of this association shall be —— THE RADIO CLUB OF NEW YORK CITY —— or the —— THE CLEVELAND WIRELESS CLUB —— or the —— ALLIED AMATEUR RADIO CLUBS OF CHICAGO —— etc., etc.

Sec. (2). The object of this club shall be the bringing together of the amateurs of this city who are interested in the advancement of radio telegraphy and desire to become more familiar with the radio art. Progressiveness shall be the keynote of this organization, and a general diffusion of knowledge pertaining to radio telegraphy its endeavor.

Article II

Sec. (1). The membership of this club shall be divided into two classes, FULL MEMBERS and STUDENTS.

Sec. (2). Full members shall be those who have been actively connected with amateur radio telegraphy for at least one year and are able to receive messages in the Continental telegraph code at a speed of at least five words per minute.

Sec. (3). Students are those who have had no previous connection with amateur radio telegraphy, but are interested in the art and who, in order to familiarize themselves more fully with radio apparatus, desire to join a radio club.

Sec. (4). A full member shall not be less than 16 years of age, and a student not less than 12 years of age.

Article III

Sec. (1). The entrance fee (payable upon admission to the club) shall be $1 for full members and 50 cents for students.

Sec. (2). The annual dues for full members shall be $2, and for students, $1.

Article IV

Sec. (1). The officers of the club shall be a

President
Vice-President
Secretary-Treasurer

(the latter office shall be filled by one member).

Sec. (2). The President and Secretary-Treasurer shall be elected for six months and the Vice-President for one year. The President and Secretary-Treasurer shall not be eligible for immediate re-election to the same office.

Sec. (3). The terms of the officers elected at any annual meeting shall begin on the second meeting of the club following the election.

Article V

Election of Officers.

Sec. (1). Election of officers shall take place once every six months.

Article VI

Management of the Radio Club.

Sec. (1). The management of the radio club shall be in the hands of the President, Vice-President and Secretary-Treasurer, who, in addition to their regular duties, shall be known as the Board of Directors.

Sec. (2). The Board of Directors shall direct the care and expenditure of the funds of the club, shall receive and pass on all bills before they are paid by the Secretary-Treasurer, and shall decide upon the expenditure of all moneys in various ways.

Sec. (3). The Board of Directors shall from time to time adopt a series of by-laws which will govern the procedure of the various committees which are later to be formed.

Sec. (4). The President shall have general supervision of the affairs of the club under the direction of the Board of Directors. The President shall preside at the meetings of the club and also at the meetings of the Board of Directors.

Sec. (5). The Secretary-Treasurer shall be the executive officer of the radio club, under the direction of the President and Board of Directors. The Secretary-Treasurer must attend all meetings of the radio club and of the Board of Directors, and record the proceedings thereof. He shall collect all membership fees due to the club, and shall give receipt for same. He shall have charge of the books and accounts of the club. He shall present, every three months, to the Board of Directors, a balance sheet showing the financial condition and affairs of the club.

Sec. (6). Three committees shall be formed:

(1). A Library Committee.
(2). A Meetings and Papers Committee.
(3). An Electrical Committee.

It shall be the duty of the Library Committee to keep the members of the club familiar with the latest articles pertaining to wireless telegraphy appearing in various publications, and to see that the literature and books of the club are properly kept on file.

The Meetings and Papers Committee holds the most important position of all. It shall be the duty of the members of this committee to make the meetings of the club of interest to all, particularly as regards intellectual development. It shall also be their duty to make the meetings of scientific and electrical interest to the members of the club, and they shall do all in their means to enhance the knowledge of the members of the club in matters pertaining to radio telegraphy; they shall also see that once each month a paper is read by an amateur member, chronicling interesting experiments which he has performed or suggestions he has to make.

The Electrical Committee shall have direct charge of all the experimental apparatus in use by the club. The members of the committee shall see that the apparatus loaned by various members of the club is well taken care of. The Electrical Committee shall conduct all experiments and shall see that these are performed in a scientific manner.

Article VII

Sec. (1). The semi-annual business meeting of this radio club shall be held on the first Tuesday in November and on the first Tuesday in April of each year. At this meeting a report of the transactions of all meetings of the previous year shall be read and the semi-annual election of officers shall take place.

Article VIII

Sec. (1). The regular meetings of this club shall be held on Tuesday night every week throughout the year. Every fourth meeting shall be devoted to the reading of a paper on radio-telegraphy by one of the members present.

After the constitution and by-laws have been agreed upon and accepted by the members present, it will be in order for the Nominations Committee to present to the chairman a report on the nominees for the various offices to be filled. If the nominees are accepted, a general election by ballot shall take place. These officers should be elected in accordance with the constitution and by-laws adopted.

Quarters

A radio club should, if possible, maintain quarters of its own. It is possible in the majority of cities to secure a room at a low price in one of the less prominent buildings upon which may be erected an antenna of fair dimensions. If the finances of the organization will not permit this, it is best that the meetings be held at the station of the member having the best facilities for the accommodation of the members and an antennæ well suited for their experiments.

Antennae

It is particularly important that the location of the club rooms be where it will be possible to erect a first-class antenna. There should be two separate and distinct antennae, one of the inverted "L," flat top type, having dimensions of about 50 feet in length and 40 feet in height. This will permit radiation at a wave length of two hundred meters to comply with the government law. The second antenna may be swung parallel to it and its length may be anything up to 500 feet. The longer antenna is for the purpose of receiving the longer wave lengths from the various high-power stations. The shorter antenna is strictly for the purpose of sending and receiving to amateur stations.

The Clubrooms

In the clubroom there should always be on hand copies of all magazines pertaining to wireless telegraphy, particularly those containing accurate and authoritative information. The apparatus room should contain a blackboard to be used in the drawing of circuit diagrams and for the explanation of apparatus.

At the earliest possible moment the members should raise a fund for the purchase of books on technical wireless telegraphy. These are to be added to from time to time until the library is considered quite complete. These books will do at the start:

Manual of Wireless for Naval Electricians for 1913, by Commander Robison.

Principles of Wireless Telegraphy, by G. W. Pierce, A.N., Ph.D.

An Elementary Manual of Radio Telegraphy and Radio Telephony, by Ambrose J. Fleming, M.AD.ScF.R.S.

The Year Book of Wireless Telegraphy and Telephony for 1913, Marconi Publishing Corporation.

Wireless Telegraphy and Telephony, by A. E. Kenelly, A.M. Sc. D.

Wireless Telegraphy, by Gustav Eichorn.

Radio Stations of the United States, (Department of Commerce and Labor), July 1st, 1913.

Lessons in Practical Electricity, by Swoope.

Elementary Lessons in Electricity and Magnetism, by Silvanus Thompson.

A series of maps should be purchased from the Department of Commerce and Labor showing the location of wireless telegraph stations of the world. It is suggested, too, that one of the members of the club who is quite familiar with the handling of drawing instruments, draw a city map and locate all the stations of members belonging to the particular club; the distance in miles from the club quarters to each station should be noted on the map.

The Workshop

A workshop should adjoin the radio station, the tools and material for which may be supplied by the amateurs themselves, or preferably by a fund collected specifically for this purpose. No apparatus should be constructed in the wireless station proper. All work of this nature should be done in the workshop, and after the experiments have been completed the apparatus should be transferred to the radio room to be tested.

The room should contain a full set of electricians' tools, including an electric soldering iron and a first-class work bench.

Drawing Materials

It need not be added that the radio club room should have a substantial drawing table with a full set of drawing instruments, necessary in the drawing of circuit diagrams, the plotting of resonance curves and the laying out of plans for the construction of apparatus for club purposes.

(*To be Continued*)

MESSAGE PREPAYMENT PLANS

Plans for the prepayment, from any point of origin in the United States, of messages to be sent abroad, when either cable or wireless, or both, as well as land telegraph lines are called into service, were taken up recently in a conference at the office of Commissioner Chamberlain of the Department of Commerce's Bureau of Navigation. Representatives of the telegraph companies, private, and government wireless plants, and the United States Revenue Cutter Service were present. In a general way, the plans provide for a system of accounting by which each company or party interested may receive its proportionate share of the tolls.

NEW RULE FOR FRANK MESSAGES

Beginning January 1, 1914, the Marconi Wireless Telegraph Company of America will discontinue the use of frank or "D. H" messages, except for Marconi officers and employees. The franks of the company for the current year will be valid till December 31st, 1913.

WIRELESS AID FOR VESSEL ASHORE

Wireless telegraphy was employed to bring aid to the yacht Wakiva, which went ashore 180 miles south of Galveston, Tex., at four o'clock in the morning on November 3. When the yacht grounded, the operator on board sent out the S O S call, which was responded to by the Galveston station of the Marconi Wireless Telegraph Company of America. The tug Senator Bailey, with C. D. Campbell, Marconi operator, aboard, went to the aid of the Wakiva.

MARCONI'S ANECDOTE

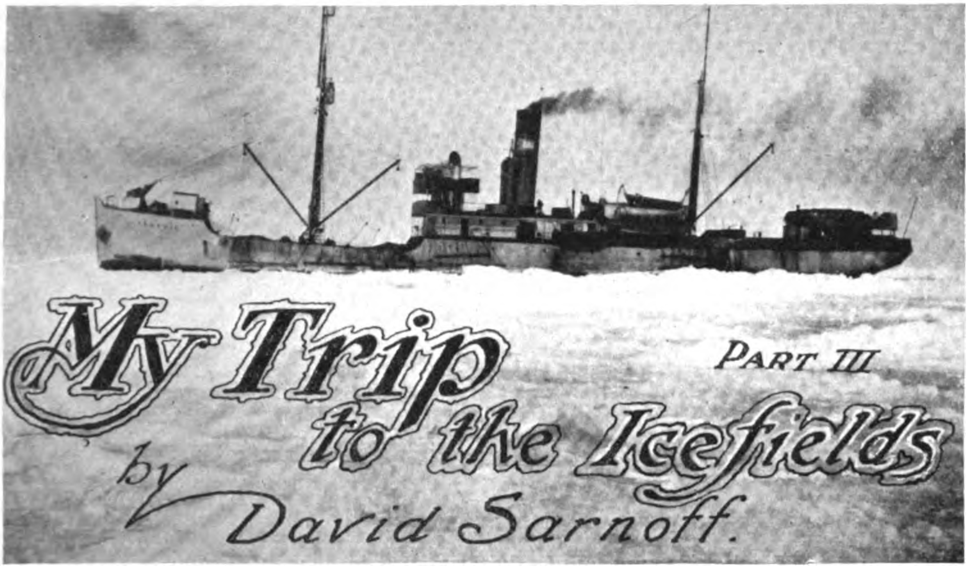
It is now well known that Mr. Marconi lost considerable flesh in his unfortunate motor accident. A reporter remarked that Mr. Marconi was thinner than when he last saw him.

"Yes," replied the inventor, "I am not like the Italian admiral, you see. Libertini had won many battles, and great renown. Attending a ball one evening, he was presented to two charming American women. After the admiral had passed on one of the women remarked to the other:

"'How frightfully fat the admiral is growing. I think it is so unbecoming to a man, don't you!"

"'Yes,' replied the other woman, thoughtfully, 'as a rule I do. But in this case it seems fortunate. Otherwise he wouldn't be able to wear all his medals.'"

In the article, "A 200-Meter Amateur Set," in the November issue, the statement on page 93, "if the apparatus is to be operated on a frequency of 1,000 cycles" should have read, "on a frequency of 500 cycles"; and on page 96, "Its scale reading need not be more than 4 meters," should have read "4 amperes."



FROM the time when the seal hunters' shouts that "dem don't bite" helped me to overcome any hesitation to end the life of the helpless little animals, I took an active interest in the work of our expert Newfoundlanders. This interest was sustained throughout several days of white coat slaughtering, when our ship's hold was found to contain nearly 28,000 sealskins. Reports from our sister ship, the Neptune, showed that she, too, was loaded with a goodly number of pelts, and it gave me a glow of satisfaction to know that this was due to our wireless advices, giving the exact location of the main patch of seals.

Then followed a period when we hunted perhaps the most interesting of the various types found in the Arctic, the "hood" seal. It is characteristic of these seals to stay close together for protection, so they have become known to the Newfoundlanders as "hood families."

A family consists of the male seal, familiarly termed "the old gent," the female seal, considerably smaller in size and weight, and the baby seal, carefully watched over by Pa and Ma until it is able to hustle for itself. This is usually a month or so after its birth, when it takes to the water. The favored location for the home that the head of the family builds is a large pan of ice adjacent to a pool of water. Chunks of ice are selected by the "old gent" and a small wall is built around its edges to shield the family from the wind. Here they lie, during what might be termed the young one's infancy, while the father forages about or takes his daily dip in the nearby pool.

The male seal is a most ferocious animal and well able to take care of himself and his family. He is generally an enormous mass of fat and muscle, his pelt alone weighing in the neighborhood of 500 pounds. In addition to a most disconcerting array of weapons, nature has provided the male of this species with an effective means of protection from enemies. This is the hood from which it takes its name—a covering shot out from the nostrils at will and which, when fully inflated, takes the shape of a large rubber ball, completely covering the head of the animal. The hardest blow from a gaff or club can make no impression whatever on this hood, and all missiles hurled at it bounce off harmlessly. A certain amount of this method of attack will be received by the seal with disdain, but once he is convinced that you are his enemy, a glance at the aperture which serves as his mouth will cause you some concern for the motive portions of your anatomy.

As may reasonably be expected, the

ice "trotter" does not court the possibility of a chunk of his leg wishing him *au revoir* via the seal route, thereby depriving himself of the most necessary and useful adjunct in the business, so he hunts this species very much as the woodsman does his game—with a rifle and ammunition. It seemed strange to me that a man should shoot a "fish," but when I discovered that monetary considerations entered into the question, everything was clear. In answer to my query, I was told that only the most skilled marksmen were employed, as these seals must be shot in the neck; for if a bullet hole penetrated any other part the sealskin was spoiled and the offender is docked fifty cents per miss. Few, if any, penalties were exacted from the men on the Beothic, so far as I could learn.

My endeavors to acquire knowledge as to the life of a seal resulted in more conjecture than definite information. The captain's opinion was about 15 years, and he noted that during this period both male and female strictly observe the ethics of their union; unlike his polygamist brother, the harp seal, the hood is deserving of commendation for faithfulness to the lady of his choice; yet, on the other hand, both father and mother betray the most distressing indifference to the fate of their offspring once it takes to the water. On this question I could not obtain a satisfactory reply.

But let me not give the reader the impression that the seals interested me more than the seal hunters. The fact is that throughout the trip my association with these men of the cold regions was of such absorbing interest that I now find myself longing for the facility of expression of a Howells, that I might give some idea of what it means to live with, observe, and talk to these men every day. I do not know of any race with such pronounced characteristics. Courageous almost to the point of folly, yet tender-hearted as children, uncultured and unlearned—one might easily say ignorant—yet they are strategists of the highest order in their chosen vocation. One thing that struck me forcibly was their sincerity of purpose in everything they did. This is probably best exemplified in their observance of religious doctrines. Various denominations were represented in the crew, Methodists and Episcopalians predominating, and each sect held its own services in the hold on Sundays.

Divine services on a sealing vessel jammed in the Arctic icefields are really little different from those held in the granite structures of our fashionable avenues. The atmosphere and surroundings may not be so conducive to exalted thoughts among the unaccustomed, and the appearance of the congregation may be unusual, but I doubt if anywhere in the civilized world there can be found churchgoers who observe and feel the sanctity of the institution to a greater degree than do these men of the frozen North.

It was my misfortune to violate the rigid observance of the day they hold so sacred; yet, despite the enormity of the offense, it was, from all appearances, immediately condoned and forgotten.

This particular Sunday I speak of was our first, and I recall my amazement when, promptly at midnight on Saturday, the captain ordered the vessel stopped and all fires banked. Some masters will steam their vessels onward during the Sabbath, but not the captain of the Beothic. The ship came to a dead stop in the midst of the ice and the men suspended all labor for twenty-four hours. And though obtaining sealskins was the sole object of the expedition, and their one opportunity to provide themselves with the means for a year's sustenance, not a man in the entire crew would strike a seal one minute after midnight Saturday, nor one minute before midnight Sunday.

Breakfast on the Lord's day brightened my mental horizon perceptibly, for a great luxury, porridge, graced our never-festive board. When this was followed by an egg my amazement knew no bounds. After a steady diet of salted pork through what seemed an endless period, any addition to our regular bill of fare appeared in the light of a benediction. The boon lost some of its sheen, however, when I observed that these culinary concessions were extended only to the officers, doctor and the 'Coni Man; with the crew the fare remained unchanged.

They may have envied we favored ones; that I do not know; but lest some

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of my readers become envious of my Sunday spread I hasten to add that—my conscience will not let me term it food—the grub, then, throughout was *a la nausea.*

For the most part we were encompassed, engulfed and submerged in salted pork, taken on board the vessel before we left St. Johns. I have never encountered such a doubtful delicacy in the food line and I have assimilated many and variegated types and conditions of provender. When I look back now and consider how consistent an arrival this was to our table, the doctor's designation, "salt horse," has an added significance for me. And, along with the certainty of its appearance at each meal, we were equally sure that mess steward Dick would ask: "What will you have to-day, sir?" and place the salt horse in front of us before the sentence was completed. There were other victuals, or, more explicitly, extracts of presumably familiar interior adornments, but these may be dismissed with the observation that they were difficult, nay, impossible and unworthy, of the most democratic person's recognition. It was on this trip, too, that I made the acquaintance of oleomargerine, a very distant cousin of butter, and certainly unworthy of its euphonious appellation. As a matter of fact, I am still open to conviction that it was ever intended for eating purposes.

But to return to and, incidentally, arise from the Sunday breakfast table.

We sought the deck, the doctor and I, and opened up the flood gates of our impressions of the novel experience we were undergoing, spending a delightful half-hour swapping opinions. Dick, the steward, then helped to make our conversation more interesting, for, being an old hand at the game, he was primed with reminiscences. That morning is indelibly impressed on my memory. We listened to many tales of the Eskimos, of the exploits of the Arctic hunters, and all through the conversation ran an accompaniment of hymns arising from the throats of small groups of men gathered about the deck. The strange contrasts of this world we're living in were never more graphically revealed. All about us lay a great sea of crunching ice, stretching as far as the eye could span, and there, sitting on the deck of the vessel, conceived and wrought by the hand of frail mortals, were big powerful specimens of manhood who had slain, and who would again slay, thousands of living, breathing creatures—yet such was the power of the Faith that bound them together that they were singing hymns and, during those few hours, were quite as harmless as little children.

After a time, the mess steward left us, to return in a moment with a number of sealers who had been commissioned to invite the doctor and myself to attend their church. The glance the doctor flashed at me told me as plain as words could have that it would be discourteous to refuse the invitation. The warning was unnecessary; I was anxious to see everything that was going on.

While we were descending to the ship's hold, my companion told me that no doubt the entire crew would be at the service, for, while each sect held church by itself, it was a mark of respect to attend the other's services. Then we entered into as strange a place of worship as could be imagined. The air was stifling. The only ventilation came from a single hatch, opened to admit a little sunlight. In the small space, lined with bunks containing boots, clothing and what not, were crowded 250 men, many of them engaged in drying their wet clothes. Pungent odors arose from all directions, fouling the atmosphere until it was all but overpowering.

The boxes and sleds of the men served as seats; two were quickly secured for the doctor and myself and hymn books pressed into our hands. They called upon the doctor to lead in prayer. I must admit that he did exceptionally well. After each prayer various members of the congregation offer testimony. The first one to arise was a sturdy sealer, well over six feet in height, and one of the most powerful of the crew. His language was crude, but there was no mistaking the sincerity of his grief as he told of the death of his five-year-old boy, just before the departure to the icefields. His massive frame shook with emotion, and all through his discourse bitter tears rained down his weather-beaten face. It was a novel sensation to me, but nothing compared to what was to follow; for, as he neared his concluding remarks, I pulled up with a start on hearing this:

"Now, we've wid us one from a foreign land, a man what never see anyting like dis, and everyting is new to. An' he's new to us an' we want him to make talk. Dis one I mean, he's the 'Coni Man." A low murmur ran through the congregation and several of the men voiced their endorsement by cries of. "Speak!" while I nervously fumbled with the tails of my coat. I could not understand why I had been called upon. What could I possibly say to these men? Affairs for me had taken a most disconcerting turn; for, while I do many things badly, extemporaneous speech-making is probably the worst. A dig in the ribs from the doctor, however, made me realize my obligation, and with ill-concealed trepidation I rose to address the assemblage.

At this time it is difficult to recall just what I spoke of, but I vaguely remember saying something about the brave body of Newfoundlanders gathered there, to whom the perils of the Arctic were as nothing, and who encountered obstacles and brushed aside almost impassable barriers in the pursuit of duty to the dear ones dependent upon them. I gave them some idea of my early impressions and how all the unfavorable aspects of the situation had been overcome by the sterling traits of character evidenced in their daily actions. I told them how firmly they had established themselves in my good graces and that this trip would hold for me many pleasant memories through years to come.

The respectful and close attention given to me was stimulating, and as I warmed up to the subject I found myself scaling the dizzy heights of quasi-eloquence. Finally I paused for breath, and incidentally for something further to say, when one of the devout admirers broke in with, "God bless 'Coni Man!" The phrase was taken up and repeated by the entire congregation with such sincerity that a flood of emotion swept over me and I made for my seat in confusion.

When the meeting ended, my very good friend the doctor and myself adjourned to the wireless cabin. Earlier in the trip I had promised the medical man an informal dissertation on wireless tel-

A snapshot of the author taken aboard the sealing vessel on a Sunday morning devoted to listening to tales of the Eskimos, while an accompaniment of hymns arose from the throats of small groups of men gathered about the deck.

After several days of white coat slaughtering we had 28,000 sealskins aboard. Reports from our sister ship, the Neptune, showed that she, too, was loaded with a goodly number of pelts, and it gave me a glow of satisfaction to know that this was due to our wireless advices, giving the exact location of the main patch of seals.

egraphy, its theory and practice. I found that he readily grasped each detail of my explanation, for being a scientific man himself he was more or less familiar with many of the terms that mean nothing to the layman. Besides, in a measure he had been closely allied with wireless, for to him was due the credit of having prescribed for a suffering seaman, as related earlier in the series. It occurred to me that some little time before, the operator at the Belle Isle station had complained to me that he was working single-handed, as his colleague, the junior operator, was ill and unable to work. No details were given and he had not mentioned it further since. To add the practical touch to my remarks, I turned to my friend and said: "Now, Doc, I am going to call Belle Isle and tell the wireless man there that you are in the cabin with me and would like to know what is the nature of the illness of the second operator at that station."

"Fine!" exclaimed the doctor. "This gives promise of being an unusually interesting demonstration."

After calling Belle Isle several times, I received a very faint reply. We were 200 miles southeast of the isolated plant.

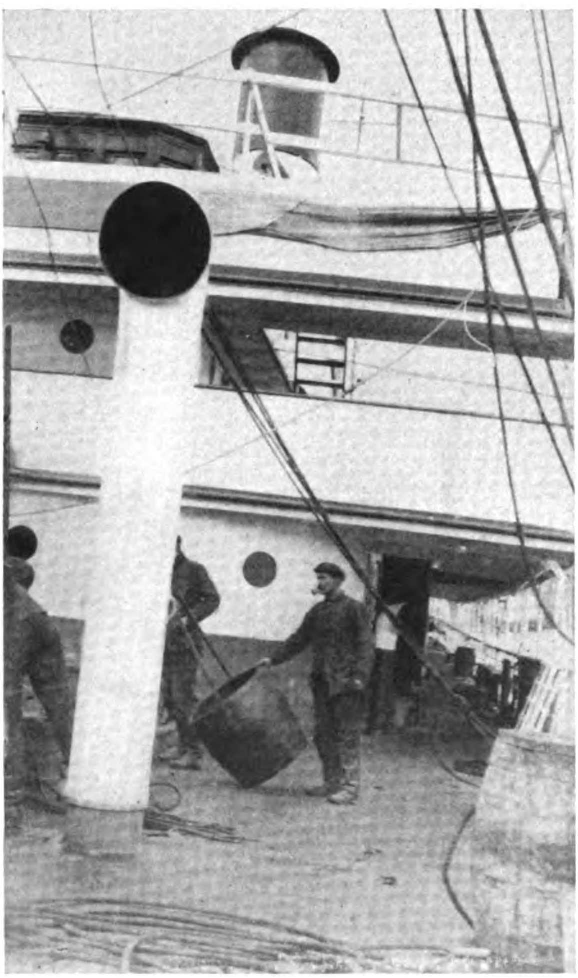
It was like hearing the voice of an old friend when the signals came in, for I was already on a very friendly footing with the Belle Isle chief, Jack Daw, an expert operator and one with a most generous sense of humor. His descriptions through the ether of the humorous aspect of the life at Belle Isle and the analogies he employed had given me many a hearty laugh.

This time I inquired as to the welfare of his assistant, and immediately Jack became very serious.

"Old man, I am up against it," buzzed in the head phones. "This fellow Barrett seems to be getting worse instead of better. His cheeks are swollen frightfully, his temperature is alarmingly high and he can eat nothing. He is suffering from a severe toothache and has been unable to leave his bed for nearly a week. I have done all that I could for the poor chap, but the suffering has nearly driven him mad and broken me up considerably. Our only neighbors are the head lighthouse keeper, a Newfoundlander; his assistant, and the assistant's wife—French Canadians. There are two lighthouse keepers on the other side of the island, but it is almost impossible to reach them, as we are separated by ten miles of wind-swept ice. The Canadian Government vessel comes here twice a year bringing fuel and provisions, but during the ice season we see no one. None but sealing ships can navigate through the ice, and it will be three months before the government vessel will arrive. Unless my assistant improves or secures prompt medical attention I shall lose him."

I copied this story as the dots and dashes buzzed in the phones, the doctor leaning over my shoulder and reading each word as I wrote it down. So absorbed was he in the human side of the message, he had completely forgotten that it had come as part of the wireless demonstration, when he generously offered every assistance at his command. It is difficult for anyone who has not experienced occurrences of this nature to know the helpless feeling that steals over one. My first thought of a comforting visit was immediately followed by the realization that 200 miles of ice and icebergs lay between our ship and the shore, blocking all plans for assistance and leaving us little opportunity to aid, save in offering our sympathy. This I gave cheerfully. "Cheer up, old boy," I clicked off. "Take good care of your partner. The doctor feels that from what you say the man is probably suffering from an abscess. He wishes to know what medicine you have on hand." The contents of the medicine chest proved to be meagre indeed. The doctor prescribed some simple remedies for the patient, and instructed that he be put on a diet of condensed milk and hot water—no fresh milk being available—and requested that Jack advise me by wireless several times each day as to the condition of the patient.

Other vessels in the neighborhood had evidently been listening to my chat with Belle Isle, for when I signaled BI, TIS (stand by) I could hear several boys sending consoling remarks to Daw.



Promptly at midnight, on Saturday, the captain ordered the vessel stopped and all fires banked. Obtaining sealskins was the sole object of the expedition, and their one opportunity to provide themselves with the means for a year's sustenance, yet not a man in the entire crew would strike a seal on Sunday.

It did not seem that anything further could be done. The realization that it was Sunday, and we were scheduled to stand still at least until midnight, was distressing. If we had only been moving I would have felt more relieved. Knowing that we were bound north, the fact that were we forging ahead we would be getting closer to Belle Isle would have made the possibility of rendering assistance more real. I fumed and fretted in the wireless cabin for a time, but it was evident that this would avail me nothing and I dejectedly sought the deck.

A group of men gathered at the rail were discussing a hood family yelping on a nearby pan of ice. The male seal was taking frequent plunges in a pool of water and on his return would play gently with the baby seal, patting it with his flippers. The serenity and intimacy of animal home life had its appeal, for only in the fact that it was Sunday were they saved from the general slaughter.

The sun was shining brightly and it seemed a glorious opportunity to take photographs of this hood family. These would have to be taken at close range, for my camera was small, so I asked the captain's permission to go out on the ice. He attempted to dissuade me from attempting the snapshot, adding a warning that the male hood seal might not view the project favorably and decide to make my acquaintance in a manner not beneficial to my continued health. This had little effect, beyond inducing me to promise extreme caution, and I crawled over the side with the camera in one hand and a gaff in the other. It was a simple matter to snap the mother and baby seal, and an exact likeness appears in this article; but this did not satisfy me, as I felt that I should include the head of the family in the picture. Occasionally my subject would stick his head out of the water, inflate his hood and make weird noises, and immediately plunge into the pool again. I drew nearer the baby seal, figuring that this would tempt him to come out. I was within five feet of the young one, yet the father still remained in the pool, with his head above water, watching me critically. The men on the vessel shouted a warning for me to retreat.

Above is a picture of the man who probably saved the life of the author through a timely shot that killed an enraged hood seal. Shooting a seal on Sunday was a grievous offense, but never afterwards was the incident mentioned in the author's hearing. Above is the photograph of the mother and baby seal taken just before the male attacked Mr. Sarnoff.

So intent was I on getting the group that I ventured a trifle nearer, focused the camera on the vicious animal, and made my snap shot. The click of the shutter enraged him and in an instant he had pulled his big body from out of the pool and was making for me across the ice. He looked as big as an elephant and twice as ferocious.

I turned and ran, fortunately having sufficient presence of mind to adopt a zigzag course. This gave me a slight advantage, for it was extremely difficult for the seal to swing his big body at each turn. In a few moments, however, I found that this strategy would avail me nothing, for the strongest man cannot long continue a flight on the jagged and slippery ice. A glance over my shoulder showed me that the seal was close behind and gaining rapidly. My breath came in gasps and my knees were giving out. Just when I was so exhausted that I was ready to drop, a shot rang out from the vessel. With one agonized yelp the brute flopped over on his side. One of the men aboard the vessel had realized my danger and, disregarding all other considerations, had ended the life of my pursuer just in the nick of time.

Shooting a seal on Sunday was a grievous offense. Many times since I have reproached myself for this desecration, solely my own fault. And judging from the captain's attitude immediately after the shooting I presumed that, rather than have this rule violated, I had better been a martyr to the cause. Perhaps this impression was due to the way I felt about it myself, and it seems to me now that the others must have realized my frame of mind, for never afterwards was the incident mentioned in my hearing.

The days following this memorable Sunday were devoted to seal hunting, which had become slow work. The main patches had been so thinned out that only a few scattered groups could be located, but our hold then contained 34,000 pelts, which was considered an exceptionally good haul.

Each day, as arranged, I received messages from Belle Isle reporting the condition of the patient.

Poor Barrett's suffering was steadily growing more intense.

The abscess had become so large that the unfortunate man could scarcely open his mouth and was taking most of his food through a tube.

How this serious situation came to a crisis and how wireless was instrumental in saving the life of one of its own servants, will be told in the succeeding installment.

The concluding article by Mr. Sarnoff will appear in the January issue.

ORGANIZATION AND A BASIC BUSINESS AXIOM

Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, talked interestingly of the art on his return to New York from a trip to Europe on October 29. He declared that the part played by wireless in bringing aid to the Volturno made a far-reaching impression in England and on the Continent. Speaking of the development of wireless communication between ships at sea and the shore, he said:

"Few persons ever think of a fact of most vital importance to the continued use, without hitch, of Marconi's invention, now a common factor in our daily lives, increasing our personal comforts as well as our business facilities and providing a constant means of livelihood for increasing thousands of employees of all grades.

"I refer to that marvelous organization which has been built up side by side with the technical development of wireless on board ship. I think I may trace its origin to the basic business axiom, laid down by Marconi and his aids, from the outset, that it was not right to sell their installations, drawing immediate profit, and then leave their clients to work out their own salvation. They realized at once that it would avail a shipowner nothing to be possessed of a plant, working it how and when he willed, if other shipowners did not work on similar regulations and methods.

"The question of language between ships of different nationalities is of much more complex nature than it is on the land lines of the Continent, for instance. A Swiss operator may talk to operators in neighboring countries of three nationalities; one wireless operator at sea may communicate during his voyage with operators of as many as twelve nationalities beside his own.

"Added to the language difficulties, there is that presented by the different manner of doing things in different countries and ships—different sense of responsibility, of initiative, and ideas of discipline.

"All of these obstacles were obviously almost insurmountable if apparatus were to be disposed of finally by the manufacturer to each and every shipowner, the latter being left to his own resources to reap the best benefit he could.

"Clearly there was to be an international creation, not only to supply the shipowners with apparatus of recognized efficiency and uniform standard, but also to supply him with operators corresponding to the nationality of the ship, trained on uniform lines, possessing the same *esprit de corps,* subject to the same rules and regulations, and, however numerous their nationalities, all having a fair knowledge of one common language. In this direction, and in this direction only, was it felt that wireless could be applied successfully at sea.

"Accordingly, after Marconi had developed his invention to an extent at which its utility to shipping was obvious, the Marconi International Marine Communication Company, Limited, was constituted for the object I have mentioned, and how wonderfully and effectively it has succeeded is the evidence of history as recorded in the Republic, Titanic and Volturno disasters, and in the many unrecorded instances of daily travel by sea.

"A good deal has happened since the conception and realization of the international wireless scheme. The rapidly increasing use of the wireless on board ships and the vast systems planned and in progress of international long distance wireless, to compete with cables, rendered desirable the formation of national corporations in all the principal countries; and companies associated with Marconi have been constituted in New York, Montreal, Paris, Berlin, Rome, Brussels, St. Petersburg, Madrid, Argentine and Sydney, to look after the maritime interests of the principal Powers, leaving the company in London free to care for its own enormous interests in the British Mercantile Marine.

"The object of our companies forming this international organization is to carry on the work they have begun in conjunction with the different governments, to render it more efficient still and to apply their experience and immediate contact with the maritime communication, to the solution of problems which are confronting us now and those likely to arise in the future."

RECEIVERS REPORT ON SIGNALING COMPANY

Upon application of Attorney Frederick J. Faulks, of the law firm of Lindabury, Depue & Faulks, Judge Rellstab, in the Federal Court in Newark, N. J., received the fourth report of Samuel M. Kintner, of Pittsburgh, and Halsey M. Barrett, receivers of the National Electric Signaling Company. The report provides for the payment of $5,000 to the receivers on account and $2,500 counsel fees; asks that the business shall be continued by the receivers for a period of six months, and also asks authority to continue patent litigation and to take whatever steps may be necessary for the preservation and working of the patents of the defunct company.

Further, the receivers in their report ask to be authorized to borrow sums not exceeding $35,000 in the aggregate, in addition to $75,000 to be borrowed upon receivers' certificates.

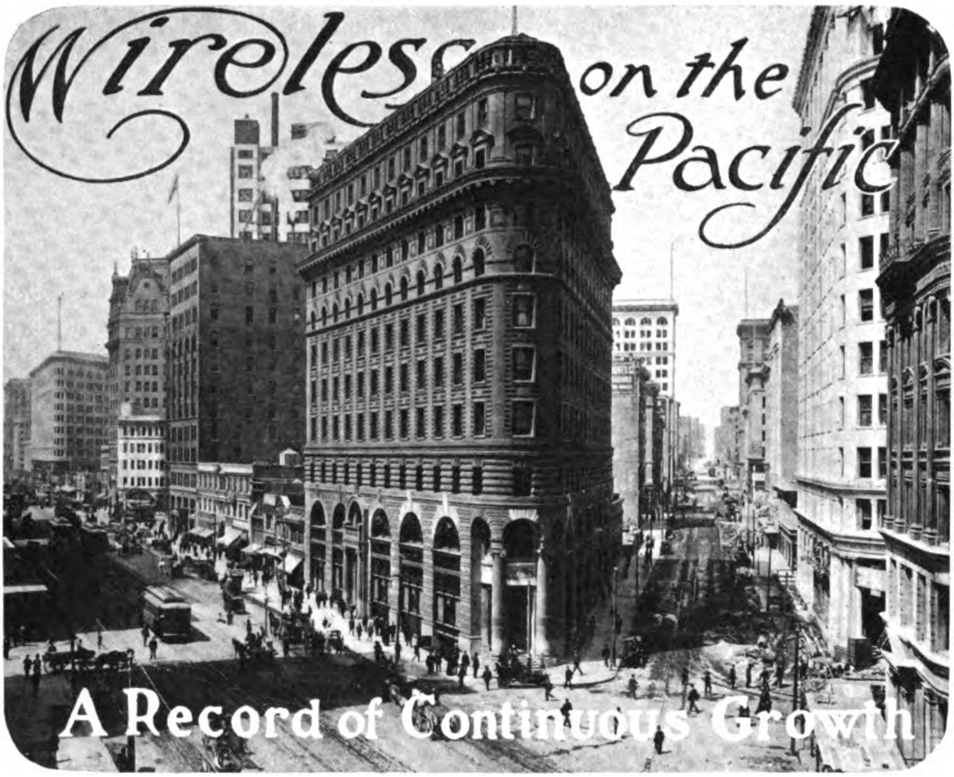
The defendant company has several wireless telegraph stations, has its system in use in the United States navy and has contracts with several steamship companies. Some time ago it was made the defendant in a suit brought by Reginald J. Fessenden, the inventor, who was awarded a verdict of $413,000, which was afterward set aside by the United States Circuit Court of Appeals in Portland.

SERVICE ITEMS

Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, has been elected a director of the Marconi Wireless Telegraph Company of Canada, Limited. He attended a meeting of the directors of the latter company in Montreal, Que., on November 11.

* * *

Miss Theresa Geaney and Samuel McCullough were married in the rectory of St. Augustine's Church, New York City, on the evening of November 26. Mr. McCullough is a member of the staff of the auditing department of the Marconi Wireless Telegraph Company of America. His bride is a daughter of Mr. and Mrs. John Geaney, of No. 754 East 169th street, the Bronx.



Market and Post Streets, San Francisco

THE Pacific Coast is about to enter upon a new and prosperous era. From San Diego to Behring Strait there lies a vast region, practically undeveloped, which is awaiting efficient transportation facilities at reasonable rates to and from the financial and commercial centers of the world. Residents of the Coast predict that unlimited capital for investment will be drawn to the shores of the Pacific following the opening of the Panama Canal, and through publicity from the Exposition to be held in 1915.

The Pacific Division of the Marconi Wireless Telegraph Company of America is making arrangements to meet the demands which will be placed upon its resources when the wave of prosperity arrives. In fact, the company is already feeling the effect of preparations which are being made by the steamship companies to handle the increased shipping business. One year ago, the number of ship equipments operated by the Marconi Company on the Pacific Coast was 140. To-day 189 ships are equipped with Marconi outfits. Twenty-one of the vessels equipped are oil tank craft. The owners of these vessels state that they save enough in one or two days through the wireless outfits to cover the cost of the equipments for a month.

Oil-carrying ships have no regular route, but cover all ports, meeting the demand for the different grades of oil at each point. It is a daily occurrence to transmit a wireless message to a tanker, as these vessels are called, ordering her to proceed to a different port than the one she was originally directed to go to. This necessity generally arises from an unlooked-for demand for oil. All coastwise vessels and many Trans-Pacific ships as well, use oil as fuel, and it is necessary to keep a constant supply at various ports. The oil fields of the Coast are located principally in Southern California. The vessels are used to convey the oil from the fields to the refineries and to all the ports of the Pacific. The operating companies' offices are located in San Francisco and the ships are controlled from that city.

Many of the vessels ply between the loading points and Honolulu, Alaska, Washington or Oregon ports for several months at a time without touching San Francisco, coming into that port only when they are due for boiler inspection. During this period the commanders of the craft are in daily communication with headquarters in San Francisco by wireless. If a piece of machinery needs attention the proper mechanics meet the ship at the oil fields; if new members of the crew are needed, they are ordered from San Francisco, and in numberless other ways many thousand of dollars are saved annually through economical operation by the aid of wireless.

One of the oil tanks equipped is the Erskine M. Phelps. She is a four-masted steel sailing ship, owned by the Union Oil Company of California, and was recently equipped with a Standard Marconi 1 K.W. set. The Phelps left Port San Luis, Cal., for Honolulu on July 13 last. The operator was in direct communication with the San Francisco station of the Marconi Company every night of the voyage to and from Honolulu.

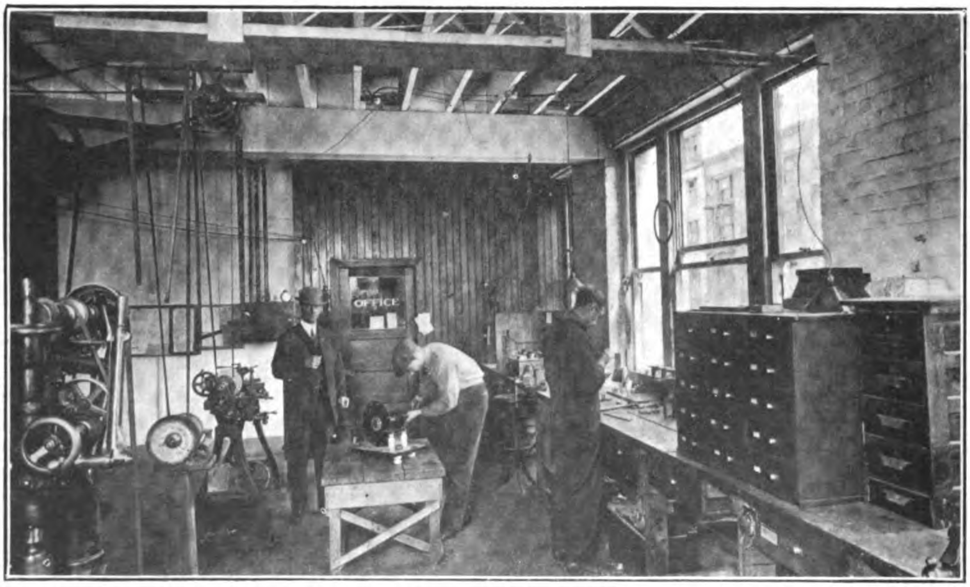
A. H. Ginman, Pacific Coast manager of the American Marconi Company, under whose direction the work of equipping the mercantile marine with wireless has gone forward rapidly. The owners of the twenty-one oil vessels recently equipped stated that they save enough in one or two days through the wireless fits to cover the cost of the equipments for a month.

This is a good illustration of the phenomenal distances worked on the Pacific Coast. It is not an uncommon occurrence for the Enterprise, of the Matson Navigation Company, which plies between San Francisco, Honolulu and Hilo, H. I., to work direct with San Francisco from a distance of approximately 2,200 nautical miles. The Enterprise carries a 3-K.W. set. On February 1, 1911, the Korea, of the Pacific Mail Steamship Company, while en route to Hong Kong was in direct communication with the Marconi San Francisco Station when 4,492 miles distant. The ships of this line, as well as those of the Oceanic Steamship Company and the Matson Navigation Company, find no difficulty in communicating with San Francisco every night on the entire trip to and from Honolulu. These vessels carry equipment ranging from 3 to 5 K.W.

The marine installations on the Pacific Coast have been the means of saving many lives and thousands of dollars during the last three years. If a coasting vessel loses her means of control, she must have prompt assistance to escape the danger of being forced upon the rocks. In fully a dozen instances during the last two years the S. O. S. call has

The office of the cashier. The entire Pacific Division is financed from this office, an extremely busy one, for there are a large number of men carried on the pay-roll and many accounts to be kept.

been the means of saving lives. On other occasions it has been the means of saving considerable expense to ship owners. There have also been cases in which the commanders of ships that have broken a propeller shaft or rudder have communicated with their owners regarding the accident and made the arrangement for a tow. Then, too, there have been instances of a captain summoning aid by means of wireless and making direct arrangement regarding the towing bill with the commander of the vessel responding to the call. A case in point was that of the Enterprise, which dropped her propeller when 300 miles



The shop, located near the waterfront and in the center of the shipping district. Repair work to apparatus is done here, and six men are employed to attend to the installation, repair and inspection of ship and shore sets.

from San Francisco, en route to Honolulu. The owners were notified of the accident and the Lurline, owned by the same company, was ordered to tow the vessel back to San Francisco. Three oil carriers have been picked up with broken propeller shafts by ships of the same company and two or more passenger vessels have also been given aid by means of wireless.

While the increase in the number of vessels equipped with wireless during the last year is due to some extent to the laws governing the operations of passenger-carrying vessels, it is expected that this record, with the opening of the Panama Canal, will be kept up for several years to come. Announcement has been made that several large steamship companies intend to engage in trade on the Pacific through the Canal. Some of these companies control hundreds of steamships and propose to build many new ones. A considerable number of the vessels that are being built for the passenger carrying trade are designed for a speed of twenty-fiur and twenty-five knots an hour.

At present the Pacific Coast Division of the Marconi Company has 252 employees. Of this number, 221 are operators, while the balance are employes of the construction department and office. Schools of instruction for operators are maintained at both San Francisco and Seattle. In the San Francisco school there is room for seventy-five students.

In circle, George Jessop, commercial superintendent, and a view of the main office. A telephone line, seven and one-half miles long connects with the local wireless station and a telegraph buzzer is attached to either end whenever messages are to be transmitted. All traffic between office and station is handled in this way.

Thirty-two hundred feet of floor space, located in the building at 50 Main street, San Francisco, is used as a shop and storage place for apparatus. Complete machinery needed for the manufacture of any part of the Marconi apparatus is installed there under the supervision of A. A. Isbell. Very little manufacturing is done in this shop, however, all the new apparatus being furnished direct from New York. Practically all of the repair work, however, is done in San Francisco.

In addition to the outfits aboard ships, the Marconi Company has installed ten land stations under lease. Six of these are leased to the Alaska Packers' Association and are located in Bristol Bay and other points in Alaska where that company maintains salmon packing plants. Prior to the installation of wireless at the fishing plants it was necessary for the Packers' Association to dispatch a steamer from Bristol Bay to St. Michaels or Nome at the close of each season in order to transmit a message to the company at San Francisco, stating the condition and amount of the catch. The company depended on this information to guide it in fixing the prices for the coming year.

With the installation of wireless, not only the expense of dispatching a steamer a long distance was saved to the Packers' Association, but it was also enabled to keep in touch with the field during the entire season. The stations are used daily to direct the fleet in its work. The salmon are at times extremely elusive, and when none are being caught at one point on the fishing grounds another cannery may be receiving more than it can take care of. With the wireless at hand this disadvantage is eliminated, as messages can be sent to have the surplus supply transferred from one factory to the other.

Two Marconi stations are leased to Alaska Mining Companies. One station is controlled by the Ellamar Mining Company, located at Ellamar, Alaska, and the other by the Algunican Development Company at Jualin. Ellamar is located about twenty miles from Valdez, and up to the time of the wireless installation had no telegraphic communication with the latter point and the outside world.

Jualin was also without telegraphic communication with the outside world until the installation of a 5 K.W. Marconi Wireless set. This station is employed on various occasions to communicate with vessels prior to the time they reach Juneau to ascertain how much freight and how many passengers are bound for Jualin. The information is obtained so that arrangements may be made with Juneau to have the vessel stop at Jualin, or for the freight and passengers to be trans-shipped.

A station has also been leased to the Los Angeles Y. M. C. A. for use in connection with the organization's school of wireless instruction. The Los Angeles Examiner, to which a station has been leased, enjoys the distinction of being the only newspaper on the Coast that has a wireless telegraph installation. The outfit not only gives the Examiner a unique advertising feature, but places it in a position to gather all the news of the sea. Negotiations are now pending for the installation of a station on the San Francisco Examiner Building for the use of that paper.

At Avalon, Catalina Island, Cal., the Marconi Company maintains a commercial station and enjoys the exclusive privilege of telegraph service between that point and the main land. A night letter service, to and from Avalon, has also been recently inaugurated.

Catalina Island is one of the show places of the Pacific Coast and during the summer months is thickly dotted with tent cities. The owners of the island maintain an excellent steamship service between San Pedro and Avalon, which are twenty-seven miles apart. These vessels carry Marconi apparatus.

Ketchikan, one of the largest towns in Alaska, is located approximately 650 miles from Seattle, and is the first port of entry to the territory. It is a flourishing town and the center of large fishing and copper mining industries. This port has the advantage of being open to navigation during the entire year. It is at present served by government cable with a rate to Seattle of nineteen cents per word. The cable is in bad repair and is frequently interrupted. On these occasions communication is carried on by wireless through a series of relays via the Dominion Government stations, the present 2 K.W. wireless installation at Ketchikan being inefficient for direct use.

Janeau, the capital of Alaska, has many large mining interests. The famous Treadwell mine, located in that city, employs 2,000 men and crushes 5,000 tons of ore a day. The Gastineau mines, owned by the Jackling interests, are now being opened and a tunnel several hundred feet long has been constructed to bring their output directly into Juneau. Big fishing plants also abound in the neighborhood. Juneau is served by the same cable as Ketchikan and also has a small Marconi station, which is used for communicating with ships.

All along the Yukon communication is maintained by telegraph lines operated by the government, which are often interrupted by forest fires in summer and severe storms in winter. Business in Northern Alaska is quiet at present, owing to the government's conservation policy, but the entire territory abounds in natural resources which have been little prospected.

Fairbanks, at the head of the Tenana River, is the center of several mining properties and will be the inland terminus of the proposed railroad. Alaskans are strongly demanding a government railway to the Yukon, from either Seward, Valdez or Cordova, and if this is built the seaport used as its terminus will develop into a large town. It is likely that either Seward or Cordova will be selected as the terminus. Cordova, which is the larger of the two, is the seaport terminus of the Tenana River Railway, controlled by the Guggenheims. There is considerable activity in Cordova at present, due to the gold stampede to the Shushana. It is in this locality that the much discussed coal fields lie. Valdez is the present seaport terminus of the Fairbanks winter trail, but has not the harbor facilities of Seward or Cordova, and is located on low lands.

Nome is quiet at present, as placer mining is gradually being worked out, but it is probable that a better class of quartz mining will develop. This will immediately increase the activities of that town. The telegraph outlet at Nome is by government wireless via St. Michaels, where the messages are placed on the military telegraph lines. St. Michaels, the terminus of the Yukon river steamers, is located 110 miles southwest of Nome.

Wireless conditions existing in Alaska are not to be found elsewhere. Southern Alaska is made up of vast wooded mountains and the rainfall is heavy. While a station is often able to communicate 1,000 miles in one direction, it is sometimes unable to communicate any reasonable distance in another. For this reason it is necessary to give careful study to the location of stations. It is believed that a 25 K.W. station at Ketchikan and a 10 K.W. station at Juneau will assure continuous communication between those points and Seattle.

Alaska is a country of tremendous resources and will be rapidly developed as soon as proper transportation is provided. The Marconi Company intends to act quickly in placing wireless communication throughout this country after it has once been established that a station at a certain point can be depended upon to carry out its requirements and prove to be the source of a reasonable amount of revenue. The stations at Ketchikan and Juneau will be among the first to be constructed.

Talking It Over

It is not enough to know, we must also apply; it is not enough to will, we must also do.

⦿ ⦿ ⦿

There is no nobler feeling than admiration for one higher than oneself. It is the vitalizing influence in a man's life.

⦿ ⦿ ⦿

Some folks are able to decide in five minutes what it takes others five days of worrying and fussing to settle.

⦿ ⦿ ⦿

Many of the best fish swim near the bottom.

⦿ ⦿ ⦿

Ambition can creep as well as soar. To be a fifth-rate something is better than being a first-rate nothing.

Applause is the spur of noble minds, the end and aim of weak ones.

⊙ ⊙ ⊙

The desire to appear wise often prevents our becoming so.

⊙ ⊙ ⊙

Success is a great teacher; failure is a greater.

⊙ ⊙ ⊙

One of these days is none of these days.

⊙ ⊙ ⊙

One man makes chances while ten men watch them.

⊙ ⊙ ⊙

It is by presence of mind in untried emergencies that the mettle of a man is tested.

⊙ ⊙ ⊙

The final achievement of genius is the introduction and skillful use of the abnormal.

⊙ ⊙ ⊙

A man's kingdom should be not what he has, but what he does.

⊙ ⊙ ⊙

They are few who can give you wiser advice than your own; it is well to listen to your own suggestions occasionally.

⊙ ⊙ ⊙

When work is a delight, no life can be dull.

⊙ ⊙ ⊙

The best workman is he who adapts means to a definite end; we tire of those who, with no message to deliver, elaborate their style.

Nineteen Wrecks Within a Month

IN the story of havoc made by a storm that swept the Great Lakes for two days, leaving a trail of death and destruction, the Marconi system is shown to have scored another triumph by bringing aid to the vessels in distress and conveying information about them and those aboard. Starting on Sunday morning, November 9, a gale that brought fear to the hearts of the bravest mariners lashed the waters of the lakes into huge waves. The blow was accompanied by a heavy snow which placed added hardship on the folk at the mercy of the storm.

The list of steamers that were wrecked is as follows: The Fulton, of the Pittsburgh Steamship Company; the D. O. Mills and the Victory, of the Pickands-Mather Company; the W. G. Pollock, of the Jones & Laughlin Steel Company; the F. G. Hartwell, of the Tomlinson Company; the H. B. Hawgood, of the W. A. and A. H. Hawgood Company; the J. T. Hutchinson, of the J. T. Hutchinson Company; the J. H. Shadle, of the Cleveland Cliffs Iron Company; the Mathew Andrews, of the H. Steinbrenner Company; the L. C. Waldo, of the H. H. Brown Company; the Wexford, of the Western Steamship Company; the Regina, of the Canadian Interlake Steamship Company; the H. M. Hanna, of the M. A. Hanna Company; two unidentified steamers at Isle Royal.

The Waldo is a total wreck, although the members of her crew were rescued. The Wexford was also wrecked and her crew of twenty men lost their lives. The bodies of five members of the Regina's crew have been washed ashore; the vessel is a total loss. The waters swallowed the Hartwell, but the members of her crew, it is believed, were saved. Recent reports from the scene of the disaster were to the effect that the Hawgood was aground and in danger of being pounded to pieces by the waves. Another victim of the storm was the government lightship No. 82, off Buffalo. She was completely destroyed and no information has yet been obtained to contradict the report that all of her crew perished. The other steamers mentioned in the list of wrecked vessels are aground, and it is likely that they will be prevented from foundering. The total life loss as a result of the disaster was about 100.

Not only on the water, but on the land, was the value of wireless communication demonstrated. During the two days that the storm raged there was not a telegraph or telephone wire leading out of Cleveland in operation, Marconi wireless being the only means of communication. The owners of the vessels equipped with wireless expressed considerable satisfaction with the Marconi installations, which had enabled them to communicate with their craft when word to and from the vessels meant so much.

There were few accidents to the wireless apparatus, although all of the wires in the antennae at the stations and on the boats were coated with ice. The ice and snow broke the halyards on the station of the Marconi Company at Cleveland, and shattered a mast in the installation on the steamer City of Buffalo. It also broke a block of the set on the steamer Western States. When the accident occurred at the Cleveland station the operators were sent to the school, where they transmitted and received messages. The damage to the outfits of the two steamers was quickly repaired.

There are many thrills in the account of how wireless telegraphy brought a rescue ship to succor the folk on the steamship Merced, which was wrecked on Point Gorda, about thirty-five miles south of Eureka, Cal., and completely destroyed. The report of P. J. Phair, first Marconi operator on the Merced, tells a graphic story of the disaster. The report in part is as follows:

"On Wednesday night (October 15) I went on watch at 6.00 P. M. A little after

10.00 P. M., I felt the boat strike the rocks. At first I was not sure whether we had hit or not, but awoke Mr. Hull, the second operator. By the time he was out of bed the captain phoned me to send a distress call, as we were on the rocks, which I did, and was answered at once by the KTK (The steamship El Segundo). He said that he would come to us, but that WTE (the steamship Roma) was nearer to us than he was. A little later he said that he wasn't coming, but that WTE (the Roma) was, and he had also talked with WTT (the steamship Atlas), which was light and was using all possible speed for us.

"At that time I could hear the KTK (the El Segundo) and WTE (the Roma), but not the WTT (the Atlas). A little later, about 10.30, the word came to abandon the ship. Having life preservers on, we made for the nearest boat. After passengers and crew were safely off in boats and drifting around the Merced, the chief engineer said he was going back, which he and his assistants did. Then the captain called for the wireless. I then went back to the wireless room, where I talked with KTK (the El Segundo).

"Arriving between 3.00 and 3.30 A.M., WTT (the Atlas) proceeded to pick up lifeboats. Soon the WTE (the Roma) was standing by, awaiting orders from us.

"7.30 A. M.—Up to this time the fires were going fine and we had plenty of steam for lights, wireless, whistle, etc. But at this time the water put the fires out. I started to use my storage set, which hardly raised enough steam to heave a line from WTT (the Atlas). The water was now rapidly rising. Things were about the same until a little before noon, when the captain said for us to leave the ship. After some difficulty I got into a small boat and was soon aboard the WTT (the Atlas).

"I do not know what time it was that the WQY (the Yosemite) appeared, but she took out passengers from the WTT (the Atias). I did not have any trouble with either big set or storage set."

The steamship Stanley Dollar struck the Viti Rocks on the Pacific Coast on October 23. E. N. Orth, Marconi operator aboard the vessel, sent out a distress call which was responded to by the Tahoma. The latter hauled the Stanley Dollar off the rocks on October 25.

When the steamship Pleiades came into collision with an unknown steamship recently off the Pacific Coast, P. M. Jacobson, Marconi operator on the Pleiades, sent a wireless message at the direction of the captain, asking for a tug to come to the assistance of the vessel. The message met with a prompt response and the Pleiades reached port safely.

The Beaver, owned by the San Francisco and Portland Steamship Company, was recently in collision with the steamship Necanium, a few miles north of San Francisco. From the Beaver, which carries wireless equipment, was sent a message a few minutes after the accident, telling her owners that the vessel was not in immediate danger and would arrive in San Francisco in a few hours. The owners of the Necanium, which does not carry a wireless equipment, heard of the accident through the owners of the Beaver. The Necanium arrived in San Francisco ten hours after the Beaver reached port, in a crippled condition.

THE SHARE MARKET

NEW YORK, November 20.

Various opinions were advanced at the close of the stock market to-day regarding the lull which prevailed. The Mexican situation was put forth by one broker as an explanation for the apathy; another believed that politics, the reduced tariff, and the uncertainty relating to currency legislation had considerable effect on the general conditions.

It is possible, of course, that there will be a revival in the market of the interest which was taken in the Mexican question, but it is not believed that this will come about soon. Professional traders expressed the opinion that Marconis are doing extremely well in view of the circumstances governing conditions in the street.

American, 3⅞—4⅛; Canadian, 2¼—2⅜; English common, 16—18; English preferred, 13—15.

From and For those who help themselves

Experimenters' Experiences.

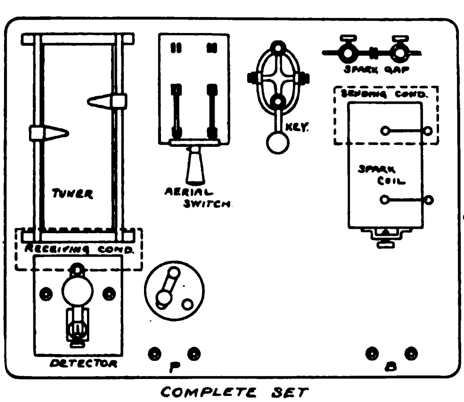
First Prize Ten Dollars

An Inter-City Set Well Adapted to the Use of Beginners

I recently constructed an inter-city set which is just the thing for a beginner in the wireless arc. The apparatus is mounted on a base, 17 inches by 14 inches. The base is constructed of a shallow box 1½ inches deep to allow the condensers to fit underneath. The apparatus is made up of the following parts:

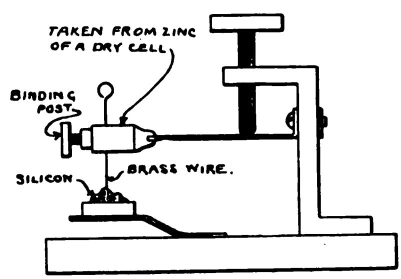
Sending—¾ of an inch spark coil, key, condenser and spark gap.

Receiving—2 slide tuner (No. 24 wire wound on a core, 8 inches by 2½ inches); detector, condenser, phones and a small 2 pt. switch which is used to connect the phones around the condenser or the detector by a single movement. (See hookup.)

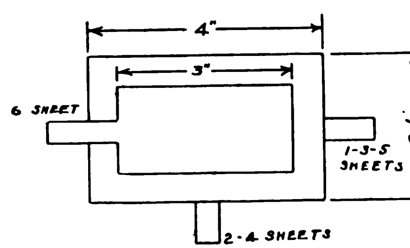


COMPLETE SET

An ordinary D. P. D. T. switch is used as an aerial switch. The sending condenser consists of 6 sheets of foil, 1½ inches by 3 inches, between 7 sheets of glass, 2½ inches by 4 inches. This gives a margin of ½ inch around the edges.



DETECTOR

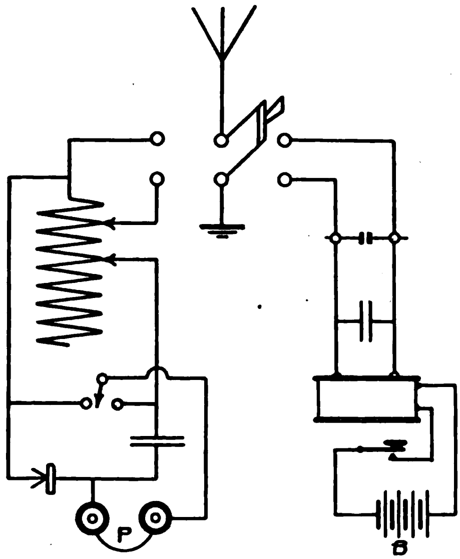


SENDING CONDENSER

The first, second and fifth sheets have their lugs connected; the second and fourth are connected, while the sixth is left separate. A moment's consideration will show that any number of sheets may be used, a great advantage when, as in this case, a helix is not employed.

The spark gap is made up of 2 double binding posts with a couple of 5 penny nails for plugs. The fixed receiving condenser may be made by placing two sheets of tin foil, 3 inches by 12 inches, between three pieces of waxed paper, 4 inches by 15 inches, rolling them up and taking a lug out of each sheet of foil.

The sketch of the detector fully explains itself; any "pet" mineral may be used in this stand.



CONNECTIONS OF SET

The two condensers are mounted under the base and the remainder of the apparatus is placed on top and wired up. The sketch shows the location of each and the corresponding hookup. The aerial and ground are connected with the blades of the aerial switch, batteries to bending posts, B, and phones to P. These should be of 1,000 ohms each, in order to obtain the best results.

THOMAS W. BENSON, *Pennsylvania.*

Second Prize Five Dollars

A Device to Minimize Interference and Eliminate Dead End Effect

Those who operate wireless stations in large stations, or where interference is generally great, will welcome any device which will reduce it to a minimum. In addition to minimizing interference, the device which I am about to describe helps to do away with one of the causes of a loss of energy in tuners, which is known as dead end effect.

On the majority of tuners and loose-couplers, only a part of the inductance is in use. The other part is left free to vibrate with the incoming wave, thus absorbing some of the energy. The free end corresponds to that in the well known Oudin oscillator. A few of the amateurs have eliminated the loss by using a scheme of short-circuiting the ends as shown in Fig. 1. However, after experimenting with this scheme for several weeks, I found that the strength of the signals from certain stations was markedly decreased and that the tuning was not very sharp.

The results of my experiments is an improvement on the scheme mentioned. The hookup is shown in Fig. 2, where it is applied to one of the standard methods of connecting up a loose-coupled set. It may be applied to a close-coupled set with equal advantage, however. The additional piece of apparatus is a small variable condenser, V¹ C¹. Even when the capacity of the condenser is excedingly small, surprising tuning results follow.

It will be seen from Fig. 2 that A B C D forms a closed oscillatory circuit, closely coupled to the antenna circuit. When the latter circuit is set to, say 600 meters, and we set the circuit A B C D to, say, 500 meters, the energy in the 500-meter wave, if the interfering station operates on this wave, will be largely dissipated in the small circuit; the desired

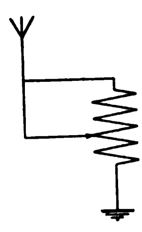


Fig. 1

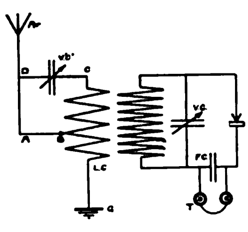


Fig. 2

wave (600 meters) will hardly be affected. At the same time, the device accomplishes the aim sought by short-circuiting dead ends.

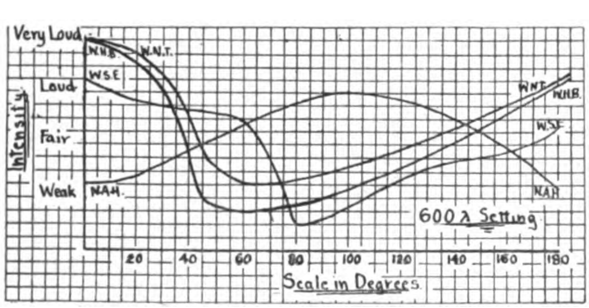
The method of operating the apparatus is as follows: The station wanted is tuned in as usual with the scale of the variable condenser at zero. The pointer is then moved slowly across the scale. There will be one or two points where the interfering stations's signals decrease considerably. In like manner, other points mark the position of decrease in signals from the required station. The pointer is now set at the position of minimum interference from the station that is not wanted, and the incoming message can be easily read.

I have found it very convenient to plot the curve between the intensity of the signals from the large nearby stations and the position of the scale for different settings of the antenna circuit. This enables one to read through nearby stations by glancing at the curve for these stations. I have reproduced curves for various stations around New York City from data obtained at my stations. Curves, of course, will vary with different receiving sets and, at the best, are only approximations. It will be seen that if I wanted to read Sea Gate (W. S. E.) for instance, through the New York Herald (W. H. B.), it would be necessary for me to set the condenser on 60 degrees; then I should be able to read the desired signals without trouble.

The little addition to tuning circuits which I have described will, I believe, prove of great value to amateur station owners and can be constructed at small cost.

Walter S. Lemmon, *New York*

Note.—It is doubtful if the electrical actions referred to by Mr. Lemmon actually take place in the circuit; the article is published, however, because of the scientific manner in which the investigation has been made and the results tabulated. It shows ambition for research which might well be followed by a good majority of amateurs. It should be noted that the data secured is from commercial stations within a 15-mile radius of Mr. Lemmon's station and might not hold as well on weaker signals. It is a question whether the loss due to the dead-end effect is actually eliminated, because the added condenser and the unused turns make an oscillatory circuit coupled to the antennæ circuit, which undoubtedly draws more energy from the relative circuits than before the condenser is added. It is, however, made to assist in tuning and we have no doubt but that the results recorded were actually obtained.—*Contest Editor.*



Third Prize Three Dollars

A Magnetic Swith Designed for Grounding the Aerial Outside the House

The following is a description of a magnetic switch, especially designed for grounding the aerial outside the house:

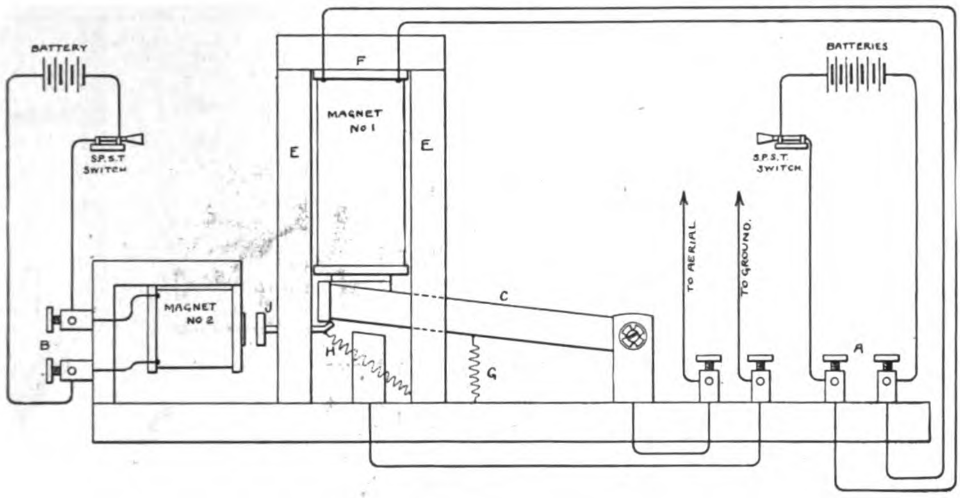
The Base, D, is made preferably of slate or some other good insulating material, 10 inches long by 2 inches wide. The uprights, E, are made of wood 4 inches high. These uprights are spaced just far enough apart to mount the magnet, No. 1, to the crosspiece, F.

The size of the switch used varies with the numbers of lead-in wires used in the aerial. For example: If there is one lead-in wire in the aerial, an S. P. S. T. switch is used. Mount the switch on the base so that one end of the switch will come directly under the magnet, No. 1. A small piece of steel or iron should be fastened to the end of the switch that goes under the magnet. A spring, G, is fastened under the switch, so that when the current is turned off the switch will not catch when it falls down.

Another magnet, No. 2, is mounted on the base so that when the current is turned on it will operate the piece of metal, for which the writer used a common wire nail filed off to the right length. A hole is bored through the upright to allow the nail to slide easily. Another spring, H, is fastened to the small end of the nail, so that when the current is off the nail will be pulled over.

Two binding posts, A, are connected to the two terminals of the magnet, No. 1. Two more binding posts should be mounted on the other end of the base. These should be connected to the two terminals of the magnet, No. 2. The two binding posts, marked A to G, are for the aerial and ground connections.

In order to operate the switch, the current should be thrown into the magnet, No. 2. This operates the nail. Then the current should be thrown into the magnet, No. 1; this pulls the switch up. The



current in magnet No. 2 should next be released, allowing the nail to go under the switch and hold it up. To ground the aerial again throw the current into magnet No. 2, which will pull the nail from under the switch and allow it to drop.

If 110 V. A. C. current is used, a water rheostat should be employed to reduce the voltage.

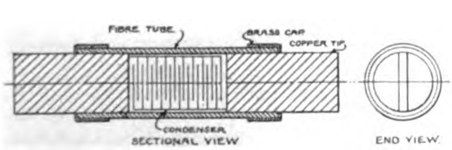
FRANK E. DIETTERICH,
MARVIN WOODWARD,
Missouri.

NOTE.—From the amateur's standpoint the device undoubtedly effects the purpose, but from the standpoint of the fire underwriters we remain silent.—*Contest Editor.*

Fourth Prize Subscription to the Wireless Age

A Condenser Substitute

The sketch accompanying my article shows a 150-amp. fuse which has been blown. I have inserted in that space a small fixed condenser to be used with the receiving set. The space was filled with thin sheets of tin foil, separated by layers of mica or paraffined paper. The condenser will give better service than one of the ordinary type. In order to obtain the best results, the ends of the foil should be soldered to the copper tips.



The amateur should make three or four each varying in size and consequently having different capacities. Before putting on the cap, E, fill the inside with wax to keep out the dampness.

R. R. FERRIS, *Michigan.*

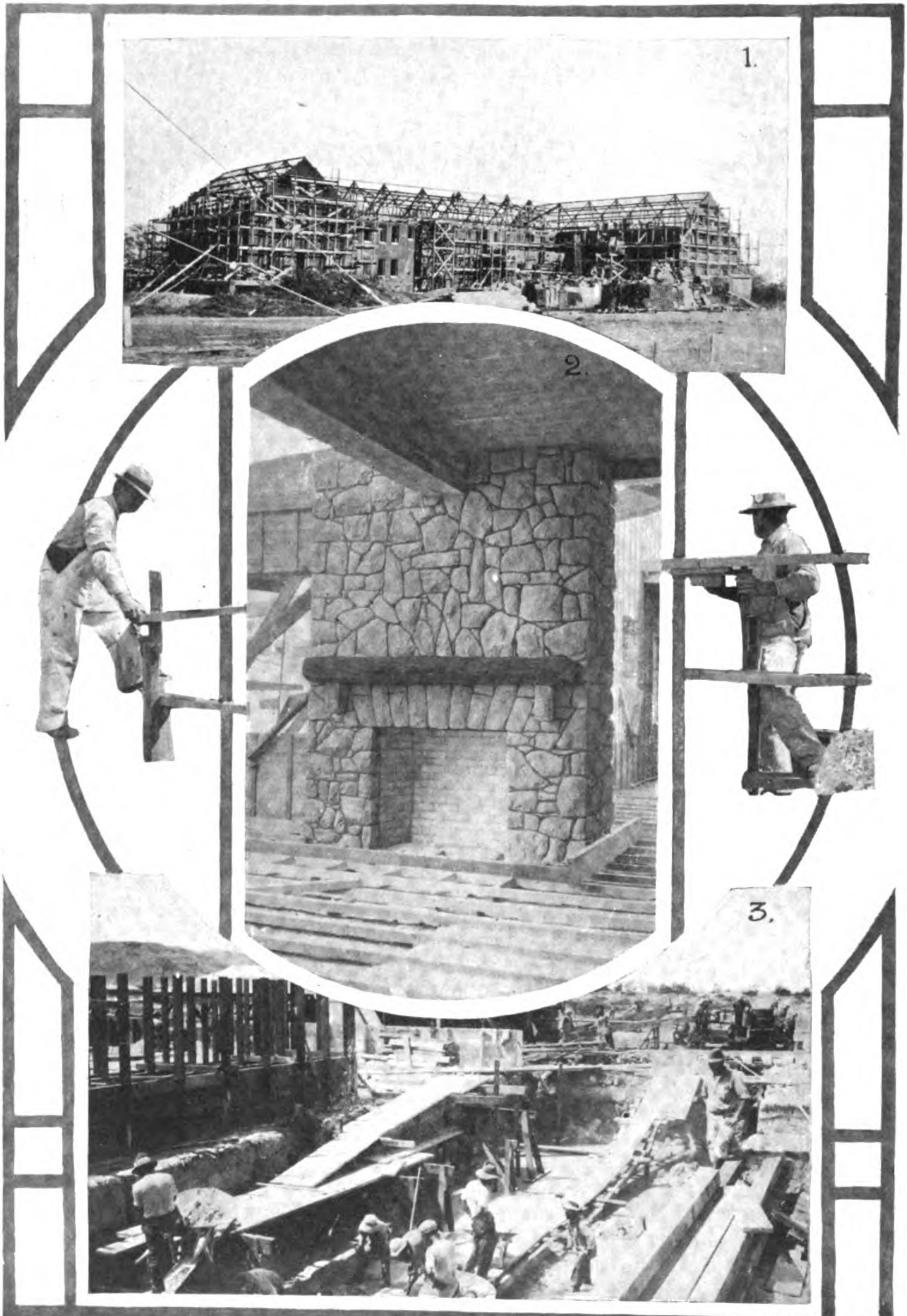
STATION 250 FEET ABOVE SEA

Planted on the crest of a lofty eminence, which rises 250 feet almost sheer from the waters of the harbor, the wireless station at Alert Bay, 240 miles northwest of Victoria, B. C., just been completed by the government, has one of the most efficient equipments along the shores of British Columbia.

When the government engineers were laying out the site for the new station they found that a huge British Columbia fir tree, a very large specimen of the trees which are famous throughout the world for their great size, stood almost on the spot where they sought to erect buildings. Instead of cutting it down, they trimmed it and spliced a long stick to its top for one of the masts carrying the aerial.

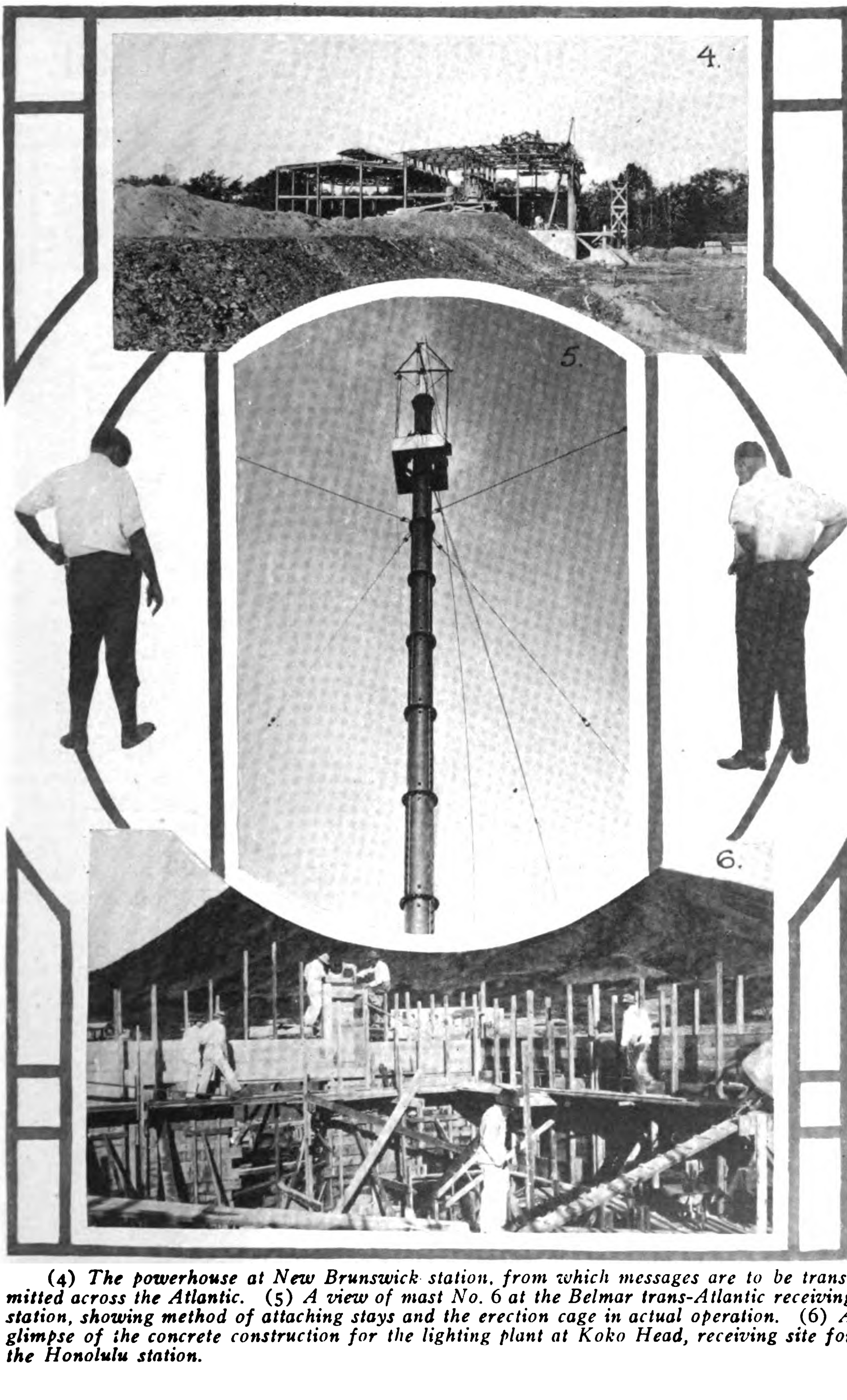
The practice maintained by vessels not equipped with wireless of putting in at Alert Bay to have messages sent to owners at ports hundreds of miles away or to vessels out at sea, has been growing greatly, with the result that the new station has a marked usefulness. Often, with sailors from a deep sea ship crowding its public room, it bears the appearance of a commercial telegraph office.

Preparing to Connect the



(1) *Rear view of the hotel at Belmar, showing the steel girders of the roof in position; an idea of the great size of this structure may be had by closely examining the photograph, in which men may be seen working on the right wing of the building.* (2) *The fireplace in the hotel for operators at Marshalls, Cal.* (3) *Excavating the condenser pit for the powerhouse at the Kahuku transmitting site.*

Continents by Wireless



(4) The powerhouse at New Brunswick station, from which messages are to be transmitted across the Atlantic. (5) A view of mast No. 6 at the Belmar trans-Atlantic receiving station, showing method of attaching stays and the erection cage in actual operation. (6) A glimpse of the concrete construction for the lighting plant at Koko Head, receiving site for the Honolulu station.

WIRELESS ENGINEERING COURSE

By H. SHOEMAKER
Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER XII

Electrical Oscillations

IN the preceding articles I have considered closed oscillating circuits, and their characteristics only. The oscillations can also be produced in open circuits which have the additional property of radiating energy into space, or, in other words, producing electro magnetic waves, in the ether. These waves have the same velocity as light waves, *i. e.*, 10^8 meters (100,000,000 meters) per second.

The first open oscillating circuits used by Hertz and others consisted of two metal rods, lying in a straight line, and with their ends nearly touching so as to form a spark gap. Metal plates were attached to the other ends to increase the capacity of the system.

Fig. 49 shows a circuit excited by a spark coil. A & A′ are the two plates, R & R′ the two metal rods, S the spark gap, and C the spark coil. Hertz found by a series of experiments that this form of oscillator produced a free wave in space which could be reflected and refracted in the same manner as light waves. In fact, he proved experimentally that they were really light waves, having a longer wave length or lower frequency than those which affect our eyes.

While this form of oscillating circuit led to the discovery of the more important form, *i. e.*, the grounded aerial, it is not used in practical wireless telegraphy. Those desiring to go into this matter fully will find an excellent treatise on the subject in Electric Wave Telegraphy, Chapter 5, by Fleming.

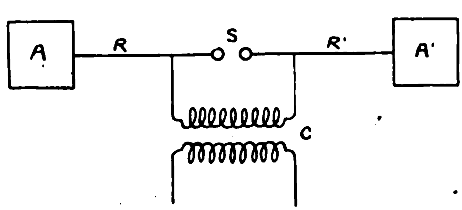


Fig. 49

Marconi discovered that if he replaced one half of the Hertz Oscillator with an earth connection and placed the axis of the oscillator vertical instead of horizontal, he could get greater effects, and over greater distances.

Fig. 50 shows the type of oscillator he first used for producing the electro magnetic waves, and also for detecting them. A is a metallic plate, R is a wire or rod, S is the spark gap, G the earth connection, and C the spark coil. A′ is a metallic plate, R a wire or rod, D is a detector, or sensitive device, for detecting the oscillations in the circuit, G is the earth connections. With these forms of circuits he was able to send messages over distances of several miles. Later on the plates A and A′ were dispensed with and longer vertical wires were used. At present this open oscillating circuit is used in conjunction with a closed circuit

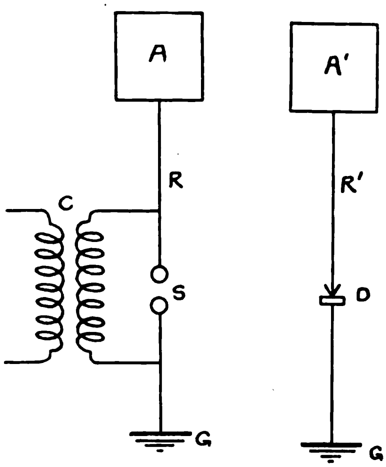


Fig. 50

to excite or produce oscillations in it, and is called the radiating circuit.

The oscillations are produced in the open circuit in the same manner as in the closed circuit. The vertical wire has both inductance and capacity of such dimensions that the wave length of the wave emitted from the vertical earthed oscillator is approximately four times its length. This wave length can be increased by inserting inductance in series with the vertical wire as shown in Fig. 51.

A is the vertical wire or aerial, L the inductance, S the spark gap, and G the earth connection. The inductance, L, not only increases the time period of oscillations, or the wave length of the wave emitted, but it also increases the number of oscillations in a wave train. it decreases the decrement of the oscillations, because the ratio $\frac{C}{L}$ is decreased (see formula 5), and also because the inductance, L, does not radiate energy. The energy loss due to radiations has the same effect on the decrement of the oscillations as resistance, and is termed the radiation resistance.

As the capacity of an aerial is always small, the largest seldom more than .002 or .003 micro-farads, the amount of energy which can be used will be limited. (see formula 7). If the voltage or potential is increased, then it is necessary to lengthen out the spark gap. This increases the resistance of gap, and also the decrement of the oscillations; therefore we are limited in the increase of potential to increase the amount of energy. This amount of energy can, however, be increased by increasing the wave train frequency, and adding to the number of discharges per second.

To overcome these difficulties the open and closed circuits have been combined, the closed circuit being used to produce strong oscillations having a definite frequency, and very low damping. If this circuit is then coupled or brought in inductive relation with an open circuit, as shown in Fig. 51, where the spark gap S is short circuited, then oscillations will be produced in the open circuit.

Fig. 52 is a diagram of a closed circuit

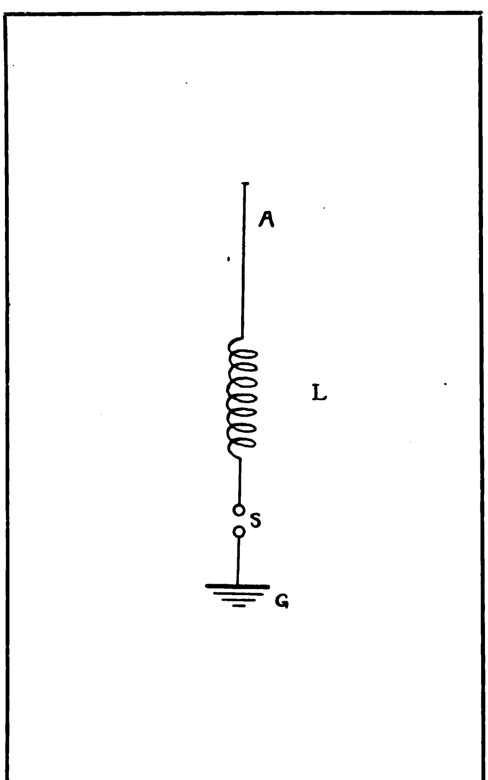


Fig. 51

coupled to an open or radiating circuit, K is a condenser, L the inductance, S the spark gap, and C the transformer or coil secondary. A is the aerial, L_1 the inductance, which should be so constructed that its inductive relation to L can be varied, and G is the earth connection.

If the closed circuit has the same time period as the open circuit, then the two circuits will be in resonance and a maximum current will flow in the open circuit as in the circuits shown in Fig. 48. The process of bringing these two circuits into resonance is called tuning. In practice the closed circuit is set or adjusted to the desired frequency or wave length and the open circuit inductance adjusted until a maximum current flows, which can be indicated by an ammeter, in series with it. Another and better method is to adjust both circuits to the same frequency by causing them to excite a third circuit, whose natural frequency is known. This third circuit can have either its capacity or inductance or both variable, and be calibrated so as to indicate the natural frequency of its circuit for any adjustment of the variable elements. Instruments of this character are called wave-meters, and are of great use in wireless telegraphy.

If the open circuit and closed circuit are adjusted to the same frequency independently, and then operated together, two oscillations will be set up in them, one having a higher and the other a lower frequency than when operated independently. This frequency will differ greatest when the mutual inductance between the two circuits is greatest.

If M is the mutual inductance of the two circuits, L and N, the inductance of the two circuits respectively, then:

$$k = \frac{M}{\sqrt{LN}} \qquad (10)$$

where k is a factor called the coefficient of coupling, and can have values between zero and unity. Where k has a value near zero the coupling is said to be loose, and when near .5 it is said to be close. In practice k never has a value over .05 and very seldom over .1.

If n is the frequency of the two circuits when operated separately, n_1 and n_2 the frequencies when coupled then:

$$n_1 = n \frac{1}{\sqrt{1-K}} \qquad (11)$$

and

$$n_2 = n \frac{1}{\sqrt{1+K}} \qquad (12)$$

If K = O in equations, 11 and 12, then the fraction $\frac{1}{\sqrt{1-K}}$ and $\frac{1}{\sqrt{1+K}}$ is equal to unity, and n_1 and n_2 become

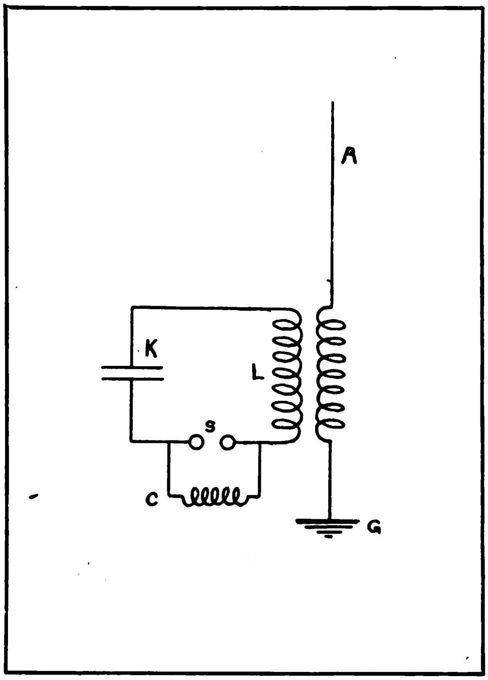


Fig. 52

equal. If K = 1, then $\frac{1}{\sqrt{1-K}}$ becomes infinity and n_1 also becomes infinity, and $\frac{1}{\sqrt{1+K}}$ becomes $\frac{1}{\sqrt{2}}$ or .707 and n_2 becomes $n \times .707$. In this case only one wave will be emitted. It is, however, impossible to have a case where k = 1 in a coupled, open and closed oscillating circuit, as it would be necessary to have the values of M, N and L equal.

As it is difficult, and in some cases impossible to determine the values of M, N and L, the value of k is found by measuring the frequencies of the waves emitted from the circuits, when they have the same independent frequency.

From equations 11 and 12 it will be seen that:

$$n = \frac{n_1^2 + n_2^2}{2}$$

and (13)

$$K = \frac{n_1^2 - n_2^2}{n_1^2 + n_2^2}$$

As the wave length is inversely proportional to the frequency we can write 13 in the form:

$$K = \frac{\lambda_2^2 - \lambda_1^2}{\lambda_2^2 + \lambda_1^2} \qquad (14)$$

Where λ_1 is the wave length corresponding to n, and λ_2 the wave length corresponding to n_2.

If we measure the wave length of the oscillations by means of the wavemeter and substitute the value in equation 14, we can determine the value of K with great ease. We can also find K from the oscillation constants of the respective waves:

$$K = \frac{O_1^2 - O_2^2}{O_1^2 + O_2^2} \qquad (15)$$

Where O_1 is the oscillation corresponding to n, and O_2 that corresponding to n_2.

In practice k is always (less than .1) and the circuits are so adjusted that one of the waves emitted predominates. For a more detailed treatise on this subject, the reader is referred to Chapter 9 of Principles of Electric Wave Telegraphy, by J. A. Fleming. Also see page 416 on wavemeters.

(To be Continued.)

This course commenced in The Marconigraph, issue of December, 1912. Copies of previous lessons may be secured. Address Technical Department, THE WIRELESS AGE.

PROTECTION FOR EXPERIMENTERS

A society has been formed in London to guard the interests of experimenters in wireless telegraphy and telephony. It is to be called the London Wireless Club and at the first meeting a letter was read from the postmaster-general, welcoming the formation of this society. One of the chief objects of the Wireless Club is to guard the interests of workers in wireless telegraphy by securing the granting of licenses. The chairman, F. Hope-Jones, M. Inst. E. E., said he was sure they would continue to have the support of the postmaster-general if they took care that no more complaints were received of interference with commercial and government stations, by the use of excessive powers and untuned aerials.

The qualifications for a license have not yet been clearly defined, and the law on the subject is indefinite. But the qualifications for admission to the Wireless Society are to be identical with those required for obtaining a license. The society may be of great use in connection with the radio-telegraphic committee appointed by the British association.

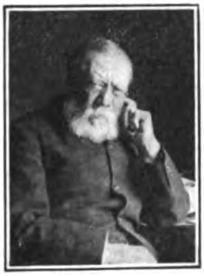
This committee, of which Sir Oliver Lodge is chairman, is to investigate: (1) The influence of sunrise and sunset, of daylight and darkness, and of meteorological conditions on the propagation of electric waves over long distances. (2) The origin and laws of "strays," *i. e.*, natural electric waves. The observations on these subjects must be as widespread as possible, and the committee proposes to send to amateurs a simple scheme of instructions, so that, if they wish, they may be able to help in these investigations.

WORLD-WIDE AID TO TESTS

The Provisional International Wireless Committee has decided, according to an announcement in Brussels, to organize committees in all the countries adhering to the wireless telegraph treaty, to aid the governments in extensive wireless observations and experiments. These experiments will be conducted simultaneously on three days of each week, beginning in January.

OBITUARY

Sir William Henry Preece, F. R. S., known in England as the "Father of Wireless Telegraphy," died in London on November 6. Born February 15, 1834, near Carnarvon, North Wales, Sir William was actively engaged in telegraph work from 1852 until the time he resigned from active service as consulting engineer of the Post Office Department in 1904. His connection with the Post Office Department lasted more than twenty-seven years.



He completed a full course at King's College, London, and studied electricity under Faraday at the Royal Institution, becoming, at the age of twenty-six, superintendent of telegraphs on the London and Southwestern Railway. In 1852 he entered the office of the late Edwin Clarke, who was then chief engineer of the Electric Telegraph Company. From 1854 to 1856 he acted as assistant to Latimer Clarke, and in the latter year was made superintendent of the southern district. During the early part of his career, Sir William took out patents of a duplex system. In 1860 he was appointed by the London and Southwestern Railroad to be superintendent of its electrical system, and in 1870 he entered the post office service as division engineer for the South of England.

Accompanied by Sir Henry Fisher, Sir William visited the United States in 1877. The result of their investigations was the introduction of "sound reading" into England. Sir William also brought to England the quadruplex system of telegraphy. He visited the United States again in 1884 and, when he returned to England, introduced the multiplex system of telegraphy.

He began experimenting with wireless telegraphy in 1884 and worked out an electro-magnetic system. His inventions, which were many, dealt with the telephone, Wheatstone apparatus, duplex, quadruplex and multiplex telegraph, wireless telegraphy and electrical devices for increasing the safety of railway travel. He was the second man in England to adopt electric lighting in his private residence. He was for years president of the Institute of Civil Engineers, and had been prominently connected with other societies. He was an honorary member of the American Institute of Electrical Engineers and of the New York Electrical Society. He was also well known as an author and lecturer on scientific subjects.

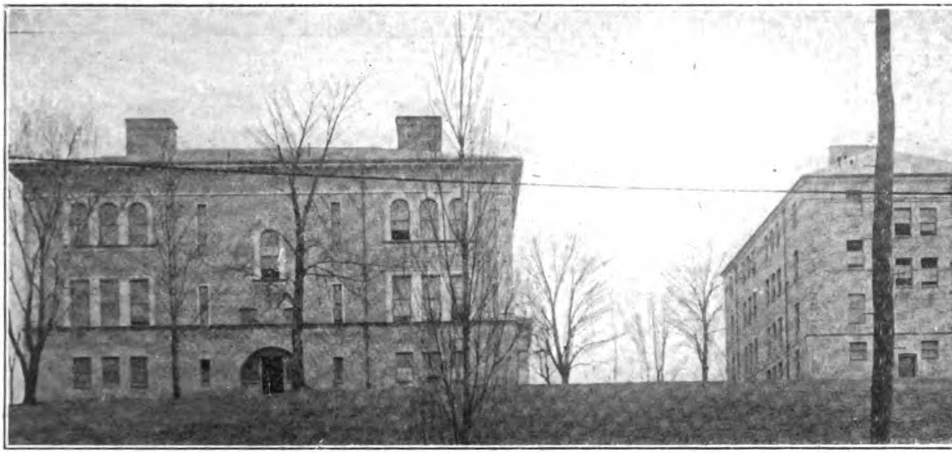
Guglielmo Marconi paid the following tribute to Sir William:

"I deeply regret the death of Sir William Preece, who was the first person in England to take an interest in my early experiments and to lecture upon them. It is due to his influence that I received considerable encouragement from the British Post Office."

James Mulford Townsend, director of the Marconi Wireless Telegraph Company of America and a member of the executive committee of the company for the last five years, died on October 31 at his country home, Borradil Farm, Mill Neck, L. I. His death followed an operation at Roosevelt Hospital, New York City.

Mr. Townsend was born in New Haven, Conn., on August 26, 1852, the son of James Mulford and Maria Theresa Clark Townsend. He received his early education at the Hopkins Grammar School in New Haven and, after traveling some time in Europe, entered upon an academic course in Yale University. He was graduated from Yale in 1874. At the time of his death he was senior partner in the law firm of Townsend and Button, No. 2 Rector street.

While devoting himself to general practice, Mr. Townsend gave his attention particularly to corporation law.



Antennae of Tufts College Wireless Station, which Extend Between the Chimneys of Paige Hall, on the Left, and Miner Hall, on the Right

New Station at Tufts

College Students Install Apparatus Given Anonymously—How the Members of the Wireless Society of the Institution Demonstrated that They were Practical by Obtaining Scores of Football and Baseball Games

MEMBERS of the Wireless Society of Tufts College, which is made up of the class in wireless research at the engineering school of the institution, have completed the installation of a new wireless station on College Hill in Medford, Mass. With the new apparatus operators, under favorable conditions, are able to send messages more than 1,000 miles, and to receive them from twice that distance. While the work of the Wireless Society is voluntary, Acting President Hooper, of the college, is planning to give an elective course in wireless study during the current half-year.

The apparatus was given to the Wireless Society by an anonymous friend. The station is located in Paige Hall, on the crest of College Hill, the antennæ stretching from the chimneys of Paige Hall to Miner Hall, a distance of 225 feet. More than 1,000 feet of wire were used in making the antennæ. The station apparatus includes the latest model of commercial high voltage transformer, rated at two kilowatts and capable of stepping from 110 volts up to 15,000 volts. A synchronous rotating spark, driven by a one-eighth horsepower motor, is used to set up the Hertzian waves and discharge the condenser.

In connection with this gap will be used an inductive coupled oscillation transformer, which is constructed so that great changes in the wave length and character of the wave are possible at the will of the operator. This feature elminates the necessity of special apparatus to comply with the United States wireless regulations, which require a wave length of not more than 200 meters. With this the Tufts station expects to prove the fallacy of such a wave length regulation.

The synchronous rotating spark gap is another distinct feature of the sending apparatus, since by its means a characteristic and musical note is produced, enabling operators at various stations to recognize Tufts messages before the signal letters are even understood.

The receiving station is equally well equipped. It includes the latest type of inductive tuner, variable condensers, loading coils, a combination of pyron and periken detectors and a pair of extremely sensitive high resistance wireless receivers. The inductive tuner is of novel design and is, as far as can be ascertained, the only one of its kind that is provided with a system of switches to cut out the dead ends of the coils, thereby improving the efficiency. It has no sliding points of contact to weaken the received waves, but is regulated by a series of many point switches that afford a wide range of selection.

By means of the variable condensers and loading coils the set can be tuned to receive from stations of different wave lengths. It can successfully tune out the government stations while receiving from other amateurs who have the regulation 200-meter length.

The Tufts College Wireless Society began its existence in 1910, but not until the next year were the members able to secure any apparatus. Then Professor Harry C. Chase of Tufts, captain of the Massachusetts National Guard Signal Corps, obtained the loan of a portable field wireless set from the State militia, and a series of complete tests was made, the results being sent, by request, to the Signal Corps authorities in Washington. A year ago the society was formally organized with Harold J. Power, of Everett, as president. He was one of the first amateurs in New England to set up a station.

In 1905, when as a young boy he completed his little receiving set, there was only one other amateur station in New England. He continued to widen his knowledge of wireless and in the summer of 1907 became wireless operator on the steamship Yale. Later he was on the steamship Harvard, the Florizel of the Red Cross Line, and Colonel John Jacob Astor's yacht Noma, as wireless operator. Last summer he was chief wireless operator on the St. Louis, of the American Line.

Joseph A. Prentiss, treasurer of the society, first became interested in wireless telegraphy in 1908, when he erected an aerial on the roof of his home in Belmont. He made a carbon coherer and other crude instruments used by amateurs then. Since that time he has been improving his home apparatus until now he has an excellent type of a small station. Last June he passed the government examinations for licensed first-class operators.

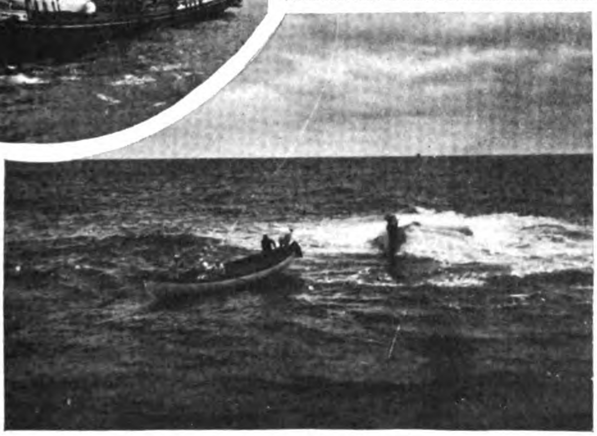
The members of the Wireless Society have given practical demonstrations of their work with the old apparatus. While the Tufts-Trinity football game was being played on the Tufts Oval last year, the Tufts station was receiving bulletins of the Harvard-Yale game and telephoning them to the Oval for announcement to the spectators. During the World's Series of baseball games between the New York Giants and the Red Sox, reports were received by wireless and posted in front of Robinson Hall.

Receiving a Message at the Tufts Station

The Wireless Club now has fifteen members. Walter L. Kelley is vice-president. The members include Leon W. Peterson, Howard E. Grupe, Everett B. Miller, Roland G. Stafford, Arthur D. Stewart, Herbert E. Metcalf, Joseph L. French, Walter L. Jones, Raymond U. Fitz, Gordon F. Holland, Chauncy L. Delano and Harold Ramsay.

Snapshot Stories

Caught by Radio Men



An oft-told tale of the sea visualized. The upper picture shows the schooner Cottonfield flying the distress ensign, a mute appeal for aid. A member of the crew had been severely injured and by good fortune the steamship Nelson sighted her in time to save the man's life. This remarkable snapshot was secured by operator Randow of the Marconi service.

In the center is illustrated the salvage of the schooner Lottie R. Russell, which had drifted bottom up from the Virginia capes to a point off the coast of Newfoundland. Two men can be seen on the keel of the wreck; they are members of the crew of the U. S. Revenue Cutter Seneca making fast the hoisting tackle. These men were washed off while at work and narrowly escaped death. Photo by operator Borch of the U. S. Revenue Cutter service.

Amateur photographers will appreciate the difficulty in securing a picture like the lower one—porpoises running ahead of a ship. The arrow indicates the bow of the vessel. One porpoise is completely out of the water and those on either side are diving with only their tails showing above water. This unusual photograph was taken by operator Bierfreund of the Marconi service.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

H. E., Upton, Mass., writes:

In the article published under the heading "Engineering Measurements of Radio Telegraphy," by Dr. A. N. Goldsmith, I would like to call attention to a mistake in formula (No. 23) on page 59 of the October number of THE WIRELESS AGE. In my opinion it should read:

$$C_x = \frac{r_2}{r_1} Cn.$$

Ans.—The formula as printed in the October issue is correct. If the formula directly precedin~~g~~ No. 23 be squared, inverted, and then algebraically simplified, it will be found that the printed formula is obtained.

Your confusion probably arises from the fact that if the bridge were solely made up of resistances your correction would be valid. The following must be borne in mind: that resistances differ from capacities in that the larger the resistance the more it opposes the flow of current, whereas the larger the capacity the less it opposes the value of current. There is thus a sort of reciprocal relation between resistance and capacity which affords a physical reason for the difference in the bridge formula when capacities occupy two of the arms.

* * *

S. I., St. Louis, Mo.:

(1) The natural wave length of your antennæ is very roughly 430 meters.

(2) With the apparatus you have on hand it may be possible for you to receive wave lengths up to 2,500 meters.

(3) If you intend to use two one-quart Leyden jars in shunt with a 1½-inch inductance coil we fear you will meet with discouragement. The capacity is entirely too high.

(4) As regards the series condenser to reduce this antennæ to wave length of 200 meters, we cannot answer the question at all accurately. As we do not know the capacity of your antennæ in microfarads, I would suggest that you put a small Leyden jar in series with the antennæ and have the government inspector in your district adjust your wave length.

(5) The operation of a quench spark gap in connection with a 1½-inch spark coil will not be at all satisfactory.

M. W., Holly, Mich., sends us a number of queries. The questions and the answers to them are as follow:

Ques. (1) How many kilowatt do the operators at the station at Sayville, N. Y. (call WSL), use when they send out press at night? What is the wave length used?

Ans. (1) The power supplied to the antennæ at Savville is 35 kilowatts; wave length, 2,800 meters.

Ques. (2) To whom do they send press?

Ans. (2) To ships at sea.

Ques. (3) What wave length and how many kilowatts does NAR send with?

Ans. (3) 25 kilowatts; wave length, 1,600 meters.

Ques. (4) What time of the night would NAR be liable to send?

Ans. (4) He is apt to be sending at any moment during the first 15 minutes of the hour.

* * *

R. St. J., Montreal, Canada, says:

I have made a one-kilowatt open-core transformer, primary, two layers No. 12 D. C. C. wire, 7 inches long; secondary 5 pounds No. 30 black enameled wire in 25 sections. I have no electric light current at home and have to use this transformer as a spark coil in connection with vibrator and 8 dry cells. Can you tell me how many sheets of tin coil, size and distance between each (air as dielectric), for a secondary (sending) condenser ought to be used with this coil? What will be the capacity of such a condenser? How much capacity will a condenser require for a ½ kilowatt?

Ans. (1) It is very difficult to answer your communication, as we do not know the voltage of the secondary. The proper condenser is best determined by experiment. See the article in the November issue of THE WIRELESS AGE entitled, "A 200 Meter Amateur Set." Build a condenser of these proportions and make several trials, using more or less plates until a clear spark is secured. The capacity the condenser will require for a given number of watts depends entirely upon the voltage.

* * *

G. E., Savannah, Ga., writes:

Please inform me what type or form of aerial, 70 feet in length, composed of six wires, gives the best results. Also what form will give the longest wave length?

Ans. (1) Make your antennæ of the inverted L type; space wires 2 feet.

Ques. (2) I have a 110-volt direct-current source of supply and wish to procure a transformer to be used with an interrupter and produce one kilowatt. Will an ordinary transformer do, or will it be necessary to have it specially made? If so, where can I get dimensions and sizes of wire to make it myself?

Ans. (2) When transformers are used with interrupters they are usually termed induction coils. An ordinary transformer will not do; you must have an induction coil. You do not state the type of interrupter you intend to use; you will find it very difficult to handle one kilowatt through a platinum interrupter. Using an electrolytic interrupter, you will be able to purchase coils consuming very nearly one kilowatt. You will find a coil of such dimensions rather difficult to construct. You probably have not the facilities for properly winding the secondary. We suggest you get in touch with one or two concerns handling X-ray apparatus. They will be able to furnish you with coils of this nature.

* * *

A. S., North Hackensack, N. J., sends a circuit diagram of his receiving apparatus and says he is unable to hear any signals.

Ans.—Provided there are no open circuits in your apparatus, the connections shown in your diagram should give results. You have the head phones connected around the silicon detector. You will find increased strength in signals after your apparatus is working properly, if you connect the phones around the fixed condenser. See the November issue of The Wireless Age, Fig. 1, page 166. Make use of the circuit diagram shown. The secondary of your loose coupler does not show a variable inductance. It should be so constructed for best results.

* * *

E. P. K., New York City:

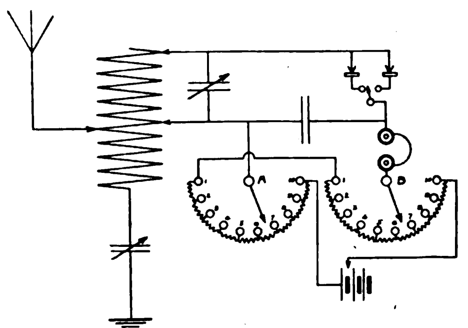
We can not be more specific in giving data regarding your receiving wave length, because we do not understand the arrangements of the antennæ. Any calculations of the wave length with the arrangement you have would be merely guesswork. Your night range may be, estimating roughly, 500 miles; as to your day range I cannot answer. The Fleming oscillation valve will not particularly increase the range of your present equipment. It requires a 6-volt storage cell. You will find it more stable in its operation than the audion.

* * *

R. E. G., Brooklyn, writes:

I am enclosing a diagram of receiving set, but as I have recently constructed a potentiometer, of which I also enclose diagram, I am at a loss to know just how it is to be connected.

Ans. (1) On this page we show a hook-up, indicating the proper connections when the apparatus shown in your diagram is to be used. Your diagram is incorrect, and while you may receive signals you have not the most efficient hook-up obtainable. You have two fixed condensers in series. They should not be used in this manner unless the capacity of the condenser is very large. Follow our diagram and you will have an efficient set. Note our connections of the two potentiometers. When switch *A* is on point 1, and swich *B* is on point 1, the current flow through the head phones will be practically zero. If switch *A* is moved to point 2, and *B's* position varied, a very fine regulation of the intensity of current in the head phones is secured. The remainder of the circuit diagram is self-explanatory. If you wish to employ the batteries and potentiometer in connection with silicon and perikon detectors, you should insert a fixed resistance of 1,800 ohms in series with the battery lead to the potentiometer.



G. C., Brooklyn, N. Y., desires to equip a Bleriot monoplane with a radio telegraph apparatus. He describes fully his equipment and asks for a proper hook-up. On the following page is shown a diagram of the connections to be used.

Ques. (2) What would be best, a 25-foot horizontal aerial, 8 wires stretched across pole on the top of monoplane, or as soon as plane leaves ground drop a 4-wire, 100-foot antennæ beneath the monoplane?

Ans. (2) You should use the truss wires for the earth connection, the 100-foot wires for the antennæ. You should calculate the wind resistance of 100-foot antennæ. It may seriously interfere with the stability of the monoplane. See the February issue of *The Marconigraph*, page 211, showing the arrangement of the antennæ and apparatus connections on a Bleriot monoplane; also see the April, 1913, issue of *The Marconigraph*. You will there find an excellent article describing the Marconi aeroplane set, its method of use, etc. If you wish to cut down the wind resistance of the hanging wires, why not use a single wire with a small weight at the end to hold it taut?

Ques. (3) Would the gasoline engine have sufficient capacity to act as a ground? Or, what can I use to better it, or make it so it will have a larger capacity?

Ans. (3) It is insufficient. Use the truss wire.

Ques. (4) Can I use the rotary gap with this transmitting set? At what speed must it run in order to give a singing spark? Give diameter of the disc and the number of points.

Ans. (4) You will find the operation of a rotary gap in connection with a 5-inch induction coil very unsatisfactory.

Ques. (5) Can you give me the approximate distance at which I can receive and send with this apparatus?

Ans. (5) About six miles.

* * *

H. R., Cleveland, Ohio, says:

I write to ask you which of the following statements is correct? (1) Stranded wire should be used in connecting up a wireless set, because high frequency currents travel on the surface of a conductor and there is more surface to stranded wire. (2) Solid wire should be used because it has less surface and therefore less resistance, for the more the surface the more resistance.

Ans.—The first statement is correct.

* * *

P. H. S., Franklin, Pa., sends us a communication regarding his radio station. He says that he does not hear signals and asks if we have any suggestions to make. He also describes the antennæ, which are freakish in construction.

Ans. (1) First, we cannot understand why you have the single wire 300 feet long in the direction opposite to that of the antennæ proper. Why is this necessary? Antennæ of symmetrical design are always best. The inverted L type of antennæ is best for your purposes. We believe you have been misled as to the distance your set should cover. Keep in mind that the long-distance amateur work which you hear so much of is done during the cold winter months and in the night time only. Understand also, that signals received under such conditions vary in intensity and are not constant. See the hook-up on page 82, October number, The Wireless Age. Connect your apparatus after this manner. A variable condenser should be used in the detector circuit. We do not know the conditions surrounding the antennæ and cannot tell you how loud the signals from a 5-kilowatt station 200 miles away should be.

* * *

E. H. Salem, Wis.:

Your queries are of such a nature that they cannot be answered specifically. Regarding the loading coil you refer to, this will increase the wave length of your circuit, and if the rest of your apparatus is in proportion you may be able to get time signals from Arlington. As regards your sending range with a 1½-inch coil, you refer to a 1-quart Leyden jar to be used in connection with this coil. Have you tried this? You will find it is likely that the capacity of the jar is far too great for a 1½-inch coil. Your sending range will be about three miles.

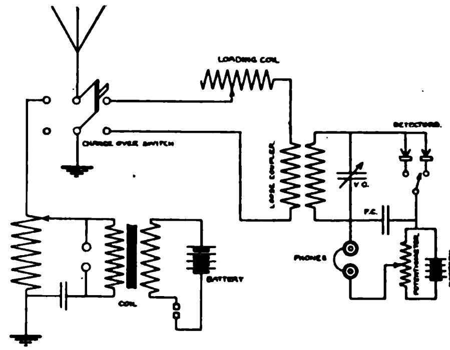
* * *

V. F., New York City:

Regarding your argument with "Doc" at the Marconi School, "Doc" surely understood that a motor will not run with armature wires burned out. He meant, if the motor armature should burn out and, after rewinding, was placed in the frame and ran backwards, what would you do? Probably the easiest thing to do would be to reverse the connections from the brushes to the shunt field winding.

(2) A hot wire ammeter is generally used to tell whether or not your antennæ is radiating.

(3) For information regarding the Pierce wave motor, I refer you to page 144 of the Manual of Wireless Telegraphy for Naval Electricians, 1911, second edition.



R. N. L., Woodlawn, N. Y., inquires:

Give an explanation of the operation of the break-in system.

Ans.—There are a number of break-in systems in use, and to completely cover the subject would require much more space than we could give. Note in the October issue of The Wireless Age, under "Operators' Instruction," the "break-in" device as used by the Marconi Company; also note on page 85, in the October number of The Wireless Age, an article on a break key for a loose coupler.

(2) Give an explanation of a buzzer test.

Ans.—A complete answer to this question will appear in an early issue of The Wireless Age.

* * *

The Queries Department has received many questions from readers which show that they lack knowledge relating to the elementary principles of wireless telegraphy. We suggest that they devote some time to the study of a book on the elementary principles of the art, in order that they may be able to put their questions in better form and obtain a more intelligible comprehension of the answers given.

THE WIRELESS AGE

JANUARY, 1914

IN OUR OPINION

THIS is the day to begin looking forward to and planning what we purpose doing in the New Year that stretches alluringly before us.

You have no doubt summed up your work of Nineteen Thirteen. What a disheartening array of disappointments! This and that were not completed, you failed in the one thing you felt certain of success with, and, worst of all, not a single thing you managed to do to your full satisfaction attracted any notice. This old world of ours is a cold proposition. Each year you have started off with renewed vigor, fresh enthusiasm and a determination that was bound to get you somewhere. But it didn't.

Summing Up the Disappointments of the Past Year and Looking for the Reason

Why?

Well, there was that absolutely brilliant inspiration that came in the night and kept you tossing about on your pillow, impatient for the dawn when you could commence working out the details. How you labored day after day, night after night, to get the whole thing perfect! It was a really big idea. And the more you investigated, the greater were its possibilities. At last you had everything just right.

Then came the sudden bump. Some one had done it before—it had been a success, too, but that was poor consolation. It had been done.

Or perhaps it was a lot of little things, nothing very important in the eyes of the world, but a mighty big help in carrying on its work. You are sure of that. You know, because you watched those ideas take form, and saw what a short cut they proved to be, what an amount of labor they saved. It was good work, well done. But nobody noticed.

Neither one fits your particular case? All right; we'll take it that you just plod along, hemmed in by routine, no opportunity to display any initiative; just a lot of old humdrum work that has to be done, petty stuff that takes up all your time and gets you nowhere.

Ever stop to think that it doesn't take up all your time? For instance, what do you do with your evenings?—what do you think about when you are dressing in the morning?—on the cars to and from your daily tasks? Suppose you reserved this time to plan a little ahead. Never mind the evenings. The man who spends them profitably is bound to go on up the ladder. But suppose you forgot about the exasperating routine and the lost individuality during those few moments devoted to dressing or while riding on the cars, and used them to figure out exactly what your work means. The mere fact that it has to be done shows that it is important. Maybe only as a cog in the powerful machine of commerce or a stitch in the great mantle of science that is being draped about the world—yet the greatest machine cannot run without each part being in place and a stitch dropped can unravel the most gorgeous banner. Now if your work was a little better the fabric would be stronger, the machine more efficient. And your work will be better if you know more about it.

THERE is a fellow just above you. What does he do? Could you do it? If he was promoted to-morrow could you fill his place? You think you could. In fact, you are sure of it. But do you know *more* about his work than he does?

On Adding an Extra Month to the Working Year

You should. That is, if you expect to take his place. When he goes a step higher, his successor will not make a very great impression unless he can do *better*. Those few minutes you ordinarily waste will prepare you.

It takes the average person twenty minutes to dress. Forty minutes more, twenty each way, are consumed in traveling to and from the office or shop. In all, one hour. Figuring three hundred working days in the year, this makes three hundred hours—or more than thirty-seven full working days!

Use this time profitably and there will be an extra month credited to your progress preparation in the year we have just ushered in.

Every so often we hear someone say that their particular line of endeavor holds no tangible reward. Which is a very foolish remark.

There is positively no manner of accomplishment that is not recognized, either by riches, gratitude or glory.

You have heard about the Nobel prize, a truly magnificent reward, for it stands for the gratitude of humanity and comprises both money and glory. A few years ago Mr. Marconi received this great honor. Why he was selected needs no further comment, for his gift to humanity is known far and wide. The prizes—there are more than one—are given each year. Chemistry, physics, medicine, peace and literature are the divisions. Do you realize that you can earn one? It does not matter who you are, or what you do; with the proper amount of concentration and energy and purpose you, or anybody, can attain this greatest of rewards.

Nobel was a Scandinavian, the inventor of nitroglycerine, or the dynamite that destroys life and property. He left to civilization his vast fortune that prizes might be given each year for the best work of the human mind.

The literature prize for the year just ended was given to a poet!

WHERE is the argument now that any particular line of endeavor lacks reward? For among all the thankless, ill-paid, little respected and less appreciated classes of work the making of verses

Honors Showered on a Comparative Unknown, Whose Message Came in a Strange Tongue

stands alone. The prose author has his troubles, but they pale into insignificance beside those of he who elects to spend his days and nights reaching for the expression of ideas, interminably polishing his phraseology—while the cartoonist looks on and makes him the laughing stock of the civilized world.

Remember that the Nobel prize stands for the best work of the human mind. In years gone by, many men you knew at least by reputation have received it. Now it goes to a poet, one whose writings you know little if anything of, whose name has not been seen in the magazines. He is a silent toiler, an earnest hard-working man who has labored steadily without thought of reward. But he had something to say, something that would do the human race good. And he learned how to say it.

Tagore is the man's name, Rabindrath Tagore, who wrote his poems in the Bangali language of India, a tongue you probably never heard. He has translated them into English, so that all of us might profit by his teachings. And the wisest among us will.

There is one story which contains a lesson applying directly to each one of us as we stand on the threshold of the New Year.

A MAN believed that somewhere could be found a magic touchstone that would change base metals into gold. He went along the shore of the ocean, with one hand picking up stone after stone—thousands, tens of thousands, hundreds of thousands of them. A chain of iron was about his neck, and as he picked up each stone he touched it with the chain. For when the magic stone appeared it would change the iron to gold.

An Indian Parable that Lights the Road to Success

Day after day, down through the long years, he continued the search until he became "a wandering madman seeking the touchstone, with matted locks, tawny and dust-laden body worn to a shadow, his lips tight pressed, like the shut-up doors of his heart, his burning eyes like the lamp of a glowworm seeking its mate."

One day a village boy asked the old man where he got that golden chain about his neck.

And the poor, tired and miserable old hunter looked down and saw that the iron had changed to gold. But he did not know when it had changed.

"It had grown into a habit to pick up pebbles and touch the chain and to throw them away without looking to see if a change had come; thus the madman found and lost the touchstone.

"The sun was sinking low in the west, the sky was of gold.

"The madman returned on his footsteps to seek anew the lost treasure, with his strength gone, his body bent and his heart in the dust, like a tree uprooted."

What a lesson for old and young in this fine parable of Tagore's!

EVERY day we see humans turn back, weary and hopeless, along the shore of life and time, vacantly seeking to recover the opportunity neglected and missed.

Pointing Out the Error of Doing Your Work Carelessly

And the story takes added strength in the fact that men at one time actually hunted for the touch-stone, or "Philosopher's Stone," and believed it would change baser metals into gold. Chemistry began with the ancient alchemists' struggles to manufacture gold artificially. They did not discover how to do this, but they did learn how to change human thought and painstaking experiment into something more valuable—scientific knowledge.

This knowledge came in the effort to learn the truth. We know now that there is no Philosopher's Stone. But we have discovered great scientific truths, more beneficial to humanity than all the gold in the universe.

We have learned that work, not magic, changes the dross of iron of monotonous toil into the gold of opportunity and success.

Yet many of us are like the madman in the story. We go through life intent on the magic stone representing opportunity and success in commerce or scientific achievement and, reaching old age, find that we held it in our hands only to drop it without realizing what it was.

When Tagore's seeker began his search he did his work well. He believed in ultimate success and his mind was keen and alert. He felt that he would continue to do his work attentively. And he would seize the precious stone of opportunity when it came within his reach.

But as time went on he grew careless. He began to do his work mechanically; the oft-repeated process became monotonous and a function of the body as his mind relaxed its vigil. He was a dull machine grinding out his daily task when success came to his hand. So he lost it.

You can make no better resolution for the New Year, no better one through life, than an unswerving determination to keep watching as you work, never relaxing your vigilance.

Then, when you come to old age you will not have to face the truth from a younger man—that you had your chance, and didn't know it.

WE are starting this New Year with the business outlook none too cheerful, and men none too optimistic.

Yet the prospects for wireless workers were never brighter.

The Exceptional Opportunities in Wireless that Will Occur in the Next Twelve Months

The student at his desk has unprecedented opportunity to prepare himself for the great future that may be his. A few years ago, one might say a few months ago, wireless was more or less a mystery. Now colleges and preparatory schools are including wireless courses in the curriculum. In place of a few scattered text books mainly devoted to obsolete apparatus and general theory, there are a number of standard reference works, ranging from elementary instruction to weighty engineering treatises, and there are monthly magazines to keep step with the progress of the art.

The assiduous seeker after knowledge on wireless matters can now go deep into the subject, theoretically at least, and emerge from the institution of learning with a secure foundation for his practical application to the working problem of the day. Certainly no broader nor more promising field exists. Wireless telegraphy will soon connect the remotest corners of the earth with the great centers of population; wireless telephony will follow. And in view of man's conquest of the air—long looked upon as an absolute impossibility—who can doubt that some day will come the transmission of power by wireless?

Then our whole scheme of transportation and manufacture will be revolutionized. Men will have to direct the great forces, men who grew up in the wireless business. They will be the great human factors of their time, reaping reward beyond all dreams of avarice. Wireless transmission of power may or may not come in our generation. But if it does—will you be ready?

AND as the young student looks forward, using his imagination to spur him to greater effort and the shaping of his destiny, his elder brother, the practical worker in wireless to-day, can look upon his more tangible prospects for the year with justifiable enthusiasm.

What the New Developments Should Mean to the Commercial Wireless Man

The first links in the chain of powerful stations that will girdle the globe are receiving their finishing touches. Hundreds of men will be needed to operate and keep the massive machinery in the pink of condition, night and day. Good salaries, ideal living conditions and limitless opportunity for advancement await those who earn these appointments.

These stations represent a mere beginning. Each year wireless communication will come into more general use. Tens, hundreds, thousands, of stations will eventually dot the earth. Men will be needed to care for and operate them. Engineers will be required to design apparatus of ever-increasing efficiency.

Wireless engineering cannot be mastered in a day. The men on the big problems will have come up from the ranks. And they will be those who make brain and hand work together *all the time*.

The application of wireless to railroading is significant. In fact, all its present-day uses are but harbingers of what is to come. The surface has only beeen scratched; below lies a golden mine of opportunity for the technically inclined.

And you business men—are you wide awake to what this year will mean in commercial wireless? Have you figured out the increase in traffic when all these new stations are working?

A lot of business problems are going to arise. Some one will solve them. Perhaps the fellow at your elbow, at the next desk, will be the one to work out the short cut, or that quiet little man who has scarcely been noticed since he came into the department is going to offer a suggestion that will lift him out of drudgery and start him on up the ladder. Among the men around you there is one who some day will be pointed out as the great success.

He has no more chance than you have right at this moment.

Jot this down on the calendar pad of your mental resolutions, to be referred to as you turn over the leaf for each new day:

> "Keep your brain active every minute of your waking hours so that you will recognize opportunity when it comes."

Which is in substance the lesson of the illuminating story told by Tagore, winner of the Nobel prize. It applies particularly to your work in the New Year, for there can be no question that Nineteen Fourteen will figure very prominently in the history of wireless telegraphy.

THE EDITOR.

AS VIEWED BY A MARCONI ENGINEER

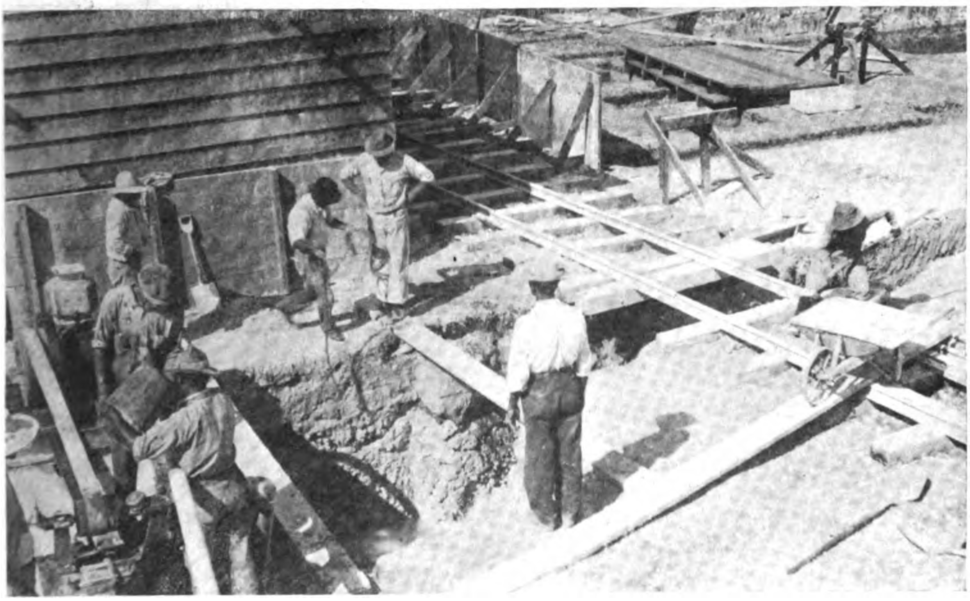
NONE of the features to be taken into consideration when determining the site of a wireless telegraph station receive less thought, as a rule, than accessibility. This condition prevails perhaps because the factor of accessibility and the chief commercial factors are not in accord. It is needless to say that the latter factors carry the greater weight; yet, following the increased demand for power plants in wireless telegraphy, additional consideration is being given to easy access, with the result that the long distance installations now under construction for the American Marconi Company are more approachable than the majority of the larger ones erected in the past.

Why accessibility has increased in importance can be easily explained. Broadly speaking, accessibility means good railway transportation facilities—either steam or electric—for long distance freight haulage, and durable roads on which motor-driven or horse-drawn vehicles can convey materials to the sites. When the material necessary to build a wireless telegraph plant was measured by tens of tons, and the supplies required for maintenance were correspondingly small, speaking comparatively, the roads and their durability were not given great consideration. But since it has become necessary to reckon on tonnage of material to be hauled to one station site in three, and even four figures, transportation demands careful thought.

The Marconi station at Clifden, Ireland, is located on a site surrounded by soft peat bogs. A good macadam road, about five miles long, leads from the steam railroad to the edge of the bogs. From this point a road was built to connect with a railway about a mile in length, which extends over the bogs to the station buildings. All of the material used for the construction of the station and the supplies necessary to maintain it have been transported by means of this railway which has a road bed that is far from being firm.

Ditches that have been dug on both sides of the railway are the cause of considerable inconvenience and some danger because of the fact that there is barely room to step off the tracks when a locomotive approaches, without falling into one of the ditches. Indeed, he who wishes to traverse the tracks, particularly at night, will do well to ascertain the location of the locomotive and the plans of the engine driver before he starts. For it is not a pleasant sensation to see the headlight of the locomotive rapidly draw near you and realize that your shouts cannot be heard by the man at the throttle. In a situation like this there remains little to do but decide between balancing yourself on what is practically the edge of nothing while the locomotive roars by, or jump blindly into one of the ditches.

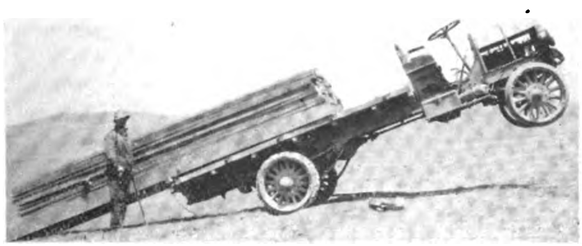
An illustration of how little dependence can be placed in the track occurred when several heavy pieces of machinery were being transported from the road to the plant. On this occasion the rails built up the bluff, which is 100 feet in height, to the power house. The lighter weights were hauled up the incline without much difficulty, but the heavier pieces caused trouble. A boiler piece weighing eight tons was placed on a truck and started up the incline. After watching it enter the cut, we ran up the pathway to see that it arrived on top of the bluff without mishap. When we reached the summit of the incline we



The Kahuku station is made accessible by a steam railroad. The subsoil at the station is made up of porous coral rock, and there has been considerable trouble in putting down foundations.

sagged to such an extent that it was necessary to place timbers under the rails as supports in order to insure safe transit for the load.

That luck sometimes plays a part in transportation was shown during the construction of a station about half a mile from a wharf where the material was being unloaded. An inclined track had been found that the hoisting engine had stopped and that the load was within about ten yards of the top of the bluff. Inquiries showed that the negro in charge of the hoisting engine had neglected to keep up a full head of steam as he had been instructed to do. There was nothing to do, therefore, but hold the load on the brake until there was enough



A bucking auto of the West; the result of leaving the overhang out of load calculations.

Motor trucks, which were used to haul material, made such slow progress, because of the condition of the roads during the rain, that horse-drawn vehicles were requistioned to keep the field force supplied with material.

steam to work the hoisting engine. Then another difficulty arose. The engine could not be started while the drum was holding the load, and we were unable to remedy the trouble. After every one of our attempts the weight of the load pashed back the blocking until the latter was useless.

While we were trying to find a way out of our dilemma, the negro let the rope slip momentarily, and then started the engine. The load began to slip down the incline as the rope slackened, but when the engine was started the cable tightened with a jerk that made the boiler piece rock. In the slight pause that ensued before the issue was decided it seemed likely that the load would be tumbled off the car or the hoisting rope broken. With a grunt and a chug, however, the engine took hold and the load began its interrupted journey to the heights; and it did not stop again until it was safely landed upon level ground.

The same hoisting engine pulled the boiler piece on to its foundation in the power house, about a quarter of a mile away through the forest. The only trouble met with at that end of the haul was caused by a hitch in the signaling system between the men at the power house and the man in charge of the hauling engine. As a result, when the building was reached the load was carried too far and demolished some metal work in the structure before it could be stopped.

The largest wireless telegraph station at present under construction is located at Kahuku Point, on Oahu Island, one of the Hawaiian group. Wireless stations larger than this one, however, will be erected shortly in connection with the British Imperial Scheme, which will eventually connect with the Trans-Pacific stations. The Kahuku station is made accessible by a steam railroad. The subsoil at the station is made up of porous coral rock, and in consequence there has been considerable trouble in putting down foundations for the power house and masts. In order to control the flow of water which leaked into the foundation excavation for the condenser pit, a battery comprising three-inch, four-inch and six-inch pumps was put in operation. So great was the flow, however, that not until an eight-inch pump had been added to the battery could the foundation work be completed. In all of the excavations for the mast anchorage foundations, were built water tight wooden cribs into which was poured concrete. Different sections of the site have needed different treatment, but, generally speaking, the trouble has been due to the presence of water in the subsoil, a factor which will materially add to the ease of operating the station. Some details of this station and the plant at Koko Head appeared in a recent issue of THE WIRELESS AGE.

Of the two stations forming the California end of the Trans-Pacific circuit, that at Marshalls is the more accessible. A steam railroad passes along the front of the property, and there are good thoroughfares on two sides of the site. Bolinas, the site on which the power station is being erected, is more accessible by water than by railroad. The site is about four miles from the wharf and the road is poor. That section of the thoroughfare which passes through the village is good, but when the main highway is left it quickly changes into an ordinary farm trail. This type of a road is adequate for the comparatively light haulage normally required on farms, but as soon as the heavy loads for our construction work are transported over it the surface gives way and the thoroughfare becomes a series of bad ruts.

In wet weather the roads become soft and practically impassable for vehicles transporting material. Rain has been falling for weeks, but the roads are now being remade, and as soon as the weather moderates they will show the results of the work done. Motor trucks, which were used to haul material, made such slow progress because of the condition of the roads during the rain, that horse-drawn vehicles were requisitioned to keep the field force supplied with material.

The facilities for handling heavy material at Bolinas are not good and all the resources at our command were needed to transfer 275 transformers from the schooner to the truck and then to the site. In the future the heavier pieces will be sent by rail to Point Reyes and trucked along the main road via Bolinas to the site. The bridges and culverts along this road were not built to carry extremely heavy weights. Therefore, before hauling any very heavy pieces of freight, they must be tested and, if necessary, strengthened temporarily to enable them to carry the loads.

The Bolinas station will be supplied with energy from the Pacific Gas & Electric Company's power lines; an extension is now being built from its lines on the eastern side of Bolinas Bay. It was at first believed to be possible to run this extension out on a sand spit which forms the bar across the major

In order to control the flow of water which leaked into the foundation excavations at Kahuku a battery of pumps had to be put in operation.

portion of the entrance to the bay and spans the narrow channel on the west side of the harbor. But careful investigation showed that the stability of a line so located could not be guaranteed, and this plan was therefore abandoned. The extension is being carried around the head of the bay and thence as directly as possible to the power station.

As a result of purchasing the power the amount and weight of machinery to be installed in our plant are materially reduced. No generating plant with its numerous accessories is needed. In its place are motor-driven alternators which are merely frequency changers. That is to say, the motors of these sets take power at the frequency of the transmission line, while the alternators, driven by the motors, deliver power at a frequency more suitable for wireless work. Thus it will be seen that the weight of material to be hauled to the site will be less than in the case of the steam-driven plant at Kahuku.

The New Jersey stations are both accessible, the power plant at New Brunswick being the more approachable of the two. The Raritan Canal passes across the front of the property and the steam roads are within five miles of the site. The road surface near the site is very bad and was quite impassable for motor vehicles during the wet weather of October last. The bulk of the material, which comes by canal, is unloaded on the site and distributed as required. The New Brunswick station is supplied with energy by the Public Service Company, which has extended its power line from New Brunswick toward the site. The machine installed in our power house, therefore, will be merely a frequency changer set like that the Bolinas station.

The Belmar site is about four miles from a steam railroad. The highway is in satisfactory condition for about three miles. The last mile of the thoroughfare, however, is not all that could be desired. The haulage to the Belmar site has been accomplished entirely by teams of horses.

SANTA CLAUS VISITS THE HOME OF WIRELESS

In appreciation of their faithful service during the year, and with the object of bringing the organization still closer together, the members of the office staff of the Marconi Wireless Telegraph Company were guests at a Christmas party given in their honor on the afternoon of December 24.

All work was suspended at noon and

The Invitation

at two o'clock the eighty-odd members of the home office staff assembled in the fourth floor suite in the Woolworth building.

The rooms were decorated with bells and garlands, and a large table in the center was arranged to represent a snow field. A gigantic snowball gushed forth a mass of red ribbon streamers, each one leading to a small favor for each individual present. One by one the packages were opened and its accompanying jingle read aloud by a Santa Claus who knew respective weaknesses and hobbies well enough to send a shaft of wit home in each case.

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, the College of the City of New York

ARTICLE IV

In the article published in this issue the principles of distributed capacity are discussed in detail. Its effects are told of and a table is published for the purpose of calculation. The author takes up the subject of measurement of distributed capacity at radio frequencies and low voltage, and describes the theory of the practice.

II.—MEASUREMENTS OF DISTRIBUTED CAPACITY

12. *General Considerations.*—We have shown various methods of measuring capacities at radio or audio frequencies, and at high or low voltages. In all the cases treated, the device, the capacity of which was determined, was a condenser; that is, a device specially arranged to have electrostatic capacity and consisting essentially of (nearly) inductance-free conducting surfaces, insulated from each other. The capacity under these conditions is *localized* in the circuit, and the circuit has been assumed to contain no capacity such as was concentrated in condensers. This assumption is, in general, only approximately true, for the inductances used in these experiments contain what is known as *distributed capacity*. Since the notion of distributed capacity in some ways is less simple to grasp than that of ordinary or localized capacity, we shall discuss it in detail. Its effects, particularly in incorrectly designed receiving sets, are very marked, and may lead to greatly diminished efficiency of the set as a whole.

In Figure 17 a number of turns of an inductance is shown. If a varying current is passing through this coil, there will be a difference of potential between the ends, A and B, of the coil, quite independent of its ohmic resistance. Between turn 1 and each of the other turns a difference of potential will exist, and consequently *electrostatic* lines of force will pass from each point of turn 1 to every point of the coil which is at a different potential. It is to be noted that we are not referring to the *magnetic* lines of force which are interlinked with the entire coil. Some of the electrostatic lines of force between turns 1 and 2 are shown in Figure 17. We have then the interesting conditions that turns 1 and 2 are, in effect, plates of a condenser. Electrostatic energy is stored in the space between each portion of a turn and every

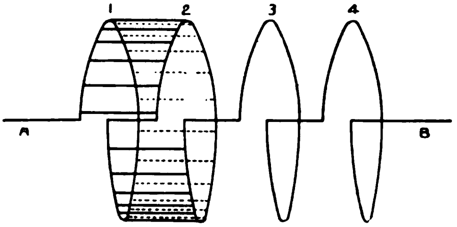


Fig. 17

part of every other turn; and, since such energy can be stored only in capacities, we have distributed capacity along the entire coil.

It is evident, therefore, that the coil can no longer be considered as a simple inductance, but must be treated as an inductance across the terminals of which a capacity (equal to the total distributed capacity) has been shunted. It might, at first sight, seem that this assumption that the distributed capacity may be regarded as equivalent to a single concentrated capacity across the terminals of the coil, is of doubtful validity; but it can be demonstrated that in circuits where the resistance is so small as not to affect the natural period of the circuit appreciably, the assumption referred to is justified. We may, therefore, consider the coil L (Figure 18), which has a distributed capacity C_d, as equivalent to a simple inductance L, across which is connected the localized capacity C_d, as shown in dotted lines.

The effects of this distributed capacity are as follows: To begin with, if the inductance of the coil be calculated by the usual formulae, and the coil be placed in an oscillating circuit with a known capacity, C, the period, instead of being, as usual

$$T = 2\pi\sqrt{LC} \qquad (30)$$

is given by

$$T = 2\pi\sqrt{L(C + C_d)} \qquad (31)$$

The distributed capacity of a coil may therefore be very objectionable, particularly if work is being done at short wave lengths where the permissible external (and adjustable) capacity, C, is already quite small.

Another point of difference between a coil having distributed capacity and a simple inductance is of importance. Even if no capacity be connected across its terminals, such a coil may vibrate electrically. It is, in fact, a so-called open oscillator, and behaves in this respect quite like the usual antenna of a radio station. If, in Figure 19, G is a generator of radio frequency alternating current, and L_1 an inductance which couples it electrically to the coil, L, having a distributed capacity C_d, it will be found that for some particular frequency of excitation the coil, L, will vibrate powerfully electrically. The particular frequency in question will be (if the coupling between L_1 and L is very loose), the natural frequency of L. The second circuit, L_3 C_3, will then indicate this frequency by means of a maximum reading of the indicator, I, provided that its capacity and inductance are properly adjusted. This last circuit will therefore serve as a "wave meter," or more strictly, a frequency meter.

If we consider more carefully the mode of electrical vibration of the inductance L, which possesses distributed capacity, we find it differs considerably from that

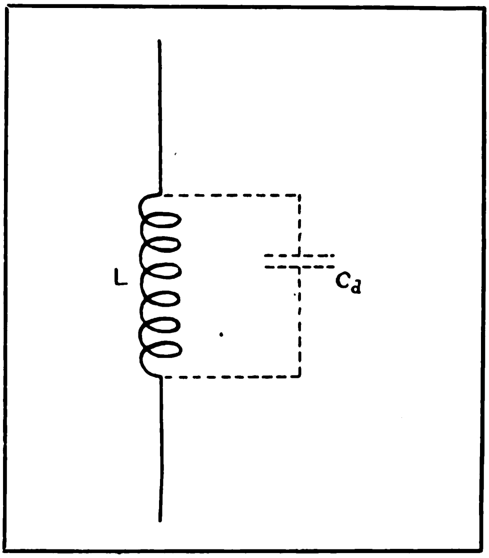


Fig. 18

in ordinary audio frequency alternating current circuits. In the latter, the value of current is the same at every point of the circuit at a given time. This is not the case for the open oscillator, L. At the left of Figure 19 is shown the curve of current distribution along L, the length of the short horizontal lines being proportional to the current at that particular level of the coil to which they correspond. The voltage or potential distribution along the coil is similarly shown in the second curve, to the right of the first. It will be seen that the potential is highest at the ends of the coil, but that the current is greatest at the middle. Remembering that the ordinary antenna corresponds roughly to one-half of such a coil, the ground connection being the analogue of the middle of the coil, it is immediately evident why the current in an antenna is greatest at the bottom, but the potential highest at the top. And a coil having distributed capacity resembles an antenna in another respect; it serves as a radiator of electromagnetic waves, and the greater the distributed capacity in proportion to the inductance, the more prominent does the radiation become.

It is possible to calculate the distributed capacity of an inductance from its dimensions. A convenient formula for practical purposes, and a quite accurate one, is given by Drude. It is the following:

$$C_d = 2\,\alpha\,r\,\frac{2 + \dfrac{h^2}{r^2} + \dfrac{r^2}{h^2}}{10 + 4\,\dfrac{h^2}{r^2} + 3\,\dfrac{r^2}{h^2}} \qquad (32)$$

where h = length of the coil, 2r = diameter of the coil to the middle of the wire.

α = a factor dependent on value of h/2r, and given in the following table. The top headings are core material. In the case of the tubes, the ratio of thickness of tube to radius was 0.05. In all cases, the ratio of diameter of wire with insulation to diameter of wire alone was taken as 1.09. The following table has been specially calculated from Drude's data to adapt it to ready use in calculating distributed capacity:

h/2r	Ebonite	Air	Ebonite Tube	Glass Tube	Ash
6.	2.10	1.81	1.83	1.86	2.24
5.	1.92	1.64	1.64	1.76	2.05
4.	1.74	1.47	1.48	1.54	1.89
3.	1.66	1.87	1.40	1.46	1.82
2.	1.62	1.26	1.34	1.43	1.82
1.	1.54	1.12	1.28	1.37	1.81
0.8	1.54	1.10	1.26	1.37	1.81
0.6	1.52	1.07	1.22	1.34	1.79
0.4	1.36	0.043	1.10	1.24	1.62
0.2	1.00	0.69	0.855	1.06	1.19
0.1	0.72	0.498	0.615	0.828	0.91
0.05	0.41	0.282	0.383	0.50	0.50

To facilitate interpolation of values, the curves of Figure 20 have been drawn. In order to find the value of α for any coil, we calculate h/2r, that is, the ratio of the length of the coil to its diameter, and find the value of α corresponding to the ratio, and to the type of core employed. Formula (32) can then be directly employed.

The free period of a coil of inductance, L, and distributed capacity, C_d, can be directly calculated from the formula

$$T = 2\pi\sqrt{L\,C_d} \qquad (33)$$

and its free wave length from

$$\lambda = 18.85\,(10)^8\sqrt{L\,C_d} \qquad (34)$$

with L expressed in henrys and C_d in farads.

Once the distributed capacity of a coil has been determined, and its natural wave length calculated, it is well never to use it in receiving sets intended to cover a range of wave lengths including the natural wave length of the coil. If this precaution is not observed, considerable energy will be absorbed in the free electrical vibration of the coil, and this energy is useless so far as receiving efficiency is concerned.

13. *Measurement of Distributed Capacity at Radio Frequencies and Low Voltage (by the Impulse-Excitation of Free-Period Method.)*

(*a*) *Theory.*—We shall suppose that the inductance of the coil in question is known for audio frequencies, either by direct measurement with an inductance bridge (as hereafter described), or by calculation, using the formulas given in Bulletin of the Bureau of Standards, Volume 8, Number 1. (Formulas and Tables for the Calculation of Mutual and Self-Induction, Revised.) We shall then determine the free period of the coil by exciting it impulsively, and calculate its distributed capacity by a simple formula derived from Formula (33).

It is assumed that the reader is aware

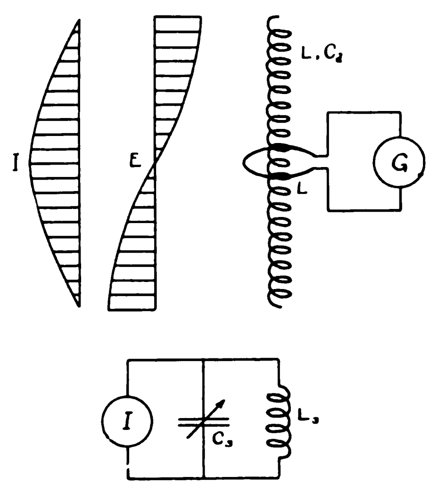


Fig. 19

that impulse excitation as used, for example, in the usual quenched spark sets, is a simple means of exciting a secondary circuit to vibrate in its own period and damping regardless (or nearly so) of the

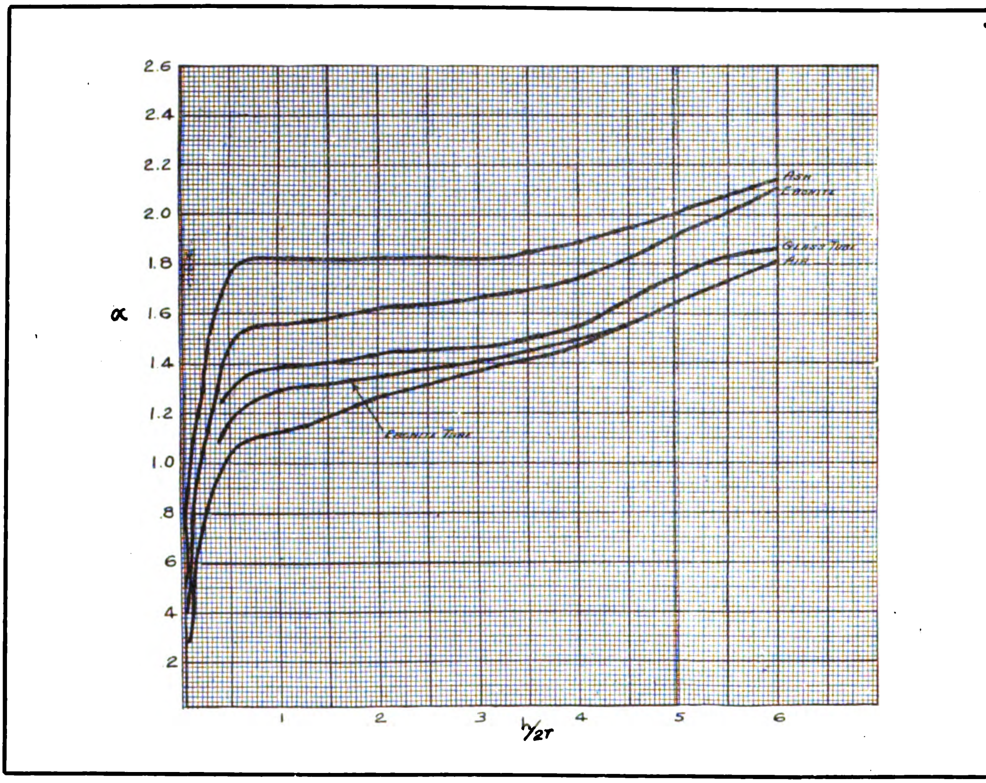


Fig. 20

period of the primary. In order that impulse excitation should be secured, the primary circuit should be highly damped and its coupling to the secondary not too close. We shall meet these requirements by making the primary circuit actually aperiodic, so that no free alternating currents can occur in it at all, but only individual highly damped pulses of current. We shall then couple it loosely to the secondary circuit, which is the inductance having distributed capacity, thus causing that coil to vibrate in its natural period. Suppose that the indicator I which is shunted across the capacity C_3 is of so high a resistance that its influence on the period of the circuit L_3C_3 is negligible. This is the case if its resistance is much larger than the quantity

$$\sqrt{(L_3/4C_3)}.$$

We may then take the period of this last circuit as

$$T_3 = 2 \sqrt{L_3 C_3}$$

and the period of the inductance itself as

$$T_2 = 2 \sqrt{L C_d}$$

If the condenser C_3 is varied while L is in vibration till a maximum indication is obtained, $T_1 = T_3$, and therefore

$$C_d = \frac{L_3 C_3}{L} \qquad (35)$$

which enables us immediately to calculate C_d.

It was mentioned that the primary circuit was to be made aperiodic. The condition for this is that, if R_1 is the resistance of the primary exciting circuit, C_1 its capacity, and L_1 its inductance, the resistance must be at least as great as the value of R_1 given by the equation

$$R_1 = 2 \sqrt{\frac{L_1}{C_1}} \qquad (36)$$

R_1 may be made larger than this, but nothing is gained by so doing.

(*b*) *Arrangement and Description of Apparatus.*—A wiring diagram of the apparatus is given in Figure 21. A, B, and H are the terminals of a high pitch buzzer, F if the battery which operates the buzzer, and E is a regulating resistance for controlling the buzzer current. Connected across the gap of the contact point of the buzzer are L_1, R_1, and C_1, all in series. As indicated, L_1 is loosely coupled to the coil, L, which is the inductance having distributed capacity under measurement. L_3 and C_3 are the inductance and capacity (both known) of the wave meter circuit, D is a detector, and T a telephone receiver. With the apparatus as actually used, F was a 10-volt storage battery, E was from 10 to 20 ohms, C_1 was a 2-microfarad No. 21-D Western Electric Condenser, L_1 a single turn or two turns of No. 18 lamp cord wound around L, and R_1 was between 10 and 100 ohms. L (in one case) was a coil of 157 turns of multiply stranded wire (so-called "litzendraht"), consisting of 7 sets of wire, each set made up of 7 strands of No. 32 enamel covered copper wire, the sets being all twisted together and the whole triple silk insulated, radius 8.045 cm., length of winding 31.7 cm. The wave meter circuit L_3 C_3 consisted of the inductance L_3, which was made up of 16.8 turns of No. 18 lamp cord wound on a core 8.7 cm. in diameter. Its inductance was 18,980 cm. The capacity C_3 was a small variable air condenser, maximum value being 0.00074 μf. The detector, D, was a usual crystal rectifier, and the telephone a 2,000-ohm double head band receiver.

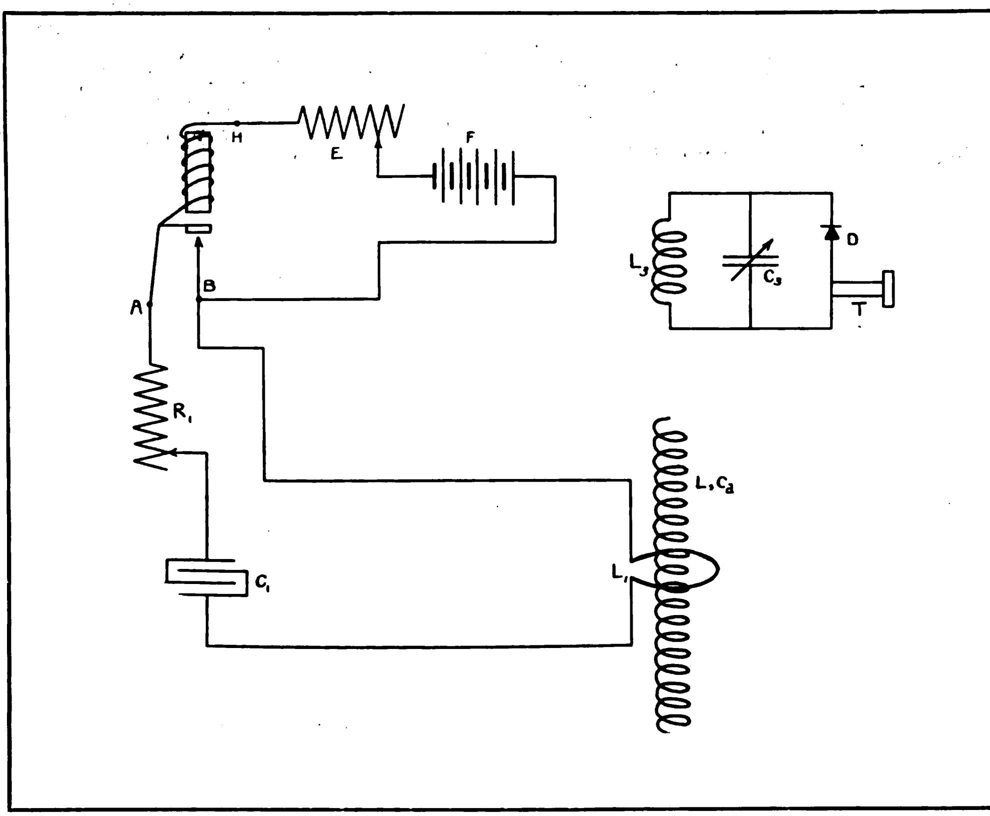


Fig. 21

The actual arrangement of the apparatus is shown in the photograph, Figure 22. To the left are seen the enclosed buzzer, and the resistances, E and R_1. The condenser, C_1, and a long coil, the distributed capacity of which is being measured, are in the middle. The two turns of the coupling inductance, L_1, are shown wound around L. To the right,

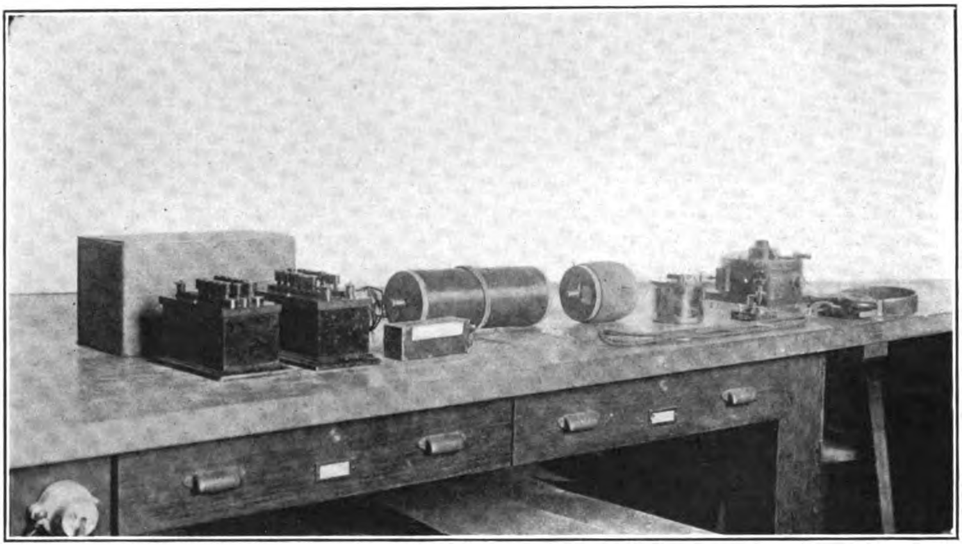


Fig. 22

L_3, C_3, D, and T are seen in order.

(*c*) *Procedure.*—An estimate of the magnitude of the distributed capacity C_d is made, and L_3 and C_3 are so chosen that it is possible to make

$$L_3 C_3 = L C_d$$

L_3 is then loosely coupled to L, and a number of readings of the resonance point of C_3 are taken. It is necessary to know the values of L and L_3, either by calculation of measurement. The condenser C_3 must also be calibrated.

(*d*) *Errors of the Method, Their Elimination; and Probable Accuracy.*—Unless L and L_3 are loosely coupled, the readings of the wave meter circuit are not dependable. Furthermore, it is essential that the resistance of D and T shall be high, as mentioned under theory.

As an example of the measurement, we consider the following: Coil of which the distributed capacity was being measured; "Litzendraht" coil, described under *b*.

L (as calculated by Nagaoka's Formula) = 16.55 $(10)^{-4}$ hy.

L (as measured on special apparatus at approximately 2,500 meters) = 16.7 $(10)^{-4}$ hy.

C_d (as calculated by Drude's Formula, number (32) above, assuming air core) = 5.85 $(10)^{-12}$ farad.

L_3 (in wave meter circuit) = 18.98 $(10)^{-4}$ hy.

C_3 (in wave meter circuit, when resonance is secured = 20 divisions) = 4.9 $(10)^{-10}$ farad.

C_d (as calculated from Formula (35) above) = 5.68 $(10)^{-12}$ farad.

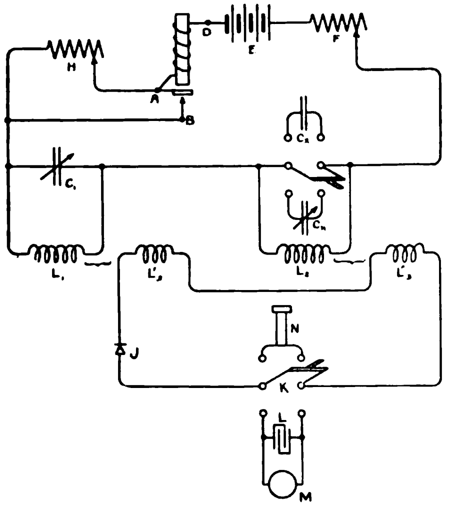
λ_f (fundamental free wave length of the coil as obtained from the calculated values of L and C_d) = 186. meters.

λ_f (fundamental free wave length of the coil as obtained from the measured values of L and C_d) = 183. meters.

It will be seen that the discrepancy in the value of C_d = 2.9 per cent, and that the discrepancy in the value of λ_f = 1.6 per cent.

The method which has been here outlined can readily be employed at high voltages. It becomes necessary to replace the buzzer excitation circuit by a quenched spark circuit, still further damped, if necessary, by insertion of the additional resistance R_1. Instead of the detector and telephone indicator, a hot wire ammeter in series with L_3 and C_3 may be employed instead. The theory is in no wise altered by these changes.

In the December issue of the WIRELESS AGE a connection was omitted from Figure 14, published to illustrate The Engineering Measurements of Radio Telegraphy. On the following page a corrected diagram of the figure is shown.



This is the fourth article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The fifth will appear in an early issue.

DR. DeFOREST ON THE AUDION

At the November meeting of the Radio Institute at Fayweather Hall, Columbia University, an interesting lecture was delivered by Dr. Lee DeForest on the Audion—A Detector and Amplifier. The lecture was followed by a practical demonstration of the device.

The inventor gave a novel explanation of the operation of the audion, asserting that it did not obey the rectifying principle, but that the effect of the incoming oscillations from a transmitting station was to suddenly increase the resistance of the local circuit containing a high-voltage battery; this in turn, he said, caused a fluctuation of current that reproduced the radio signals in the head-phones.

After describing the steps preliminary to the discovery of the audion, Dr. De Forest showed in an elementary way the circuits of the audion as an amplifier. The instrument on exhibition consisted of four audions, each of which gave an increase of intensity of signals over the one preceding it; thus, amplications of 200 times the original strength of signals received in the first audion were obtained, according to the speaker.

In the practical demonstration of the apparatus the application of the devices to wire telephony was shown. A pair of ordinary wireless telegraph headphone receivers were connected to the audion amplifier. The first audion was then connected to a single magneto telephone receiver. The currents produced by the vibration of the single magneto receiver when near to the faintest sounds were sufficient to cause clear reproduction in the double headphone receivers. When a handkerchief was dropped on the single magneto telephone the feeble electric currents generated by the impingement of the sound waves upon the telephone diaphragm were sufficiently amplified by the audions to produce a considerable racket in the ear-pieces.

The single magneto telephone was then taken to a distant room and the audion amplifier connected to three loud-speaking telephones. Dr. DeForest's assistant in the distant room whispered into the magneto receiver and the electrical impulses thus produced were sufficiently amplified to be heard over the entire lecture hall.

It was stated that it is proposed to use the audion in connection with long distance wire telephony as an amplifier and that it might make transcontinental (New York to San Francisco) telephony possible.

A demonstration of the application of the audion in connection with wireless telegraphy was given. Radio signals coming from several wireless telegrah stations in the vicinity of New York had been recorded on the steel tape of the Poulsen telegraphone. The audion amplifier reproduced radio signals from the telegraphone records, which were so faint that they could not be heard on the telegraphone in the regular way. They were, however, sufficiently increased in intensity by the audion amplifier to make them audible. It was possible in this way to record the sound of the human breath on the telegraphone records and reproduce it quite distincly.

A new type of audion having double grids and double plates was shown. With this arrangement it is possible to light all three filaments from one storage cell, which, of course, is conducive to the simplicity of operation of the set.

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE II

READERS of the series on How to Conduct a Radio Club will be interested to learn that the Bureau of Navigation, United States Department of Commerce, has concerned itself with the plan outlined relating to the formation of an organization, and suggested that the following be published:

"Radio station licenses can only be issued in the name of a club if it is incorporated in some State of the United States; otherwise the license must be in the name of some individual of the club who will be held responsible directly for its operation.

"Radio clubs having a club station should apply to the radio inspector of their district for the assignment of an official call signal which must be used for all radio communication."

In view of recent developments in radio telegraphic research the writer of these articles has decided to vary the practice generally employed relating to the order of publication; thus this article is written specifically for members of radio clubs already in existence, in the hope that it will spur them on to renewed efforts in investigating.

In it will be described two methods for the amplification of radio telegraph signals. As a rule, amateurs try to make the loudest noise possible when receiving signals from distant transmitting stations. At all radio stations, in fact, commercial or amateur, efforts are invariably made to obtain the greatest intensity of signals possible. Of the two methods presented for the amplification of signals, the second is not original with the writer, but was obtained as a result of his attendance at a lecture delivered recently at a meeting of the Institute of Radio Engineers. The first method was not brought out at the meeting, but suggested itself to the writer during the lecture.

Many amateurs are already familiar with the audion detector and the method of its application to wireless telegraphy, but there are some who are absolutely without knowledge relating to the device. For the benefit of the latter readers the audion will be explained in all of its details, accompanied by a diagram; a brief description of the construction and operation of the audion will also be given.

The audion detector is not a new apparatus, having been in use since about 1906. For some reason, however, it has not been employed generally in commercial service. This is probably due to the fact that, because of the battery current required, it is believed to be a device of considerable expense. The writer will show that this impression is erroneous.

In the equipment of every radio club should be included an audion detector. The apparatus, however, should be placed in charge of responsible members of the organization, for through careless usage it may easily be burned out.

The audion detector is shown in Fig. 1, and consists of a 4 to 6 volt lamp filament, F, a nickel-plated grid, G (which may also be a plate bored full of holes), and a plate, P, to which is connected one side of the local headphone circuit. The grid, G, is connected to one side of the closed oscillatory circuit of the receiving tuner and the filament, F, to the opposite side of the circuit. Either the B or A side of the filament may be connected to the lead D; the B side will generally give the best results.

The secondary of the receiving tuner is represented at L′, which is shunted by a variable condenser, VC. The variable condenser is of very small capacity; the maximum need not be more than .0001 mfds.—in fact, it may consist of two very small concentric brass tubes sliding over one another.

The members of radio clubs should

note specifically that the fixed condenser ordinarily used in the local oscillatory circuit of crystal detectors is entirely unnecessary in this circuit. This is an error found in many amateur audion circuits. The terminals of the coil, L', are directly connected to the filament and to the grid. If desired, however, a fixed condenser, PC, of the .005 mfds. may be shunted across the headphones as shown in the diagram. It is not absolutely necessary, but gives a slight increase of signals.

A rheostate (Rheo) of 10 ohms is connected in series with the lamp filament and is used to regulate the heat of the filament. It should be a rheostat capable of fine adjustment, for the heat of the filament must be closely regulated.

The type of tuner ordinarily employed by amateurs in radio work has not the right values of inductance for use in connection with the audion, nor is the capacity used in shunt with the secondary of the tuner of correct value. It is generally too large.

The audion is considered to be a voltage operated device, and it is best at all times to have the maximum potential from the receiving tuner act upon the bulb. This being the fact, inductance should predominate in the secondary tuner circuits, and the capacity used in shunt should be of a minimum value and within the range suggested.

The operation of the audion is as follows: The filament of the lamp, when heated by the storage battery, emits negative electricity and is said to be in a state of ionic discharge. When signals are received from a distant transmitting station the high frequency oscillations produced in the secondary of the receiving tuner may pass through the vacuous space between F and G in one direction, but are opposed in the opposite direction by the ionic discharge from the filament. In simple language, then, a collision takes place between the ions produced by the high frequency oscillations and those of the filament, which gives a decided increase of resistance in the vacuous space between F and plate P. This, in turn, causes a variation of current in the headphone circuit, making the diaphragms of the telephones vibrate.

The audion is therefore often referred to as a "trigger" device, for the reason that the high frequency oscillations produced in the receiving antenna do not energize the headphones direct, but are used to pull the "trigger," so to speak, of the local circuit containing the heavier battery current; hence the sensitiveness of the device. It is not unlike the operation of a telegraph relay where the feeble currents are used to operate a local circuit carrying heavier current.

A 4-volt 40-ampere hour storage battery is generally sufficient to operate the

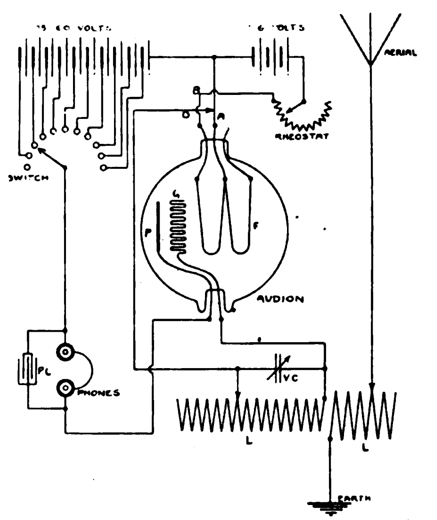


Fig. 1.—The audion detector and inductively coupled tuner; a detector which is noted for extreme sensitiveness.

filament of the audion, and will burn it on one charge of the battery for 100 hours. If the members of a radio club do not care to go to the expense of purchasing a storage battery they may use four dry cells of high amperage capacity similar to those employed for automobile ignition. The writer found that four cells of the HI-UP battery burned the filament for 75 hours before becoming exhausted.

From 35 to 60 volts is necessary in the headphone circuit, but the consumption of current in amperes is exceedingly small, and therefore batteries of the smallest possible size obtainable may be used; as a matter of fact, the writer employs the ordinary flashlight cells, which are exceeingly diminutive.

It will be understood, then, that the

cells are divided into two classes, the low voltage for the filament and the high voltage cells for the headphone circuit. After ten cells are included in the high voltage battery, a multiple point switch should be used to connect in three cells at a time from ten to maximum; for it is very important that the adjustment of the voltage in the headphone circuit be exact. At a matter of fact, no one can tell in advance the values of voltage to be used in either the high voltage battery or the filament, but after a little experimenting it will be found that a certain proportion between the two will give the best results.

It is well to bear in mind the necessity for having 60 volts in the headphone circuit, because there are some types of audions that require this amount of power.

The audion filament should never be burned in a vertical position; it should be used with the head of the bulb hanging down, for otherwise the filament might curl up and touch the grid, causing a short-circuit. Several wireless telegraphy amateur supply houses furnish miniature lamp stands, purposely constructed for the audion.

The audion has several peculiarities. When the filament of the audion is burning particularly bright and an abnormal amount of current is sent through the headphone circuit a blue glow takes place in the bulb, indicating that too much current is flowing across the vacuous space. The audion is then inoperative. It may be restored to sensitiveness again, either by reduction of the low voltage battery current to the filament or by reduction of the high voltage battery current through the headphone circuit. This action inside of the bulb is sometimes referred to by amateurs as a "spilling over." The audion may "spill over" when a high-powered station nearby to the amateur station is operating.

It requires considerable experience on the part of the amateur to properly manipulate the audion detector, and the best results can only be obtained through practice. It is, however, exceedingly sensitive, and, from official government tests, shows several times the sensitiveness of the ordinary electrolytic detector.

Particular care should be taken that at point E the negative end of the storage battery is connected to the positive end of the high voltage battery, for if the batteries are connected in opposition at that point the intensity of signals is considerably reduced.

For best results with the audion detector separate tuners should be employed for long and short wave lengths. Dimensions for tuners covering two ranges of wave length are as foldows:

Receiving tuner, 200 to 1,600 meters—loading coil (aerial tuning inductance) 5½ inches in length by 4⅛ inches outside diameter. Wound full with No. 20 S. C. C. wire; winding divides equally through a 10-point switch. Primary receiving transformer—wound on form 3¾ inches in diameter by 3 inches in length, with No. 20 wire; winding equally divided to the contact points of

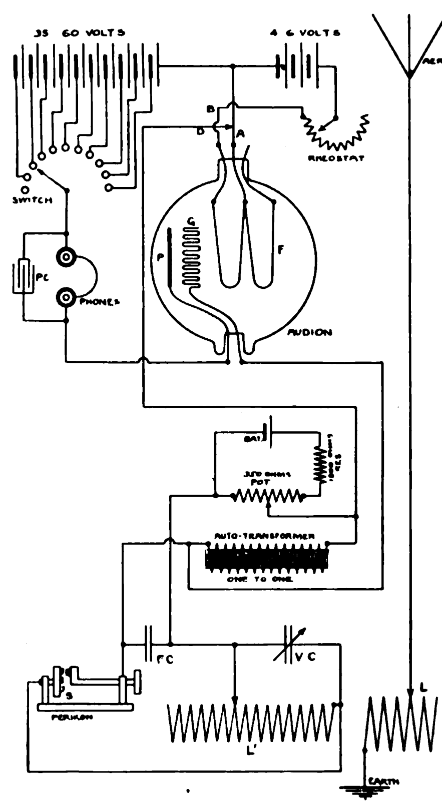


Fig. 2.—The audion as an amplifier of signals received with ordinarily inductively coupled tuner and perikon detector. With this arrangement the author claims amplifications of twenty times the strength received with the perikon alone.

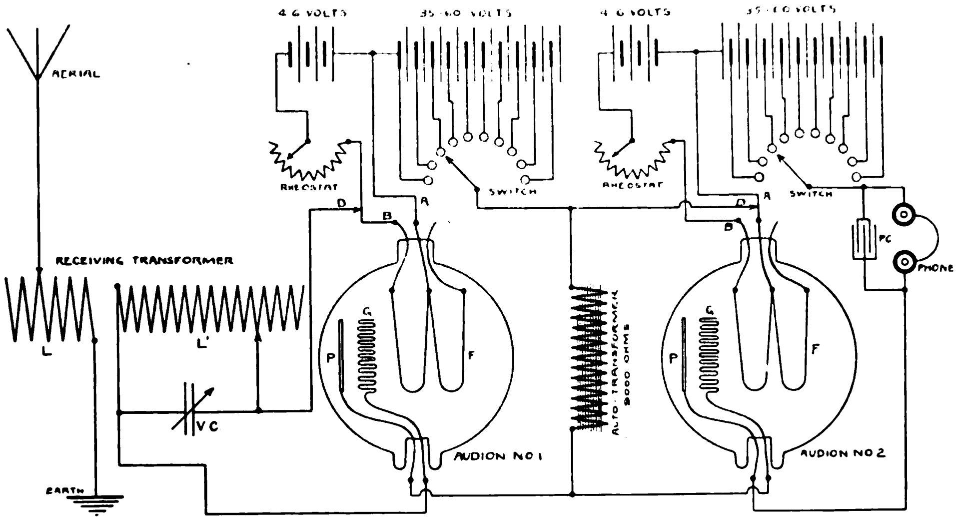


Fig. 3.—With this device it is claimed that messages may be copied from ships equipped with the standard types of apparatus up to a distance of 900 miles in daylight and 2,800 miles after dark. It is also possible to read signals which are otherwise undecipherable.

a 3-point switch. Secondary receiving transformer—Outside diameter tube 4⅛ inches, length 7 inches; wound with No. 22 S. C. C. wire; winding equally divided between the contact points of a 14-point switch.

Receiving tuner, 1,200 to 3,600 meters—loading coil (aerial tuning inductance), 7 inches in length by 4⅛ inches outside diameter; wound full with No. 20 S. C. C. wire; winding equally divided between points of a 20-point switch. Primary receiving transformer—3½ inches in diameter by 6 inches in length; wound full with No. 20 S. C. C. wire; winding divided into three taps. Secondary receiving transformer—wound on tube 12 inches in length, 4 inches in diameter; wound full with No. 28 S. C. C. wire; winding equally divided between contact points of a 12-point switch.

These tuners have been experimentally tried in connection with the audion and give excellent results. The dimensions may be slightly altered to suit the material on hand.

The expense attached to the purchase of an audion outfit is as follows:

1 audion detector	$3.50
1 10-ohm battery rheostat	.50
4 high-up dry cells	1.00
1 miniature lamp stand	.60
1 10-point wooden base multiple point switch	.30
*15 flashlight cells	2.10
	$8.00

*(*No. 503—Ever-Ready giving 60 volts.*)

The device, therefore, as will be seen, is not beyond the financial resources of the average radio club.

If the members of a radio club have on hand a perikon detector the audion may be used to amplify its signals.. As follows is the manner in which it should be employed:

The primary of the loose-coupler is represented at L, the secondary windings at L', the variable condenser in shunt by VC, the fixed condenser at FC, the perikon or silicon detector at S, the potentiometer at POT and the battery at BAT. When this loose-coupler is used with a perikon alone the headphones would ordinarily be connected around the fixed condenser; in this method there is shunted around the fixed condenser a one to one auto-transformer, the terminals of which are in turn connected to the audion detector. The one to one transformer is wound with about 3¾ pounds of No. 34 wire on a core 14 inches in length by 2 inches in diameter, and has a resistance of 8,000 ohms. The two ends of the auto-transformer are connected to the grid and filament of the audion detector, which otherwise is hooked up in the regular manner.

For best results the perikon detector should first be adjusted to maximum sensitiveness by connecting the telephones across the fixed condenser, FC, adjusting the values of the potentiometer, POT, until the loudest signals are obtained. The potentiometer, POT, may be of the values to be had in the ordinary potentiometer, 300 to 400 ohms, and should be connected in shunt to one cell of a dry battery. A fixed resistance of 1,800 ohms is connected in series with the 300-ohm potentiometer; thus a very small electromotive force may be applied to the perikon circuit and the best results obtained.

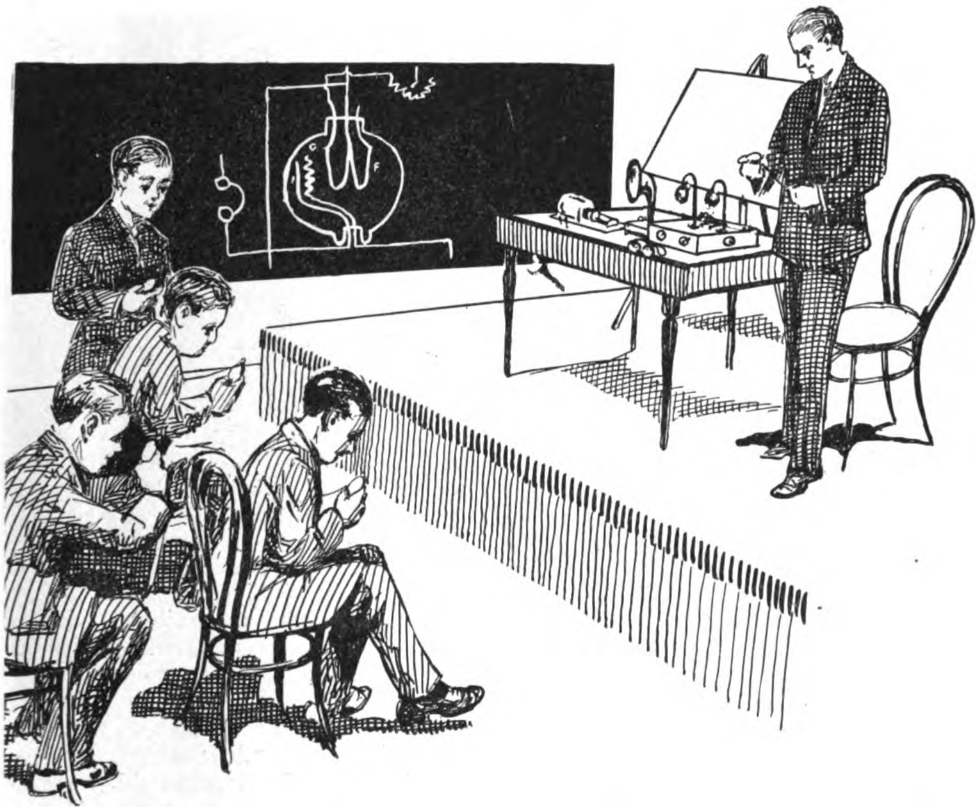
After the perikon detector has been adjusted to the highest sensitiveness the headphones should be removed from the fixed condenser and connected to the audion in the regular manner, as shown in Fig. 2.

The one to one transformer is then

connected in place of the headphones, as shown in Fig. 2.

The rheostat, R, in the low voltage battery circuit of the audion is now adjusted to give a certain degree of head to the filament, and the high voltage battery varied in intensity while some station is working. A point of adjustment will be found at which very loud signals will be obtained, much louder than are to be obtained with either the perikon or audion alone. Like all devices of this nature, it demands skill on the part of the amateur and an intimate knowledge of radiotelegraph receiving circuits; he should not be discouraged if the first tests are not successful.

The leads, H and H′, connected respectively to the grid and filament of the audion, should be reversed and it will be found that the best signals are obtained one way or the other. This is best determined by experiment. If this arrangement is connected up exactly as shown, surprising results are in store for the amateur, but he must take particular care to keep the perikon and the audion in the most sensitive adjustment. During tests of this device the writer obtained amplifications of Arlington's time signals of 20 times the strength produced in the headphones with either the perikon or audion alone. A single audion may be employed to amplify the signals from any of the detectors like the silicon, perikon, carborundum, galena, and electrolytic,



After the Audion is Properly Connected Up, and a Loud-Speaking Telephone Substituted, Those Present Will be Able to Set Their Watches by Arlington Time

ordinarily used in wireless telegraphy.

Members of radio clubs will find it to their interest to purchase two or three audions and use them in series as amplifiers. It might be well to add that the audion as an amplifier is patented and may be used experimentally only.

A hook-up with two audions as they are used to amplify signals is shown in this article (Fig. 3). Observe that audion No. 1 is connected up in the regular manner with the exception of the headphones. In place of the headphones is placed one to one auto-transformer having a resistance of 9,000 ohms, with a core of the same dimensions as the one previously described. The core is wound with 4¼ pounds of No. 34 wire. Two leads are then tapped off from the one to one transformer and led to the grid and filament of the second audion. The second audion has its individual high voltage battery and the telephones are connected to it in the regular manner.

Like all similar devices, familiarity with the apparatus is necessary, and it is impossible to advise in advance as to the adjustments of battery current or voltage in either audion. This can be determined by experiment. It is not difficult when one understands the adjustment of audions as used individually, but in all cases there is a proportionment of the high voltage battery to the degree of heat of the filament which gives the best result; when two audions are used as an amplifier, however, these adjustments may not be the same as when either audion is used singly and in the regular manner. As stated previously, this must be determined absolutely by experiment.

There are various types of ampliphones on the market to-day, but they will only increase the strength of signals which are already loud enough to be heard in the ordinary magneto telephone. The audion amplifier, however, will pick up and intensify signals when other types of crystal or electrolytic detectors fail to do so. When two audions are connected together the signals are so loud that stations which the amateur would ordinarily hear with fair intensity may be read at least 15 or 20 feet away from the headphones. Using this amplifier the writer has copied messages from 2 K. W. sets at sea in broad daylight at a distance of 900 miles with surprising clearness.

Members of radio clubs can give an interesting demonstration of the art of radiotelegraphy by purchasing a loud speaking telephone to be used in connection with the double amplifier. Then it will not be necessary for them to wear headphones in order to receive radio signals. Loud speaking telephones may be purchased from the large commercial telephone companies at reasonable prices. After the audion is properly connected up the loud speaking telephones should be substituted for the regular telephones, placed in the center of the room and the receiving tuner adjusted to the Arlington time signals. The ticks of the clock from the Arlington Radio Plant can be easily read twenty to thirty feet away from the headphones, and those present will be able to set their watches by Arlington time.

Using the amplifier described there is no reason why the members of any radio club within a range of 600 miles of Arlington should not be able to read the signals from ten to twenty-five feet from the loud speaking telephone, provided the club is equipped with an efficient antenna.

If any difficulty is experienced in securing results with the amplifier, it is undoubtedly due to the fact that the batteries (low and high voltage) are opposing one another in each individual audion or that the connections from the second audion to the one to one transformer are incorrect and need to be reversed.

If the radio club members desire a more elaborate arrangement they may place a third audion in the circuit, using another one to one transformer between the second and third audions. The third audion must have its individual lighting and high voltage batteries.

If all connections are properly made with the triple arrangement and the voltage is properly adjusted, amplifications 150 times the strength of signals to be had from the perikon or electrolytic detector can be obtained.

Amateur stations equipped with the more elaborate receiving antennae should be able during the winter months to receive signals from ships at a distance of 2,800 miles. It has often been noted that surprising results in tuning can be secured by the adjustment of either the battery voltage or the filament voltage of the second or third audion. As a matter of fact a slight adjustment of voltage will enable the experimenter to completely eliminate signals having different spark frequencies, although the various stations sending these signals may be operating on the same wave length.

(To be Continued)

RADIO CLUB OF AMERICA MEETS

The regular monthly meeting of the Radio Club of America was held on December 6 at eight o'clock in the evening at 327 West 107th street, New York. George Burghard, of 1 East Ninety-third street, secretary of the club, will answer inquiries relating to the organization.

The Lackawanna Tests

WIRELESS telegraphy, bearing a long list of triumphs wrested from the waters, has found new fields to conquer on land in conveying intelligence to speeding railroad trains. It is predicted that the new application of the art will revolutionize railroading, as it relates to the safety and convenience of travelers, for already passengers have experienced the novelty of reading news of the minute while they rode in cars thundering along at the rate of sixty miles an hour.

The value of a wireless installation was strikingly illustrated during a test on the Lackawanna Railroad train which left Hoboken at fifteen minutes after ten o'clock in the morning on November 24. The conductor of the train, known as the Lackawanna Limited, which was bound for Buffalo, became ill when thirty miles east of Scranton, Pa. Ordinarily it would have been necessary to stop the train and send a telegram asking for a relief conductor to be ready to take charge, or else wait for another conductor when the Scranton station was reached. The Lackawanna Limited is scheduled to run from Hoboken to Buffalo in nine hours and forty-three minutes, which means there is a constant fight against the loss of time.

On this occasion David Sarnoff, chief inspector of the Marconi Wireless Telegraph Company of America, was operating the wireless apparatus on the Limited train. The train was running at a speed of fifty miles an hour, but a wireless message telling of the conductor's illness and asking for a relief was dispatched to Scranton. The train arrived in Scranton about half an hour afterward and another conductor was on the station platform ready to step aboard.

When the Limited left Hoboken it was filled with passengers, and as it continued the conductor realized that he would need another coach. It was only necessary for him to notify the man at the wireless apparatus of what he wanted and a few minutes afterward a message was sent flashing over the mountains to Scranton, asking for another car to be held in readiness and added to the Limited when it arrived. The car was waiting when the train reached Scranton and no time was lost.

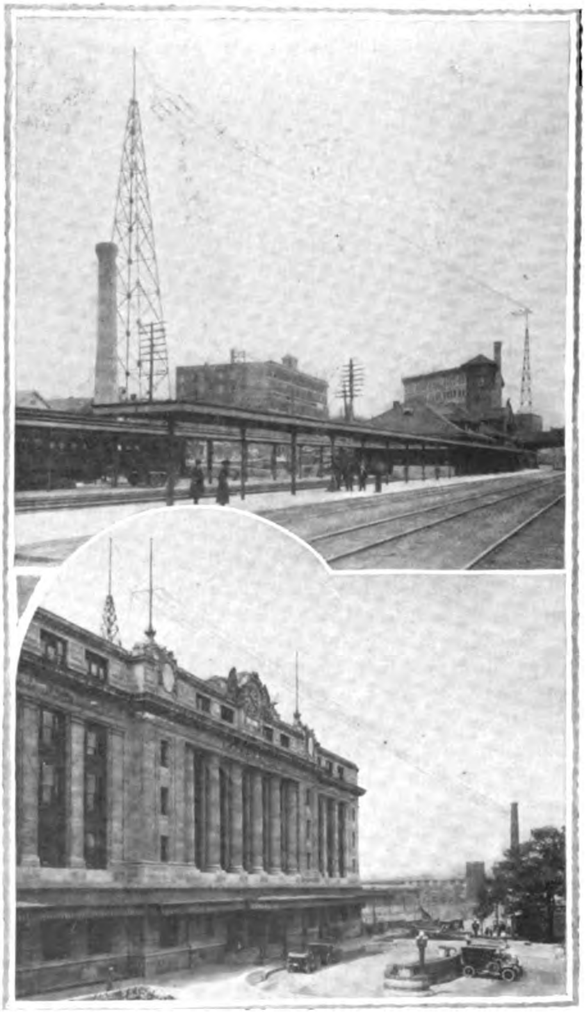
In charge of the wireless test on the train was L. B. Foley, Superintendent of Telegraph for the Lackawanna. He decided to get off at Scranton and return to New York on a train due in the former city two hours after his arrival. Mr. Sarnoff, however, remained on the train to continue the tests, and as the train Mr. Foley had planned to take—the Eastbound Limited—was due in Binghamton an hour before the arrival of the Lackawanna Limited, the Marconi employee decided to leave for New York on an express at midnight.

While in Scranton, however, Mr. Foley was informed that the Eastbound Limited was an hour behind time. A wireless message was therefore sent to Binghamton from Scranton and thence to Mr. Sarnoff on the Lackawanna Limited, informing him that he could make the connection with the Eastbound Limited at Binghamton. In consequence, he and Mr. Foley returned to New York on the same train.

Mr. Foley believes that when all trains have been equipped with wireless the absolute severing of all communication between trains and stations will be done away with. This will mean that disasters like the Dayton flood and the San Francisco earthquake will not cut off communication between the storm-devastated sections and the outside world. Wrecked or derailed trains will be able to notify stations about accidents as soon as they occur and word can be flashed to the nearest point outside the storm centers.

"Communication by wireless telegraph to and from fixed stations with moving trains is no longer an uncertainty," he said. "Railroads can now go ahead and install the service without any fear of failure. There are many fields for the wireless telegraph in railroad operation, in routine business, and emergencies when lives and property can be saved by its use.

"And the service can be put into operation without increasing the train crews. Regular trainmen can easily learn the telegraph alphabet or telegraph operators



The towers at Binghamton, showing the antennae suspended beside the railroad tracks.

The Scranton passenger station, with the aerial stretching to a nearby chimney.

on trains can perform the duties of trainmen. Later, it may be found necessary and profitable to place a telegraph operator on limited trains running long distances without stopping to handle commercial telegrams for the public. Telegraph offices on trains in the future may be of as much value to the public as branch offices in hotels and other places where people congregate in large numbers.

"In my opinion the wireless will revolutionize railroading. The time is coming, and it is not far distant, when the wireless telegraph on trains will make the safety and convenience of railroad traveling 100 per cent greater than they are to-day. And as a preventive of accidents I think the wireless will prove of the greatest value.

"In the Hudson tubes and subway, for example, the train dispatcher sits in his room, and by the flashing of lights knows where every train is. If two trains get dangerously close together he can send a signal that will almost instantly stop one or both of them. I believe that the same thing can be done on railroads with the wireless. The dispatcher can sit in front of a board on which the location of each train will be shown by wireless telegraph. If he sees trains getting too close together for safety, he can send a wireless message that will stop one of them any where—out in the country miles from a telegraph station.

"But of course all this is in the future. At present we are only experimenting. As far as they have gone, however, the experiments justify the predictions.

"Our doubt when we contemplated installing the wireless was about using the rails for grounding the electric current. There is a ground wire at every wireless station, but you can't have one from a moving train. So we tried sending our ground current to the rails. The scheme worked well and the first difficulty was overcome.

"And another problem was settled at the same time, that of supplying the electric current for the messages. We simply used the dynamos already in the train for lighting purposes. We had feared that they would not furnish sufficient current for the wireless, or if they did, that using it would weaken the lights. But we used all the electricity we needed and the lights were not perceptibly dimmed. I think it is certain that we can use the rails for ground wires and the ordinary lighting dynamos for our current. This was demonstrated.

"Our next problem is to get our instruments on the train absolutely in tune with those at Scranton and Binghamton. You see, on account of the tunnels and low bridges over the tracks we cannot have a high aerial on the train, but high aerials are necessary if messages are to be sent any great distance, so we built them high at the stations and work them with a low aerial on the train. This makes the transmitting of messages between the train and the stations more difficult, but I believe this difficulty can be overcome.

"We have sent and received messages so easily that we are convinced that the only thing required to perfect the service is a perfect adjustment of the instruments. We shall make an experimental trip every other day until this adjustment is satisfactory. Then the wireless service on the Lackawanna Limited will become a regular thing."

Setting signals by wireless is the next step, according to Mr. Foley. He said that if an operator wishes to set a signal for a moving train not in communication with him he can cause the semaphore blade of the signal post to rise or fall at his will by sounding the correct dots and dashes on his key.

"Signals can be set by wireless," he said, "as easily and as surely as they are now set by electricity conducted in wires.

"This means that if any mistakes are made in the orders issued to engineers and conductors at stations or in the case of any emergency in which a train must be stopped to avert an accident the station operator can signal the train as certainly as if he had direct wire communication with some one on board.

"Another valuable use to which the wireless-controlled signals can be put is the handling of freight trains on long runs. At present a through freight must make many stops between its starting point and destination, so that orders and instructions concerning right of way can be delivered to the conductors, but these frequent stops are a source of expense and delay which will be abolished by the wireless telegraph.

"Keeping freight trains in motion for long distances without stops will result in great economy of operation. Railroad operating officials know how expensive it is to start and stop heavy freight trains, the additional cost of fuel with the attendant pulling out of drawheads and the wear and tear of equipment being no inconsiderable items in themselves. With direct communication with a train and the ability to set and release signals by wireless, dispatchers can keep in touch with conductors and make the stops needless. The wireless permits the dispatcher to board every train and deliver his instructions as surely as if he handed them to the conductor in a sealed envelope.

"That the wireless service for ordinary operating purposes is no longer an experiment is proved by the fact that the Lackawanna has already depended upon it when wire communication was cut off. The railroad has used the wireless for handling train orders, and find it as accurate and reliable as the telegraph or telephone. Recently, when a severe sleet storm put all telephone and telegraph lines out of commission in the Mountain Division of the Lackawanna Railroad, all train orders were handled by wireless between Scranton and Binghamton, where the railroad's two fixed stations are. The signals were strong and distinct, and the messages were received and sent by the operators without difficulty. The wireless was the only means of communication between Scranton and Binghamton for two hours during which fifty-four orders were transmitted."

Commercial telegrams have already been sent from the Lackawanna Limited and a set of regular toll rates is now being prepared.

The wireless apparatus on the Limited has been installed in the forward part of the train. The aerial consists of a quadrangular closed loop on each car, supported at each corner by insulators on iron pipe attached to the corners of the car. They are raised eighteen inches above the roof of the car, this being the maximum space allowable on account of bridges and tunnels. Four cars are thus equipped, the connection between cars being by means of a plug and socket. The aerial on each car is sixty-five feet long and is composed of a twisted cable of seven No. 18 silicon bronze wires. The car aerials are brought together at a point about the center of the train and lead into the station, which is located in a small box-like compartment at one corner of the passenger cars.

The power for operating the train equipment is obtained from the generator storage battery and lighting outfit, and about 2 KW of energy is used for the wireless service. There is no appreciable effect upon the electric lights when the wireless is in operation.

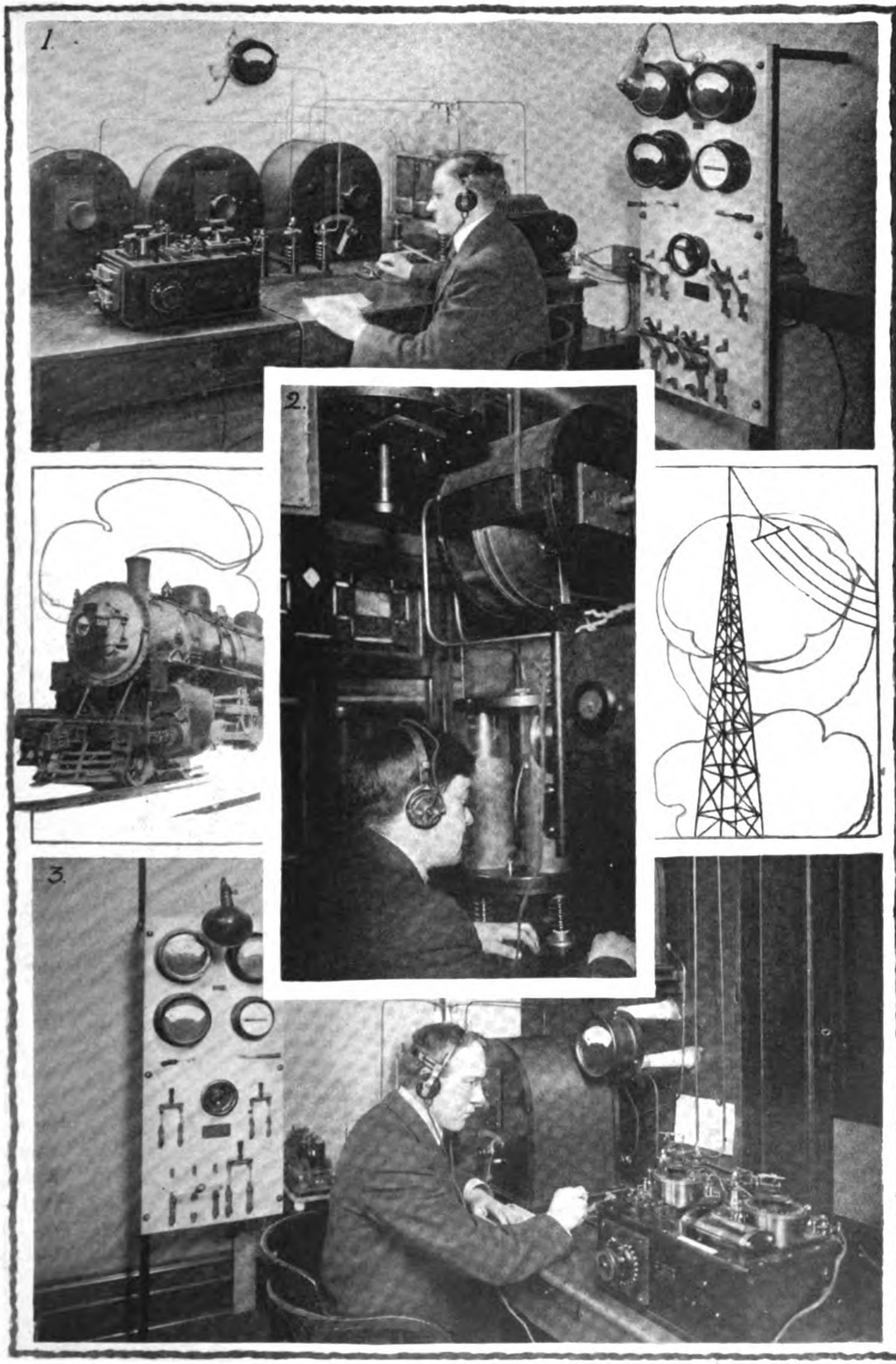
The radius of train operation at the present time is approximately fifty miles, but this range will be extended after the equipment has been tuned up.

The ground connection on the train is obtained through the steel trucks and wheels of the cars and rails.

The equipment on the train consists of a standard 1-KW Marconi set of modern design, especially adapted to this service. The motor-generator is automatically controlled, the operator simply throwing on and off a switch, as necessary. A special feature of the installation is the limited amount of space required for it. A photograph of the station accompanies this article.

The distance between Scranton and Binghamton is about sixty-five miles, and in the experiments it was found possible to maintain communication from the train running at fifty-five miles an hour, part of the time direct from the train to the fixed station away from which the train was speeding, and when the train had proceeded to a point too far away for its short aerial to force signals through to this first station direct, the signals were delivered to the station by being picked up at the second station and relayed back. At no time during the tests was the train out of communication with both stations.

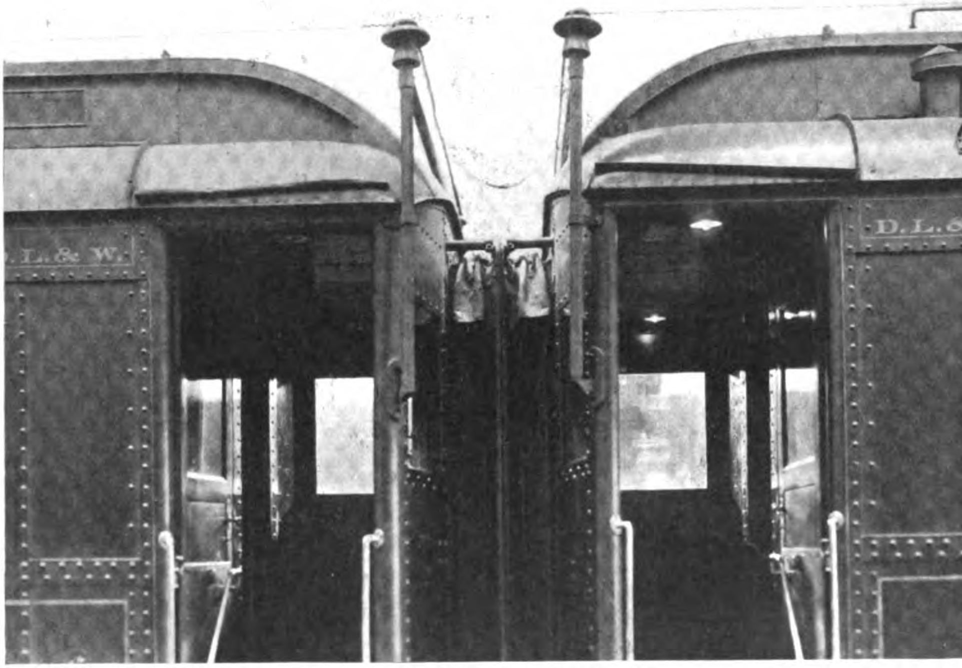
One of the most striking features in connection with train wireless was illustrated during one of the test trips, when news of the day was received while the train was demolishing distance between



(1) *The wireless room at the Binghamton railroad station.* (2) *Operator at the key of the train station.* (3) *J. J. Graf, Lackawanna electrical engineer in the Scranton station.*

Scranton and Binghamton at a mile-a-minute speed. Passengers were shown the latest dispatches from the United States and abroad, 250 words having been sent to the train by the Scranton Times. The sending of the dispatch recalled the fact that the daily news contained in the Ocean Wireless News, published on ocean steamships, was obtained by wireless and suggested the possibilities of a train wireless newspaper.

Railroad men, both in this country and abroad, have shown great interest in the tests. On December 17 Messrs. Logan and McDonald, of the telegraph department of the Pennsylvania Railroad, made a two days' inspection of the Lackawanna wireless system. They spent the first day watching the wireless work between Scranton and Binghamton. On the second day they were at Scranton when Mr. Sarnoff, of the Marconi Company, on the Limited, fifty miles east of Scranton, sent a wireless message to Mr. Logan, introducing himself. From that time until the train, which was westbound, arrived in Scranton, communication between the Limited and the Pennsylvania men at Scranton was kept up. Then Logan and McDonald boarded the train at Scranton, the former taking the key in the wireless room. He sent messages to both Scranton and Binghamton.



The aerial consists of a quadrangular closed loop on each car, supported at each corner by insulators on iron pipe attached to the corners of the car. They are raised eighteen inches above the roof of the car.

Sarnoff, Logan and McDonald left the train at Binghamton and J. J. Graf, the Lackawanna's electrical engineer and operator on the Limited, sent a wireless from a point twenty-two miles west of Owego to the effect that the train was stalled because of trouble with the locomotive. The message was relayed to the chief train dispatcher at Scranton, and from that time until the locomotive had been temporarily repaired more than a dozen messages passed between the train and Binghamton. A new locomotive was ordered from Owego by the train dispatcher, and in twelve minutes it had been coupled onto the train.

Attention was called to the fact that if the accident had occurred in a storm that paralyzed the telephone and telegraph lines it would have been impossible to obtain another locomotive until the train reached Owego, and a considerable delay would have been experienced.

Mr. Graf sent out the following call recently while the Lackawanna Limited was forty miles from Buffalo and speeding toward that city: "Any radio station in Buffalo, adjust me." He repeated the call for twenty minutes and finally received a response: "Who are you?" This was followed by "What position are you in?" Graf replied, "Operator on board No. 3 Lackawanna Limited speeding toward your city."

The Buffalo operator, evidently believing that he was communicating with a wireless man on the Great Lakes, asked, "What longitude and latitude are you in?" Once more Graf flashed back an answer, and this time it was understood. The Buffalo operator, Jackson, of the Marconi Wireless Telegraph Company of America, sent his congratulations on the success of the train wireless and met the Limited when it arrived in Buffalo.

The possibilities of wireless applied to railroads multiply almost constantly. Soon after the installation had been made on the Lackawanna Limited, three tramps were discovered by Conductor Simrell riding on the tank of the locomotive, unobserved by the engine driver and the fireman. The Limited was between Scranton and Binghamton at the time and the conductor did not want to stop the train to put the men off. Therefore he reported his discovery to Mr. Foley and Operator Graf, who were in the wireless room.

The wireless apparatus was put in operation and a message sent to Binghamton informed M. F. Collins, a special division agent of the railroad in that city, of the fact that the Limited was carrying three men who were without tickets. When the train pulled into the outskirts of Binghamton and slowed up, Collins and his assistants took the three into custody. The tramps were greatly surprised when they were told of the means employed to capture them, and apparently took pride in the fact that they were among the first of their class to take a place in the history of train wireless.

The first Lackawanna train order was sent on October 23, from Scranton to Binghamton. It marked the first time in the history of the world that a train order was sent by wireless. But already wireless dispatching has become a daily occurrence, and as Mr. Foley says: "The total loss of communication between stations, caused by the prostration of poles and wires is a thing of the past."

THE SHARE MARKET

NEW YORK, December 22.

While Marconis hold at about the same level as last month, a good deal of stock market pessimism has been put to rout, and the scattered but heavy liquidation in leading, or what are termed standard stocks, came practically to an end with the close of the week. A sharp upward turn is now looked for in the general market, and Marconi issues will no doubt reflect the change in sentiment.

The sturdy resistance which Marconi shares showed to the adverse influences growing out of the anti-trust action against the American Telegraph & Telephone Company and the proposal for government ownership of telegraph and telephone lines indicated very definitely that the professional trader has ceased his depredations.

This opinion was confirmed this morning by a leading broker, who stated that the light trading was confined to purchasers of small allotments of Marconi stocks for investors. It was further added that Marconis were every day receiving wider recognition from the conservative investors and with currency matters adjusted in Washington and the new high-power stations opened, a gradual rise could be anticipated beginning with the first of the new year.

Bid and asked prices to-day: American, 3⅞—4⅛; Canadian, 2¼—2½; English common, 16—17; English preferred, 13½—15.

Starting the New Year Right

Whatever you do, do wisely and think of result.

⊙ ⊙ ⊙

Many things difficult to design prove easy of performance.

⊙ ⊙ ⊙

Facility of action comes by habit.

⊙ ⊙ ⊙

Apology is only egotism wrong side out.

⊙ ⊙ ⊙

Those who apply themselves too much to little things commonly become incapable of great ones.

⊙ ⊙ ⊙

There is no slipping uphill again, and no standing still, when once you've begun to slip down.

⊙ ⊙ ⊙

That which is everybody's business is nobody's business.

Character must be kept bright as well as clean.

⊙ ⊙ ⊙

Circumstances are beyond the control of man; but his conduct is in his own power.

⊙ ⊙ ⊙

Have the courage to face a difficulty, lest it kick you harder than you bargain for.

⊙ ⊙ ⊙

Industry pays debts, while despair increases them.

⊙ ⊙ ⊙

Diligence is the mother of good fortune.

⊙ ⊙ ⊙

A man in earnest finds means or, if he cannot find, creates them.

⊙ ⊙ ⊙

Nothing great was ever achieved without enthusiasm.

⊙ ⊙ ⊙

A great man is one who affects the mind of his generation.

⊙ ⊙ ⊙

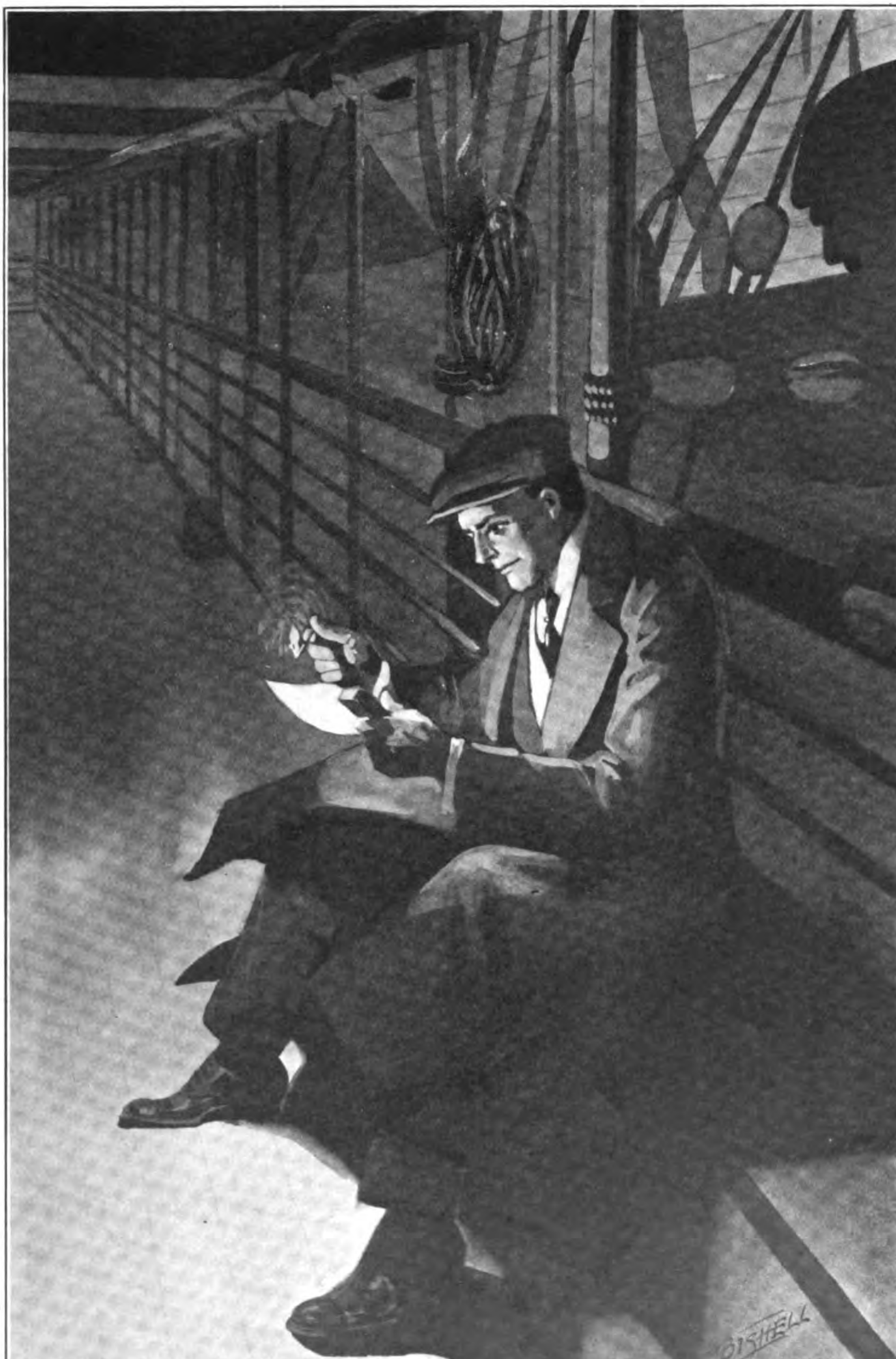
The efficient man is always in haste and never in a hurry.

⊙ ⊙ ⊙

Nothing is too difficult; it is only we who are indolent.

⊙ ⊙ ⊙

Some people never make any mistakes because they never try to do anything that is worth doing.



With these thoughts in his mind, Rance struck another match. "K"— "K"—. He cudgeled his brain in a useless effort to identify the sender of the marconigram.

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so litle promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Following an accidental meeting with Bonanza late at night, Rance has an encounter on the deck of the Ostentacia with Sidney, who draws a revolver. Johnnie Clendenning, wireless operator, witnessing the fight from the roof of the deck house, descends and stops it by disarming Sidney and restraining Rance.

CHAPTER V

SO far as Sidney was concerned, Clendenning, in taking the revolver, had checked for the time being his fighting spirit. Rance, however, might not have yielded to interference so easily had the compelling power of Bonanza's words failed to mainfest itself: "All the mines in the world could not make up to me the loss of an atom of my faith in you. Remember that!" And as the wireless man stood between him and Sidney, Rance remembered it.

"Man from the first cabin trying to take a pot shot at a man from the second!" came scathingly from Clendenning, "and the fellow aft doing his darndest to choke the chap with the six-gun! Pretty how-d'ye-do I must say! Shoo!"

He tossed the revolver over the side, where it glimmered a second in the moonshine and then carried its menace into the depths. "Go back where you belong, Mr. Sidney," advised the operator; "and you," addressing Rance, "better do the same. If you two will let the matter end here, so will I."

Rance drew back against the rail. Sidney started for the passage along the starboard side of the cabin, but paused and whirled.

"Your hand is on the table, Rance," said he, with forced calmness, "and so is mine. I have the winning cards, and you know it. I would have borne with your folly and reasoned with you. But you would not have it. Now take the consequences."

He lingered, perhaps expecting a retort and wondering why it did not come. Rance closed his teeth on the words at his tongue's end and, his eyes gleaming with suppressed anger, watched his enemy pass from sight.

"That's right," said Clendenning, expressing approval of Rance's silence. "Least said, soonest mended. Beautiful moon, eh? And the Atlantic's like a duck pond. Good night."

The wireless man moved off and vanished among the shadows. Rance remained by the rail, wondering what new developments might come of events unfolded by the last hour. His apprehensions had mostly to do with Bonanza. For himself, he did not care.

Sidney must have been convinced that his own position was impregnable. Rance firmly believed that trickery had been employed in the negotiations by which the option on the mine was obtained. But how could this be proved to the satisfaction of John Maglory?

Kennedy had been instructed to keep secret the operations at the Bonanza. These orders had come from Maglory himself. Rance had worked in the mine, however, and Kennedy, for a consideration, had agreed to keep him informed about the property. But from what source had Sidney secured his information?

Kennedy was shrewd, and had an eye

to the main chance. In spite of his shrewdness and vigilance, however, news of the "strike" at the Bonanza had found its way to Sidney.

Presently this one-sided fight, in which Sidney seemed already the winner, would shift to Southern Arizona. Rance yearned to push the calendar ahead, to take a leap through time and space and find himself at once in the vicinity of Lost Horse Cañon. There all was familiar to him, and he could battle for Bonnie's rights with weapons he knew how to use.

His last marconigram to Kennedy had told of the Sidney option, and it had promised the superintendent a dazzling bonus if he would discount the tales of the mine's success and turn that foot vein of hundred dollar rock into a limestone stringer. This was to be Rance's move in the attempt to checkmate Sidney. Kennedy would stand by, Rance felt positive.

Rance felt that he was helplessly drifting, that he could not do a man's work for Bonnie and the mine until his two feet were on the soil and in the surroundings he knew best. The outlook was dark indeed. He was on the decks of a liner, with many leagues of sea and land between him and Ragged Edge. His sole resource was the antennae of the wireless, which caught from the air and transmitted to Clendenning the dots and dashes which were to make or mar the fortunes of Bonanza Denbigh. And this resource was as available to Sidney as to Rance.

Reflections brought Rance nowhere, and with something of despair in his heart he bowed his head and started for his stateroom. Abruptly he halted.

Something lay on the deck. His eyes glimpsed it vaguely, and he would have passed on. Then, by one of those processes of the mind which now and again help fate to blunder and destiny to stumble, he was moved to investigate. Stooping, he picked up the object which had caught his attention.

It was a folded paper. He walked to the bench, seated himself and struck a match. He held in his hands a wireless message, originally transmitted to William Sidney. It was a code message, and the meaningless words danced vaguely before Rance's eyes.

The match flickered and died in a breath of air. Rance's fingers closed on the paper with a convulsive grip and his hand fell to his knee. In some way, that struggle at the rail had caused the message to drop from Sidney's pocket. He had passed on without discovering his loss; and the paper, cast up on the shores of chance, had come into Rance's possession.

All methods seem fair when you are fighting for the girl you love and her rights. In worsting a crook at his own game, one may not pick and choose the weapons that please him. With these thoughts in his mind Rance struck another match. His eyes, running over the words that might mean so much, yet promised so little, came to the letter "K," which was the sender's signature.

That one letter was a clue to the mysterious person in Ragged Edge who was keeping Sidney posted regarding the Bonanza Mine. "K"—"K"—Rance cudgeled his brain in a useless effort to identify the sender of the marconigram by the first letter of his last name.

Every American and Mexican, all up and down Lost Horse Cañon and in the Poco Tiempo district, Rance knew. And he had known every man in the workings until his uncle had ordered him away from the mine. Yet he could not think of one man, whose name might be abbreviated with the letter "K," who would pose as a spy for Sidney.

With an exclamation of disappointment, he folded the note. Then, once more, pure luck favored him. On the back of the sheet, written in red, were comprehensive words—undoubtedly a translation.

Here was a stroke of fortune which caused Rance to gasp. Again he read, from beginning to end; and, at the end, even that elusive "K," through some vagary of the translator, was followed by the letters which gave the informant's full name.

Another gasp, this time of consternation, was wrenched from the young man's lips. He went hot and cold, and his brain grew dizzy.

"Kennedy!" he whispered huskily. "Merciful powers, can it be Lafe? Has he sold out to Sidney, and is he against us—against Bonnie——"

A burly form rounded the corner of the deck-house, muttered wrathfully and planted itself squarely in front of Rance.

"Found you!" rasped a familiar voice. "By the jumping sand-hills, I'm having more luck than I expected! The night's well along, but I reckon you have an idea that Bonnie will come back? Oh, you low-down coyote! Now, Jeff Rance, you listen to me—and for the last time."

With a chill of apprehension racing through his nerves, Rance arose from the bench. But he faced his uncle squarely.

CHAPTER VI

A portentous silence followed the coming of John Maglory. The old man's face was shadowed by his hat-brim, but his eyes flashed angrily in the darkness. They looked the younger man over, up and down, apparently taking his measure in a new and contemptuous light.

Rance returned the stare as calmly as he could and waited for the storm to burst. He knew that it was coming.

"Man, man," came from Maglory, in a strangely repressed voice, "I knew you had hit the down-grade, that you had tossed most of the things that make life worth while into the discard, and that you had herded with tin-horns and crimps until you had become a crimp and a tin-horn yourself; but, so help me Gawd, I still had hopes that the Maglory part o' you would somehow and sometime strangle the Rance deviltry that tainted your blood. You're right. I'm an old fool; and I have been an old fool all along to harbor such notions. What I've heard to-night—what I've——"

His voice choked and died into silence. Maglory struck at his forehead with a clenched fist, then dropped his gripping fingers and worried at his throat. He staggered.

"Uncle!" cried the alarmed Rance, stepping forward with outstretched arm.

The other stiffened and drew back. Once more he grew firm on his feet and his eyes continued to blaze.

"Sheer off!" he ordered hoarsely. "You dog my heels like a coyote on the trail of a wounded buffalo. I can't even cross the water without having you camped on my trail, doing your little best to back-cap me at every turn. How long ago was it I told you to stop pesterin' Bonanza? D'you think I ain't man enough to look after the girl and keep her away from you? D'you allow you'll carry her off, in spite o' me? If orders don't count with you, I'll couple the orders with something else. Bonanza is pure gold, and you're only a mess of country rock and not worth your salt. You've been meeting her here o' nights, eh? What's her good name to you that you'll connive at such doings? I know—don't you dare deny it! I got it straight from Sidney, and straighter still from Bonnie, herself. That Rance streak of yalluh is about all there is left in your make-up, and——"

Rance flung himself forward. Maglory tossed up an arm to ward him off. Rance, with his face close, looked his uncle fearlessly in the eyes.

"You're wide of your trail, John Maglory!" he said, struggling to hold his temper in check. "If another had laid tongue to all that, something would have happened on this part of the boat. There's more Maglory than Rance in me—and you'll acknowledge it before we're done. I have met Bonnie here because it was necessary, that's all; and her good name is as safe in my hands as it is in yours. What's more, I'm not the devil you think I am. That is something you'll acknowledge before you're many weeks older."

"Well, look!" exclaimed Maglory fiercely. "Don't you ever let me see your face again, either on this boat or in Ragged Edge! I'm done with you, and Bonnie's done with you. Try to cross trails with me again, and I'll show you what I mean. That's my last word."

Breathing heavily, and swaying a little as he walked, he started to go away. Rance stopped him with a word.

"Wait! You've had your last word, now give me mine. Out of regard for Bonanza and the Bonanza Mine, John Maglory, you've got to listen. This man Sidney is no better than a thief. Through you he is robbing Bonanza blind! I have the proof!" and Rance lifted the hand that clutched Sidney's marconigram.

"You're a rainbow-chaser!" growled Maglory. "You haven't sense enough to wad a gun, and Bonnie is getting the brunt of all your tomfoolery. You——"

"Lafe Kennedy is in cahoots with Sidney," cut in Rance; "he——"

"He's in cahoots with you, I reckon, and he'll hear of that when I get back to Ragged Edge."

"Kennedy is working with Sidney to give you and Bonnie the worst of this mine deal. Here's a message to him from your superintendent—it's the one that caused Sidney to close that deal with you for the thirty-day option. Kennedy says that the Burton-Slocum Syndicate has got wind of the 'strike,' and that their agent is waiting for your arrival in Arizona to offer two hundred thousand for the property! That's Kennedy's tip to Sidney, and on the strength of it he has nailed that thirty-day option at fifty-thousand dollars—a clear steal of a hundred and fifty thousand from Bonanza! In the name of heaven, John Maglory, can't you wake up and see this thing as it is?"

Under this torrent of words, Maglory stood bewildered. Then he stirred suddenly.

"Lies, lies!" he cried angrily. "I'm doing the best I can for Bonnie. It's crooked talk you're giving me!"

"Bad as you think I am," continued Rance, "in your own heart you know I never lied to you."

"If that's Sidney's message, how'd you get it?"

"I picked it up, here on the deck!"

"Picked it out of his pocket, I'll bet, when he wasn't looking. That sort of work seems to be your stripe, since you headed down the wrong trail. That Burton-Slocum talk is moonshine! Wasn't I after 'em to buy, before I touched up the Poco Tiempo outfit?"

"That was before the 'strike' at the mine," insisted Rance, overlooking the hard words that were thrown at him in the desperate hope of carrying his point. "Of course they were not in the market, then; now the Bonanza Mine has been proved a winner, and they're wild to get hold of it and cut out their rivals, the Poco Tiempo crowd. The message came to Sidney by wireless, direct from——"

"Don't talk to me," snapped Maglory. "All lies, wireless lies!" and he tossed his hands contemptuously. "When I'm back in Ragged Edge I'll figure this all out first-hand; and about the first thing I do will be to get Kennedy's scalp, if he's really paying fast and loose with me. Thank goodness it won't be long, now, till I'm back on the old stampin' grounds with Bonnie. And if you show up there and try to cross trails with me," he finished, "there'll be fireworks. I'll not keep hands off of you, same as I've done up to now!"

He tramped away, and left Rance, discouraged and bitterly resentful, peering out over the heaving waste of waters.

(To be continued)

FIRST FINE UNDER NEW LAW

Collector of Customs Stone, of Baltimore, Md., recently fined Captain Ghakoenneman, of the North German Lloyd liner Frankfort, $100 for failing to maintain a radio wireless operator on duty at all hours while the vessel was en route from Philadelphia to Baltimore. The decision was the first under the new Federal Radio Inspection act, and if upheld by the Treasury Department will establish a precedent.

Collector Stone overruled the defense offered that the wireless law does not apply to foreign shipping and that the Collector lacked jurisdiction. He ruled that the law covered all shipping in American waters and likewise that he had power to hear the case. The evidence showed that the Frankfort did not have its wireless operator on duty during the full twenty-four hours.

INSTRUCTION TO BOY SCOUTS

By A. B. COLE

CHAPTER VI

The Transformer

As we have previously stated, the main application of the transformer is in a permanent station, like the home or the armory. The following directions show how to build a ½ K. W. transformer, the transmitting range of which in connection with the other necessary apparatus and a good aerial, is from thirty to fifty miles over water or level land:

The transformer operates from an alternating current lighting circuit without any interrupter or choke coil. The standard voltage of most lighting circuits is 110 and the frequency is 60 cycles; consequently the design for this transformer is for circuits of this description.

The core is made of thin strips of soft iron which are shellacked or varnished to keep them from coming into electrical connection with each other. Two sizes of strips are used. Fig. 26 shows the method of forming the core. The first "layer" of the core consists of strips laid as shown at the left, and the second layer is illustrated at the right side of the drawing. One layer is placed over another until the core is completed. The third layer is the same as the first and the fourth the same as the second, and so on.

Strips A are 7¾ inches long and strips B are 5¼ inches long. Both sizes of strips are 1¾ inches wide. They should be cut from soft sheet iron, 1/32 inch or less in thickness. A sufficient number of strips should be used to give the core a cross section 1¾ inches square.

After the core has been formed as described, the legs, B, should be wrapped

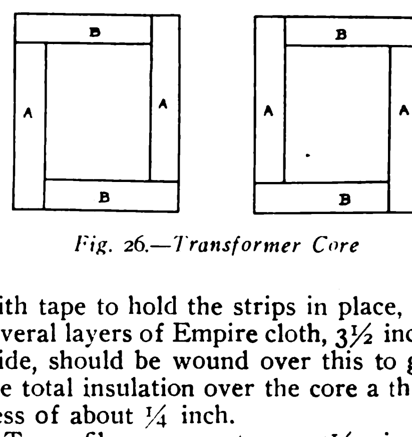


Fig. 26.—Transformer Core

with tape to hold the strips in place, and several layers of Empire cloth, 3½ inches wide, should be wound over this to give the total insulation over the core a thickness of about ¼ inch.

Two fiber separators, 5½ inches square and 3/16 inch thick, are made with a square hole in the center of each, 2¼ inches square, as shown in Fig. 27. These are to fit over one leg, B, and its insulation is to prevent the primary winding from coming in contact with any part of the core. In order to set these separators in place it will be necessary to swing one end of B away from one side, A.

After the separators are in place at

each end of leg, B, and the core is replaced in its original position, the primary may be wound over the insulation and between the separators in twelve even layers. No. 16 double cotton-covered magnet wire is used for this purpose and approximately four pounds will be required. A binding post set on each of the separators may be used to anchor the ends of the winding and as terminals for the primary.

The other leg, B, of the core is treated in much the same way as the first leg, by winding on two layers of tape and sufficient Empire cloth to give an insulation thickness of 1/4 inch. Six fiber separators, 5 3/4 inches square by 1/8 inch thick, are made with a square hole in the center 2 1/4 inches square, as shown in Fig. 27, and two similar ones with a thickness of 3/8 of an inch. The thick separators are to prevent the end sections of the secondary from coming near the sides, A, of the core. The secondary consists of seven sections, formed on a winder constructed somewhat as shown in Fig. 23, except that the mandrel, P, should be square. Each section is 1/4 inch thick and 5 1/4 inches square, although the corners will be somewhat rounded off. As soon as the winding of a section is finished, enough hot paraffine should be poured over it while on the winder to cause it to retain its shape when removed. As soon as this has cooled the section should

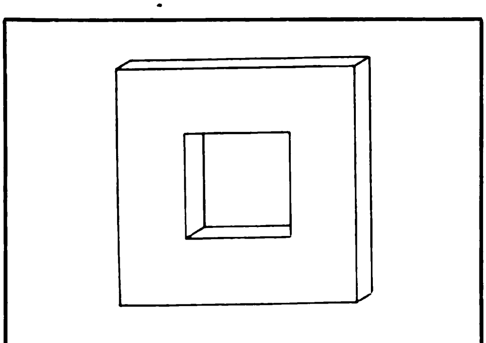


Fig. 27.—Fiber Separator

be held together by tapping where necessary, and it should then be boiled in paraffine until thoroughly saturated. It may then be removed and allowed to cool.

The sections are built of No. 34 single silk-covered magnet wire, and if convenient it is well to run the wire through hot paraffine as it is being wound on the form; this method will make handling a simpler matter. If the sections are carefully wound, about nine pounds of secondary wire will be needed.

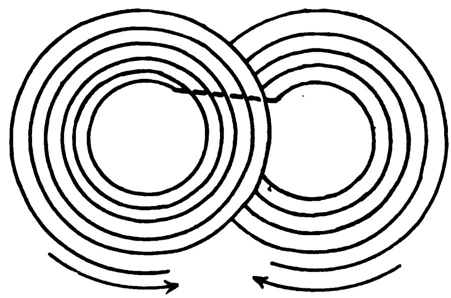


Fig. 28.—Two Sections Connected

The thin separators are to be placed between adjacent sections. In assembling the sections, after the first is in place, the second is swung around 180 degrees from the position of the first, so that, by following the path of the current around the wire, starting from the inner end, the direction of the second will be opposite to that of the first.

The third section is placed the same as the first, the fourth the same as the second, and so on, so that in alternate sections the current flow is in opposite directions. By arranging the sections in this way the inner ends of the first and second may be connected together under their separator, the outer ends of the second and third above their separator, and so on.

After the secondary winding is assembled and the leg, B, replaced, two pairs of wood cleats should be made, 11 1/2 inches long by 1 3/4 inches wide by 1/4 inch thick. One pair of these is placed on each side of the core, above and below the sides of the core at C (Fig. 29), and secured by two bolts, D, which do not touch the core itself. These cleats will hold the core in position. A leg, R, should be bent from sheet iron 1/2 inch wide for each side of the transformer.

The completed transformer may be placed in a wooden case if desired, and in this event the terminals of the primary and secondary will be connected to posts on the outside of the case. If no case is used, two hard rubber posts should be set up on cleats, C, for connection to the secondary terminals. These wires must not be allowed to approach either the core or the primary on account of the high voltage currents which they carry, and care should be used in handling them for the same reason.

This transformer will develop between ¼ and ½ K. W. if carefully made, and with a fair aerial will send over level land up to fifty miles.

Chapter VII

Aerials and Grounds

The aerial is of the same construction in general for all types of outfits, although a large set should naturally have a large aerial for the highest efficiency. The importance of having a good aerial for any station cannot be emphasized too strongly, for upon it the success of the station or equipment largely depends. The very best instruments are of little practical value unless the aerial is sufficiently high and long, but on the other hand, satisfactory results may be obtained with only a few instruments in connection with a properly designed aerial.

The purpose of the aerial is, primarily, to radiate the electro-magnetic or electric waves supplied to it by the transmitting instruments, and to bring into the station to the receiving instruments as large an amount of energy from passing waves as possible.

All buildings, trees and other objects between two stations will absorb and reflect electric waves to a certain extent. This is especially noticeable where many steel structures stand between the stations. Such objects act as aerials, and since they are all more or less perfectly grounded, they will absorb considerable energy from the waves. It is a simple matter to show this experimentally. A portable wireless outfit may be connected to a fence wire or the tin roof of a house or almost any other imperfectly grounded electrical conductor, and it will be possible to receive messages from considerable distances. This fact is of especial value in field work, but to obtain satisfactory results, the fence wires should not be in contact with the earth at any point.

High hills also detract from the energy transmitted between stations if they are between the stations or close to them. It will therefore be understood that the greatest distances can be covered over water, because the space between stations is unobstructed, and then, too, a good ground connection is available.

The prime reason for having a high aerial is that it may be above surrounding objects, so that the paths to and from other stations may be as clear as possible. Bearing this in mind, it can be seen that in some localities the aerial might be much lower than in others and still give good results; consequently it is impossible to say exactly how high it should be without a knowledge of local conditions. The aerials of commercial stations are generally between 100 and 500 feet above the earth, except on ship stations, when less height is necessary.

The height of the aerial is of more importance in transmitting than in receiving. It has been observed that a difference of two feet in the height will make a difference in the transmitting radius of the station.

The length of the aerial plays an important part in the radius of operation. A long aerial is more likely to be crossed by waves from another station than a short one. It has been found that the greatest distances can be covered in transmitting if a comparatively long wave length is used. If the aerial is long, its natural wave length will be long and thus assist in transmission. In an amateur installation the aerial should not be too long, for it would be difficult to receive from other stations of similar equipment, due to the fact that its natural wave

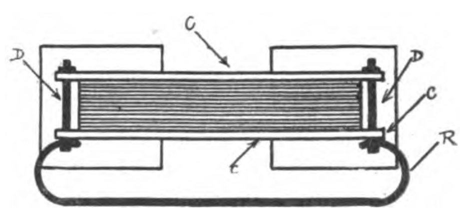


Fig. 29.—Use of Cleats on Core

length would be too great. A length of 100 to 150 feet will give the best results in most cases.

The number of wires in the aerial will also affect the radius of the station, especially in regard to transmission. The greater the number of wires, the better the results will be. An aerial of many wires is a better radiator of electric waves because it has a greater surface and a greater capacity to absorb energy from the tranimitting instruments. An aerial of a certain number of wires will have a greater capacity if the wires are far apart than if the distance between them is small.

The aerial may be supported in any convenient manner, either on poles, houses or trees. The method depends largely upon its location. The size and shape should also be determined in some degree by local conditions. Any of the forms shown in this chapter will give good results.

The vertical aerial, which is used least of all, sends out and receives electric waves equally well in all directions. A horizontal aerial sends out waves best in the direction from which it points. An inclined aerial also has a directional effect, but less marked than the horizontal aerial. This effect should be considered when the direction of the aerial is being planned, so that messages can be sent and received with best results in the direction desired.

One of the best aerials for general purposes is the umbrella aerial illustrated in Fig. 33. The aerial wires, which are arranged in different directions, are insulated from each other, and lead into the building to porcelain base switches, so that one or any combination of wires can be used at will. The arrangement permits transmission and reception of messages equally well in any direction desired. This type of aerial gives very good results, but is limited to locations where considerable space can be devoted to it.

The types of aerials shown in Figs. 30-33 are all of the "straight-away" class, which are most generally employed. The "loop" type aerial is also used to a certain extent. One form of this aerial is illustrated in Fig. 34. The difference between these two classes of aerials is that in the "straight-away" class all the wires act as a single wire; in the "loop" aerial each wire is insulated from the others, and two wires, insulated from each other, are led from the ends of the aerial, so that it acts as a continuous circuit or loop.

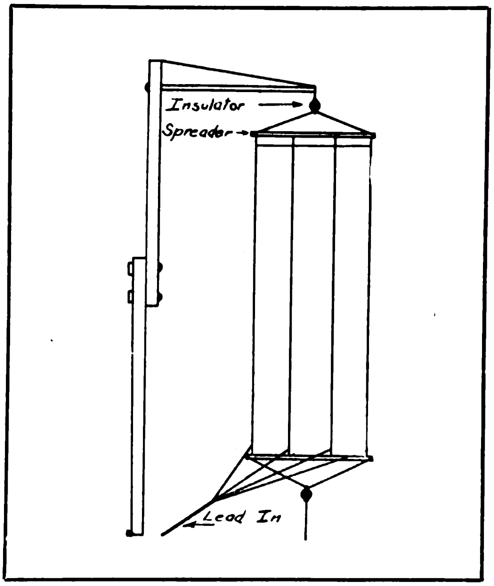


Fig. 30.—Vertical Aerial

Practically the only advantage of the loop type aerial over the straight-away class is that it permits a little closer tuning, but it has the disadvantage of requiring an anchor gap unless a special kind of aerial switch is used.

In some places it is impossible to build an aerial outside the building. In this case an indoor aerial may be used, and this will be quite satisfactory if it has sufficient length and capacity. A larger number of wires is required for an indoor aerial than for one built in the open, because the walls of the building will reflect and absorb a certain amount of the received and transmitted energy. A room having as great a length as possible should be selected; it should be as high above the ground as convenient. At least a dozen wires should be strung the length of the room and connected together in the same way as those of outdoor aerials. Porcelain knobs are entirely satisfactory as insulators in a dry place. It has been possible to transmit and receive over very fair distances with well designed indoor aerials.

All the wires of any outdoor aerial must be well insulated from any objects with which they might come in contact. The use of ordinary insulations on the wire, such as rubber, or weatherproof compounds, does not meet the requirements, since no ordinary insulation will stand the high voltages to which it will be subjected in an aerial. The proper method of insulating these high tension wires is to support them on insulators of glass, porcelain or special composition. Bare wires are generally employed, supported in this way.

Fig. 35 shows the type of glass insulator generally used in telegraph construction. This style may be used to support the leading in wires and may be convenient to use in other parts of the aerial.

The two wire porcelain cleat shown in Fig. 36 is acting as an aerial insulator in many amateur stations. It is quite satisfactory for receiving outfits and for transmitting sets of low power. A single cleat will serve the purpose where the spark coil of the station gives a one-inch spark or less. Where a larger coil is used, two or three cleats may be joined in series to form one insulator. The wire to be insulated is passed through one of the holes and the supporting wire passes through the other.

Porcelain knobs, of which one kind is illustrated in Fig. 36, are often used instead of cleats. The supporting wire passes through the hole and the aerial wire passes around the groove. Several knobs may be connected in series to give greater insulation if necessary.

A form of insulator which gives good results in small equipments is shown in Fig. 37. This consists of two porcelain knobs connected by a strip of wood on each side. A small bolt passes through the insulators and the wood strips as shown. This type of insulator is sometimes used also in the guy wires of the aerial. These guy wires should be broken by insulators at points about ten feet apart to prevent them from acting as aerials and conducting the oscillations to the earth.

The best aerial insulator is made of shellac and mica, molded under heavy pressure. These composition insulators are made in several styles, but those shown in Fig. 38 are representative. The ball type is suitable for small stations where a coil giving a two-inch spark or less or a transformer of 100 watts capacity is used. The corrugated type insulator is made in a five-inch and a ten-inch size. The former gives good results in stations employing coils up to three inches long and transformers up to ¼ K. W. output. The ten-inch size should be used for larger stations.

The composition insulator will stand any ordinary degree of heat or cold, is strong and of very high resistance and is practically unaffected by dilute acids or alkalies. It is used extensively by commercial wireless telegraph companies.

AERIAL WIRES.—All aerial wires should be of high conductivity if best results are desired. These should be not smaller than No. 14, and if larger so much the better. The wire in the aerials of commercial stations is generally composed of seven strands each, No. 20 gauge. Any wire through which currents of high frequency are flowing develops a resistance beyond that of ohmic

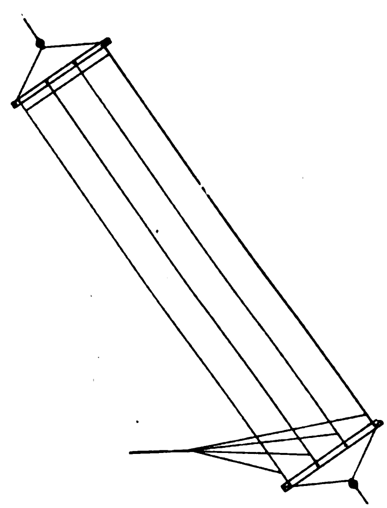


Fig. 31.—Inclined Aerial

resistance, generally known simply as "resistance." This additional resistance is known as "high frequency resistance" and its effect on the currents is called "skin effect." It has been found that

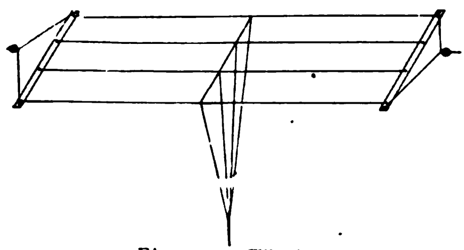


Fig. 32.—"T" Aerial

currents of constant intensity travel through the entire cross section of the conductor, but in the case of alternating currents of high frequencies, the tendency is for more to travel on the surface than in the center; this effect is more pronounced with increase of the frequency. For this reason it is desirable to use wires which have large diameters so that there is a low ohmic resistance and also a small resistance to the high frequency currents.

The wire or wires connecting the aerial with the instruments are known as the "lead in", wires. There should be as many wires leading from the aerial to the instruments as there are in the aerial itself. There is little advantage in having a large aerial if most of the energy from the sending apparatus is to be absorbed by the "lead in" wires before it reaches the aerial. The advantage in keeping the resistance of the aerial low and of having a lead in of many wires is

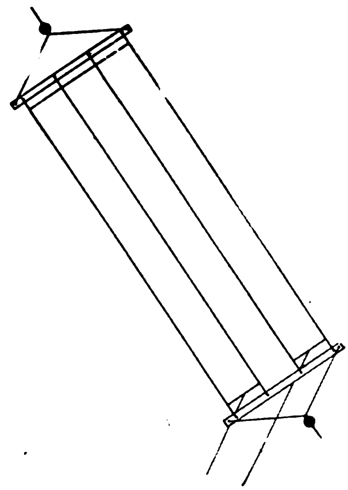


Fig. 34.—Inclined Loop Aerial

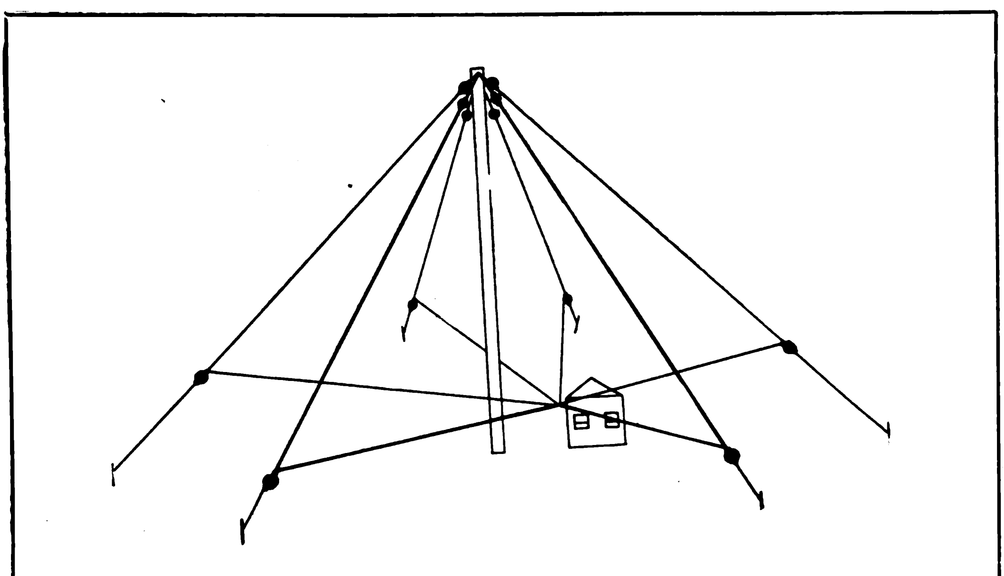


Fig. 33.—Umbrella Aerial

very apparent when transmission is attempted.

AERIAL WIRES.—The cheapest wire used in the construction of aerials is of galvanized iron. This wire is fairly

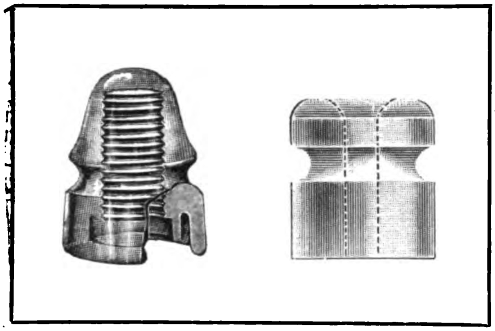


Fig. 35.—Glass Insulator *Fig. 36.—Porcelain Insulator*

satisfactory, but has quite a high resistance, which is undesirable.

Aluminum wire is to be found in more aerials than any other wire. This is because the first cost is less and because aluminum is light. Aluminum wire is not to be recommended for this purpose, however, since the joints develop high resistance in the course of about six months, causing a material decrease in the intensity of received signals and also in the transmitting radius. This resistance is due to the formation of an oxide of aluminum around the wires, but may be prevented to a certain extent by covering all joints with tape.

One of the best wires for aerial construction is ordinary copper, either insulated with cotton or rubber or bare. In either case it must be supported on insulators. Copper wire has a high conductivity and will last several times as long as aluminum. Moreover, copper wires are easily soldered, causing joints to be good, both electrically and mechanically. This wire is suitable for all stations where the length of the aerial is not over 150 feet. Where longer wires are used, copper wire is likely to stretch after a time, since its tensile strength is not sufficient to support its weight on so long an aerial.

Where the aerial is to be a long one, a wire composed of some strong alloy should be used. Several different alloys are used for this purpose, among which phosphor bronze is well known. There is a certain amount of copper in all of them with some hardening material added. Joints between these wires can be soldered without difficulty. The commercial wireless telegraph companies generally use these wires in the form of stranded cables. A stranded wire has a greater surface than a solid wire of the same carrying capacity, and consequently has a less high frequency resistance.

GROUND CONNECTIONS.—The ground connection must be a good electrical connection with the earth if high efficiency and long distance operation are desired. The wire running between the instruments and the ground connection should be short and its diameter should be large. Copper wire should be employed for this purpose. It need not be insulated if it is short, but if it is ten feet in length or longer it should be supported on porcelain insulators.

If a city water or gas supply pipe is near the instruments, the simplest way to make a ground connection is to fasten the ground wire (the wire leading from instruments to the ground connection) to the pipe by means of a ground clamp, of the kind used by telephone companies. The pipe should first be scraped until the surface is bright and clean, to insure a good electrical connection between it and

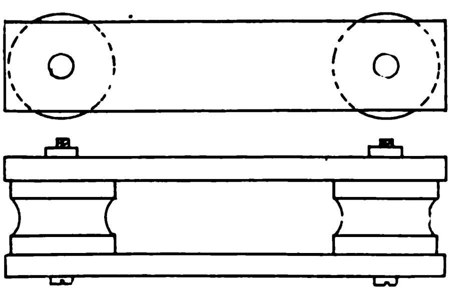


Fig. 37.—Composite Insulator

the ground clamp. The water pipe is to be preferred, although a gas pipe will serve the purpose. In either case it is always advisable to connect a wire to the pipes as they enter and leave the meter, so as to bridge it, since the contact between the meter and the pipes have considerable resistance.

In case one of these pipes is not available, the ground wire may be connected by means of a ground clamp to a piece of pipe driven into the earth in a damp place. This method is employed in field work. A pipe of this description should be five or six feet long. If holes are drilled in it and it is filled with water occasionally, a better ground connection will be afforded because the water will flow out slowly through the holes and moisten the earth around it.

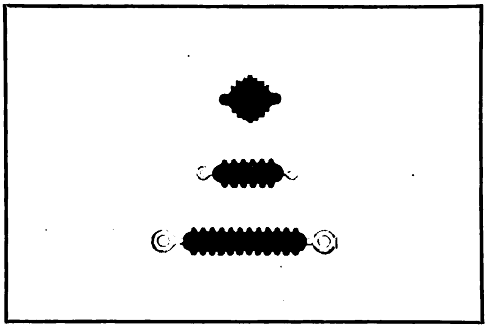


Fig. 38.—Composition Insulators

LIGHTNING SWITCH.—In permanent stations, some suitable arrangement should be made to effectually connect the aerial to the earth at all times when the station is not actually in use. Fuses are of no value to protect the instruments from lightning, for by the time sufficient energy is developed in the aerial to melt the fuse, much damage will have been done to the apparatus.

The best device to use for this purpose is a single pole, double throw knife switch mounted on a non-absorbtive insulating base. Slate is not satisfactory for switches carrying high tension currents, as it is not a good insulator at these voltages. Porcelain is one of the best materials for the use of this switch.

The switch should be mounted outside the buildings at the point where the wires enter. It should be connected, as shown in Fig. 39, so that the aerial may be connected to either the instruments or to the ground, but not to both at the same time.

The purpose of the switch is to carry the small electrical charges which compose lightning when accumulated, to the earth before they can combine to form one large charge. A 25-ampere, 250-volt switch is satisfactory for small stations, but in some places the fire underwriters require a 600-volt, 100-ampere switch. The wire from this switch to the earth should be of copper, and should not be brought into the building; it should run directly to a pipe driven into the earth. If a 25-ampere switch is used, the ground wire should not be smaller than No. 10. Where the 100-ampere switch is installed, the ground wire should be No. 4 or larger. In either case the wire should be supported on porcelain insulators.

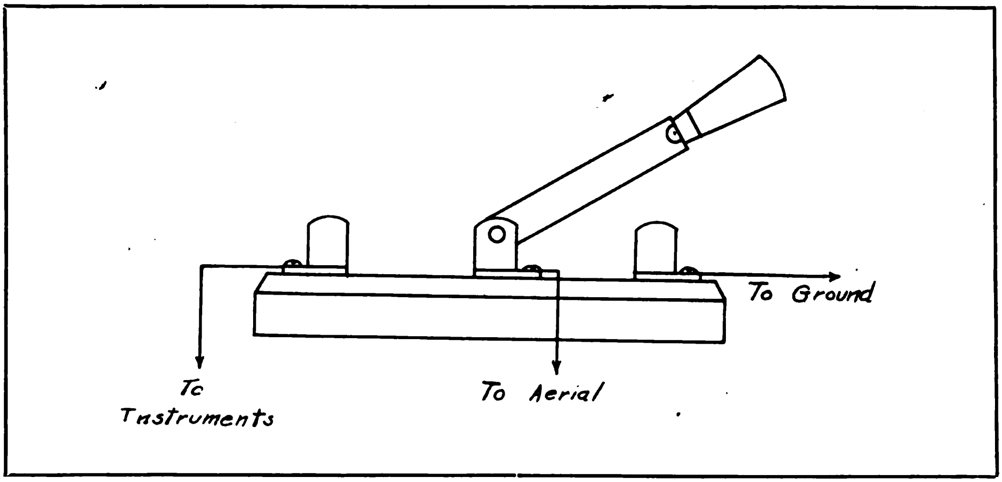


Fig. 39.—Lightning Switch Connections

This is the fourth installment of instruction for Boy Scouts. The fifth lesson by Mr. Cole will appear in an early issue.

From and For those who help themselves

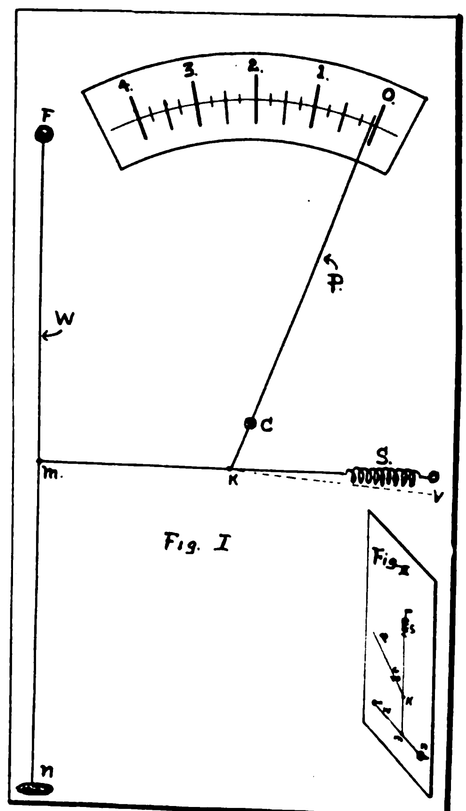
Experimenters' Experiences.

FIRST PRIZE TEN DOLLARS

A Hot Wire Meter for Spark Coils and Transformers

The most important instrument conducive to a first class sending set which rardiates a high percentage of the energy expended in it, is a hot wire meter. Without this device the amateur can never be sure that he is getting all of the radiation possible out of his set. The methods of tuning up with a spark gap in the aerial or ground lead and of having a friend listen to the spark while adjustments are being made, are both very inaccurate. I have in this article described a hot wire meter that I have found to be very satisfactory with spark coils as well as transformers. Its chief merit lies in the fact that the pointer is under the influence of a spring at all times, thus insuring accurate results.. A few words will make the accompanying diagram clear:

A piece of No. 34 or 36 climax resistance wire, which may be purchased from any supply house, is stretched from a nail, F, to a screw eye, N. It is so fastened to the latter that the tension of the wire may be varied by screwing the eye in or out. In the middle is fastened a piece of silk thread, which runs up to a spring, S. A pointer (an aluminum strip will serve nicely) is mounted, as shown in the sketch, on a small knob (battery nut) to raise it off the base. The ratio of the short end, CK, to the rest of the pointer should not be less than 1 to 8 for accurate results. (Make CK equal to 3/8 of an inch and the rest 3 inches.) A scale is made out of cardboard and placed on the baseboard. It should be divided into the necessary equal divisions. With the pointer on zero, the other end is fastened to the silk thread at K. This may be done by taking a few turns around the end and then applying sealing wax or glue.



With the pointer in position at zero, it is evident that the line, MKS, should not be perfectly straight, but should tend to follow the exaggerated line MKV (dotted). As the pointer approaches the center of the scale, K will have to push down against the spring S. If this allowance is not made, the turn must be very slight; otherwise the same action will take place when the pointer passes the center of the scale. A side view is shown in Fig. 2.

The operation is extremely simple. When the current is passed through the climax wire, it heats up, due to the high resistance of the material. In heating it expands. The spring takes up all of the slack thus formed. It is this movement that works the pointer.

This meter will not, of course, measure the current in amperes. It will, however, readily show the relations between different adjustments or changes. The pointer can be kept on the zero mark by adjusting the screw eye, N. The spring must not be too strong, because the wire must work against it when it cools. With a moderate spring it will be found that the pointer will draw back to the exact starting point when the current is shut off. For spark coils up to 2 inches, No. 36 or 38 climax wire should be used; but with transformers (from a fourth K. W. up, No. 34 to 36 should be employed.

The instrument is placed in the aerial lead-in wire, with connections made to F and N. It is convenient to shunt a single pole knife switch around F and N so that, when through experimenting, the sending set may be used without disturbing the meter by simply closing the switch. It must, of course, be open while using the meter.

K. W. NICHOLSON, *California.*

SECOND PRIZE FIVE DOLLARS

The Use of Single-Wire Antennae in Receiving

Give an amateur 400 feet of antenna wire, and he will promptly put up a 4-strand aerial 100 feet long. With this he will hear WNT, WSE, WCA, WHB, WHE, NAH, the boats within, say, a hundred-mile radius, NAI, if he is lucky, and perhaps Arlington, Virginia, NAA. Then, some "freak night" in December or January, he will hear Cape Hatteras and get his name in the papers as a rising young radio expert. Some do better than this, but a great many never hear anybody beyond the city limit.

If you will take 400 feet of phosphor bronze cable, fasten one end of it either to a convenient apartment house, a tree, or anything which will stand the strain, and place the other end in your station, inserting insulators wherever necessary, you will have a single wire antenna with no poles, spreaders or guy wires. If you do not like the results you can always revert to the standard 4-strand aerial, but you won't care to. Neither will you be writing to the WIRELESS AGE to ask why your receiving range is not as great as it ought to be.

I believe that a long single wire always gives better results than a short aerial composed of a number of conductors in parallel. I am not arguing against the use of more strands than one in an antenna. A single wire 300 feet long will not bring in signals as well as two properly spaced wires 300 feet long, but it will do far better work than the same amount of wire used in a short multi-strand antenna. This is a fact which few amateurs seem to realize.

The best wire for any antenna is probably the standard 7-strand phosphor bronze stock. The cost of this wire is in most cases prohibitive. Aluminum wire is hardly suitable. I know of one strand of this wire which has been up four years and is still in use. The length is 400 feet. I believe, however, that this is an exceptional case and that aluminum should not be used. I have never used hard-drawn copper wire, for the reason that its tensile strength is hardly great enough to justify the risk.

The best wire at a moderate price is stranded copper clad steel cable, or duplex wire, which comes in 4 and 7 strands of No. 20 or No. 22. The 4-strand article can be used up to 250 feet; beyond that 7 strands are necessary. Do not use porcelain cleats as insulators. I can exhibit several which broke while in the air and released my antenna. In one case two cleats in tandem broke. The round split knobs are much better, for even if the insulator should crack, which is improbable, the wire will stay up. You can, of course, use electrose if you prefer it, especially if the antenna is to be used for transmitting.

Place your aerial at a good height and in a horizontal position if possible. A single wire is always more or less directive, even if it is parallel to the ground. A wire of this description, when tapped at or near one end, favors stations in the direction of a stone thrown from the free end towards the tapped end. Moving the lead into the middle does not help, for the range in a direction at right angles to the wire remains low. If the wire is higher at one end than at the other it becomes a so-called "compromise antenna," which is extremely favorable to stations in the direction of the lower end, particularly if the down-lead is taken off at this point, as is desirable.

I am at present using a 250-foot wire, 4 strands No. 22 copper clad, about 70 feet high at one end, and about 40 at the end from which I lead into my instruments. The latter end is made fast to a chimney, about 5 feet above a grounded roof. My set consists of a loading transformer, a loose-coupled tuner, galena detector, fixed condenser, and a pair of Brandes phones. No sliders are used, and the set is not well designed for distance work, because it is wound with enamel wire and has other faults. Enamel wire should not be used as inductance because of its effective capacity. In spite of these disadvantages, and others, my distance log shows the following:

Oct. 25, 3.15 A. M., S. S. KCV working WPD, Tampa, Fla. Did not hear WPD. KCV 500-cycle spk. clear. Distance to Tampa, 1,050. Atmospherics light.

Oct. 29, 11.20 P. M. New Orleans, La., WHK. Rotary spk. Signals fine. Distance, 1,200 over land. Atmospherics moderate, intermittent.

Oct. 31, 9.55 P. M. S. S. Tivives, AHW, wkg NAW, Guantanamo, Cuba. Did not hear NAW. Signals GHW fine, 500-cycle spk. GHW gave position, 26-28, 74-16. Heavy static. Distance fm. N. Y. about 1,080.

Nov. 1, 11.15 P. M. Heard Guantanamo, Cuba, NAW wkg S. S. Ancon. NAW 500-cycle spk. Signals weak. Ancon using rotary, good. Etatic very slight. Distance, 1,500.

Since then I have heard NAW and WPD several times. It will be observed that none of the stations heard use a large amount of power. I am about to construct a new set, designed especially for distance work, with which I should get better results.

The local stations, of course, come in very loud, especially Sayville, L. I., 40 miles away, which I have copied with the phones on the table 5 feet away.

I have known an amateur to send 8 miles with a 1-inch coil directly connected to a single wire. This, however, was done on a 600-meter wave some years ago, and on a wave too broad to be tolerated now. The single wire gives the better results because of the fact that under such conditions the wave length of the antenna is more suited to the wave length of distant transmitting stations than when using a 100-foot antenna having four wires. CARL DREHER.

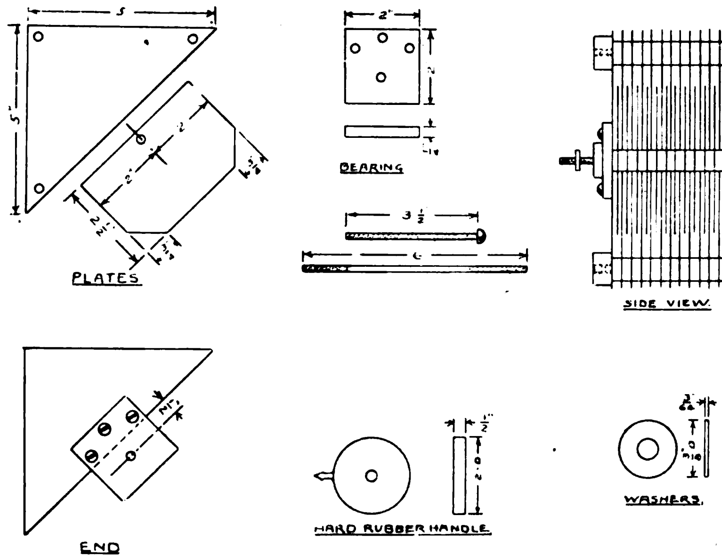
THIRD PRIZE THREE DOLLARS

A Variable Condenser of the Rotary Type

A good variable condenser of the rotary type is an instrument that many amateurs cannot build with the common tools he may have. I know how much trouble I had before I discovered several easy short cuts.

About 3 square feet of aluminum will be sufficient for a primary condenser. The most difficult part in the construction of a condenser is the cutting of the plates. A good steel ruler or metal strip, and a sharp, right-angled edged knife is all that is needed. Place the ruler on the aluminum to be cut and run the knife hard up and down its edge several times; then do the same on the other side, taking care that you keep the line already cut. The aluminum will then snap off easily, leaving a smooth, flat plate.

Cut off 9 squares on an edge, each 5 inches. Then cut it diagonally. These are the fixed plates. The movable plates are 4 by 2½ inches and are cut across



VARIABLE CONDENSER PARTS

two ends. Seventeen will be needed. (See diagram under plates.)

Washers are the next in importance to be considered. Of course they cannot be made. Small brass washers can be obtained at any wholesale house dealing in brass. Two washers, each 3/64 of an inch in thickness, is what I used for separators, and I had no trouble with plates touching one another.

Bearings for the movable plates are made from two hard rubber blocks 2 x 2 x ¼ inches, drilled to the dimensions, and screwed to the two end plates (see diagram). The bottom block is countersunk so that the movable plates will move freely between the fixed plates.

A rough piece of hard rubber should be obtained from a wholesale hardware store. It may have dimensions 2 inches in diameter and ½ inch thick. Smooth all faces with emery cloth and polish with pumice stone. This gives it a shiny appearance. The sides may be made to have a milled appearance by cutting small slits with a file. A small piece of 5/32 brass rod is tapered to a point at one end and threaded at the other. This is screwed into the knob which has a hole drilled in the center, and countersunk so that a nut can slip into it.

Three bolts, long enough to hold the plates together, should be bought. The shaft for holding the movable plates is also cut to a sufficient length. Nuts on each end hold the plates together. The dimensions for the small articles are not given. These may be obtained from the stock the amateur always has on hand. A protractor serves for a good dial. The condenser can be placed in a box, or mounted in a cabinet set.

JOSEPH KAUFMAN, *Massachusetts.*

FOURTH PRIZE SUBSCRIPTION TO THE WIRELESS AGE

A Rotary Gap For Small Coils

For amateurs who use a 1-inch coil or over with an interrupter and who get a very low toned spark it will be interesting to know how to make a rotary that will give increased efficiency. This can be made for about $1.50.

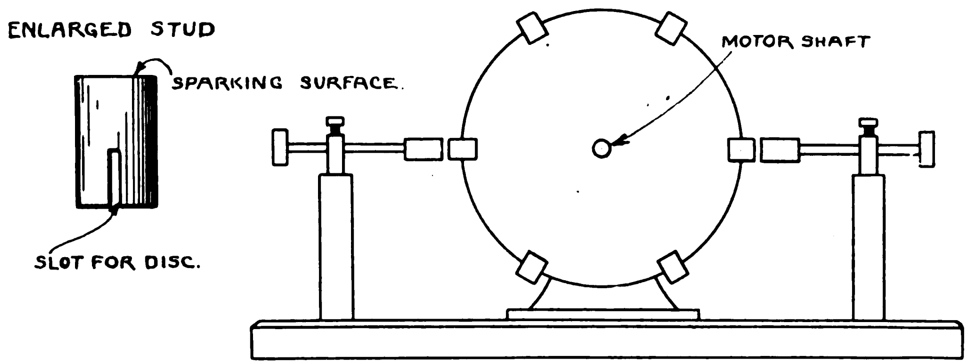
First get a small motor on the order of the Gem, Little Hustler, Little Giant, etc., and use six batteries with a rheostat in series, or a step-down transformer with a rectifier if A. C. current is used. Then procure a disk of tin or zinc about 3½ inches or 4 inches in diameter and mount it on the shaft of the motor. Make sure to place the exact center of the disk on the shaft. Divide the circumference of the disk into six equal parts, and at each of these points mount a zinc stud in the following manner.

Take a wet battery zinc and saw off six pieces about ¼ inch or ⅜ inch long and file the sparking surface smooth and slightly convex. In the center of these studs, on the opposite side of the sparking surface, cut a slit with a saw (as in diagram) about ⅛ of an inch deep that will fit over the disk. Solder these studs on at the points previously mentioned, being careful to have all the sparking surfaces exactly the same distance from the center. This is very important, as the rotary will break up if these are not exact.

Mount the motor on a suitable base, about 6 by 5 inches. Also mount two stationary studs as shown in the diagram. Adjust the stationary studs as closely as possible to the rotary studs without touching. Connect the gaps, using the stationary studs as though they were on a stationary gap. The rotary is now ready for use.

Start the motor up and when it is going at good speed press the key. The gap may be disappointing at first and you may not be able to clearly hear the note go up in the room, but if you listen in the phones with the detector set you will be able to distinguish the tone mixed with the sound of the interrupter. After regulating the gap any of your friends who are listening will hear only a clear high note with no breaks in it. The rotary will also send farther and come in louder and more distinctly.

H. B. HENGERER.



Increased Efficiency Rotary

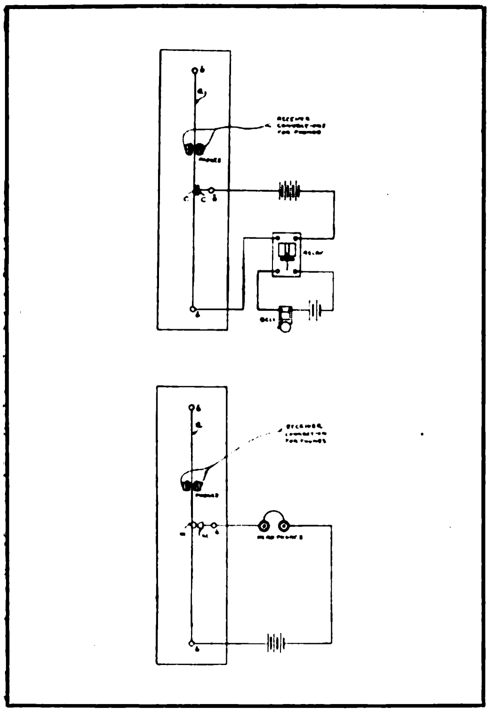
HONORABLE MENTION

A Device of Scientific Interest.

I enclose a sketch of a device which I believe to be of scientific interest. Referring to the sketch on the following page, the E string of a violin is stretched between binding posts B and B; on either side of the string is placed the magnets of an ordinary headphone receiver, P and H. C and C are two finely adjusted contacts which, when closed, send a battery current through the relay, ringing the electric bell in turn, as noted. The violin string, A, can be tuned to a certain pitch and consequently will respond to a certain spark frequency at the distant transmitting station. If the incoming signals produced in the head phones have the same period of vibration as the violin string, the string will vibrate energetically, closing the contracts C and C, and causing the bell to ring. A silicon detector can be used in place of contacts C and C.

MAURICE WINGLEMEYER, *Michigan*.

NOTE.—The device is certainly interesting. We believe, however, that considerable difficulty would be met with in attempting to operate the relay from contacts *C* and *C*. We suggest that contacts *C* and *C* be replaced by a carbon microphone (Fig. 2), in turn connected in series with a head phone and several cells of battery. This would not only make the device an amplifier, but would also effect an arrangement by which the receiving set could be tuned to a spark frequency of a distant transmitting



station. We suggest that amateurs make tests of the device and let us know the outcome of the experiments. If the distant transmitting station has a rotary spark gap giving 120 sparks per second, there will be 120 fluctuations of current per second in the head phones. If the *E* violin string is adjusted so that it has a natural vibration period of 120 per second it will give a maximum response to the string and consequently through the microphone.—*Contest Editor.*

STORY OF A COLLISION TOLD IN WIRELESS

The story of how wireless telegraphy was employed to tell of the collision between the freight steamship Pleiades and an unknown vessel about thirty miles from San Francisco, Cal., is contained in radio messages copied by K. W. Nicholson, of that city. The Pleiades, which left San Francisco on the night of November 8, was bound for Panama when the accident occurred. She reached San Francisco safely on the morning following the collision, escorted by the revenue cutter Unalaga. The messages are as follows:

8.25—Pleiades: S. O. S. S. O. S. S. O. S. S. O. S.

K. P. H. (Marconi station, San Francisco) K. with your position and state your trouble.

Pleiades: We are in sinking condition 15 miles south of lightship collision with an unknown ship in thick fog. Want help.

K. P. H.: R. B. K. To W. T. T. (Oil ship, Atlas): Do you hear Pleiades?

W. T. T.: Yes.

K. P. H.: Then stand by.

8.45—Atlas to Pleiades: To Captain Armstrong: Am on my way out and will stand by and render any assistance you need. What is your position?

Captain Smith.

9.10—K. P. H. to Atlas: Have you seen or heard him since your message?

Atlas: No.

(No answer can be obtained from the Pleiades to the calls of K. P. H.)

9.20—K. P. H. to Revenue Cutter Unalga: Go to assistance of Pleiades, about 15 miles south of lightship in sinking condition.

Captain Ulke.

9.40—Unalga to K. P. H.: To Captain Ulke, Custom House S. F.: Unalga standing through Golden Gate to assistance of Pleiades; thick fog.

9.45—Unalga to Atlas: Are you going out to Pleiades? Our whistle going all the time. Do you hear anything?

Atlas answers they hear the Unalga.

9.50—K. P. H. to Unalga: Notify Revenue Cutter McCulloch regarding sinking ship south of lightship. Both vessels are to proceed to assistance of Pleiades.

9.55—Unalga to McCulloch: Captain Reynolds requests that you proceed to scene of Pleiades 15 miles south of lightship.

(For the first time in forty minutes the Pleiades answers the incessant calls of the Atlas.)

10.05—Pleiades to Atlas: To Captain Smith, Atlas; 10 P. M.: Pleiades 10 miles S. E. by S. 1 m. m., 25 magnetic from lightship; do not require assistance.

Captain Armstrong.

10.10—Atlas to Pleiades: Message received, had fog out to main channel gas buoy. At present we can see about 3 miles.

10.15—Pleiades to K. P. H.: 10.10 P. M.—10 miles S. E. by S., 1 m. m., 25 magnetic from lightship; proceeding back. Number 2 hold full of water. Think we can make port without assistance. Will require a tug for docking.

Captain Armstrong.

10.45—Pleiades to K. P. H.: 10.45—Have just sighted the lightship. We are making for port at rate of 5 miles per hour.

103 PASSENGERS ESCAPE DEATH ON BURNING VESSEL

With seas running so high that it was seemingly impossible for small craft to live in them, 103 passengers of the Spanish steamship Balmes, threatened with destruction by flames, were taken from the burning vessel to the Pannonia, of the Cunard line, on November 14, after aid had been summoned by means of wireless telegraphy. The rescue, which occurred 600 miles east of Bermuda, added another stirring chapter to annals of the deep.

While Captain Ruiz, of the Balmes, and his men battled with the flames, Inocencio V. Michavila, chief Marconi wireless operator on the burning craft, began sending out the S O S call. Two hundred and eighty-seven miles north of the burning ship was the Pannonia, with Captain R. Capper in command. In the wireless cabin of the Cunarder was Senior Marconi Operator Stanley G. Rattee. He had been doing double duty because of the illness of his assistant, Edward Murphy, who was in the ship's hospital. The latter left his sick bed to go to the wireless cabin when the S O S call came. The Pannonia was at once turned about in her course and headed for the Spanish vessel.

Captain Capper told a graphic story of the rescue.

"I had preparations made for the reception of those whom we might be able to save," he said. "The hospital was made ready and food and hot drinks were at hand. At 7.20 o'clock that evening (Thursday) we came in sight of the Balmes. She was coming at us so straight that if she had not been well lighted we should have run her down.

"When about half a mile distant Captain Ruiz told me of the condition of the fire, declaring that his men were so exhausted that half of them were laid up, and he could not man boats to send his passengers to me. He said that the fire, which was in No. 2 hold, was in the cotton and that there were 200 hogsheads of rum on top of that, and that if the fire reached the rum there would be an explosion, which would mean the end of the Balmes, he said. There were fifty-eight in his crew, only half of whom were available to fight the fire and run the ship, the rest being laid up from fatigue and injuries.

"Finding that he could care for his passengers during the night, and it being needless to risk my men in the heavy seas, I lay by and at daybreak got off three boats. The sea had risen and was so high when my boats got away that they sank and rose twenty feet in the trough and crest, while the gale blew the spume into the faces of the crews. The Balmes had dropped a companion ladder over her side and my first boat, containing thirty-seven passengers, dropped away from her at 7.50 o'clock Friday morning. At 9.15 o'clock we had finished the task of transferring the passengesrs."

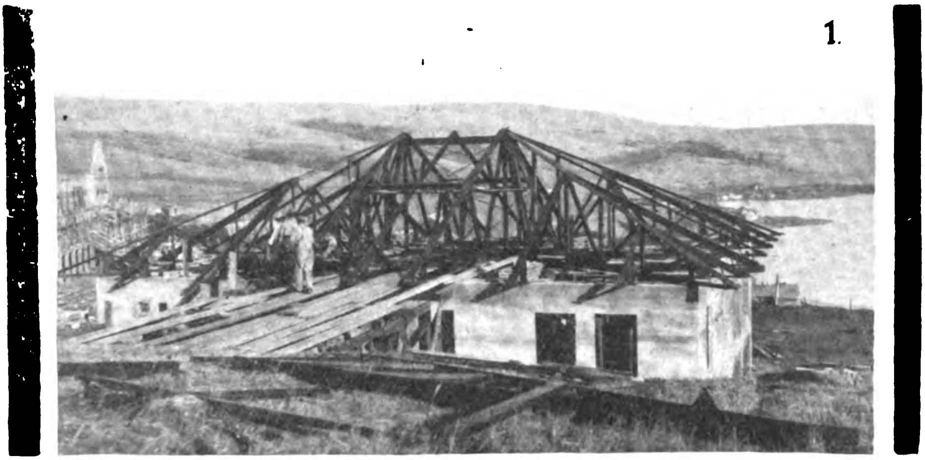
Passengers on the Balmes spoke highly of the devotion to duty displayed by Operator Michavila. He remained at his post for many hours without rest.

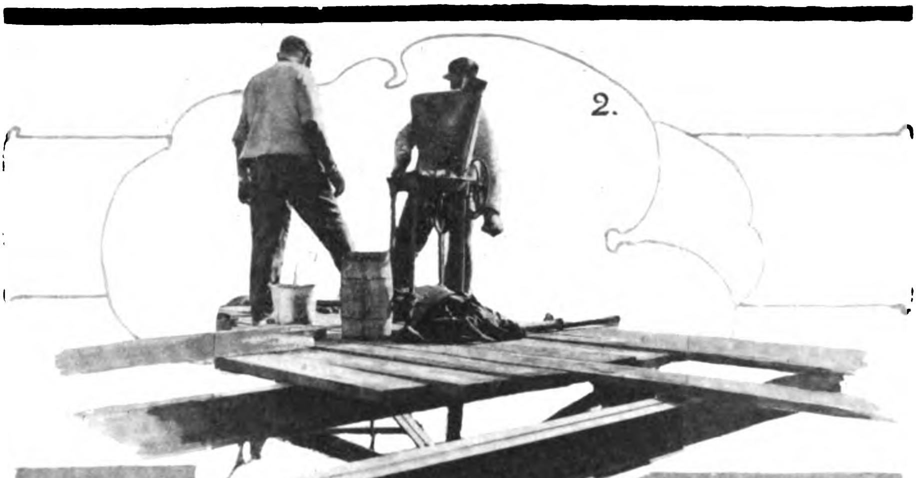
The Balmes, which was towed by the Pannonia to St. George, Bermuda, and beached, is owned by the Pinillos line, of Cadiz. She left Havana, Cuba, November 4, bound for Barcelona. The Pannonia was bound from Trieste to New York.

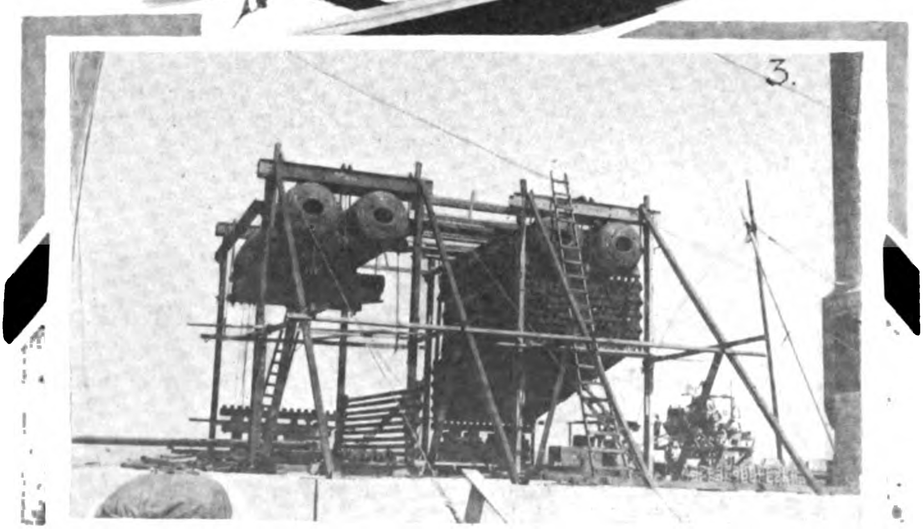
WASHINGTON GETS PARIS TIME

The naval observatory in Washington is now regularly receiving time signals from the observatory of Paris by wireless telegraphy between the Eiffel Tower and the naval radio tower at Arlington, Va. The scientific object is to measure by the velocity of the propagation of radio signals over the intervening distance the precise difference of longitude between Paris and Washington.

Photographic Glimpses of

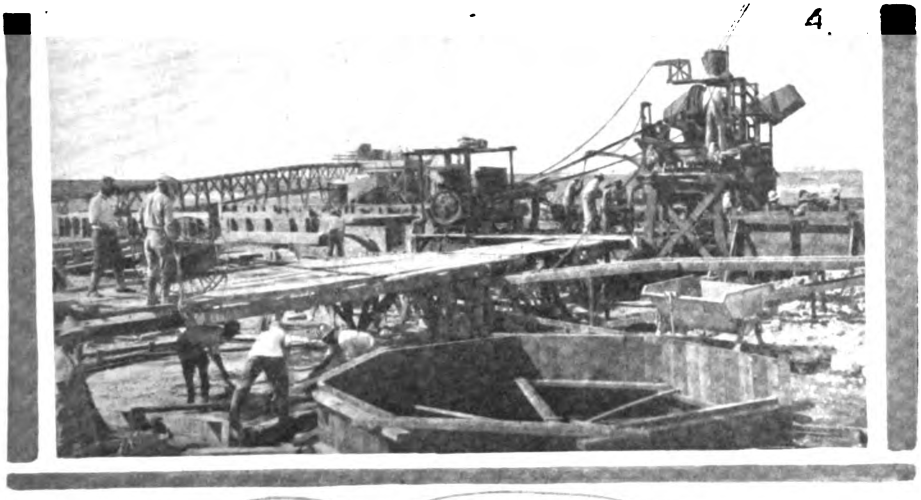


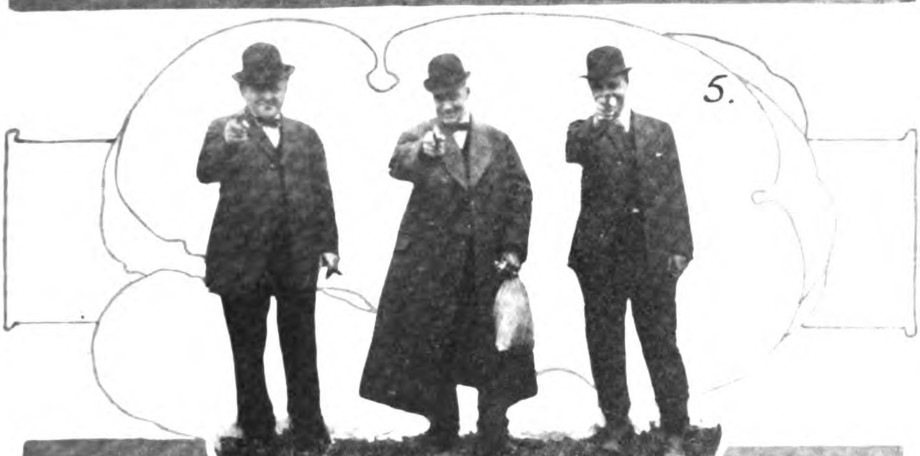


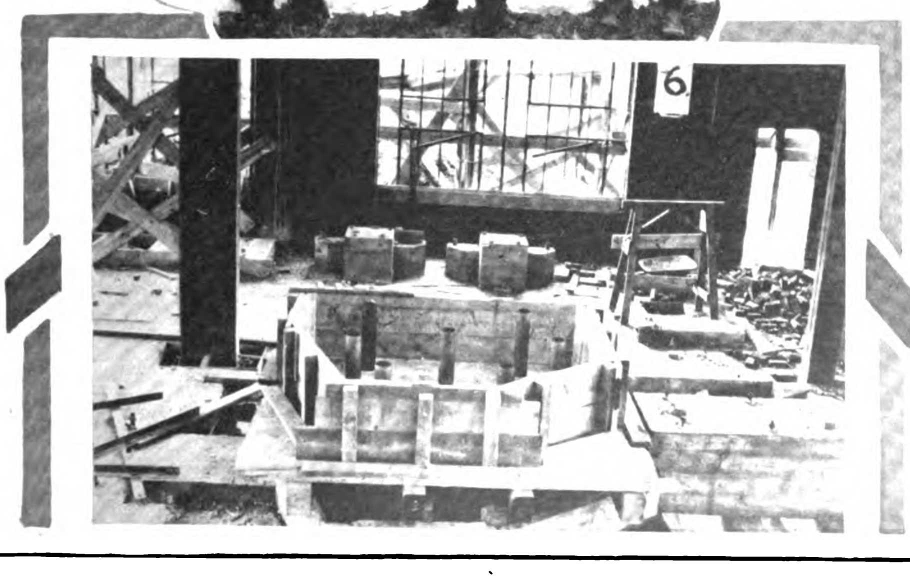


(1) *An interesting view of the structural steel detail of the roofs of the engineers' cottages, taken at the Marshalls, Cal., site.* (2) *Two of the riveters at their furnace atop the power house at New Brunswick, N. J.* (3) *Illustrating the method of installing the boilers at the Kahuku, Hawaii, transmitting site; a firebrick furnace is built underneath and a concrete building erected to contain them.*

the High Power Stations







(4) *The forms for the disc discharger foundation are seen in the foreground of this Hawaiian view; concrete is poured into them and the apparatus mounted on the solid block.* (5) *The armed escort which invariably accompanies the payroll, drawn twice each month; the bag carried by the central figure contains* $10,000 *for the workmen at the New Jersey stations.* (6) *The disc discharger foundation forms in the power house at New Brunswick.*

MIAMI STATION WORK BEGUN

Active work on the erection of the new Marconi station at Miami, Fla., will be commenced within the next few days, according to a report given out at the offices of the Marconi Company. J. C. Lewis, formerly manager at the Marconi South Wellfleet station, sailed on the Lenape on December 23 to take charge of the construction work.

The towers, of which there will be two 200 feet high, have been shipped, and the 5-kilowatt set to be installed will shortly follow. The towers are to be of the self-supporting type, and will be located close to the ocean front. Directly adjacent to a small lake will be erected a comfortable cottage for the operating staff, containing a living room, dining room, kitchen and three bedrooms.

It is expected that the station will be completed during January or early in February and will control a large share of the business which has been formerly routed through the government station at Key West. Besides breaking up the long stretch between Jacksonville and Key West, thereby greatly facilithating the handling of messages, it is expected that connection will be made between Nassau and the new Miami station to supplement ship to shore business.

SERVICE ITEMS

F. M. Sammis, chief engineer of the Marconi Wireless Telegraph Company of America, lectured on wireless telegraphy in Christ Church, East Orange, N. J., recently. Mr. Sammis illustrated his talk not only with lantern slides, but with wireless apparatus. After showing the operation of the apparatus by means of a sending and receiving device, he plucked several press dispatches out of the air.

* * *

Miss Elizabeth Sullivan and James O'Sullivan were married on November 26 in St. John's Cathedral, Brooklyn, N. Y. Mr. O'Sullivan is employed as an operator by the Marconi Wireless Telegraph Company of America at its station at Sagaponack, L. I.

VALUE OF WIRELESS IN GREAT LAKES STORM

The value of wireless has been demonstrated, according to the United States Department of Commerce, by the fact that none of the nineteen American vessels lost in the storm which swept the Great Lakes last November was equipped with wireless, whereas the vessels which had wireless received warning of the coming storm and sought safety. This information has come to the department from its radio inspectors at Chicago and Cleveland.

About fifty vessels are preparing to install wireless equipment, the inspectors report, as a result of the lesson. The Cleveland inspectors say that just before the storm three vessels cleared from Detroit, one with wireless, two without. The former, after attempting to warn the other two, returned to port and was saved, while those without wireless were lost.

WELSH STATION ON A MOUNTAIN

The Marconi wireless station in course of construction at Carnarvon, Wales, is nearing completion. Located on the side of the Cefndu Mountain, the station site is 800 feet above the sea level, and will communicate with the New Jersey station. The Welsh station is built at a height of 750 feet and the last row of masts, it is estimated, stands about 1,400 feet above the sea level.

DIRECTION FINDER FOR SENECA

Secretary of the Treasury McAdoo has given permission to the Marconi Wireless Telegraph Company of America to equip the derelict destroyer Seneca with a radio-goniometer or direction finder. By means of the apparatus it is possible to detect the direction from which wireless messages are sent.

SHORT DISTANCE SERVICE AT WELLFLEET TRANSFERRED

The short distance station of the Marconi Wireless Telegraph Company of America at Wellfleet, Mass., was discontinued on December 31. The station at Boston (call letter WBF) will be used in its place.

SEA SAFETY DELEGATES MEET

At the opening of the International Conference on Safety at Sea, which began in London on November 12, Sydney Buxton, president of the London Board of Trade, made an address, outlining the scope of the Conference. He indicated the questions to be discussed, one of which he expressed as follows:

"How can aid and assistance from another ship, or from the shore, be most quickly and effectively invoked and obtained? Under this head I especially have in mind wireless telegraphy—a question of vital importance. I should in this connection like, on your behalf as well as my own, to pay a tribute to the inventive genius who has rendered effective this great discovery."

The King sent a message to the delegates, telling them that he took a special interest in the subject of their discussions, and calling attention to the fact that he had personal experience of many of the matters to be considered. Sir Edward Grey afterward welcomed the delegates on behalf of Great Britain. Lord Mersey, principal British representative, was chosen as president of the conference.

At a luncheon given in honor of the delegates at the Foreign Office, M. Guernier, chief French delegate, made an address in which he referred to wireless as a rescuing agent for the shipwrecked. The delegates were entertained at dinner by the British government on November 18, Mr. Marconi being among those invited to meet the guests.

$20,500 TO REPAIR PHILIPPINE STATIONS

The Secretary of Commerce and Police has authorized the expenditure of $20,500 for the repair and improvement of wireless stations operated by the Bureau of Posts; 200-foot steel towers will be built at Zamboanga and Davao, a new power plant will be installed at Puerto Princesa, and a latticed steel mast 120 feet high erected at Cuyo. The Collector of Customs has drafted a law for the installation of wireless on all steamers carrying 150 persons or more in the inter-island trade.

COMMITTEE ON RESEARCH

Great Britain has appointed a committee to consider how far and by what methods the government should provide for research work in wireless telegraphy.

Lord Parker, of Waddington, is chairman of the committee which has among its members W. Duddell, president of the Institution of Electrical Engineers; R. T. Glazebrook, of the National Physical Laboratory; W. Slingo, engineer-in-chief to the Post Office; Joseph Larmor, secretary of the Royal Society, and Commander Loring.

DISSOLUTION OF LIQUIDATING COMPANY AUTHORIZED

Stockholders have authorized the immediate dissolution of the Wireless Liquidating Company. Instructions were given the directors to distribute, as far as possible, the stock of the Marconi Wireless Telegraph Company of America, held in the company's treasury, in specie. It was also voted that in case any stockholders, in the distribution of Marconi Wireless stock, shall become entitled to fractional shares, these fractions shall be transferred to a trustee, who shall issue scrip therefor, such scrip to be exchangeable for full shares whenever presented in sufficient quantities.

LIST OF STATIONS IN UNITED STATES

A list of the land and ship wireless stations of the United States has been printed by the Department of Commerce, Bureau of Navigation. The contents include a list of land stations arranged alphabetically by names, a list of all ship stations, and a list of all United States call signals arranged alphabetically, each followed by the name of the land or ship station to which the call has been assigned. In Part II is given a list of amateur stations licensed up to June 30, 1913, arranged according to radio districts, with the headquarters and territorial limits of each district.

OPERATORS' INSTRUCTION

CHAPTER VI

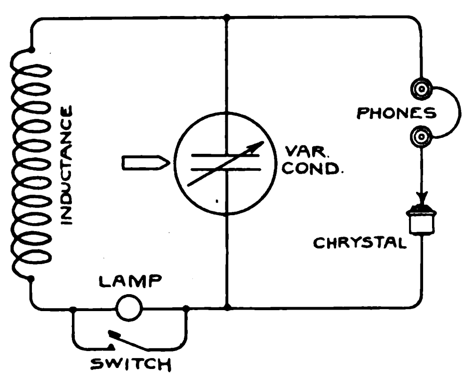
Wavemeters and the Adjustment of Wireless Telegraph Sets to Resonance—As stated previously in this series of aritcles, any circuit possessing inductance and capacity has a certain time period of vibration. In other words, it takes a certain length of time for an oscillation to complete itself in that circuit. Such a circuit is said to have a definite wave length.

Wavemeters—A wavemeter is a calibrated closed oscillatory circuit, the electrical length of which may be varied at will. It consists either of a variable condenser and a fixed inductance, or a variable inductance and a fixed condenser. Both, however, may be variable. It is self-evident that if either the inductance or the capacity of such a circuit is variable, the wave length is variable. Hence, if a pointer is attached to either the variable inductance or to the variable capacity, it can be made to move over a scale which is graduated directly in wave length.

It is customary to express wave lengths in meters rather than in feet. Common wave lengths used in ordinary ship wireless communication vary from 300 to 600 meters.

When a wavemeter is placed near to an oscillatory circuit it will absorb energy from it and maximum current will flow in the wave meter when it is in resonance with the circuit to be measured.

Marconi Wavemeter—The circuits of the Marconi wavemeter are represented in Figure 15. It consists of a variable condenser, to which is connected an inductance of fixed value. The inductance is attached to the condenser by means of a flexible cord so that it can be placed in any position desired, while the variable condenser is placed at some distance from the circuit to be measured. A carborundum crystal is connected in series with the head phones. Both are connected in shunt to the variable condenser.



MARCONI WAVEMETER.

Fig. 15

A small glow lamp is in series with the coil and condenser and is cut out by the switch.

The scale reading is placed directly on the variable condenser, which moves underneath a stationary pointer.

The scale reading of the condenser is graduated directly in wave lengths, or the data may be plotted in the form of a curve in terms of an empirical scale on the condenser. These calibrations are obtained by comparing the wavemeter to a standard oscillatory circuit or by calcuiation of the constants in the wavemeter itself.

The point of resonance on the wavemeter is located, either by the lamp or the crystal detector and headphones. If the lamp is used, it indicates maximum current flow in the wavemeter circuit; if the head phones and crystal are employed, maximum potential is indicated.

Tuning—In tuning a transmitting set to resonance, three readings are necessary.

1st—The wave length of the open circuit.

2d—The wave length of the closed circuit.

3d—The measurement of the radiated waves.

Open Circuit Readings—The wave length of the open circuit is secured as in Figure 16. The antennae are represented at A, an aerial tuning inductance at L_2, the secondary of the oscillation transformer at L_1. The primary of the oscillation circuit is designated at L. When taking these measurements, the closed oscillatory circuit is entirely disconnected from the primary of the oscillation transformer.

A small spark gap S is placed in series with the antennae and is energized by a small induction coil or transformer, the secondary of which is represented at F.

When the induction coil is set in operation, high frequency oscillations traverse the open circuit, the period of which may easily be determined by varying the capacity of the variable condenser of the wavemeter until the point of resonance is obtained as indicated by the loudest sound in the head phones.

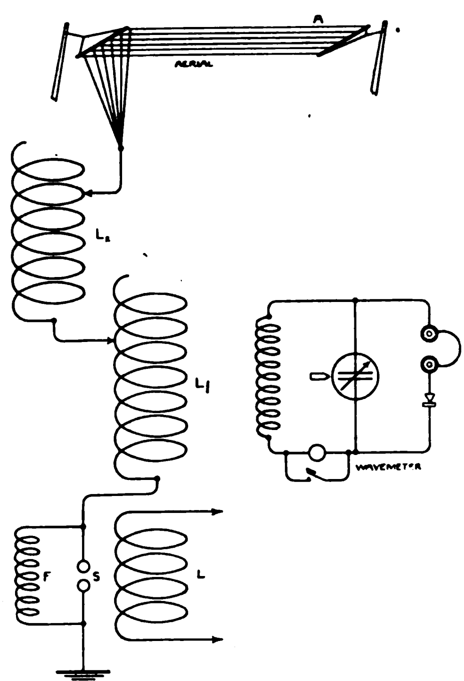
The wavemeter is now in resonance with the open circuit and the wave length is indicated directly by the pointer above the scale on the variable condenser, or may be obtained by reference to the curve sheet.

As the number of turns at L_1 are increased, it will be observed that the wave length of the open circuit is increased. Hence, if a definite wave length is to be arrived at and the number of turns in this helix are not sufficient, a separate coil of inductance will need to be added as indicated at L_2. If L_1 is an inductance of fixed value all the necessary changes will need to be made at L_2.

Closed Circuit Reading—The closed circuit readings are made as in Figure 17. The earth and antennae connections are removed from the helix, constituting the secondary of the oscillation transformer, and the spark gap of the power set, energized in the regular manner. Instead of using a detector this reading may be taken with a small lamp connected directly in series with the condenser and inductance coil of the wavemeter.

As the capacity of the wavemeter condenser is varied, the point of resonance between the wavemeter and the circuit being measured is indicated by the maximum glow of the lamp. This reading may also be taken by the crystal and headphones.

When taking the closed circuit reading care must be taken not to bring the wavemeter inductance too close to the closed circuit, as the oscillations induced in it may be so strong as to burn out the light or puncture the insulation of the inductance coil. Several trial readings should be taken until the proper distance is found.



WAVE LENGTH - OPEN CIRCUIT

Fig. 16

It will be observed that as the number of turns included in the primary of the oscillation transformer are increased, the wave length is increased.

The wave length can likewise be increased or decreased by variation of the condenser capacity.

The Coupled Circuits—After the two circuits have been independently adjusted to the same wave length the transmitting set is coupled up in the regular manner as shown in Figure 18.

The crystal detector of the wavemeter is again switched into the circuit and the inductance coil of the wavemeter held in the vicinity of the antennae.

When the transmitting key is depressed it will generally be found that two points of intensity are indicated on the wavemeter, showing that two wave lengths are being radiated.

This is due to the reaction of the magnetic fields of the closed and open circuits upon one another, causing the antennae to have two periods of vibration, one of which is shorter than the individual adjustment of the circuits, and the other longer.

Coupling—Two circuits placed in inductive relation to each other so that the magnetic lines of force of both interlink are said to be "coupled."

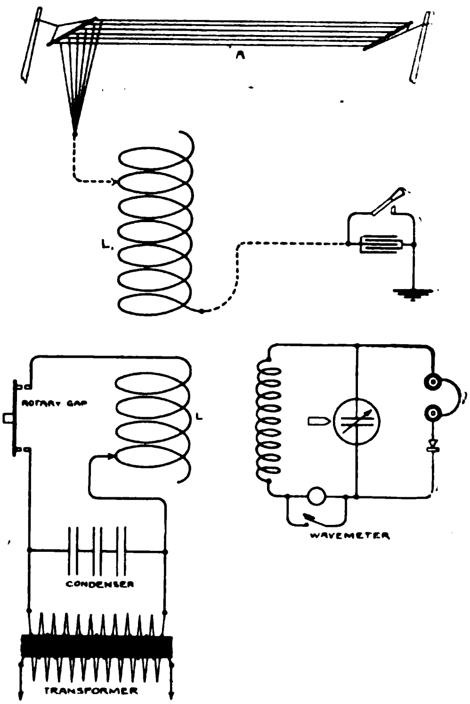
Since the production of two wave lengths is due to the reaction of these magnetic fields upon each other, because of the individual values of inductance in the two circuits altering, it is evident that as the coupling is reduced the two wave lengths will gradually approach a single radiation.

Referring to Figure 18: If the primary of the oscillation transformer is moved away from the secondary turns, the wavemeter will indicate that the two wave lengths are gradually approaching unity.

Degree of Coupling—The degree of coupling in the transmitting set is obtained as follows: Suppose the transmitting circuits were coupled together as in Figure 18: and the wavemeter indicated that two wave lengths were being radiated, one of 630 meters and the other of 570 meters, then the coupling would be:

$$\frac{630^2 - 570^2}{630^2 + 570^2} \times 100 = 9.9\%$$

When the percentage of coupling is low—5 per cent or less—the circuits are said to have "loose coupling."



WAVE LENGTH - CLOSED CIRCUIT

Fig. 17

When the degree of coupling is high, the set is said to have "tight" or "close coupling." There are no hard and fast lines to be observed; the term is merely relative.

Trial Readings—In the operation of any wavemeter several trial readings must be made in order to find the proper position where the wavemeter will be cut by the lines of force of the transmitting set.

When the correct position is found and the point of resonance on the wavemeter scale is located, the wavemeter may then be placed at a greater distance from the circuit, thereby decreasing the signals and allowing a more accurate reading to be obtained.

In making wave length tests, the operator will note that a few inches of inductance or a fraction of a turn in the closed circuit will make a great change in wave length, whereas in the open circuit it will require a considerable number of turns to create the same change. This is due to the fact that the capacity of the Leyden jars is decidedly greater than the capacity of the antennae.

Hot Wire Ammeter Tuning—It is also possible to tune a wireless telegraph transmitting set to resonance by means of a hot wire ammeter. This is shown diagrammatically in Figure 19, in which the hot wire ammeter has been purposely enlarged to give readers an idea of the internal mechanism described further on.

A hot wire ammeter is a device which measures the current flowing in a circuit by causing that current to flow through a resistance wire. In passing through this wire heat is produced which causes the wire to expand; the expansion in turn is made to work a pointer across a scale.

In adjusting a transmitting set to resonance by this method the hot wire ammeter is placed either in series with the earth lead or the antennæ lead.

The contact clip of the primary of the oscillation transformer, L, is set at some definite point, or the closed circuit may be adjusted to some definite wave length by means of a wavemeter.

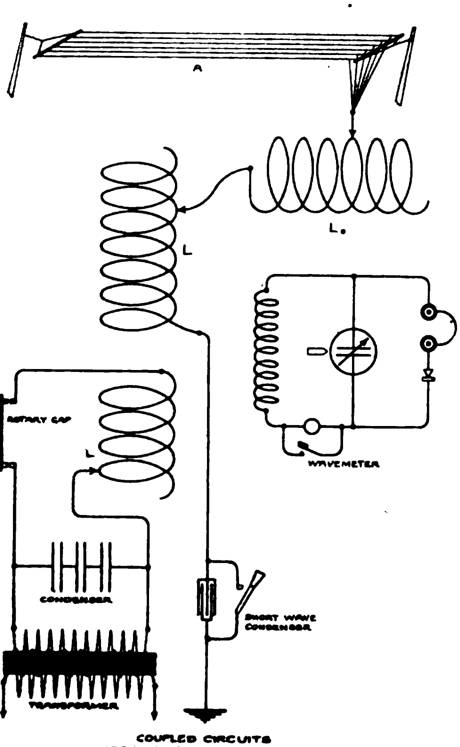


Fig. 18

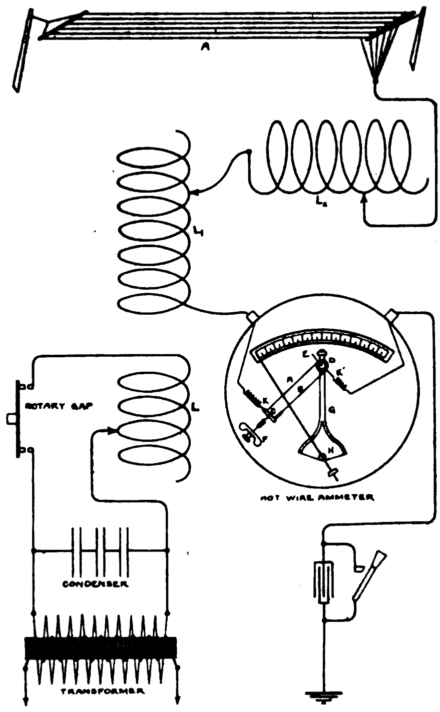


Fig. 19

The contact clip of the aerial tuning inductance is placed at some point, say the middle of the helix, and a trial reading taken.

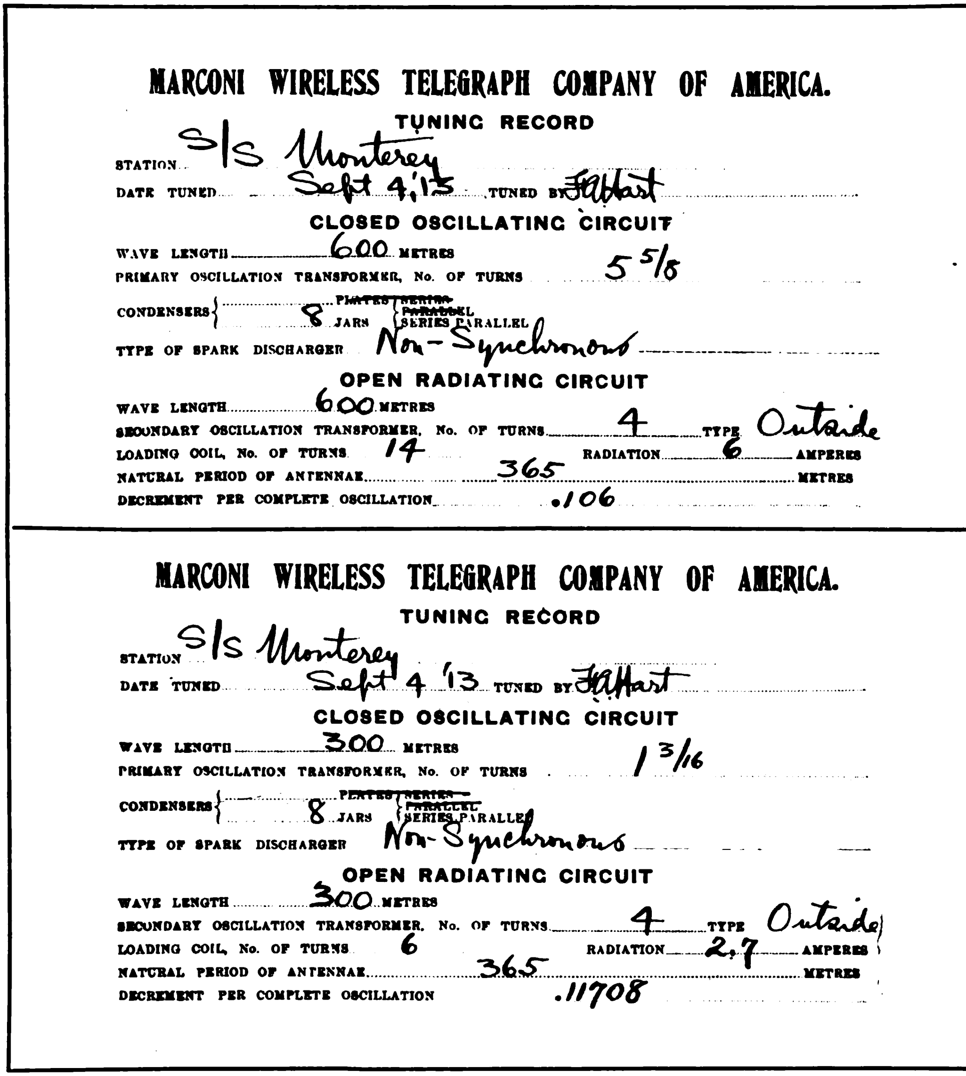
The number of turns of the aerial tuning inductance are then increased or decreased until a maximum reading is obtained on the hot wire ammeter. This reading indicates that circuits have practically the same period of vibration and are said to be in resonance.

The reverse adjustment could be made in this circuit; that is to say, a certain amount of inductance could be included in the open circuit helix and the contact clip of the closed circuit varied until the highest reading is obtained.

The Hot Wire Ammeter—The mechanism of the Roller Smith hot wire ammeter is clearly indicated in Figure 19.

A wire, AB, of high resistance is

secured at one end to a plate, C, passed around a pulley, D, secured to a shaft, E, and its free end brought back again and mechanically, though not electrically, the arm, G, is another shaft, H, on which there is a small pulley to which is attached the needle, I, that gives the desired indication; a fine silk fibre is attached at



MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

TUNING RECORD

STATION S/S Monterey

DATE TUNED Sept 4, '13 TUNED BY F.A. Hart

CLOSED OSCILLATING CIRCUIT

WAVE LENGTH 600 METRES

PRIMARY OSCILLATION TRANSFORMER, No. OF TURNS 5 5/8

CONDENSERS 8 JARS SERIES PARALLEL

TYPE OF SPARK DISCHARGER Non-Synchronous

OPEN RADIATING CIRCUIT

WAVE LENGTH 600 METRES

SECONDARY OSCILLATION TRANSFORMER, No. OF TURNS 4 TYPE Outside

LOADING COIL, No. OF TURNS 14 RADIATION 6 AMPERES

NATURAL PERIOD OF ANTENNAE 365 METRES

DECREMENT PER COMPLETE OSCILLATION .106

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

TUNING RECORD

STATION S/S Monterey

DATE TUNED Sept 4 '13 TUNED BY F.A. Hart

CLOSED OSCILLATING CIRCUIT

WAVE LENGTH 300 METRES

PRIMARY OSCILLATION TRANSFORMER, No. OF TURNS 1 3/16

CONDENSERS 8 JARS SERIES PARALLEL

TYPE OF SPARK DISCHARGER Non-Synchronous

OPEN RADIATING CIRCUIT

WAVE LENGTH 300 METRES

SECONDARY OSCILLATION TRANSFORMER, No. OF TURNS 4 TYPE Outside

LOADING COIL, No. OF TURNS 6 RADIATION 2.7 AMPERES

NATURAL PERIOD OF ANTENNAE 365 METRES

DECREMENT PER COMPLETE OSCILLATION .11708

Fig. 20

attached to the same plate, C. Plate C is kept under stress by the spring, F, which constantly tends to pull it in a direction at right angles with the axis of the shaft, E. To the shaft, E, is likewise secured an arm, G, bifurcated at one end and counterweighted at the other. Between the extremities of the bifurcated end and one end to one of the arms of G, then passes around the pulley and the staff, H, and finally has its other extremity secured to the other arm.

The current to be measured flows through the wire A only, entering at K and leaving at K[1].

When A is heated by passage of the

current, it expands, making A's tension relatively less than that of B, and equilibrium can be restored only when the pulley, D, rotates sufficiently again to equalize the strain. The rotation of D carries G with it, and G in moving causes the silk fibre to rotate the shaft which carries the needle. The movement of the needle is then dependent upon the amount of expansion in A.

Tuning Records—When the inspector at the home port has tuned a ship installation to the standard 300 and 600 meters as required by the Berlin Convention, two tuning records are left aboard the ship for the convenience of the operator. These show the adjustments necessary in changing from one wave length to the other. Facsimiles of these cards are shown in Figure 20. In this particular case it should be noted that the antenna current is 6 amperes on the 600-meter wave and 2.7 amperes on the 300-meter wave. Likewise note the number of turns employed in the open and closed circuits under such adjustments.

It is understood that on the 600-meter adjustment the short wave condenser is shunted and thereby cut out of the circuit. However, on the 300-meter wave it is connected in series and generally calls for readjustment of the number of turns in use in the aerial tuning inductance.

Degree of Coupling—The degree of coupling or, in other words, the actual distance between the primary of the oscillation transformer and the secondary, varies with the wave length used, and for the particular adjustment in the two cases cited the actual distance by which the coils are to be separated is plainly marked on the rod supporting the movable coil.

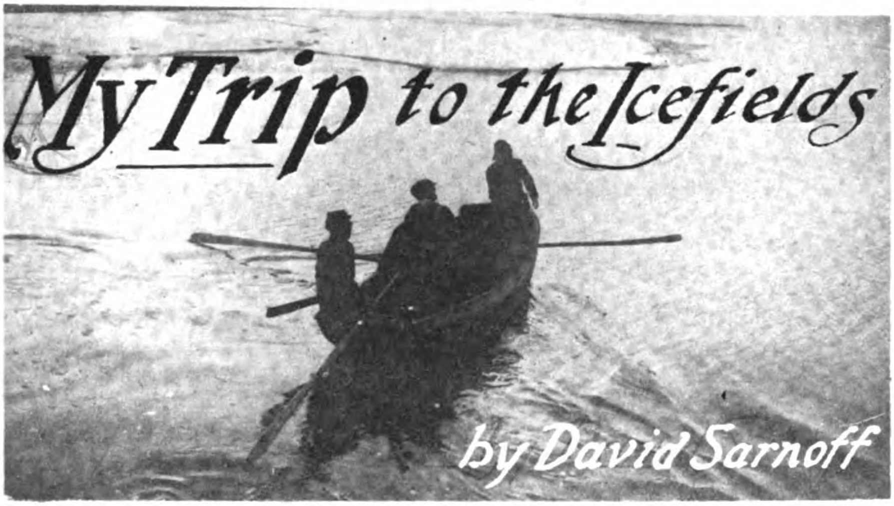
The operator should take great care in duplicating these readings absolutely, as a maximum degree of efficiency is thereby assured and the set complies fully with the U. S. Government Regulations covering coupling, damping, emitted waves, etc.

Data for Marconi Sets—Since there are various types of apparatus in use by the American Marconi Company, it is well for operators to become familiar with the capacity, voltage and frequency of each. A table is appended giving the necessary data:

Power	Frequency	Type	Pri. Volt.	Sec. Volt	Cond. Cap.	Type Condensers
1 K. W.	60 cycle	Marconi	110 V.	30000	.012 M. F.	12 copper pl. jars. 6 in parallel. 2 banks in series
2 K. W.	"	"	"	30000	.018 "	18 copper pl. jars. 9 in parallel. 2 banks in series.
1 K. W.	120 cycle	"	"	25000	.008 "	8 copper pl. jars. 4 in parallel. 2 banks in series.
2 K. W.	"	"	"	30000	.01 "	10 copper pl. jars. 5 in parallel. 2 banks in series.

The capacity of a copper-plated jar averages .003 M. F.
The capacity of a single plate of the oil condenser = .002 M. F.

(To be continued)



The Belle Isle Incident.

WE were within 75 to 100 miles of Belle Isle when word was received by wireless that the suffering undergone by the unfortunate operator Barrett had forced him to take most of his food through a tube. The ice was unusually heavy and the Beothic could make but little progress, and with the seal packs thinned out and little hunting to be done the crew became restless. Every now and then a group would form itself along the rail and voice a mild protest at the delay in returning homeward.

A change in diet which occurred about this time made the prospect of home still more alluring, for as provisions ran low our meals were principally composed of seal flippers. I had voted our former provender unspeakable, but when this ebony-hued product was placed before me my long-suffering digestive organs rebelled. I glanced at my companion, the doctor, and found a certain consolation in his woe-begone expression as he surveyed the limpid mass, squishing and gurgling in its bath of oil. An odor beggaring description and of unmatchable strength arose from the dish, and his amazement was beautiful to see when the various members of the crew actually attacked the proposition with what, from all appearances, might have been enjoyment. He looked up and saw me watching him, whereupon he executed a flank movement of the dissecting order and raised a very tiny piece of the flipper to his mouth. The consequences were all but fatal, but the doctor proved to be a good sport, and gulping down the mouthful, commenced expounding the merits of this class of food with all the zest of an epicure chancing upon a new discovery.

I had learned my lesson, however, from painful experience, and maintained a very passive and non-receptive attitude. But after a time, when he had joked me unmercifully on my perfectly justified reluctance, I threw all caution to the winds and proclaimed that I would "try anything—once."

And to the strict observance of the qualification may be attributed the fact that I am still among those present on this mundane sphere.

When I had washed away the taste of my first, last and only acquaintance with seal flipper in the guise of nourishment, I summoned sufficient courage to place before the captain the serious situation at Belle Isle. It looked like a matter of life and death with poor old Barrett, for the last wireless reports stated that he was steadily sinking, and unless the abscess was given proper medical attention he could not hold out much longer.

My efforts to have the ship turned toward Belle Isle were received with a kindly tolerance that held little encouragement. The ship was heavily laden, and should it be taken into the heavy ice floes it might become jammed and remain for weeks with all the men and cargo on board. The captain explained what this would mean in financial loss and brought out the danger to life and property in such an undertaking.

Dejectedly I sought the wireless room and sat down before the instruments, trying to find a way around the difficulty. Mechanically, through force of habit no doubt, I made the accustomed adjustments and was awakened from my reverie by the buzz of the cheery call of Jack Daw, Belle Isle's chief.

He was anxious to know what had been done toward securing assistance for his junior, and pressed me for details regarding the situation at my end.

His distress over the fate of his companion was pitiful. I simply could not tell him how unpromising things were. I cannot now recall exactly what I flashed across space to him; but I know it was a lie—a justifiable one, and one which I have never regretted, for when he heard that there was every possibility that our ship would come to Belle Isle his touch on the key fairly snapped with relief at the burden lifted from his mind.

Enthusiastic, hopeful messages, one on top of the other, buzzed into my head phones. He was sure everything would come out all right. When were we coming?—he wanted to tell Barrett the good news.

It was terrible! There I sat, staring the cold reality in the face, not one chance in a thousand that the captain would relent—and a man whose companion's life hung in the issue telling me across space how grateful he was to me for arranging his deliverance. Several times I started to interrupt and tell him the truth. But I could not bring myself to it. Then, when I had stood it as long as I could, I grasped at one despairing chance and broke in to tell him that everything was not yet settled, but it could all be fixed up if he would send a message addressed to the captain stating that his companion was suffering help-

My efforts to have the ship turned toward Belle Isle were received with a kindly tolerance that held little encouragement. The ship was heavily laden, and should it be taken into the heavy ice floes it might become jammed and remain for weeks with all the men and cargo on board.

lessly, that the end was near, and unless we hastened with medical assistance it would be too late.

I delivered this message to the captain, enlisting the doctor's aid in placing the case before him. We made a lengthy and strong appeal that from all indications reached the captain's heart. But he would not say definitely whether he would attempt the journey. It was evident that our plea had a marked effect, but the question lay with whether he would or could bring the vessel near enough to Belle Isle to permit a landing.

several days—in fact, would arrive there in six or seven hours.

With the wildest Indian warwhoop that ever broke up the tranquility of ambient atmosphere anywhere, I raced for the wireless cabin to dash off a message to Daw. Maybe he wasn't glad to hear that we were almost there!

And maybe I didn't feel like hugging the stolid old captain!

I know I meant to, but I don't believe I ever did, for during the next few hours I was about the busiest person that ever set foot on a ship. We made a systematic search from end to end of the vessel, gathering up everything that represented human comfort. Blankets, pillows and fur robes came first; then followed the collection of all manner of liquid refreshment carried "for medicinal purposes." There was little left, but what was on board we got, cheerfully contributed by the crew along with several pounds of tobacco for the game chief operator who had stood the long siege with the companion he refused to desert.

The Belle Isle lighthouse and wireless station are situated nearly 500 feet above sea level, on a mountain of ice and snow that takes on the appearance of an insurmountable glacier. When we finally reached the peak seven members of the party had dropped out.

Several days elapsed. The suspense was maddening. We filled in the time with encouraging reports to Jack Daw, in which the doctor's prescriptions for the relief of the patient played a prominent part.

Then came a message that made the doctor wince. It looked as if blood poisoning was setting in.

Gravely the doctor carried this opinion to the captain, primed for a last despairing plea in the name of humanity. The intelligence was received stolidly, and with never a change in expression the captain told him that the vessel was headed toward Belle Isle, had been for

We came to a stop two miles from Belle Isle, and a party of ten—the doctor, the captain's son, seven members of the crew and myself—started across the ice toward the wireless station and the lighthouse appearing in the distance.

To reach our destination proved to be quite an undertaking, for the Belle Isle station is situated nearly 500 feet above sea level on a mountain of ice and snow that takes on the appearance of an insurmountable glacier. When we finally reached the peak seven members of the party had dropped out, and the survivors—the captain's son, the doctor and myself—were completely exhausted.

Jack Daw and the lighthouse keeper greeted us warmly, and when we had recovered from our exertions, escorted us to the little wireless house where lay the reason for our travel over miles of frozen ocean and wind-swept glacier. On a rickety old cot in the coldest and dreariest room I have ever entered, we found the object of our journey. I experienced a distinct shock as I looked down on him. His hair was matted and his hollow cheeks were covered with a stubble beard that sharply accentuated the ghastly pallor of his features. Emaciated almost beyond recognition from twenty days in bed, racked with intense pain every minute during that time, and forced to do with insufficient nourishment, he had wasted away to a shadow of a man, and one that any moment would pass into the Great Beyond.

When he saw us he broke down completely and great gulping sobs shook his frame as the tears coursed down his cheeks. We all volunteered a few cheery words and the doctor took him in hand, quieting him so effectively that within a few moments he was able to describe briefly his condition and answer questions relating to his ailment.

The doctor joined me a few minutes later and said that a very dangerous abscess had formed, and three of his teeth must be removed at once. While he was not a dentist himself, he was willing to undertake the operation with the instruments he had brought along, but he was rather reluctant about leaving the patient afterward without further aid at hand in case blood poisoning set in.

I laid the proposition before Barrett, telling him what was necessary to give him relief, and mentioning the danger of blood poisoning to a man in his sorry condition. I told him he must take his choice; either submit to the operation then and there and take his chances, or, if he wished, we would carry him back to the ship and take him to St. Johns.

An excellent likeness of Belle Isle's chief operator, Jack Daw (to the left), and the Beothic's ship surgeon (to the right). A snapshot taken shortly after the successful operation had been performed.

He made his decision without the slightest hesitation. Under no circumstances would he leave his colleague, Jack Daw. That man had shown supreme loyalty and consideration and given him untiring care and attention, and he would never desert him where there was any alternative. If it was to be, he would end his days there rather than leave his companion.

So the operation was performed and the available remedies administered. It was a complete success, I am glad to say, and even before we left he had been relieved of his suffering and was sleeping peacefully.

As we prepared to depart we quite unexpectedly learned why Daw had been the only one to care for the sick man. Jack had told us that the only woman resident of Belle Isle was the wife of the lighthouse keeper, and we were curious to see the woman who in our opinion was deserving of a Carnegie medal for living in that desolate spot. Introductions, said Jack, would not be in order, for the husband, a short French Canadian, was a most inhuman sort and absolutely forbade his wife talking to any of the neighbors, which, of course, prevented her from administering to his companion. Nevertheless, our curiosity would not be denied, and we ventured out-of-doors in a raging wind that forced us to hold fast to the ropes placed around the houses. These ropes served to hold you on your balance, for walking is impossible, and sliding along the ice is the only method of locomotion. As we swept along in this manner toward the lighthouse the lady appeared at a window. She was a tall, striking brunette, one of the handsomest specimens of womanhood I have ever laid eyes on. She smiled a welcome and said something in French, which the doctor translated to mean an invitation to accept the hospitality of her home.

This we were willing and anxious to do, but our visit was short-lived, for hardly had we entered when the husband appeared and gruffly ordered us out, saying that he would not permit his wife to communicate with strangers. The woman was very angry, but evidently helpless, and considering discretion primarily, the doctor and I removed ourselves. The captain's son did not view the matter in the same light, however, and we had considerable difficulty in preventing him from ending the lady's tribulations by forcibly removing the cause.

This incident closed, we said our farewells and started on our return journey to the ship. A storm had come up in the interval and we experienced great difficulties and not a little hardship, but once aboard the humane object of the expedition and its entire success more than compensated for the discomfiture.

The doctor became quite a hero when we related to the men how he had conquered Barrett's malady and alleviated his suffering. Then, as the journey homeward progressed a full realization of the wonderful value of wireless in this case impressed itself on the minds of officers and crew. A human life was at stake and wireless had won. To wireless, too, could be credited the haul of 36,000 seals that lay in the hold, and these two subjects formed the principal topic of conversation that ended only with our return to St. Johns and the disbanding of the expedition.

The End

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By Wm. H. Priess

ARTICLE III

38. In the previous issue we considered the simple equation containing but one unknown quantity. This quantity was raised to the same power throughout the series of examples. The solution of two important problems of electrical design, and one of a general algebraic case, will familiarize the reader with the method of obtaining the solution. An equation is said to be solved when the unknown quantity with a coefficient and index of unity is placed on one side of the equation, while the known quantities or constants are placed on the opposite side. This is the usual form of equations for calculation of the dimensions of an electrical circuit.

Problems

39. The formula for the capacity of two parallel flat plates of equal area, separated by a dielectric is

$$C = \frac{KA}{36\pi d} \times 10^{-5}\ \mu \text{ fs}$$

where A is the area of the dielectric covered by one of the plates in cms.$^{-2}$; d is the thickness of the dielectric in cms.; and K is a number found in electrical handbooks corresponding to the dielectric used, and known as the specific inductive capacity of the dielectric. It is a number which represents the ratio of the capacity of a condenser when its plates are separated by a certain dielectric employed to the capacity of the same condenser when air is the medium between the plates. Let it be required to find the area of the conducting surface of a condenser whose dielectric is flint glass of 0.2 cms. thickness and to have a capacity of 0.01 μ f. s. capacity. Multiplying both sides of equation (1) by $36\,\pi d \times 10^5$ and dividing both sides by K we get

$$A = \frac{c \times 36\pi d \times 10^{-5}}{K} \text{ cms.} \qquad (2)$$

From hand books we find $K = 7$. Substituting the values, $K = 7$, $C = 0.01$, and $d = 0.2$

$$A = \frac{0.01 \times 36\pi 0.2 \times 10^{-5}}{7} \text{ cms.}$$

$$A = 3230 \text{ cms.} \qquad (3)$$

This will be the equivalent of a plate 2.27 feet square. In order to make the condenser compact, let us use 12 glass plates. The area of metallic foil for each plate will then be 62 inches. The condenser will therefore require 13 pieces of foil, each having an area of 62 inches, and 12 glass plates large enough to prevent sparking from one sheet of foil to the other around the edges.

40. The relation between wave-length and the inductance and capacity of a circuit may be expressed.

$$\lambda = 59.6\sqrt{LC} \text{ meters} \qquad (1)$$

where λ is the wave length in meters, L is the inductance in cms., and C is the capacity in μ fs's. With the condenser calculated in the last problem (0.01 μ f. s.), let it be required to find the inductance necessary to give a circuit wave length of 200 meters. Squaring both sides of equation (1) we get

$$\lambda^2 = (59.6)^2 LC. \qquad (2)$$

Dividing both sides of (2) by $(59.6)^2$ c we get

$$\frac{\lambda^2}{(59.6)^2 C} = L \text{ cms.} \qquad (3)$$

Substituting the values C=0.01, L=200 in (3)

$$\frac{(200)^2}{(59.6)^2 \times 0.01} = 1060 \text{ cms. inductance} \quad (4)$$

The student should calculate the constants of the apparatus he possesses. The experience thus secured will be valuable for future experimental work.

41. To find x in the algebraic example

$$ax^2 = \frac{2(b - cx^2)}{3d} + 4 \quad (1)$$

multiply both sides by 3d

then, $$3adx^2 = 2(b - cx^2) + 12d \quad (2)$$

Transpose the x terms to the left hand side of the equation,

$$3adx^2 + 2cx^2 = 2b + 12d \quad (3)$$

Write the coefficients of the terms containing x in parenthesis;

$$(3ad + 2c)x^2 = 2b + 12d \quad (4)$$

Divide both sides by the coefficient of the x term,

$$x^2 = \frac{2b + 12d}{3ad + 2c} \quad (5)$$

Taking the square root of both sides to find the value of x,

$$x = \sqrt{\frac{2b + 12d}{3ad + 2c}}$$

42. To sum up: the simple equation is one containing but one unknown quantity, the latter being raised to the same power throughout the equation. The solution is accomplished when the unknown quantity appears alone on one side of the equation with a coefficient and an index of unity, and is equal to one or more related constants. The solution is reached by simultaneous operations performed on both sides of the equation in accordance with the axioms laid down in the foregoing article.

In general, five steps are taken for obtaining the solution;

(1) *Clear the equations of fractions.*

(2) *Perform the algebraic multiplications indicated.*

(3) *Transpose all terms containing the unknown quantity to one side of the equation, and all other terms to the other side.*

(4) *Group the coefficients of the unknown quantities and divide both sides of the equation by this coefficient group.*

(5) *If the unknown quantity appears as a power other than unity, perform the inverse operation indicated on both sides of the equation, to reduce it to unity.*

Simultaneous Equations of the First Degree

43. An equation containing two unknown quantities of the first degree is satisfied by an unlimited number of different values of one of the quantities, depending on the value given the other quantity.

$$x + y = a$$
$$x = a - y$$

For every value of y there is a corresponding value of x. But if we have *two independent* equations of the first degree in x and y, there can be but one pair of values which will *simultaneously* satisfy both equations.

A pair of independent equations are such that one equation cannot be made to reduce to the second equation, by simple addition, subtraction, multiplication or division of both sides of it by a quantity. The degree of an equation is the degree of the term, the sum of whose x and y indices is the greatest.

We shall consider the solution of *simultaneous, independent* equations of the *first degree.*

Methods of Solution

44. The procedure shall consist in the deduction of two simple equations—one in each of the unknown quantities; the solution of these simple equations may then be obtained from the previous discussion.

In the example

$$ax + by = c \quad (1)$$
$$dx + ey = h \quad (2)$$

If we multiply (1) by d, then (2) by a, and subtract (2) from (1), we get,

$$adx + dby = cd$$
$$adx + aey = ah$$
$$dby - aey = cd - ah \quad (3)$$

This process is known as elimination of an unknown quantity by cross multiplication of its coefficients and subtraction of equations. Equation (3) is a simple equation in terms of y. Solved for y it equals

$$y = \frac{cd - ah}{db - ae} \quad (4)$$

Substituting this value for y in equation (1) there follows the simple equation in x

$$ax + b\left(\frac{cd - ah}{db - ae}\right) = c \qquad (5)$$

Solving for x we have

$$x = \frac{c - b\left(\frac{cd - ah}{db - ae}\right)}{a} \qquad (6)$$

The values, x and y given by equations (6) and (4) respectively, are, therefore, the solutions of the simultaneous equations (1) and (2). Regarding this method (of elimination by addition and subtraction), no further explanation is required, as the operations, after careful consideration of the problem given, should be self-evident.

45. Another method of solution is to solve both equations for one of the unknown quantities, and then to equate the sides not containing this quantity. Put equation (1) in the last example in the form,

$$x = \frac{c - by}{a}, \qquad (1)$$

and the equation (2) of the last example in the form,

$$x = \frac{h - ey}{d}. \qquad (2)$$

Since the x's are equal (1) = (2).

$$\frac{c - by}{a} = \frac{h - ey}{d}. \qquad (3)$$

This is a simple equation in terms of y. Solved for y,

$$y = \frac{cd - ah}{bd - ae} \qquad (4)$$

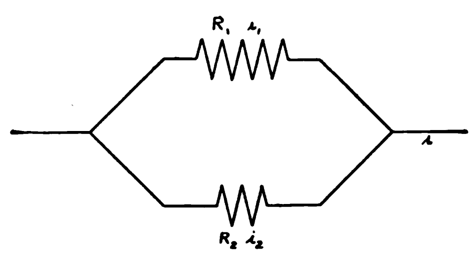
The value of y in equation (4) checks up with the value of y, found in the last example by means of elimination, cross-multiplication and subtraction. x is found, as in the previous solution, by substituting this value of y in one of the original equations. This process is known as *elimination* by *comparison*. It is labor saving and clear.

The Formation of Equations

46. Equations are the expression of a natural law. The process of forming an equation consists in writing down in algebraic form, the results of experience—dealing with the quantities whose values we wish to determine in terms of certain known quantities. All problems connected with finding the equivalent resistance, inductance or capacity, of parallel or series circuits fall into this class of equations. For instance, in parallel circuits containing resistance, the sum of the currents in the branches equals the current in the line. The voltage across each branch is the same. These two conditions lead to two equations, which permit solution of the problems when two of the values are implicated. The same applies in series circuits containing resistances; the current through each of the resistance elements is the same and equal to the current in the line; while the sum of the voltages across each resistance is equal to the voltage across the line. These two conditions likewise lead to two equations.

Examples

47. In a circuit consisting of two resistances in parallel, it is required to find the currents in each branch in terms of the resistances of the branches and the current in the line,



The voltage across each branch is the same and equal to the product of the current through the branch and its corresponding resistance. Therefore calling the currents in the first and second branches i_1 and i_2 respectively, and the resistance of the first and second branches R_1 and R_2 respectively, then

$$R_1 i_1 = R_2 i_2 \qquad (1)$$

The sum of the currents in the first and second branches is equal to the current i in the line.

$$i_1 + i_2 = i \qquad (2)$$

We now have two independent equations connecting i_1 and i_2 and may therefore solve for them from (1)

$$i_1 = \frac{R_2 i_2}{R_1} \quad (3)$$

From (2)

$$i_1 = i - i_2 \quad (4)$$

Equating (3) and (4)

$$\frac{R_2 i_2}{R_1} = i - i_2 \quad (5)$$

Solving for i_2

$$i_2 = \frac{R_1 i}{R_1 + R_2} \quad (6)$$

substituting this value for i_2 in equation (2)

$$i_1 + \frac{R_1 i}{R_1 + R_2} = i. \quad (7)$$

solving for i_1

$$i_1 = \frac{R_2 i}{R_1 + R_2} \quad (8)$$

Equations (6) and (8) are therefore the required answers.

48. The student of radio telegraphy should exercise his ingenuity to derive the audibility factor, when using a non-inductive shunt across the head telephones, in terms of the resistance of the shunt and the head telephones. This is done on the assumption that the sound in the telephones varies as the Ti^2 energy consumed, where T is either resistance and i the current through them. The audibility factor may be defined as the ratio of the energy consumed in the shunt and telephones (when the shunt is adjusted so that the sound in the phones is just readable or audible), to the energy consumed by the phones when the sound in them is just readable or audible. He should get as a result:

$$\text{Audibility factor} = \frac{T + S}{S} \, *$$

where T is the resistance of the phones and S, resistance of the shunt.

Simultaneous Equations of the First Degree in Three Unknowns

49. The first requirement for a definite solution is the statement of three equations connecting three unknown quantities. They may then be solved by one or the other of the methods illustrated in paragraphs 44 and 40. That is, a common letter is eliminated from two pairs of three equations. This leaves one pair of simultaneous equations containing two unknown quantities. This form has already been solved.

For example

$$ax + by + cz = d \quad (1)$$
$$cx + fy + gz = h \quad (2)$$
$$ix + jy + kz = l \quad (3)$$

Eliminating x from (1) and (2)

$$(eb - af)y + (ec - ag)z = ed - ah \quad (4)$$

Eliminating x from (2) and (3)

$$(if - ej)y + (ig - ke)z = ih - el \quad (5)$$

Equations (4) and (5) are simultaneous equations and may be solved for y and z by methods shown in paragraphs 44 and 45. These values of y and z may then be substituted in one of the original equations to give the value of x.

Factors

50. The problems encountered in finding the factors of an expression resolves to that of finding the multipliers and multiplicands when the product is given. The solution of many equations depends largely upon their simplification and consequent reduction by means of factors. For this reason this important attribute of an algebraic expression is considered. We shall deduce the factors from known identities, and conclude by considering the factors and roots of a quadratic equation with one unknown quantity.

Factors from Multiplication Results

51. In paragraph 29 three repeatedly recurring cases were given. They are

$$(a + b)^2 = a^2 + 2ab + b^2 \quad (1)$$
$$(a - b)^2 = a^2 - 2ab + b^2 \quad (2)$$
$$(a + b)(a - b) = a^2 - b^2 \quad (3)$$

When an expression takes the form of one of the right-hand numbers, it may be written down as product of the corresponding factors on the left-hand side, Methods, such as adding and subtracting a quantity, multiplying and dividing by and grouping of terms, serve to throw the average expression into one of these forms.

Examples

52. Factor the expression

$$x^2 + 8ab^2x + 16a^2b^4$$

* NOTE.—This is not strictly true. The standard method, in our opinion, would consist in using a box containing, say, 100 identical receivers. These receivers would be connected in parallel by split plugs to two silver-plated bars of large section. One of the receivers would then be permanently connected across the bars to serve as a test phone. Variations by unit steps from 1 ÷ 1 to 100 ÷ 1 in audibility factor could then be ascertained.

Grouping terms

$$x^2 + 2(4ab^2)x + (4ab^2)^2$$

From paragraph 51, equation (1)

$$= (x + 4ab^2)^2$$

53. Factor the expression

$$\frac{x^2}{2b} - 2a^2x + 2a4b$$

Multiply and divide the expression by 2b

$$\frac{1}{ab}(x^2 - 4a^2bx + 4a^4b^2)$$

Grouping terms

$$\frac{1}{2b}\left[x^2 - 2(2a^2b)x + (2a^2b^2)^2\right]$$

From paragraph 51, equation (2)

$$= \frac{1}{2b}(x - 2a^2b)^2$$

54. Factor the expression

$$9a^2x^2 - b^2 - 2bc - c^2$$

Multiplying and dividing by $9a^2$

$$= 9a^2\left(x^2 - \frac{b^2 + 2bc + c^2}{9a^2}\right).$$

The fractional term is a perfect square (paragraph 51, equation (1))

$$= 9a^2\left[x^2 - \left(\frac{b + c}{3a}\right)^2\right]$$

From paragraph 51, equation (3)

$$= 9a^2\left(x - \frac{b + c}{3a}\right)\left(x + \frac{b + c}{3a}\right)$$

Factors and Roots of a General Quadratic Equation

55. The form of the general quadratic equation is

$$ax^2 + bx + c = 0 \qquad (1)$$

adding and subtracting from the left-hand side $\frac{b^2}{4a^2}$ and multiplying and dividing through by a.

$$a\left[x^2 + \frac{b}{a}x + \left(\frac{b^2}{2a}\right) - \left(\frac{b^2}{4a^2} - \frac{c}{a}\right)\right] = 0 \qquad (2)$$

Factoring the first three terms and rearranging the last term

$$a\left[\left(x + \frac{b}{2a}\right)^2 - \left(\sqrt{\frac{b^2}{4a^2} - \frac{c}{a}}\right)^2\right] = 0 \qquad (3)$$

From paragraph 51, equation (3)

$$a\left[x + \frac{b}{2a} - \sqrt{\frac{b^2}{4a^2} - \frac{c}{a}}\right]$$

$$\left[x + \frac{b}{2a} + \sqrt{\frac{b^2}{4a^2} - \frac{c}{a}}\right] = 0 \qquad (4)$$

When

$$x = -\frac{b}{2a} \pm \sqrt{\frac{b^2}{4a^2} - \frac{c}{a}} \qquad (5)$$

The equation reduces to an identity, therefore, equation (5) is the solution of equation (1), while equation (4) is the equation of the factors of equation (1). These two equations are by far the most important formulæ we have reached, for by their aid any quadratic equation with one unknown quantity, and whose coefficients for x^2 and x are substituted in place of a and b respectively in (4) and (5), and whose constant term is substituted for C in equations (4) and (5), may be immediately written down as a product of three factors or as a solution with two roots.

56. When two circuits having the same frequency N are coupled, two waves of frequency N_1 and N_2 are produced, these two frequencies depend on the coupling coefficient K in the following manner:

$$K^2\frac{N_1^2 - N_2^2}{N^2} + 2K - \frac{N_1^2 - N_2^2}{N^2} = 0$$

It is required to find the coupling in terms of the natural frequency of the systems N and the frequency of the two waves N_1 and N_2. From equation (5), paragraph 55, we may immediately write the value of K in terms of N_1, N_2 and N where

$$a = \frac{N_1^2 - N_2^2}{N^2} b = 2 \quad \text{and} \quad C = \frac{N_1^2 - N_2^2}{N^2}$$

$$K = \frac{-2}{\frac{2N_1^2 - N_2^2}{N^2}} \pm \sqrt{\frac{4}{4\left(\frac{N_1^2 - N_2^2}{N^2}\right)^2} - \frac{\frac{n_1^2 - n_2^2}{n^2}}{-\frac{n_1^2 - n_2^2}{n^2}}}$$

which reduces to

$$K - \frac{n^2}{n_2^2 - n_1^2} \pm \sqrt{\frac{n^2}{n_1^2 - n_2^2} - 1}$$

52. Insight into the factors of an expression can only be gained by experience. Some additional forms are

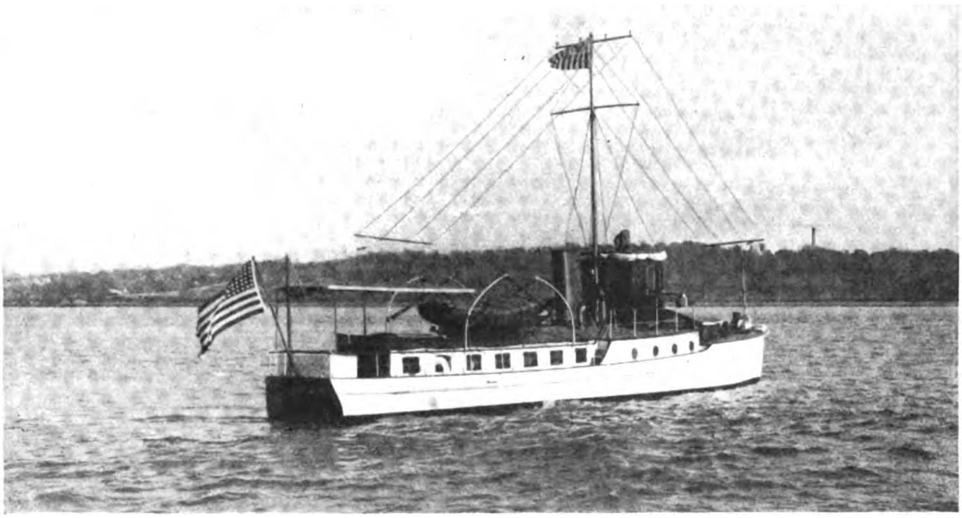
$$a^2+b^2+c^2+2ab+2bc+2ac = (a+b+c)(a+b+c) \qquad (1)$$

$$a^3+b^3 = (a+b)(a^2-ab+b^2) \qquad (2)$$

$$a^3-b^3 = (a-b)(a^2+ab+b^2) \qquad (3)$$

$$a^4-b^4 = (a^2-b^2)(a^2+b^2) = (a-b)(a+b)(a^2+b^2) \qquad (4)$$

This is the third in a series of articles on mathematics by Mr. Priess. The fourth will appear in an early issue.



The Motor Boat Tarragon, which will Patrol the Atlantic Coast to Enforce the Wireless Laws

A New Ocean Policeman

By V. Ford Greaves, U. S. Radio Engineer

THE United States motor boat Tarragon, of the Bureau of Navigation, Department of Commerce, has been equipped with an efficient wireless apparatus in charge of United States Radio Inspector Benjamin E. Wolf, and will enforce the radio laws of this country and the London International Radiotelegraphic Convention along the Atlantic coast. Particular attention will be paid to wave length and operating and traffic regulations, with a view to the reduction of interference.

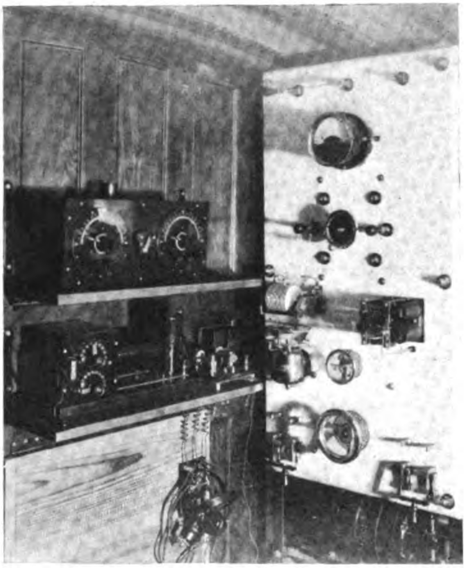
Designed and assembled under the direction of Frederick A. Kolster, of the Bureau of Standards, the noteworthy features of the Tarragon's radio equipment are compactness and facility for quick change from one transmitting wave length to another. The transmitting apparatus and motor generator are mounted as a single unit on a panelboard, thirty-two inches wide by thirty inches high. The apparatus on the back of the board projects a maximum distance of eighteen inches. The motor generator is operated by twenty storage cells, which will operate the apparatus continuously on full load for about eight hours on one charge. The cells are charged by a small auxiliary gas engine connected to a thirty-five-volt, thirty-five-ampere generator. The transmitter is of the quenched gap type. A break system relay is provided, enabling the operator to be "brooken," or to overhear interference while transmitting.

At present the normal wave length of the Tarragon is 300 meters, and in addition to this, transmitting wave lengths of 200 and 450 meters are provided for. The change from one wave length to another is accomplished by a single throw of a six-point switch, which is mounted on the panelboard. This operation tunes both the oscillating and open circuits to resonance and, with a slight variation of coupling, maximum radiation is obtained. The wave length change device and the method of varying the coupling were devised by Mr. Kolster. The receiving apparatus is secured to a bulkhead, and the operating table, upon which is mounted the transmitting key, folds down when not in use. The complete installation occupies comparatively little space, even considering the comparatively small size of the Tarragon.

The installation is rated at one-quarter kilowatt, and on the 300-meter adjustment delivers a little more than three amperes in the antenna. The latter is necessarily of the inverted V type, due to the fact that only a single mast is available. The maximum height of the antenna above the waterline is about twenty-seven feet and its natural period is about sixty meters.

A test of the apparatus was conducted recently while the Tarragon was in the vicinity of Norfolk, Va. During the trial she was able to hear distinctly the time signals and weather report from Arlington, and she was also able to hear the weather report as it was repeated by the Key West Naval station. The press messages from Sayville, L. I., were also copied and communication was established with the Norfolk Navy Yard station, thirty-five miles away.

The test showed that the equipment will have an approximate transmitting range at sea by night of 150 miles.



Wireless Apparatus on the Tarragon

EFFORT TO ELIMINATE "STRAYS" AND "X'S"

Two commissions, one international and the other English in organization, soon will begin a series of investigations in the hope of being able to codify the various laws which are believed by scientists to govern wireless telegraphy. The English commission, which is known as the committee of the British Association, will devote its investigations to the qualitative phases of the problem, while the other organization, called the International Radio-Telegraphy Commission, will study the quantitative aspects of the question.

The British commission will endeavor to discover by extensive simultaneous observations at various parts of the earth those regularities of phenomena, commonly described as "natural laws." It is hoped that if these laws are once codified it will be possible to extend greatly the commercial possibilities of wireless by obtaining valuable information concerning the electrical conditions of the atmosphere, which have such a powerful effect on the working of wireless systems.

The International Commission will begin its work from a power station near Brussels, and from this station on a specified date certain signals will be sent out for the reception of investigators and national committees, which are being organized in every participating country. Certain technical measurements will be made by the transmitting experts at Brussels and by the receivers in various countries. The International Commission will compare the results of these observations, especially with regard to the effects of time, direction and distance on the strength and regularity of the received signals.

The object of the work of both expert bodies is the elimination of such obstacles as the "strays" or "X's" of the operator, and the difficulties of communication encountered near the periods of the sunrise and sunset and from atmospheric conditions generally.

WIRELESS ENGINEERING COURSE

By H. SHOEMAKER
Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER XIII

THE reason why oscillations of different wave lengths are found in two coupled circuits under certain conditions is somewhat hard to explain. The writer will, however, endeavor to show in a simple manner why these two oscillations are found when the circuits are in certain inductive relation.

To begin with, a certain definite amount of energy is stored in the closed oscillating circuit (see Figure 52). If the energy is not removed from this circuit it will continue to oscillate until the energy is dissipated by the resistance of the spark gap and the conductors of the circuit. Any additions of resistance will decrease the number of oscillations, but will not affect the time period.

The open or radiating circuit loses its energy by radiation as well as by resist-

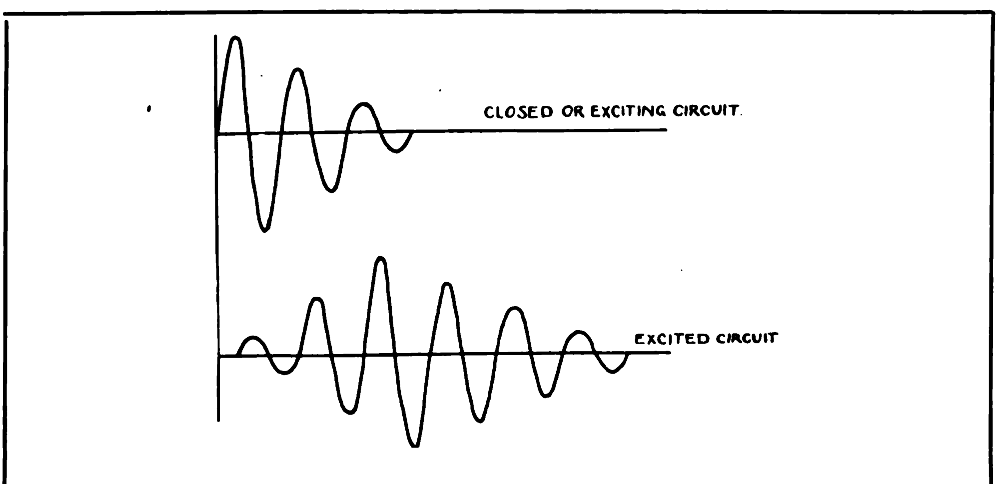


Fig. 53

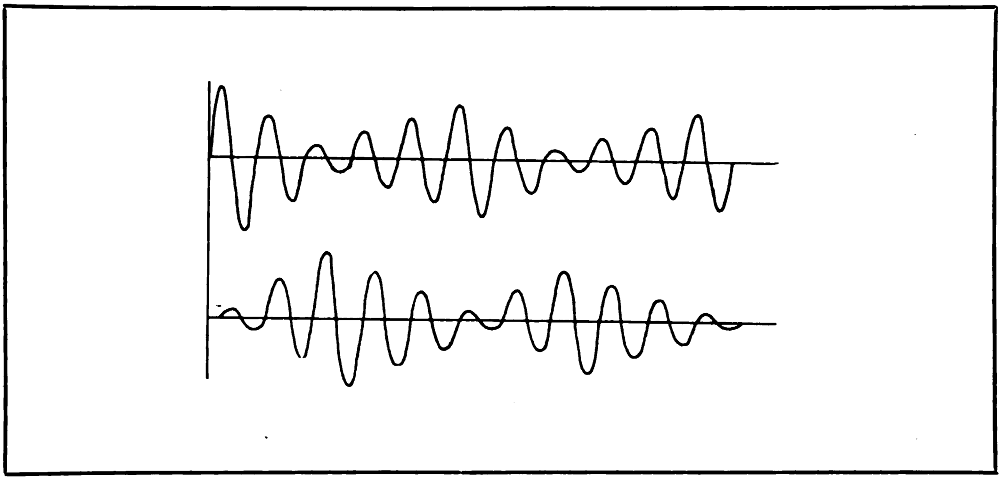


Fig. 54

ance, but does not lose it fast enough to make it aperiodic or non-oscillatory. In other words, the oscillations are persistent in the open circuit as well as in the closed circuit. This is due to the inductance of the circuit which stores the energy in magnetic form, and also gives the circuit inertia. A circuit of this description cannot be set in oscillation instantaneously, when acted on by another circuit. It requires a certain definite time for the oscillations to build up to a maximum and then die away. It is due to this inertia property of the circuits that two oscillations are set up in both circuits.

Figure 53 shows graphically how the oscillations in the closed circuit take place, and how they are generated in the radiating circuit. The closed circuit starts with a maximum amplitude because it has all the energy stored in its condenser; but the open circuit, being in inductive relation, has no energy to begin with, and as it has inertia it requires some time to take up the energy from the closed circuit. In fact it takes only a small portion of the energy at each oscillation. During this transfer of energy from the one circuit to the other the effective inductance of the circuits is changed, and this causes an alteration in the frequency of the oscillation. The extent of this change depends on the mutual inductance of the two circuits. The action referred to would account for a change of wave length, from the wave length of the circuits when operating separately; it would not, however, account for the two wave lengths found.

As the radiating circuit is also a persistent oscillator it will return its energy back to the closed circuit, if the spark gap of that circuit is still conducting, as is the case with some spark gaps. This retransfer of energy back to the closed circuit causes another change in the effective inductance, thus producing an oscillation of another wave length.

Figure 54 shows the relation of the oscillations in the two circuits, and how energy is transferred and retransferred from one circuit to another. When the coupling or inductive relation between the two circuits is small, the open circuit does not take the energy from the closed circuit at a rate high enough to cause it to build up, or absorb all the energy from the closed circuit; it only takes energy at a rate equal to that at which it loses it, and therefore the open circuit cannot return energy to the closed circuit and the oscillations take place as shown in Figure 53.

If the spark gap is so constructed that it loses in conductivity as soon as the energy has been transferred to the open circuit the closed circuit will not take energy back from the open circuit, and there will not be an effective change in the wave length of the oscillations. Spark gaps of this description are called quenched gaps. They are constructed of a number of parallel plates in series, separated by a few hundredths of an inch, and properly cooled. This construction causes the spark to be rapidly cooled, so that it loses its conductivity after a very few oscillations. With this type of spark gap it is necessary to have a close coupling, so that the energy of the closed circuit is rapidly taken up by the open circuit, which then continues to oscillate at its own period until it loses its energy by radiation and is dissipated by the resistance of the circuit. As the loss of energy by radiation has the same effect on the oscillations as the loss by resistance, it is called radiation resistance, to distinguish it from ohmic resistance.

In the last article it was shown how the period or wave length of the oscillations could be measured by means of a wavemeter.

Figure 55 is a diagram of the circuits of an instrument of this description. K is a variable condenser which has a pointer mounted on its movable element so as to indicate any change of capacity on a scale. L is an inductance which can be brought into inductive relation with other oscillation circuits. M is a hot wire, or other type of ammeter, which can measure high frequency currents. If L is brought into inductive relation with an oscillating circuit, and K is varied, a point in which M shows a maximum reading will be found. If the scale is graduated in wave lengths, this instrument will give the wave length of the oscillations taking place in the circuit. If a curve is plotted, showing current values on the ordinate and corresponding wave lengths on the abscissa, we can see exactly how the current varies in the wavemeter circuit. A curve of this description is called a resonance curve and is shown in Fig. 56.

When the wavemeter is used to measure the oscillations in a coupled circuit, where there are two frequencies, the curve will have two maximums, as shown in Figure 57.

By the use of the wavemeter it is also possible to measure the logarithmic decrement of the oscillations. This is accomplished by determining the current value in the wavemeter when adjusted for resonance with another circuit, and when the wavemeter is adjusted for a certain wave length off resonance. The ratio of these two current values, together with the amount of variation of the wavemeter circuit, can be used to determine the decrement of the oscillations.

It can be shown that:

$$\delta + \delta_1 = \pi \left(1 - \frac{\lambda}{\lambda_r}\right) \frac{a}{\sqrt{A^2 - a^2}} \qquad (16)$$

Where δ is the logarithmic decrement of the circuit to be measured, δ_1 is the logarithmic decrement of the wavemeter circuit.

$\pi = 3.1416$.

λ is the wave length corresponding to the current a, λ_r is the wave length for resonance and A is the current corresponding to λ_r.

If we write X for $\left(1 - \frac{\lambda}{\lambda_r}\right)$ and y for $\frac{a}{A}$ then we can put equation (16) in the form,

$$\delta + \delta_1 = 3.1416\, X \frac{y}{\sqrt{1 - y^2}} = X \qquad (17)$$

X is then the sum of the decrements of the two circuits.

This formula only holds for values of X not exceeding .05.

To determine $\delta + \delta_1$ the wavemeter must be adjusted to resonance with the circuit under measurement and the value of A determined. The variable condenser should then be varied so that the wave length of its circuit is decreased .05, or so that X = .05 and the corresponding value of a is determined. The value of y can then be found by dividing a by A.

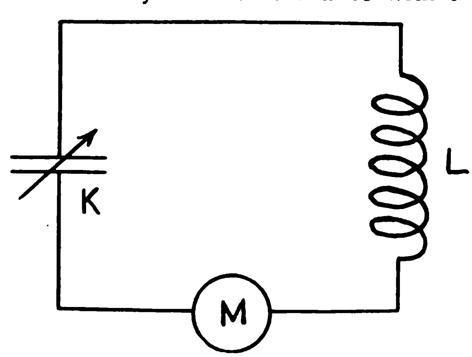


Fig. 55

These values are then substituted in

formula 17 and the value of X found. The value of δ_1 can be calculated by formula (5).

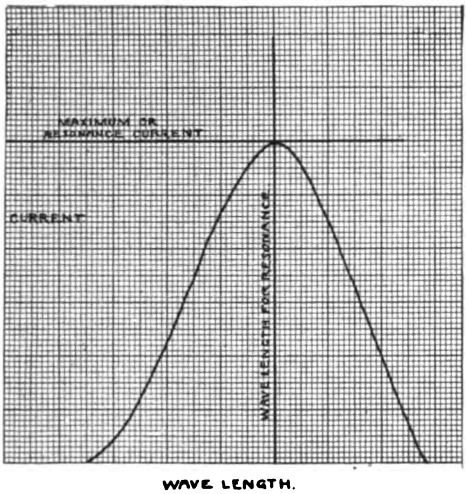


Fig. 56

$$\delta_1 = \frac{\pi}{2} R' \sqrt{\frac{C}{L}}$$

is the value of R′, the resistance, L the inductance, and C, the capacity of the wavemeter, is known.

δ could also be calculated by the same formula if it were possible to measure the resistance of the spark gap and the other element of the circuits. This is generally difficult to do in practice.

If resistance is introduced into the wavemeter circuit the total decrement is changed, and can be considered as composed of δ, δ_1, and δ_2, which is that due to additional resistance. Let this total decrement be expressed by X′, then,

$$\delta + \delta_1 + \delta_2 = X'$$

and,

$$X' = 3.1416\ X \frac{y}{\sqrt{1 - y^2}} \qquad (18)$$

Where $y = \frac{a'}{A'}$ and a′ is the current off resonance and A′ the current for resonance with the additional resistance in the wavemeter.

In taking this last set of measurements it is necessary to have all conditions the same as when taking the first set; that is, the current in the circuit under measurement and the inductive relation of the two circuits must remain constant, as X′ is determined by the ratio of the two maximum currents, A and A′.

It can be shown that,

$$A^2 \delta_1 (\delta + \delta_1) = A'^2 (\delta_1 + \delta_2)(\delta + \delta_1 + \delta_2)$$

Substituting X and X′ for their values.

$$A^2 \delta_1 X = A'^2 (\delta_1 + \delta_2) X' \qquad (19)$$

and

$$\delta_1 = \frac{X' \delta_2}{\left(\frac{A}{A'}\right)^2 X - X'}$$

and

$$\delta = X - \frac{X' \delta_2}{\left(\frac{A}{A'}\right)^2 X - X'} \qquad (20)$$

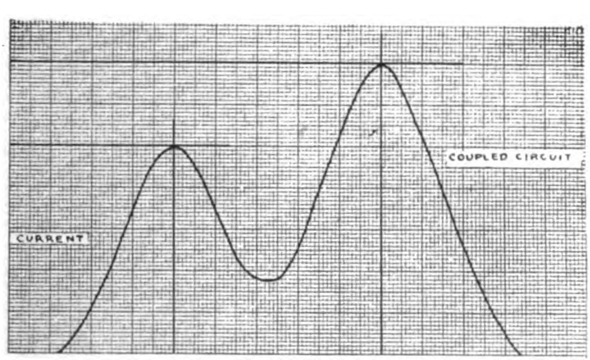


Fig. 57

When determining the logarithmic decrement by the above method it is good practice to take the average values of X and X' for different values of X from .01 to .05, as .01, .02, .03, .04 and .05.

(*To be Continued.*)

This course commenced in The Marconigraph, issue of December, 1912. Copies of previous lessons may be secured. Address Technical Department, THE WIRELESS AGE.

AUTOMATIC WIRELESS DEVICE

Leon Champeix has invented an apparatus for the automatic transmission and reception of wireless messages. It consists, in part, of a wax cylinder on which a graver writes Morse telegraphic symbols. A needle, which is connected by a lever to a key operating a wireless transmitter, goes over the signs made by the tool.

The wireless dispatch sent out in this way is received by a similar device, which is connected with the relay of the receiving installation. The graver, operated by the currents of the relay, records the message on another wax cylinder. The cylinders of each apparatus are operated by small electric motors. A horizontal shaft moves a sliding bridge by means of a comb and a helicoidal screw. The axis of the cylinder is connected by a belt to the motor and by gearing to the shaft. By operating a lever the bridge can be placed in its initial position.

A platform carried by the sliding bridge has upon it the graving and other tools. Attached to a bent lever pivoted to the platform is the graver. A silk cord connects the free end of the lever to the armature of an electromagnet. A current traversing the electromagnet attracts the armature and, by the intermediation of the cord and lever, the graver, which has a sapphire point, is plunged into the wax cylinder. A spring sends the graver and the armature back to their first positions when the current ceases.

In order to bring the reproducing needle into contact with the grooves of the cylinder, it is necessary to adjust the platform by screws that elevate and lower. The point of the needle enters the groove and passes over the various depressions made by the graver when the proper adjustment has been obtained. The needle is attached to the short arm of a lever pivoted to the platform and its movements are transmitted in enlarged form to the curved end of the long arms of the lever. The latter, by pressing on a fixed metallic piece, acts as a Morse key, making and breaking the current of the wireless transmitting device.

The obliterator is brought into contact with the cylinder in order to erase the record of the preceding message.

The original record of the message to be transmitted is made by operating the cylinder and graver manually by means of a special mechanism in the base of the apparatus.

PORTUGAL'S STATION PLANS

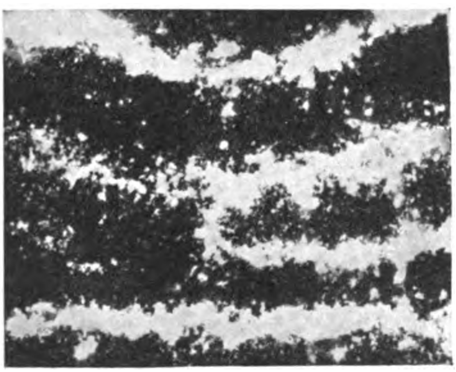
A system of wireless telegraph stations which will require several years of work to complete has been planned by the Portugese Government. The station at Libson, upon which work has already been begun, will be equipped with apparatus capable of communicating 2,200 miles by day and twice that distance at night, enabling it to keep constantly in touch with England, France and Spain. The station to be erected on the Cape Verde Islands will enable Lisbon to keep in communication with South America. The Azores Islands station will provide a link between Europe and Central America which is expected to prove of considerable value when the Panama Canal is opened to commercial traffic. The scheme embraces the erection of Marconi stations in the colonies of Angola, Mozambique, India, Macao and Timor in order to do away with heavy cable charges.

GERMAN STATION IN TOGOLAND

A wireless telegraph station with sufficient power to communicate with Berlin will be erected in Togoland, German West Africa, by the German Government.

APPARATUS TO PHOTOGRAPH WIRELESS WAVES

The basic foundation of an apparatus invented by Marcus A. Goodrich, of San Antonio, Tex., for photographing wireless waves, lies in the peculiarity of the selenium, which makes its electrical resistance vary according to the amount of light it is exposed to. Whether the light is from the visible part of the spectrum or whether it is from the invisible ends makes no difference, for selenium is sensitive to all known light, visible or invisible. In darkness, on the other hand, selenium has an electrical resistance so high as to make it practically a non-conductor of electricity. Once this is grasped the process is very simple, and is arranged as follows:



Photograph Obtained by Wireless Waves Camera

A selenium cell with a flat surface, consisting of 128 miniature cells, one quarter of an inch square, each insulated from the other, so that each little cell of the big compound cell receives and sends off its part of the current when exposed to the light independently of the other miniature cells. The selenium cell is put in the camera in place of the photographic plate, being arranged in the circuit with a set of batteries, so that no current can pass over it without first going through the selenium cell.

Back of this, in an opaque cabinet, is a platinum cell which, like the selenium cell, consists of 128 miniature platinum cells, each insulated from the other and arranged in the form of a very small screen made of extremely fine platinum wires. Each of these small platinum cells is arranged on a big compound cell in the same manner, size and position as the selenium cells on the large selenium cell.

The right sides of all the small platinum cells in the big compound platinum cell are connected directly with the set of batteries, so that each little platinum cell receives a part of the current independently of the other cells of the same size.

On the left-hand side of each small platinum cell is connected a wire running to the corresponding small selenium cell on the big compound selenium cell. Thus each small selenium cell is connected to the corresponding small platinum cell on the big compound platinum cell, so that passing through the small selenium cell the current will go direct to the small platinum cell which has the same position on the big compound platinum cell as the little selenium cell on the big compound selenium cell.

In the opaque cabinet with the platinum cell, and in a direct line and opposite to it, about ¾ of an inch away, is placed a highly sensitive photographic plate, backed by a small chamber filled with ice, to keep the emulsion of the plate from melting when exposed to the hot platinum glow.

Suppose a camera with the shutter open, supplemented with the apparatus described, is placed in position for operation on a dark night while a wireless installation is being worked. The wireless waves are constantly issuing from the aerial and the lens is gathering and placing them on the selenium cell in the same way that it would place them on a photographic plate. On the compound selenium cell the current is constantly on the verge of getting through the small selenium cells, but it is prevented from doing so to any considerable degree because the large cell is in perfect darkness. As soon as the lens concentrates the rays on the compound selenium cell in the form of a picture the current can pass through the cell and form a complete circuit. The positive current meeting the negative current in the platinum cell causes the cell to glow with a white heat in the shape and form and proportion as the wireless waves concentrated on the selenium cell by the photographic lens. The photographic plate being directly behind the platinum cell, gets the full benefit of the white-hot platinum glow, thereby, according to the inventor, impressing on the photographic plate the exact reproduction of the picture concentrated on the selenium cell by the lens. All that is needed is to develop the plate in the usual way and the photograph of the wireless waves is complete.

MORETTI'S WIRELESS PHONE

In the London Electrical Review is published an abstract of a high-frequency generator for wireless telephone work invented by Ricardo Moretti. The generator is a modification of the Duddell singing arc, but is distinguished from the latter and from Poulsen's generator by the fact that continuous wave trains are not obtained from Moretti's apparatus. The direct current arc is operated in series with a suitable ballast resistance, and is shunted by a capacity and inductance as shown in the accompanying diagram.

The positive electrode of the arc is hollow and is traversed by a continuous stream of water (or other cooling liquid). The water cools the electrode, and on entering the arc it is dissociated by the combined effect of heat and elec-

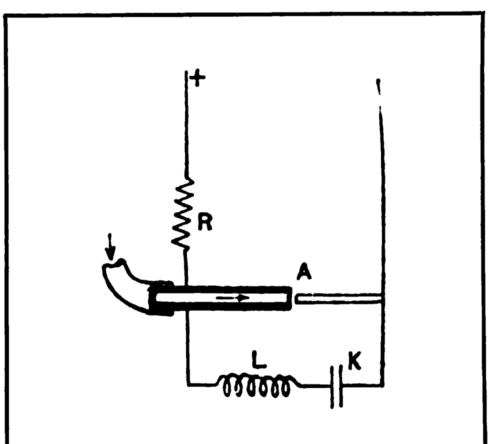


Diagram of Connections of High Frequency Generator

trolysis, and an extremely rapid series of explosions occurs in the arc, thus setting up energy surges, the frequency of which is said to be about 100 kilo-cycles per second. These discharges in the arc circuit set up oscillations in the circuit KL of frequency $F = 1/T = \frac{1}{2} \pi \sqrt{LK}$.

The frequency of the arc discharges is generally considerably lower than the natural frequency of the oscillating shunt circuit KL, so that damped wave trains are obtained—more or less closely following one another according to the frequency of the arc discharge. Hydrogen inclosure of the arc is not required. Using this generator, a hydraulic microphone and the usual arrangement of aerial, Moretti claims to have achieved satisfactory wireless telephonic communication from Centocelle (Rome) to Tripoli.

INVENTOR HAS FAITH IN WIRELESS

Dr. Robert Goldschmidt, wireless inventor, believes that wireless telegraphy has a bright future. Dr. Goldschmidt came to the United States to observe wireless experiments that are to be conducted at Arlington. These experiments will test long distance wireless telegraphy thoroughly and the Belgian inventor expects to acquire information that will be of use to him in his own work.

"I am the most optimistic of men where the wireless is concerned," he said. "We are only at the gateway, so to speak, of the development of this practical miracle."

The inventor has completed, at the request of the King of Belgium, the establishment of a wireless service in the Belgian Congo which has done away with the difficulties of communication in that immense colony.

"The King," said Dr. Goldschmidt, "was so interested in the necessity for linking together the towns and districts of his colony that he sent me to the Congo to establish a system. With my engineers I placed twelve wireless stations at Banana, Boma, Leopoldville, Coquilhatville, Lisala, Basoko, Stanleyville, Lowa, Kindu, Kongolo, Kidindja and Elizabethville, twelve wireless links covering more than 2,000 miles of territory."

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

B. M., Farmington, Ill.:

The normal wave length of your transmitting set is about 120 meters. The only proper method to figure the wave length of your aerial is by means of a wave meter. The receiving outfit which you describe will probably enable you to receive wave lengths up to 1,600 meters.

* * *

L. C. M., Brooklyn, N. Y.:

You would secure no increase in efficiency by placing a variable condenser across the circuits of the tuner described in your communication. One of the fixed condensers is supposed to be connected in series with the crystal detector, and the other in shunt with the head phones. A No. 14 earth lead is sufficient.

* * *

F. A. B., New York City, sends us a communication which we desire all our correspondents to read. He says:

"I noticed three years ago, while in the government service, a place on the Atlantic Ocean where wireless signals were so strong from all stations within several hundred miles that these stations seemed to be within very close range. It was so pronounced that no difference was noticed in the strength of signals from stations within 100 miles and those of 500 miles, and all appeared to be within 25 miles. I have never heard any one speak of this, and would like to know if it has been noticed by others. If my memory is correct this place is out of the regular courses of steamers. If you think worth while, please ascertain through your magazine and oblige."

Ans.—We should like to hear reports from others relating to this. We understand that this point of loud signals was located at the time that the United States fleet made its voyage around the world. The operators of the United Wireless Telegraph Company station at Atlantic City, N. J., received a communication from one of the operators on a battleship, saying that Atlantic City's signals could be read in daylight at a distance of 2,500 miles; in fact, all commercial stations in the vicinity of Atlantic City could be heard. This is rather singular when taking into account the power of these stations—2 kilowatts. We understand that this particular location was somewhere off the coast of Venezuela. We do not remember the communication in detail, but would like to hear from any one who is familiar with this particular incident.

* * *

E. H., St. Louis, Mo.:

An oscillation transformer to suit the needs of your 5-kilowatt transmitting set may be constructed as follows: It should consist of eight turns of copper tubing, ½ inch in diameter, wound on a form or insulating support, 12 inches in diameter. The turn should be separated 1 inch. The secondary of the receiving transformer may be made of the same material, but of smaller diameter, so that it will slide in and out of the primary. It need not be more than 9 inches in diameter.

* * *

W. K., Philadelphia, Pa.:

The wave length of your antennæ is approximately 235 meters.

Ques. (2) A loose coupler of the make you refer to has not sufficient value of inductance to allow tuning for Glace Bay. There is, therefore, no need for constructing a loading coil.

Ques. (3) The perikon detector gives far better results with a battery, provided you have a potentiometer of the proper proportions. You should have a potentiometer giving adjustments of voltage down to .01 volts.

* * *

H. M. A., Lindbrook, N. Y.:

You cannot use a rotary spark gap with a 1-inch coil. You do not require a condenser. The capacity of the antennæ is quite sufficient. The lead-in wire on the antennæ you describe should be taken off the nearest end.

* * *

C. C. K., Cleveland, Ohio:

The sketch of your receiving set is quite satisfactory. No doubt your receiving would improve if you employed four wires, each 50 feet long. You should be able to receive Arlington's time signals with little difficulty, as the wave length used is 2,500 meters.

* * *

R. M. P., Providence, R. I.:

You apparently have a misconception as to the meaning of the word "wave length." The dead-end effect in the tuner you describe would not be serious.

Information relating to the long and short-wave length tuners is published in this issue of

THE WIRELESS AGE, in the article on How to Form a Radio Club.

The same loose coupler would have the same wave length in the local circuit (detector circuit) regardless of the antennæ (provided loose coupling is used), but the wave length of the open circuit will vary with different antennæ.

Galena is said to be the most sensitive of the crystal detectors, and the audion most sensitive of the valve detectors.

* * *

J. C. R., Whitehall, N. Y.: Regarding query No. 1: You do not state the dimensions of your antennæ. It is probable that your set is out of resonance with the antennæ. This is likely to be the case if you are using an antennæ of amateur dimensions. You cannot employ 1 kilowatt in your transformer at a wave length of 200 meters.

You do not state how the plates in your condenser are connected. If they are all in parallel the combined capacity is about .02 mfds., which is far too great when using a rotary gap with a 60-cycle 1-kilowatt transformer.

(2) If you wish to purchase a device to cut down both the voltage and the amperage in the primary of the transformer you should purchase a step-down auto-transformer. Communicate with one of the electric companies, telling what you want.

(3) It is almost impossible to give you the dead-end losses of a standard loose coupler. Calculations of this description are not generally made. These losses need not be considered in the ordinary loose coupler having a wave length range of from 200 to 2,000 meters.

(4) You can obtain cardboard tubes for your windings from any concern handling fireworks.

* * *

A. R. M., Minot, N. Dak.:

Your query requesting data for a transformer to operate on 60 cycles, is fully answered on page 80 of the October issue of THE WIRELESS AGE.

(2) Divide the primary of the transformer into four equal divisions, if you wish, but you must have some means for controlling the power externally, such as reactance, etc., because, when you decrease the winding on the primary the current flow will increase.

(3) Not knowing the voltage of your transformer, we cannot give definite data on the condenser to suit the case, but assuming a voltage of 15,000 at the secondary, the capacity of the condenser should be .015 mfds. A condenser to have such capacity should consist of 8 glass plates, 14 x 14 inches, 1/8 inch in thickness, covered on both sides with tin foil, 12 x 12 inches. The entire 8 plates should be connected in parallel.

* * *

Amateur, Lynbrook, L. I.:

We are inclined to believe that the 1,000 feet of copper wire, fan shaped, will give a better earth connection than a chicken-iron wire, covering 300 square feet of earth.

(2) The secondary of the Blitzen receiving transformer has not sufficient inductance to receive Glace Bay signals. There would therefore be no need for constructing a loading coil.

(3) Regarding the valve and audion detector, we suggest that you purchase both and draw your own conclusions. The Fleming valve is exceedingly stable in its operation, and therefore of great value commercially.

(4) Write the engineering department of The Marconi Company for a catalogue of Amateur Apparatus.

(5) We are not familiar with either type of rotary gap to which you make reference, and therefore cannot answer the query.

* * *

J. H. W., Briarcliff Manor, N. J.:

There are a number of wireles telegraph experimenters carrying on their work in the vicinity of New York, making it impossible to advise. Perhaps the conversation you heard came from the wireless telephone station at the College of the City of New York.

* * *

C. A. S., Philadelphia, Pa., asks:

(1) My aerial is of the inverted L type, 4 wires, 135 feet long, space 1½ feet apart, 60 feet high, with a lead-in 25 feet long. What is the wave length?

Ans.—The wave length is approximately 338 meters.

Ques. (2) In the transmitting set what factor determines the amount of condenser capacity required?

Ans. (2) The capacity depends upon the voltage, frequency and the size of the outfit. The relation is given by the following formula:

$$C \text{ (in mfds.)} = \frac{W}{M \times V^2}.$$

Where M = cycle frequency.
V = kilovolts.
W = watts desired.

Ques. (3) What is the formula for obtaining the capacity of the condenser?

Ans. (3)

$$C \text{ (in micro-farads)} = \frac{2248 \times K \times A}{d \times 10^{10}}.$$

Where A = is the area of the smaller plate of the condenser.
d = thickness of the dielectric.
K = specific inductive capacity of the dielectric. (Varying from six to nine.)

Ques. (4) What do the abbreviations S, SG, CQ, XDH and others used in the preamble of messages stand for?

Ans. (4) CQ, according to the London Convention, is a call of inquiry, and is used by ships when desiring to know what radio stations are within their range.

S, SG, XDH are message prefixes used exclusively by The Marconi Company, and designate the type of message, to be sent as follows:

S—Paid message.
SG—Service message.
XDH—Relay dead-head message.

Ques. (5) Is there any book or pamphlet published by the government or any publishing company which contains the new commercial and amateur calls, with facts as to power, wave length, wireless abbreviations and instructions concerning the transmission of messages? If so, where may it be purchased and what is its price?

Ans. (5) A book giving the calls, call letters, etc., of the radio stations of the entire world, may be purchased from The International Bureau of Telegraphs, at Berne, Switzerland. A booklet may be obtained from the Superintendent of Documents at the Government Printing Office, Washington, D. C., giving the call letters of all land and ship stations belonging to the United States, including amateur stations. The price is $0.15.

* * *

G. T. L., Providence, R. I.:

Regarding query No. 1, relating to the advantage of a loose coupler over a 3-slide tuner: Neither has any advantage over the other, for the reason that a loose coupling can be obtained with a 3-slide tuner as well as with a loose coupler.

Ans. (2) Communicate with any of the advertisers in our publication selling amateur equipment, and you will no doubt find what you want.

* * *

O. E. C., Boston, Mass.:

Communicate with Marconi's Wireless Telegraph Company, Ltd., Strand, London, W. C. They may be able to put in touch with some one who can furnish you with a Lodge-Muirhead detector.

* * *

H. P. R., Cleveland, Ohio:

Ques. (1) Please tell me what way my aerial is directional. It hangs North and South, with the lead-in taken off the North end.

Ans. (1) Sends best toward the North; receives best from the North.

Ques. (2) Also will it decrease the efficiency of the aerial if the lead-in is taken off the middle?

Ans. (2) It is rather difficult to answer.

The arguments in your question No. 3 are fully answered in the December issue of THE WIRELESS AGE, page 254.

* * *

F. D. Columbus, Ohio:

The wave length of your antennæ is approximately 260 meters. The capacity of your antennæ is approximately .00027 mfds. It will therefore require a condenser in series having a capacity of .00039 mfds.

A condenser having this capacity may be made on a plate of glass having a thickness of 1/8 inch, coated with foil having dimensions of 5 x 6 inches.

* * *

H. V. R., Los Angeles, Cal., writes:

Within a radius of twenty miles of Poulsen Wireless Stations using continuous waves, I find it is possible to read their signals on an ordinary receiving set intended for receiving damped wave trains. With a wave length of 2,000 meters the frequency of the arc would be about 150,000 cycles per second, which is far beyond the limits of audibility. Please explain how it is possible to receive continuous oscillations of such high frequency using the regular receiving set with a detector?

Ans.—This is very interesting, and it may be possible that you are getting a "heterodyne" effect on your reeciving apparatus. This may be due to the fact that there is another Poulsen station in your vicinity, the oscillations of which are of a slightly different frequency than the stations you hear; it is possible that the coincidence of the two frequencies causes the phenomena of beats, making the signals audible. This is the principle of the "heterodyne" receiver.

Do you hear the signals from these stations constantly or only occasionally? If you hear the signals constantly, our explanation is incorrect. When an arc transmitting set is in bad adjustment, there is produced a useless superimposed set of oscillations, which in the immediate vicinity of the antennæ may exhibit damped characteristics, and are therefore audible.

Ques. (2) All so-called synchronous spark sets have the same number of spark points as the number of field poles on the alternator.

Ques. (3) There is no advantage in a duplex loading coil over a single loading coil. Duplex coils are designed to be used in connection with tuners the maximum wave length of which is below that desired.

* * *

H. D. E., Collingswood, N. J.:

VBB is the Canadian Marconi Station at Soo Locks, Canada. VDG is the Canadian vessel S. S. Aberdeen.

* * *

H. P. M., Duluth, Minn.:

The signals coming over the top of a continuous whistle are caused by certain sets that have a reactance coil in shunt with the key (using quench spark sets). The spark discharges constantly across the gap, but not to its full value. When the key is pressed the current at the spark gap increases to its maximum value, enabling the signals to be read over the top of the "continuous whistle."

* * *

H. P. R., Cleveland, Ohio:

Please advise what instruments are necessary to get NAX, Colon, with a 5-wire aerial, 100 feet long, averaging 50 feet in height, the aerial being of the inverted "L" type and directional Southwest.

Ans.—We are in doubt whether you can hear Colon unless your aerial is situated on the roof of an apartment house or some high building. If so, it would be perfectly possible to hear Colon in the night-time during the winter months, particularly if you use the audion amplifier described in this issue of THE WIRELESS AGE.

* * *

G. H., Brooklyn, N. Y.:

Connect all the wires of the aerial together at one end, bringing in the lead-in wire from the opposite end.

The hook-up necessary to give the information asked for in your query No. 2 is shown on page 166 in the November issue of THE WIRELESS AGE. This cut also shows the position of the variable condenser. The remainder of your queries are adequately answered by the cut appearing in that issue.

THE WIRELESS AGE

FEBRUARY 1914

THE RADIO REVIEW

THE most striking feature of the wreck of the West Indian liner Cobequid, reports of which are just coming in as we go to press, is the fact that, while wireless telegraphy added another triumph to its credit, all other methods of distress signaling were proven absolutely valueless.

A Lesson in the Call of the Cobequid

Impaled on the treacherous rocks of the Trinity Ledges, with her back broken, and in the midst of a blinding snowstorm, this staunch liner was in imminent danger of being rapidly pounded to pieces by the mountainous seas and dashing her hundred odd passengers into the icy waters. Six minutes after the vessel struck, an S O S went hurtling through space, and sixteen minutes later the station at Cape Sable was in possession of the full details. Several vessels sped to the aid of the sinking ship, and another tragedy of the sea was averted.

No more remarkable or thrilling rescue than this has been recorded since wireless telegraphy first triumphed over the forces of nature. The rockets, fog horns and beacon lights that seamen depended upon up to a few years ago would have been useless in this case. For, even when the rescuing ships had rushed to her aid, they were forced to lay off for several hours, not more than a mile and a half from the Cobequid, because, to quote an officer: "I couldn't see much of anything; there was a heavy vapor lying close to the water and obscuring everything within a hundred feet. At times it became so bad that we couldn't see anything a boat's length off."

There was absolutely no chance for "flare-ups" to be seen, or sirens to be heard; it remained for the wireless alone to carry the insistent appeals for succor. And these distress calls were heard. How bravely they were heeded by the ships that were groping through mist and storm is known already. Soon we shall have the complete story of the heroic rescue, and may add to our elation fitting gratitude to the men who sacrificed all other interests to turn toward the ill-fated vessel.

ONE detail is known already, and once again THE WIRELESS AGE must take exception to the careless surmises of newspapers. A prominent New York daily observes in an editorial: "Its wireless apparatus worked feebly and uncertainly in the wild disorder of the atmosphere," and added that it was never able to give the ship's exact location.

A Misleading Report and the Actual Facts

In direct contradiction we have the statement of J. W. Hitchener, chief operator on the Cobequid, that he reported many times what the captain ordered, that the ship was on Trinity Rocks, or possibly Briar Island, and that the Partridge Island station acknowledged receipt of this intelligence. The communication difficulties were due to physical conditions other than the "wild disorder of the atmosphere." Less than an hour after the vessel struck, the heavy seas had flooded the engine room, putting the dynamo out of commission. The emergency set was then switched in and the S O S calls continued. Later the wireless room was swamped and the receiving apparatus flooded, but the transmitting set was worked most of the first day and the next morning. The interruptions were caused by the heavy seas smashing the boats and carrying the aerial away. Three times it was repaired, under increasing difficulties. Furthermore, communication had been established for several hours before the first of these occurrences.

Beside the inspiring knowledge that through wireless everyone aboard was saved, an erroneously reported detail seems trivial; but we have taken exception to this newspaper statement because it intimated that the efficiency of the ship's apparatus suffered under unfavorable atmospheric conditions. Marconi wireless has never failed in an emergency, nor will it fail in any that may arise.

AN interesting illustration of how great is the confidence placed in wireless to-day was brought out at the Board of Trade investigation into the Volturno disaster.

A Panic Averted through Confidence

In the course of his examination, the third officer was asked when he was informed that the Carmania had answered the Volturno's distress signals. He replied that he was on the bridge deck when the second Marconi operator brought him the news. The captain sent him aft to the unfortunate emigrants huddled together on the burning vessel to tell them that the Cunarder was coming full speed.

He was asked: "Did that have a good effect upon them?"

And he replied: "Yes, they quieted down quite straight."

AN indication of how important a factor wireless has become in maritime affairs is witnessed in the dispatches from London reporting the work of the Revision Committee of the International Congress on Safety at Sea. As the conference draws to a close the wireless regulations are featured and other life-saving equipment is relegated to the background.

Conferees Accept American Regulations

Late reports assert that the American wireless regulations were all agreed to by the European delegates. The main feature of these is that they give the control of the apparatus and the supervision over the operations of the employees to the United States Government; no matter what may be the nationality of the ships, whenever they are coming into or departing from American waters.

This agreement preserves intact the private code signals of any country reserved for war. Use is made of the commercial code, and only one code will be used for distress calls, assuring that the calls will be understood in any language.

Why Not an International Rescue Ship?

THE installation of wireless on harbor fireboats, reported in this issue, has suggested to a reader an Atlantic fire and life-saving service to handle just such accidents as the Republic, Titanic and Volturno. Supplementing the work of our revenue cutters, a special fire and life saving vessel could be posted at some port of Southern Newfoundland, such as St. Johns. It would there be kept in readiness to start out on short notice in answer to the first wireless appeal for aid.

During the iceberg season this vessel could patrol the neighboring waters for information on the iceberg drift, a task performed last year by a Government vessel. During other times of year she would lie in port awaiting an "alarm," and her ship's company would receive and transmit reports as to fog, storms and the relative positions of ships.

The type of vessel suggested for this service is one not over 1,000 tons. Her equipment would include oil tanks, speedy oil-burning engines and plenty of lifeboats. Carrying no cargo except food and fuel, she could provide in the neighborhood of 12,000 square feet of deck space, or reclining room for a thousand persons. The craft should be capable of twenty-two knots or so when hurrying to a call. Such a speed would carry her from St. Johns half way to Queenstown within forty-eight hours, and half way to New York harbor in a single day. The portion of the Atlantic which has claimed a greater tribute of lives than any other would lie within effective striking range.

In the case of a collision or storm-battered vessel sinking, a life saver of this type would be inestimably more effectual than an ordinary steamship. She would carry oil to smooth the seas, and because of her small dimensions and special design she could launch small boats when it would be suicidal to try it from a liner. Expert crews would enable these small boats to transfer human beings under weather conditions prohibitive to ordinary crews.

In case of fire at sea the wireless alarm would bring the rescue vessel quickly, and she could, under many conditions of weather and sea, play powerful streams through the side ports of the burning ship. She could put expert fire fighters aboard, and could take aboard a line that would keep the vessel the right way to the wind.

Expense, the only barrier to all these services, would be moderate, and could be shared by several governments.

The Trans-Ocean Stations

Some Details of the Power Equipment

AS RELATED BY A MARCONI ENGINEER

READERS of THE WIRELESS AGE are familiar with the fact that the Marconi Company is erecting trans-ocean wireless stations in different parts of the world. Descriptions have been given of the work under way in New Jersey, California and the Hawaiian Islands. At New Brunswick, N. J., the concrete and brick work for the power-house is completed, while the auxiliary operating building to the north is on the eve of completion. In California, the transmitting plant at Bolinas Point, eighteen miles northwest of San Francisco, and the receiving station near the town of Marshalls are still further advanced toward completion, while the large wireless duplex station on the Island of Oahu, of the Hawaiian group, will soon present another finished link in the wireless chain that is destined to girdle the globe. Transportation difficulties in this construction work have been great, and articles have been published concerning the various methods adopted in conveying building materials and necessary machinery to the sites.

A description is now presented of the equipment that will be installed in these stations—technical information that will surely be appreciated by the wireless expert and student alike.

The work of designing a wireless station such as the Marconi Company is erecting for trans-ocean work is essentially an enlargement of the work in connection with the sets used for ship and shore stations of only a few kilowatts. The engineer cannot, however, sit down with a slide rule and multiply the figures for his calculations relating to the small stations by a hundred or so, and have as a result a station that will work over a long range. Many problems present themselves in large radio installation which require much care and experimentation adequately to cope with the requirements of large stations, and which, in smaller sets, are of so little importance as to be practically negligible.

As in the small station, the principal circuits are simple, but it is easily seen that when about three hundred kilowatts are to be carried in the circuits and turned into high frequency currents, the problem must be handled with care. Some of the special arrangements made to use this large amount of current safely and efficiently may be of interest to our readers at this time.

The closed oscillating circuit is of interest because of the size and construction of its various elements. The discharger is of the rotating-disc type, and

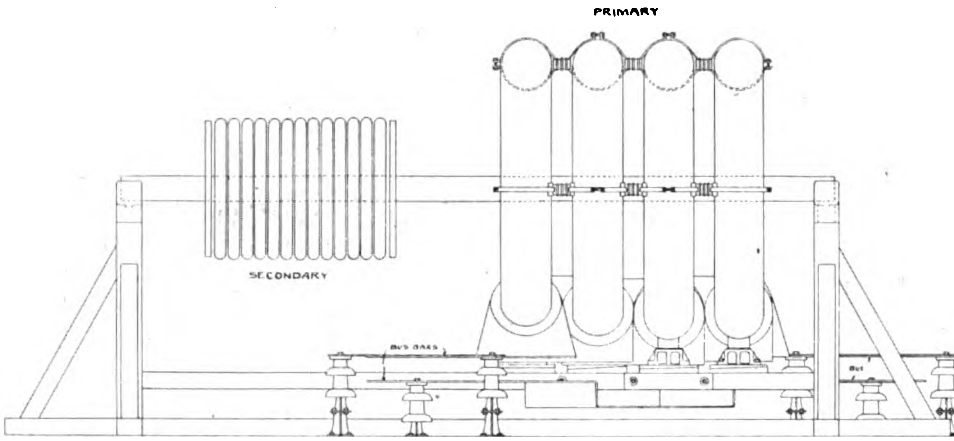


Fig. 1

is directly connected to the shaft of the alternator. The foundation upon which it rests is a solid block of concrete weighing about seven tons, supported by piles of insulating blocks and surrounded by an insulating compound in such a manner that the framework of the discharger is well protected. The coupling from the alternator is also insulated, the only live part being the discs which serve as the poles between which the studs pass. The spark discharge is well quenched by a blast of air under high pressure. In order that the phase relation between the alternator current and the spark may be varied to the most advantageous point, the alternator is built with the armature frame, the machine being of the rotating field type, mounted in a secondary outside frame, with a track machined in its inside circumference. On this track the armature frame may be rotated through an arc equal to the angle between the poles by means of a hand wheel. Thus the spark may be made to discharge the condensers at any desired point of the sine wave. The dischargers are set in sound muffling rooms and the leads run up through the ceiling to the oscillation transformers mounted on the floor above. These rooms are exhausted by motor-driven blowers of capacity sufficient to keep the air fresh and to draw out the air, which is admitted by the high-pressure blast used for quenching the spark.

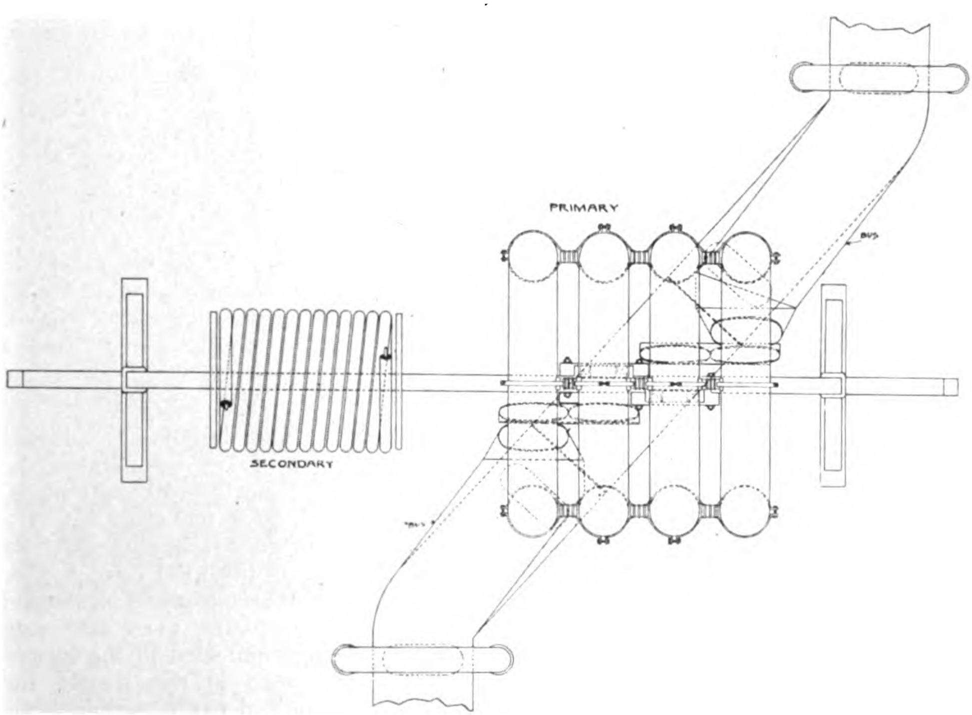
One of the precautions taken to provide an uninterrupted service is to duplicate any and all pieces of apparatus which are at all likely to be disabled. Thus, two generators and two disc dischargers are supplied for each station, and a ready means provided to connect either one to the bus and the oscillation transformer.

As the oscillation transformers are worthy of note, a sketch of them accompanies this article (Figs. 1 and 2). It will be seen that the coils are mounted on a horizontal axis and supported on a wooden frame. The primary coil is in series in the closed circuit. It consists of four turns, each turn being almost a complete ring of about 345 degrees. These turns are connected by heavy copper plates, making the equivalent of a helix of four turns. The helix is five feet in diameter and the section of the turns one foot in diameter. The turns are made of a wooden former, upon which the conductors are grouped. They follow along the length of the former, but have a long pitch spiral direction laid upon it in such a way that the length of each wire is the same, starting from one connecting plate to the next, that is, through the arc of 345 degrees. All the conductors are, in themselves, made up of stranded insulated copper wire.

The secondary coil of the oscillation transformer is wound on a wooden former, composed of two end plates with wooden rods, upon which are mounted porcelain spools. On these spools the conductor is wound; it consists of fourteen turns of a specially built high-frequency cable. The cable is made by winding thirty-six small conductors around a hemp center core, each conductor being made of seven double cotton-covered wires. There is a cotton cover over the whole cable, which is about three inches in diameter. In mounting this secondary coil on the frame, the barn-door type of roller bearings is employed. This makes a device that can be constructed totally of wood, and for close adjustment a wooden hand-screw is used, which will clamp the coil on the supporting bar of the frame, as well as furnish the means for adjustment.

From the oscillation transformer, the buses are led to the center of the condenser room, and as the transformer is on the second floor of the powerhouse, the main leads are carried horizontally about fourteen feet above the condenser room floor. The condenser bank is divided into four groups, each group being fed from the overhead buses. Each group is then subdivided into four sections of twenty-four tanks. They are connected in parallel series, three tanks being in each series and eight rows of three tanks each, parallel in each section.

From the central point of the room the overhead buses lead radially to points directly over the center of each section. Here the leads are carried down to a level with the condenser tops. From this point the sections are fed. The main bus is made of twenty-four-inch wide copper, bent in trough shape, the return lead being supported under the other. At every point where the leads divide, a smaller size conductor is used, and all the leads are so arranged that the distance between them can be adjusted, in order that the inductance of the leads can be varied as the requirements of the circuits demand. By using this system of distribution, the path of the current from the oscil-



PLAN VIEW
OSCILLATION TRANSFORMER

Fig. 2

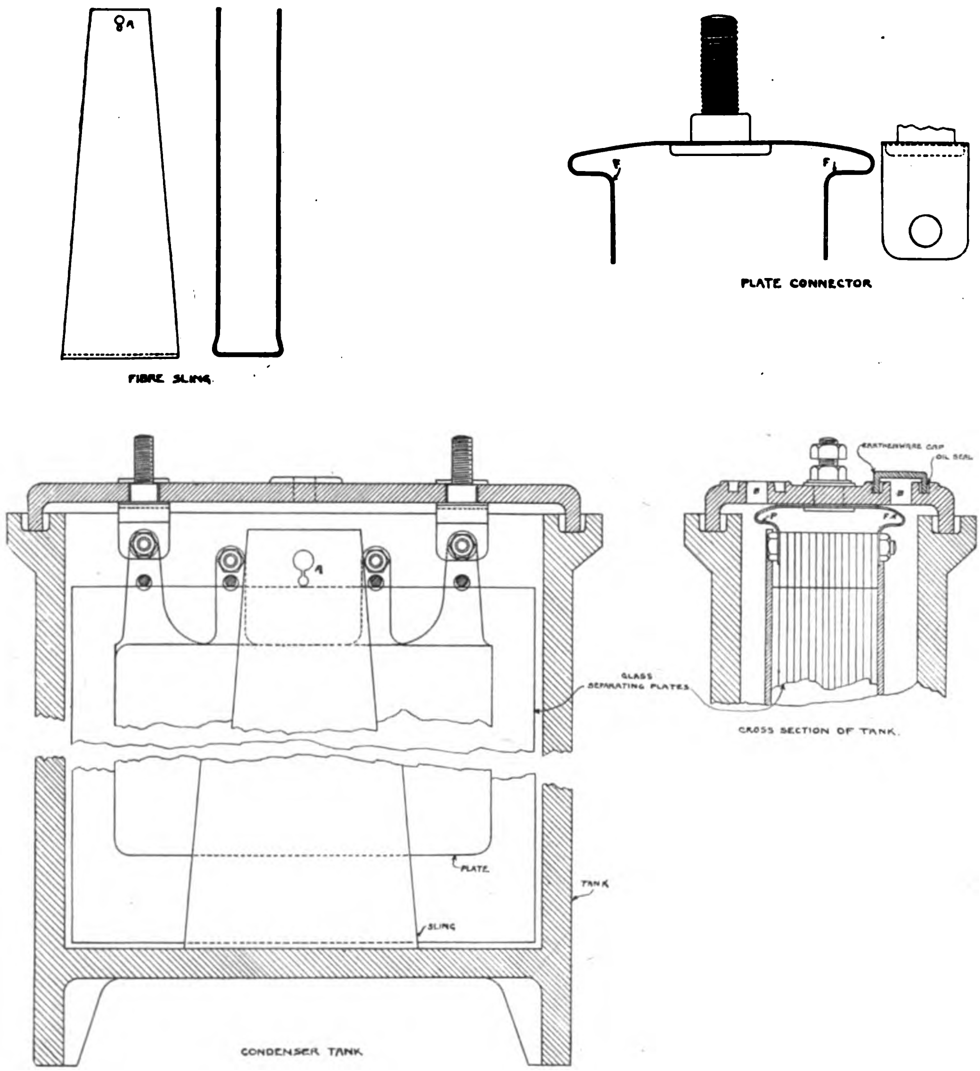
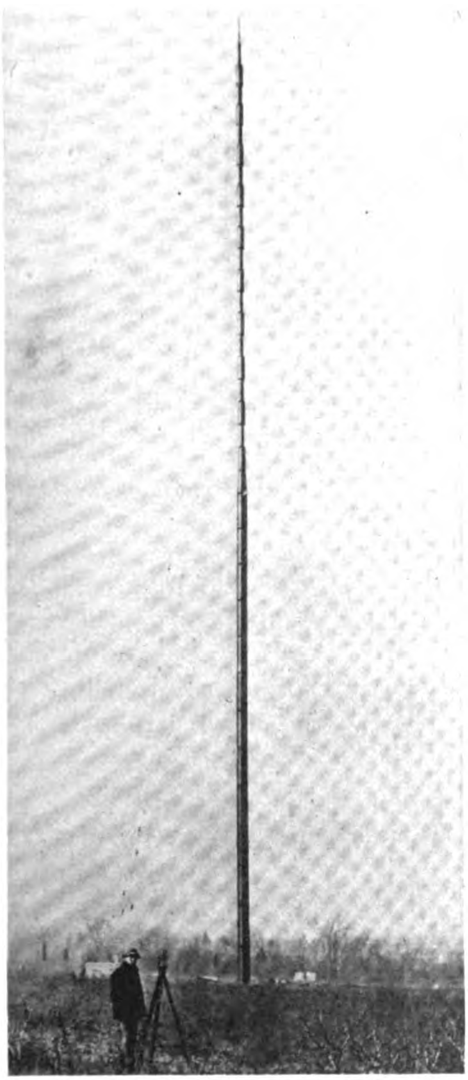


Fig. 3

lation transformer to any tank in the entire bank of three hundred and eighty-four is exactly the same. This is very important, in order that no one tank will be required to work on a greater current than any other. Each section of twenty-four tanks is set on a sloping floor, and from each section runs an oil drain, under the floor, to a single receiver.

The condenser tanks are a modification of the Poldhu type (Fig 3). They consist of stoneware tanks, thirty inches high by seventeen inches wide, by seven inches thick. The design was adopted for the purpose of keeping in view the necessity of the quick and easy replacement of plates. All the elements of a tank can be lifted out bodily and new plates of glass readily inserted. A fibre sling carries thirty-one glass plates and twenty-nine zinc plates, every alternate zinc plate being connected to the buses.

As will be seen in the sketch, the plates are connected to the terminals by flexible strips, which compensate for any inequalities in the depth of the tanks. The covers are thoroughly oil sealed, and the whole tank is filled with a high-grade mineral oil. As the slightest trace of moisture in the oil renders its insulating value inadequate, and as oil is highly hygroscopic, it is quite essential to use only very dry oil. To obtain this, a filter press is being installed in each station.



Completed Mast

If any tank fails or is broken down, the section of which it is a unit is cut out of the bank, and the spare section cut in. Then a portable derrick is run over the section, and by means of a block and tackle, which it carries, the contents of the tank are lifted out. To do this, a pair of tongs are run down through the small holes in the center of the cover, and the hooks inserted in the holes in the fibre sling. Thus the contents of the tank can be lifted out with the cover attached, and a new set of elements put in very quickly, without lifting the tank itself. After this, repairs can be made to the elements at leisure.

GOLD MEDAL FOR OPERATOR

Because of his excellent work at the key during the November hurricane in which so many vessels on the Great Lakes were lost, A. F. Moranty, wireless operator at the Marconi station at the Ashtabula (Ohio) plant of the Great Lakes Engineering Works, has been presented with a handsome gold medal by the Pickands-Mather Company.

During the storm the Pickands-Mather Company lost three ships, while the fate of many others of the same company was uncertain for many days. Moranty was able to render the company valuable service by keeping its Cleveland offices posted on the whereabouts of many of its ships. In fact, the Marconi wireless station was the only means Ashtabula had of communicating with the outside world for several days during the height of the storm.

The face of the medal is engraved with the letters "P. M. Company to A. F. M."

STATION WEATHERED STORM

The big masts and uncompleted buildings of the Marconi Wireless Station just outside of New Brunswick, N. J., successfully weathered a storm on January 12 and 13, although exposed on a towering bluff to all the force of the tremendous wind. Superintendent Rossi reported that no damage had been done to the station. The heavy wind and piercing cold did, however, interfere to some extent with the work.

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By Wm. H. Priess

ARTICLE IV

VARIABLES AND CONSTANTS

WHEN dealing with an equation representing a relationship among the various letters involved it is of prime importance to determine how one of the quantities—defined by the equation—varies when another of the quantities is varied. That quantity to which we ascribe various values is known as the *independent variable;* the other quantity, whose value we calculate from the equation in which the value of the independent variable has been substituted, is known as the *dependent variable.* Thus in the algebraic equation

$$y = ax + b,$$

y is expressed in terms of the *independent variable* x, and is therefore the *dependent* variable. All letters in an equation that are not variables are constants. Physicial constants, such as the electrical constants of a circuit, are often considered as variables, when it is desired to find the effect of their variation on the values of the dependent variables, like the current or voltage. It is apparent that the terms, independent and dependent, as applied to variables, are interchangeable and are descriptive of the viewpoint from which the relationships are regarded. Three important cases of the interdependence of variables will be considered.

(a) *Value of the Roots of a Quadratic.*

We have seen in the last issue that a quadratic equation falls in the general form

$$ax^2 + bx + c = 0,$$

and has two roots

$$x_1 = \frac{1}{2a}(-b + \sqrt{b^2 - 4ac}),$$

and

$$x_2 = \frac{1}{2a}(-b - \sqrt{b^2 - 4ac}).$$

The two roots x_1 and x_2 depend on the value of $\sqrt{b^2 - 4ac}$ in the following manner:

1. If b^2 is greater than 4ac, expressed symbolically

$$b^2 > 4ac,$$

both roots will be real and of different value.

2. If b^2 is equal to 4ac, expressed

$$b^2 = 4ac,$$

the radical reduces to zero. Both roots are real and equal to $-\frac{b}{2a}$.

3. If b^2 is less than 4ac, expressed symbolically

$$b^2 < 4ac,$$

the quantities under the radical will be negative. Since it is impossible to find a number which when squared is equal to a negative number, the radical quantity is called an imaginary number, and is equal to some constant K times the square root of minus one, or $K\sqrt{-1}$. The roots are therefore different and imaginary. Imaginary quantities will be further discussed in a later issue of THE WIRELESS AGE.

In a circuit containing resistance R, inductance L and capacity C, the conditions

$$R^2 > \frac{4L}{C}$$

for an aperiodic circuit, and

$$R^2 < \frac{4L}{C}$$

for an oscillating circuit, are obtained as the direct result of a similar form of reasoning, applied to the solution of the free discharge of a condenser circuit with respect to the current or voltage.

(b) *Resonance in a "Loosely" Coupled Circuit.* In Fig. 5, A is the primary circuit in which the current of constant effective value, I, is oscillating with frequency n. B is a circuit "loosely" coupled

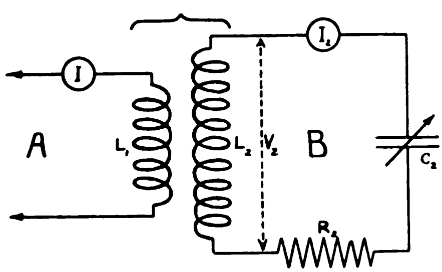


Fig. 5

to it, whose coupling coefficient, K, is a constant, and whose inductance, capacity and resistance are L_2, C_2 and R_2, respectively. L_2 and R_2 are to be maintained constant; C_2 is to be varied until the maximum effective current flows in circuit B. When this point is reached the circuits are then known as *resonating circuits*. It is desired to find the value of the capacity C_2 that will bring A and B to resonance, i. e., that will give the greatest effective current in B. Call the effective current in A, I. The effective flux through the coil, L_1, and the surrounding space depends on the effective value of the current, I_1, which is a constant. The effective voltage, V_2, across the terminals of the coil, L_2, depends entirely on the effective value of the flux from L_1 that cuts L_2, the number of turns in L_2 and the rate at which the flux varies expressed by n. Since I_1, L_1, L_2, K and n are constants, and since the voltage depends solely upon these quantities, the effective voltage is a constant and is applied periodically with a frequency n. Therefore in the equation connecting the current, the frequency and value of the applied voltage, and the electrical constants, L, C and R of a circuit

$$I_2 = \frac{V_2}{\sqrt{R_2^2 + \left(2\pi n L_2 - \frac{1}{2\pi n C_2}\right)^2}} \quad (1)$$

V_2, R_2, n and L_2 are constants, I_2 and C_2 are variables. For I_2 to be a maximum the denominator of the right hand number must be a minimum.

Therefore

$$\sqrt{R_2^2 + \left(2\pi n L_2 - \frac{1}{2\pi n C_2}\right)^2} \quad (2)$$

must be a minimum. Since R_2 is a constant and the square of any real number is positive, the radical (2) has its smallest value when

$$\left(2\pi n L_2 - \frac{1}{2\pi n C_2}\right) = 0 \quad (3)$$

Solving for C_2 we get

$$C_2 = \frac{1}{L_2 (2\pi n)^2} \quad (4)$$

When this value of C_2 is substituted in the circuit equation (1) becomes

$$I_2 = \frac{V_2}{R_2}, \quad (5)$$

in which form it is the same as Ohm's law and represents the resonant value of I_2. The usual form of equation (4) is given in terms of n as follows:

$$n = \frac{1}{2\pi\sqrt{L_2 C_2}}, \quad (6)$$

and is known as the Thomson Formula. Therefore if we wish to determine the capacity to be placed in circuit B to make it resonant with A, we must know the values of the frequency of A and the inductance of B.* If we wish to determine the frequency of A (B then acts as a wave meter) we vary the capacity in B

* NOTE:—The strictly accurate formula for the frequency is:

$$m = \frac{1}{2\pi\sqrt{LC}\sqrt{1 + \left(\frac{\delta}{2\pi}\right)^2}}$$

where δ is the decrement. For values of decrement under 0.2 the error is less than .05 per cent when the correction is neglected.

until the ammeter registers the maximum current, then from equation (6), knowing the values of the capacity and inductance C_2 and L_2, respectively, the frequency may be calculated. For example, if A and B are loosely coupled, and C_2 is varied until the current in B is a maximum, then if $C_2 = 0.001$ μ. f., and $L_2 =$ 11,200 cms,

$$n = \frac{1}{2\pi\sqrt{C_2 L_2}}$$

$$= \frac{1}{2\pi\sqrt{0.001 \times 10^{-6} \times 11{,}260 \times 10^{-6}}}$$

$$= \frac{1}{2\pi \times 10^{-7}\sqrt{1.126}}$$

$= 1.5 \times 10^6$ oscillations per second.

Since

$$\lambda = v\,T = \frac{v}{n} = \frac{3 \times 10^8}{n} \text{ meters.}$$

Where λ is the wave length in meters, v is the velocity of the wave in meters per second (= velocity of light or 3×10^8 meters per second), and n is the number of oscillations per second;

$$\lambda = \frac{3 \times 10^8}{1.5 \times 10^6} = 200 \text{ meters.}$$

(c) *Damping of a Circuit.*—The third important case is that of the damping of a circuit. When a condenser discharges through resistance and inductance, its energy surges back and forth in the circuit as electrostatic and electromagnetic energy. During each surge some of the energy is locally dissipated as heat by resistance of the conductors, hystersis and conductivity of the dielectric of the condenser, and eddy currents induced in conductors blocking the path of the magnetic flux; the remaining dissipated energy appears in the form of electromagnetic waves and is radiated. Therefore the maximum current or voltage amplitude is less than that of the previous surge. The ratio of two successive current amplitudes is expressed by the damping of the circuit,

$$\epsilon^{\frac{R}{2L}T} \qquad (1)$$

Calling the maximum current of the m^{th} oscillation I_m, and the maximum current of the (m + 1) oscillations

I (m + 1)

$$I\,(m+1) = \frac{Im}{\epsilon^{\frac{R}{2L}T}} \qquad (2)$$

The smaller value of $\epsilon^{\frac{R}{2L}T}$ the greater the value of I (m + 1) and the more nearly sustained are the oscillations. But since $\epsilon^{\frac{R}{2L}T}$ depends on the value of $\frac{R}{2L}T$, $\frac{R}{2L}T$ becomes the independent variable, I (m + 1) the dependent variable. When $\frac{R}{2L}T$ becomes 0, $\epsilon^{\frac{R}{2L}T} = 1$, and

$$I\,(m+1) = Im \qquad (3)$$

When $\frac{R}{2L}T$ becomes very large $\epsilon^{\frac{R}{2L}T}$ becomes extremely large, and

$$I\,(m+1) = \frac{1}{\text{extremely large number}}\,Im, \qquad (4)$$

or there is practically but one surge of energy.

Therefore I (m + 1) lies in value between Im and zero, as $\frac{R}{2L}T$ varies between 0 and a very large number.

Logarithms

Many students often wonder how engineers find time to perform the laborious calculation of product, quotients, powers and roots that are indicated in the various formulæ for design of apparatus. The invention of the Briggs tables has reduced all the operations to addition and subtraction. The Briggs tables are the tables of the logarithms of the number and decimals from 1 to 10. A consideration by the reader of the definition, meaning and application of the principles of logarithmic computation will be of benefit to him in the elimination of tiresome numerical labor.

Definition.—In the equation

$$a^b = c \qquad (1)$$

three possible problems may arise:

1. Given a and b, to find c. This is the process of involution or raising to a power.

2. Given b and c, find a. Solving for a, by taking the b root of both sides, equation (1) reduces to

$$a = c^{1/b} \qquad (2)$$

This is the process of evolution or finding the b root of a number.

2. Given a and c, find b. *This is the process of finding the logarithm of c to the base a.* Expressed symbolically,

$$b = \log_a c \qquad (3)$$

a is a constant, known as the base of the logarithm. It may be 10, as in the Briggs system, or 2.71828, as in the natural or *Napierian system*, or any other constant K. b is found in the tables by looking up the given number c. Since a positive number c can always be expressed as a constant raised to some power b, there is always a logarithm b, for a given positive number c. For example, if

$$10^x = 100,$$

then from equation (1),

$$x = \log^{10} 100,$$

but 10 squared is equal to one hundred, therefore,

$$x = 2.$$

That is, 2 is equal to the logarithm of 100 to the base 10. *The antilogarithm is the number corresponding to the given logarithm.* In the example given 100 is the antilogarithm of 2.

Properties of Logarithms.—1. If $\log_a n = x$, and $\log_a m = y$, since $n = a^x$ and $m = a^y$, then by the law of indices (¶ 26), $n \times m = a^{(x+y)}$, or

$$\log_a (n \times m) = x + y = \log_a n + \log_a m;$$

and by the second law of indices (¶ 33),

$$n \div m = a^{(x-y)}, \text{ or}$$

$$\log_a (n \div m) = x - y = \log_a n - \log_a m.$$

That is, the logarithm of a product is equal to the sum of the logarithms of the factors, and the logarithm of a quotient is found by subtracting the logarithm of the divisor from the logarithm of the dividend. To multiply two or more numbers together we find the logarithm of the factors, and then the antilogarithm of the sum of the logarithms. To divide one number by another we subtract the logarithm of the second number from the first, and find the antilogarithm of the difference of the logarithms.

$$n \times m = \text{antilogarithm of } (\log n + \log m).$$
$$n \div m = \text{antilogarithm of } (\log n - \log m).$$

2. If $\log_a n = x$, since $n = a^x$, then from the law of indices, $n^b = a^{bx}$, and therefore $\log_a (n^b) = bx = b \log_a n$; and since $n^{(1/b)} = a^{(x/b)}$, therefore

$$\log_a (n^{1/b}) = \frac{x}{b} = \frac{1}{b} \log_a n.$$

That is, the logarithm of a number raised to a power is equal to the power times the logarithm of the number, and the logarithm of the root of a number is equal to the logarithm of the number divided by the index of the root.

3. Since $a^0 = 1$, then

$$\log_a 1 = 0$$

The logarithm of unity is zero. Since $a^1 = a$, then

$$\log_a a = 1.$$

The logarithm of the base is equal to unity.

Change of Base. Most of the calculating is done by the Briggs tables, or to the base 10. Physical formulæ in which logarithms appear are usually to the base ϵ (2.71828). It is therefore essential for purposes of computation to express $\log_{\epsilon} n$ in terms of $\log_{10} n$. This is done by means of the easily derived form

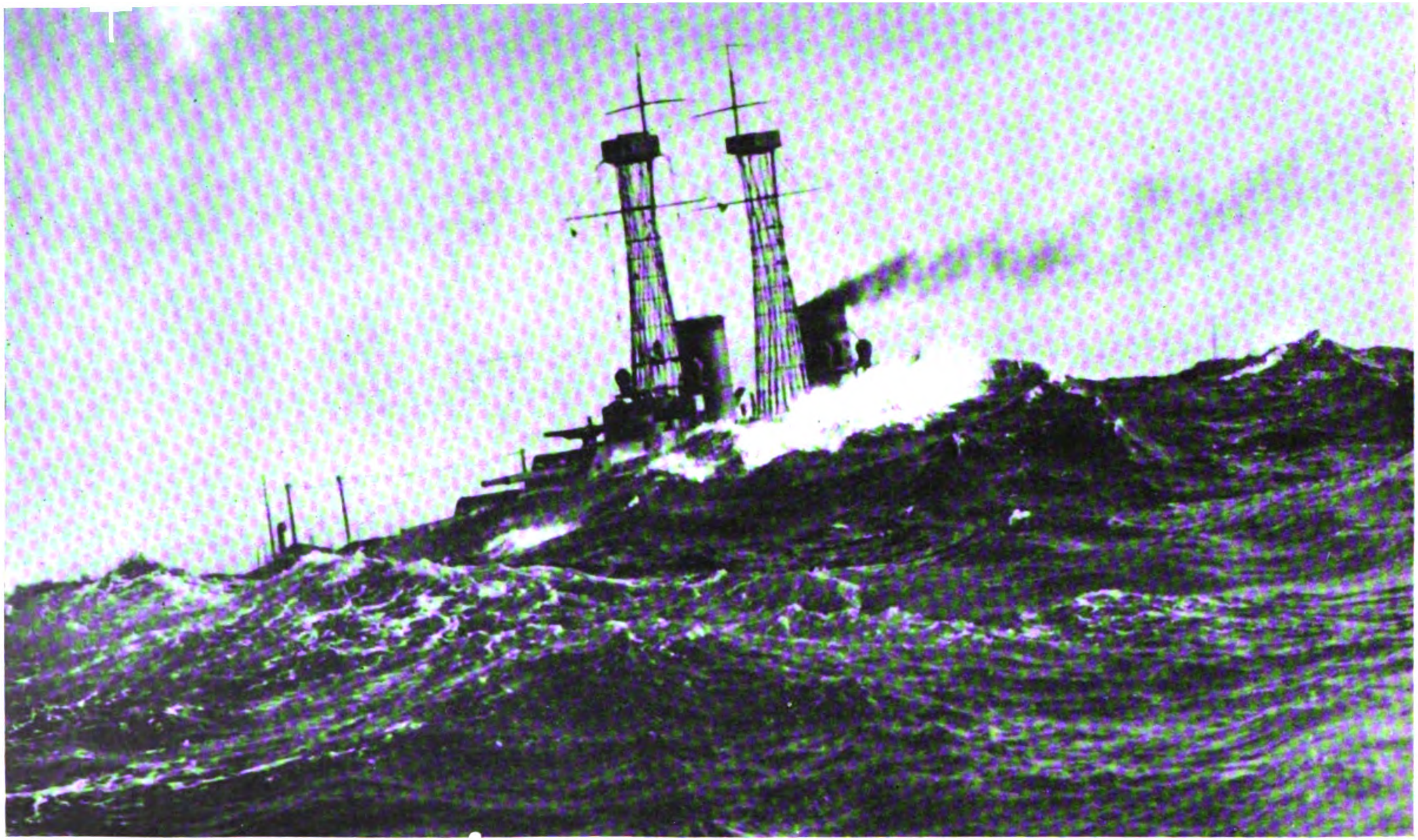
$$\log_\epsilon n = \log_{10} n \times \log_\epsilon 10 = K \log_{10} n,$$

where K = 2.3026.

The remainder of this installment, which is included in the fourth of a series of articles on mathematics by Mr. Priess, will appear in an early issue. This series will be followed by a simple explanation of the practical use of logarithms.

ARGENTINE CONTROLS SERVICE

A new law in the Argentine Republic provides that all wireless communication within the territory of the nation and for international messages up to a distance of 620 miles shall be conducted only by the state. The use of the government service is obligatory, according to the law, upon all vessels entering or leaving Argentine ports with fifty or more persons aboard, including passengers and crew.



Photo, Underwood & Underwood.

What wireless means in safety to our navy men strikingly illustrated in this photograph of one of Uncle Sam's greatest Dreadnaughts, the Delaware, fighting for her very life in the "cup" formed by the mountainous seas.

Directing Fire Boats by New Method

THE efficiency of wireless telegraphy when applied to use in the New York Fire Department was shown on December 23 last during a test of radio communication between Fire Headquarters in East Sixty-seventh street and the fireboat James Duane, steaming up the Hudson River to answer a false alarm. Following the test instructions were given to officials of the department to make further investigations with a view to installing wireless apparatus on each of the eleven fireboats in the service of the city.

"We are leaving now for Station 736 (West End avenue and Ninety-eighth street), out in river now," was the wireless message that came to Fire Headquarters from the Duane, at twenty-five minutes to four o'clock in the afternoon after an alarm had been sent in by the regular method. The wireless message followed five minutes after the alarm had been sent in.

Message Tells of False Alarm

This communication was answered as follows by the wireless operator in East Sixty-seventh street:

"Operator in charge fireboat James Duane: False alarm. Acknowledge and report by radio.

"Operator in Charge Headquarters
"(3.40 P. M.)"

From the Duane came the following reply:

"Operator in Charge Platform (Headquarters): O. K. We are now opposite Eightieth street (3:41 P. M.). Engine 85 returned to quarters at 3:56 P. M.
"Operator Martin."

When the wireless informing Lieutenant Heenan, in command of the Duane, that the alarm was false had been received, the fireboat headed about and steamed down the river to her berth at the foot of Thirty-fifth street. The message to the Duane, telling of the false alarm, showed the value of wireless as a time saver when employed in the Fire Department.

A message of congratulation to the fireboat brought the following response:

"The wireless idea is excellent and will save the burning of a vast amount of fuel in useless runs.

"Lieutenant Heenan, Commanding."

Joseph Johnson, who was Fire Commissioner at the time the test occurred, explained the advantages of wireless in directing the movements of fireboats. At present the department has no means of communicating with the craft on the water.

"We will suppose," he said, "that the first land company to reach the scene of the supposed fire—and invariably the land companies reach fires in advance of the boats—reports that it was merely a matter of a burning lace curtain and amounted to nothing.

"I want to stop the James Duane because I want her at her post in case a real fire occurs. Under the old plan I lost control of the boat the minute she put off from the wharf, but now I wireless her that the fire is out and she need not make the long run on which she has started. It means a much greater efficiency among our fireboats than we have heretofore known. In two instances fires have occurred on ships in the harbor while our fireboats have been away from their stations on long runs to waterfront fires that were out long before their arrival."

Wireless Summons for Ships Afire

Fire Department officials have considered the possibilities of receiving alarms of fire from vessels at sea by wireless and sending out fireboats to meet the craft as they entered port and fight the flames. A wireless installation would also prove of advantage in summoning the fire fighters to anchored craft ablaze. Even cargo steamships are now generally equipped with wireless and there would be little difficulty in getting assistance within a few minutes after the flames were discovered.

The apparatus used in the recent test included installations at Fire Headquarters and on the Duane rated at one-half kilowatt. The antenna in East Sixty-seventh street was located on the roof of Fire Headquarters and the set was placed in a small room on an upper floor. The set in the Duane was located in the pilot house. The apparatus is of the quenched gap type, similar to that used on the United States torpedo boats.

If the Fire Department is equipped with wireless it is likely that the central radio station will be located in the building of the department in course of erection in Central Park at Seventy-ninth street.

THE LACKAWANNA EXPANDS ITS WIRELESS SERVICE

The success of the wireless service on the Lackawanna Railroad between one of its limited trains and fixed stations at Scranton, Pa., and Binghamton, N. Y., has induced the railroad company to arrange for the installation of additional radio equipments at points between Hoboken, N. J., and Buffalo, N. Y. Another limited train will also be equipped with wireless. Wireless operators will be assigned to duty on each train, and radio communication will be established between the trains and fixed stations over the entire length of the railroad.

Wireless telegraph on trains of the Lackawanna to transmit orders to the crews and news to the passengers recently proved its worth when it was used to summon an ambulance to remove a passenger who had been seized with a fit. It was at first supposed that the man was dead, and the message was sent while the train was running at full speed, but by the time the train reached Scranton the man had been revived and the hospital conveyance was not needed.

Another passenger aboard the train, which left New York at twenty minutes to one o'clock in the aftrnoon, was met at the station in Scranton by a friend, who had been summoned by wireless. The message was sent from Cresco to the Lackawanna's wireless station in Scranton, and relayed by telephone to the home of the passenger's friend. The reply, "I'll be there," was sent as the train passed through Tobyhanna. The distance from Cresco to Tobyhanna is thirteen miles. Another remarkable performance of the wireless was a conversation kept up between the Scranton station and the express as it sped through the Nayaug tunnel.

"Stentor" transmitters and reproducers (loud-speaking telephones) will be installed on the dispatchers' circuit of the Lackawanna between Hoboken and Franklin Furnace, N. J. This apparatus relieves the dispatcher of the necessity of wearing telephone head-gear, which is a source of danger and annoyance to him, particularly during electrical storms. The receiver is placed on the desk about six inches in front of the dispatcher, and the enunciation is described as being loud and distinct. The circuit between Hoboken and Franklin is 108 miles in length, and has thirty-two stations.

STATION SITE NEAR SAN DIEGO

The Navy Department has selected a site near San Diego, Cal., for the third of the giant wireless stations which are to form a chain extending from Washington to Panama on the Pacific coast, Hawaii, Guam and the Philippines.

A California site, suitable from an electric standpoint, was the prime requisite, but its adaptability for communication with Hawaii, Panama and Washington was also considered. The site is about four miles from San Diego and eleven miles from the seacoast. Arrangements are being made for a transfer of the title to the site, the cost of which is about $15,000. The construction of the radio station will be begun immediately after the transfer of title.

The Arlington station is already in operation and the one at Panama will soon be in commission.

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Soon afterward Rance finds on the deck of the steamship a wireless message from Kennedy, superintendent of the mine, telling Sidney that the Burton-Slocum syndicate is prepared to offer Maglory $200,000 for the property. Maglory declines to credit Rance's statement.

CHAPTER VII

THE two-seated mountain wagon ground its way over the sandy trail between San Simone and Ragged Edge. It was an ineffective sort of trail and seemed rather aimless in its windings; but the Apaches had started it, and no Indian ever takes the longest way between two given points unless there is a very good reason for it.

In this particular case the reason was Lost Horse Cañon. That gash in the hills, with its precipitous sides and the treacherous ground adjacent to the rimrock made necessary a long détour in passing from San Simone to the town on the opposite brink of the cañon.

Old Joe Derry clucked to the lathered horses. It was almost derisive, that cluck in Old Joe's throat. For from the seat behind him John Maglory had remarked, in a voice husky with awe—and dust:

"God's country!"

A road-runner hustled across the road ahead of the team. At the side of the wagon a rattlesnake suddenly coiled and struck at Old Joe's whiplash.

The heat was blistering. A pall as of smoke hung low over the desert and almost obscured the dismal clumps of greasewood and the ragged growths of cactus. Old Joe coughed.

"This land must look a heap good to you, John," said he, "after crossin' the water and gettin' a bird's eye view of Yurrup."

"Out here, Joe," said Maglory, "either a man's the clear quill or he ain't—but you know it. Back East you never can tell what a man is, because surface indications don't count. Glad you're home, Bonnie?" and he turned to the girl at his side.

Bonanza's olive cheeks were flushed and her eyes were dancing. She was leaning forward over the back of the front seat, eager to catch her first glimpse of Ragged Edge through the clouds of dust.

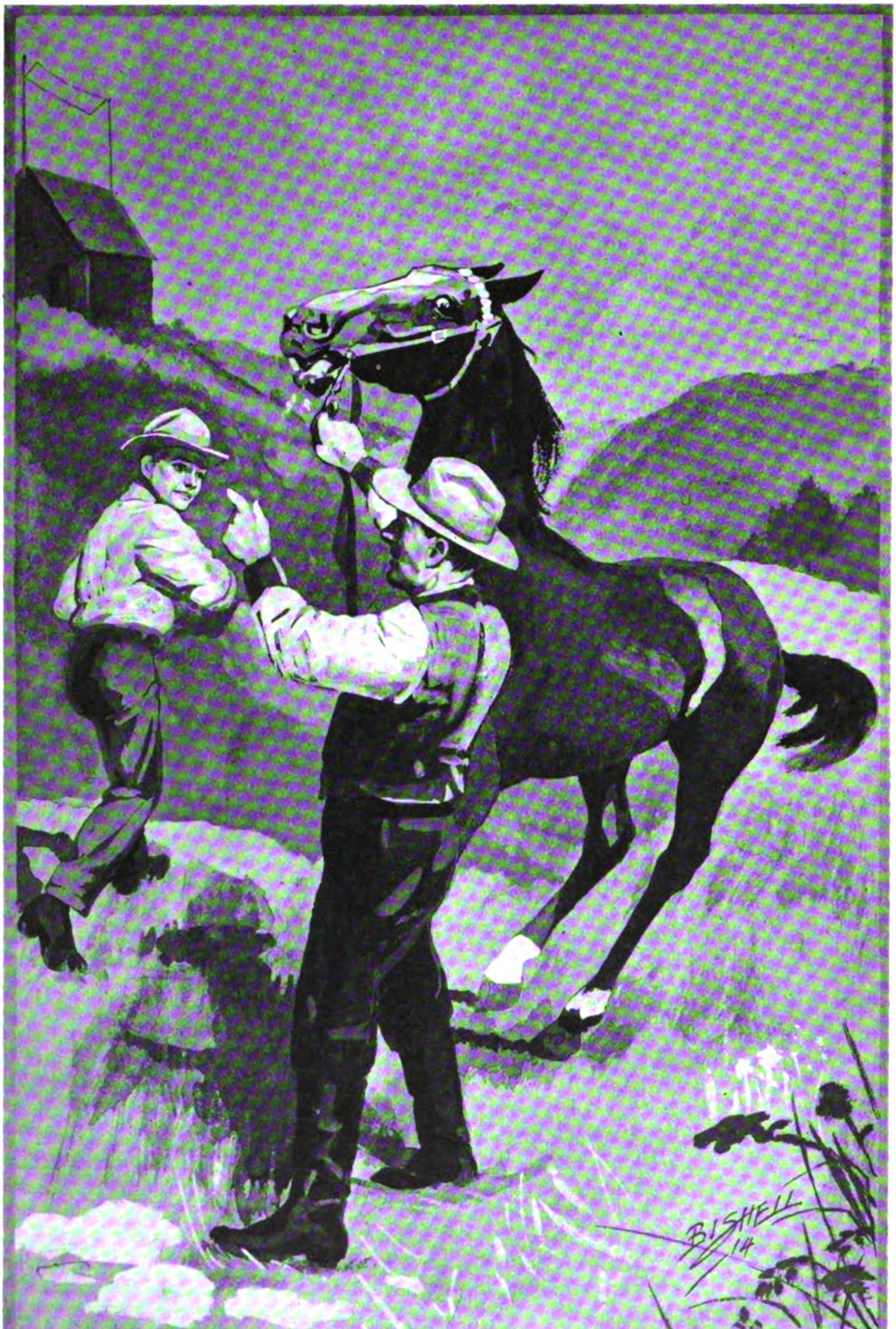
"Oh, it's glorious to be back!" murmured the girl.

"That's you!" exclaimed the old man fondly. "Home never looked so plumb good to me as it does this minute, and I allow you feel the same."

"Well," observed Derry, taking lines and whip in one hand, while he pulled a plug of tobacco from his pocket with the other, "home ain't what it was when you left it, John. A few more has pulled up stakes and gone over to San Simone."

Maglory frowned. A sadness almost pathetic showed in his old face as he answered:

"Some people are never satisfied. Since San Simone got to cooking with gas and reading by electric light, the habit of moving over there has been growing on the Ragged Edgers. But it takes something more than gas stoves and incandescent bulbs to make a New Jerusalem, and I'm hoping to live and die on



"If that wireless of yours is any good, Ollie," the old man went on, hoarsely, "use it in getting a doctor out here."

the brink of Lost Horse Cañon without ever seeing a flying machine or—now, Bonnie, you hush!"

The girl had burst into laughter. Flinging an arm around Maglory's neck, she gave him a swift kiss. Then she turned to the driver.

"How's Silverheels, Joe?" she inquired.

"Big as life and twicet as ornery, Bonnie," chuckled Derry. "Ain't no one backed the critter since you-all went away. Gee, but he feels his oats! You'll have to be right keerful when you ride Silverheels for the first time."

"Oh," and the girl tossed her head confidently, "he wouldn't cut any capers with me."

"There's the town, Bonnie!" burst out Maglory; "there's home!"

Excitedly he fanned the dust from in front of him with his hat and pointed ahead with a finger none too steady. The girl drew a deep breath and again leaned over the front seat, fixing her dark eyes steadily on what was before her.

One by one the squalid, mud-walled houses took shape and form. There was no living person abroad in the street, and a funereal silence seemed to prevail everywhere.

"What's Ryckman been doing to the top of that 'dobe of his?" Maglory inquired, his eye keen for all changes that had transpired during his absence.

A pole rose high above the flat roof of the Ryckman dwelling. At its upper end was a cross-bar, and from one end of the bar hung a swinging wire.

"That pole thing?" guffawed Old Joe. "That there is Allie Ryckman's work, John. Ryck allows his boy Ollie is some progidy. Maybe you won't believe it, but that kid can telegraph without wires. He——"

John Maglory stiffened in his seat. The red ran into his face and he almost shouted:

"Do you mean to say that's one of these fool wireless outfits?"

Old Joe looked around, mildly curious at this outburst of temper.

"I reckon that's what they call it," he answered. "When I first heard of it, I allow it struck me a heap like it's strikin' you, John, but the more you get acquainted with the thing the more you believe in it. Plumb wonderful, and no mistake."

Maglory, fleeing from civilization and returning into his own primitive haunts, was rudely shocked by encountering that little wireless station right in his home town. So it had come to this! Ragged Edge, admittedly at its last gasp, could not die without having its final moments tortured by this wireless machine!

"Stop, Joe," growled Maglory, "stop in front of Ryckman's."

The moment the wagon stopped, Ollie, Ryckman's seventeen-year-old son, came running from the house.

"Hello, Mr. Maglory," he shouted. "Howdy, Miss Bonnie. Gee, but it's good to see you-all back home once more."

He ran up to the wagon and shook Bonanza by the hand. He would have shaken the hand of Maglory, too, but the latter gave him no chance to do so.

"No good will come of your fooling with that wireless layout, Ollie," said the old man, in a voice that trembled with indignation and anger. "Chop the pole down and smash the rest of the apparatus into junk. I'll bleed for the damage."

Ollie looked dazed.

"Chop the pole down?" he echoed; "smash the apparatus into junk? What for?"

"Because you're fooling away your time when you ought to be doing something else that's worth while," said Maglory sharply; "and because it glooms me all up to have anything like that in Ragged Edge."

"Why, I can talk with a fellow in San Simone who's got a station, and with another chap at Poco Tiempo, who has fitted up a wireless place. I can't send so very far, but"—and the boyish face glowed with delight and enthusiasm—"at night I can sometimes pick up signals from San Francisco, and once I caught an S O S from a boat somewhere off the coast. I got a Government license, too, and—and—say," he broke off, a puzzled light in his eyes, "you don't really mean I'm wasting my time, do you, Mr. Maglory?"

"When I say that," scowled Maglory, "I'm mild—mild as the babble of a Chinese cook. You stop this fool tinkering, Ollie, or you'll come to grief. Wireless never did anybody any good."

The boy's expression changed. He was no longer puzzled, but frankly hostile.

"That's where you're wide of your trail," said he stoutly, "and it's about as foolish a thing as any one ever put tongue to. Excuse me for breaking out at you that-a-way, Mr. Maglory, but when they had the big fire in San Simone and were short of men, didn't they call on my station for help? And when they had the cave-in, over at Poco Tiempo——"

"Drive on, Joe!" shouted Maglory.

And they drove on, leaving Ollie Ruckman staring after them, with face flushed and the light of rebellion in his young eyes.

From his own comfortable adobe, situated on a slight "rise," similar to the site of the Ryckman home, Maglory could look across the swale at any time of day and see that tall pole with its swinging aerial. It reminded him of many things that were not pleasant and was a source of constant annoyance.

For two or three days after reaching Ragged Edge the old man was going through a period of readjustment. It was a stormy period and he did not weather it very successfully.

His journey East, and across the water, had brought him face to face with some things that hammered hard upon his primitive barriers. He was obstinately shutting his eyes against facts which sooner or later would assert themselves in spite of him.

Kennedy, the dishonest foreman in charge of work at the Bonanza Mine, he must discharge. But he delayed. He remembered that his only proof of Kennedy's treachery had been developed by Rance through a wireless telegram. He prsuaded himself that he wanted other proof, and for the present he made no move to oust Kennedy.

Silverheels, Bonnie's pinto, abruptly leaped from idleness into the busiest days of his career. The mettlesome cayuse was taken out for many a long, hard ride, and gradually the spell of the East faded out of the girl's mind, and she settled comfortably back into the old Arizona life. The pinto had much to do with making Bonanza contented and keeping her hopeful.

On the afternoon of the fourth day after the return of Maglory and Bonanza, the hum of an automobile stirred the echoes of the town. Two men were in the machine, and they raced up to the Maglory adobe and came to a halt. One of the two got up and started for the front door, but it was opened before he reached it and Maglory appeared.

"What do you mean by slamming around this burg in an old pop-bottle like that?" shouted the old man, planting himself truculently on his porch.

"Eh?" gasped the visitor, astounded.

"A team and wagon ought to be good enough for any man," continued Maglory, "and I haven't a mite of patience with fellows who turn engines loose on the trails and scare the livestock. What's your business?"

"Are you John Maglory?"

"That's my label."

"You're Miss Bonanza Denbigh's guardian?"

At this question the old man shied like a restive horse. Vague suspicions began floating through his brain on the instant.

"If you've got anything to do with Jeff Rance," he cried, "I'll tell you flat he's out of the Maglory herd. I——"

"You're getting me wrong, Mr. Maglory," the motorist interrupted. "I have heard of Mr. Rance, but do not know him. He has nothing to do with my call here this afternoon. I happened to be in San Simone this morning, and, learning that you had returned from the East, motored over to see you on a matter of business. Is Miss Denbigh at home?"

"If your business is with me, why are you asking for her?" demanded Maglory.

The other laughed a little.

"I suppose," he went on, "that my business concerns her, in the main, rather more than it does you."

"Well, she's not around; she's away, horseback riding."

"My name is Hall, Mr. Maglory, and I represent the Burton-Slocum people. If you can spare me a few minutes, I'd like to make you a proposition in the matter of the Bonanza Mine, over Poco Tiempo way."

Maglory started and stared. A strange look crossed his face, and his eyes lost their fire and grew dull.

"Come up and sit down, Mr. Hall,"

said he in a subdued voice, pushing out a chair. "A proposition, you say? What do you know about the Bonanza property?"

"The Burton-Slocum people are willing to bank on what I know," was the smiling reply.

"Well, make your proposition," murmured the old man.

CHAPTER VIII

"I understand that Miss Denbigh's property is on the market." Hall did not sit down, but leaned over the back of the chair as he talked. "On behalf of the syndicate I represent, I am here to make a spot cash offer of $200,000 for the Bonanza Mine."

Maglory stool like a man chiseled from stone. Rance had not lied to him, after all. Rance had not shown him a spurious message. He had told the truth. Maglory, who would have cut off his right hand for Bonnie, had, through his obstinacy, cheated her out of $150,000—the difference between the price called for by the option and this cash offer by Hall. He had done even more than that, for this $150,000 he had taken from Bonnie and presented to William Sidney, the man against whom Rance had warned his uncle.

The old man crumpled up and dropped into a chair. His hands fell limply across his knees and his chin sank to his breast. How grievously he was hurt no one but himself would ever know.

Hall looked at Maglory curiously. Under his wondering glance the old man lifted his head.

"There's a thirty-day option out against the property," said he.

"Sidney?" returned Hall.

"How'd you know it was Bill Sidney?"

"He sent me a wire saying he had the property cornered, and that if my people wanted it they'd have to deal with him. Much obliged, Mr. Maglory. This is about all I want to know."

Hall started down the steps. Maglory halted him with a word.

"Don't you deal with Sidney!" he shouted. "He's a thief and a liar, and the Bonanza Mine isn't his! And it won't be his, if I can find the coyote and kill him before that option expires!"

"When does the option expire?"

"At 10 p. m. the 25th of this month."

"Suppose we buy his option?"

"You take my advice and hold off. Don't you buy the option, Hall. Buy the mine—and buy it from the person who happens to own it after the 25th."

There was something here which the Burton-Slocum representatives could not understand. It was one of those cases, however, in which it was best to take advice from a man who might be supposed to know.

"Very well, Mr. Maglory," said he, "we'll let the matter wait until after the 25th."

Maglory watched with narrowing eyes while Hall climbed into his machine and started along the back trail for San Simone. The motor car had not cleared the swale when Bonnie came galloping down the opposite rise on Silverheels. The machine was stuttering loudly on the up-grade, and the racket broke suddenly on the ears and eyes of the pinto.

Fright seized the cayuse, and, taking the bit between his teeth, he started to bolt. Bonnie set out to master her mount and seemed to be succeeding, when the riding gear failed her and the saddle turned.

John Maglory, with his eyes filming and the blood congealing about his heart, saw the girl cast to the ground. The white heels of the pinto twinkled across the rise, and a limp, draggled little figure was left lying unconscious in the dust.

A heavy groan was wrenched from Maglory's lips. He staggered, brushed a hand across his face, and then ran toward the scene of the accident.

The automobile had stopped. Hall and his driver had left the machine and were bending over Bonanza.

"It was your cursed machine that did this!" shouted the old man, flinging Hall roughly aside so that he might kneel in his place beside the girl. "Bonnie!" he cried, chokingly, gathering the crumpled form to his breast. "Speak to me, *mujercita!* You're not badly hurt!"

Bonanza did not answer. Her head fell back over Maglory's arm, and her closed eyes and white unconscious face struck at his heart like a dagger.

"Mr. Maglory," said Hall, "I'm enough of a doctor to see that the young woman is seriously injured. She should have medical attention without a moment's delay. Where is the nearest physician?"

The old man lifted an ashen face.

"San Simone—twenty mines away!"

"Charlie," and Hall turned quickly to his driver, "go after the doctor—and hit it up!"

"There's not enough gasoline for the trip," Charlie answered, hurrying toward the car.

"Find some," was the response.

Gently, Maglory laid down the form he was holding so tightly to his breast; then, getting to his feet, he stood for a moment, his eyes lowered and one hand smoothing the white hair back from his brow.

"You—you think, Hall," he asked stumblingly, "that this may be a case where—where minutes count in getting the doctor?"

"It may be such a case, Maglory. If Charley can find some gasoline he won't be long in getting a doctor out from town." The old man whirled and began running up the farther slope. As he neared the top, Ollie Ryckman could be seen walking along the trail and leading the pinto. As the boy drew close the look on Maglory's face alarmed him and brought him to a stop.

"Miss Bonnie hurt?" he asked.

"Yes," was the answer. "If that wireless of yours is any good, Ollie," the old man went on hoarsely, "use it in getting a doctor out here." He took the pinto's bridle from the boy's hands. "Hurry!" he added.

Ollie, filled with the idea of showing Maglory just what wireless could do in an emergency, cast one glance toward the foot of the hill, then whirled and dashed toward his station.

(*To be continued*)

OPERATOR'S STORY OF AN S O S CALL

George Uzmann, wireless operator, of 432 Forty-first street, Brooklyn, N. Y., who has returned from a three months' stay in Galveston, Tex., recently told an interesting story of how wireless brought help to a vessel in distress.

"I was one of the operators on the cable ship Relay, stationed at Galveston to await the outcome of the Mexican situation," he said. "I worked the third trick at the Galveston station on the morning of November 4 as a relief to the regular operator. It was about 4.30 o'clock in the morning and I had been working one of the battleships at Tampico when I heard some one calling and sending out S O S

"I found it to be the yacht Wakiva, belonging to the Heustica Petroleum Company. The operator reported that the yacht had run ashore in a heavy fog and high seas and was in only four feet of water. I stood by until a wrecking tug and revenue cutter went to the Wakiva's assistance. The yacht was floated on November 21."

RADIO INSTITUTE ELECTS OFFICERS

At the annual meeting of the Institute of Radio Engineers, held at Columbia University, January 7, the following officers were elected: President, Dr. L. W. Austin; vice-president, Dr. J. S. Stone; treasurer, J. H. Hammond, Jr.; secretary, E. J. Simons; R. H. Marriott, J. L. Hogan, Jr., R. A. Wiegant and G. Hill were elected members of the Board of Managers.

WARNING CONCERNING EXPLOSIVES

Experts of the United States Bureau of Navigation, Department of Commerce, say extreme care should be used aboard vessels carrying gasolene or similar substances which generate an explosive gas or any other explosive which might be ignited by electric sparks.

A. J. Tyrer, acting Commissioner of Navigation, has directed all radio inspectors to be rigid in their examination of wireless on tank vessels and others carrying material which might be set afire by sparks. "You will pay particular attention," said the order, "to the insulation of the antennæ to metallic rigging or equipment of the vessel in which currents may be induced from the action of the radio apparatus, and to the wiring and electrical equipment of the vessel in which currents may be induced so as to cause sparks to jump between wires or between small gaps."

Five Rescued Members of the Oklahoma's Crew, and a Last View of the Oil Tank Steamship, as Seen from the Deck of the Gregory

Wireless in the Oklahoma Rescue

REACHING out over miles of mountainous seas, wireless brought rescuing vessels to the oil tank steamship Oklahoma, which broke in two about seventy-five miles south of Sandy Hook on January 4. Twenty-seven of her crew were lost, but thirteen out of the forty aboard the wrecked vessel were saved. Captain Graalfs, of the Hamburg-American liner Bavaria, made the following report of the disaster in a wireless message:

"On January 5, at 6 A. M., we sighted the signals of distress of a vessel. Wind north to northeast. Velocity 48. High rough sea. At dawn we saw the fore part of a steamer floating on the water, tank steamer Oklahoma, from New York. At 8 A. M. we were close to the wreck and lowered a boat with six men, who succeeded after great effort in seizing a rope that was thrown to them. The men of the Oklahoma lowered themselves into the boat, quite exhausted from the experience of the last twenty-four hours.

"Captain Gunter, commander of the Oklahoma, states that last Sunday at 7:30 A. M., during heavy weather, without any previous warning the ship suddenly broke in two right behind the bridge. In about twenty-two minutes the after part of the ship, with the crew of thirty-two men, sank in the sea, the stern pointing upward, with the propeller running. The fore part kept afloat by the bulkheads, the stern up to the rear edge protruding from the water. The lifeboats either went down with the ship or were swamped by the waves. Immediately after the catastrophe on the morning of January 4 a Spanish steamer appeared, but was unable, owing to the bad weather, to approach them. Immediately after the Bavaria the United Fruit steamship Tenadores appeared on the scene of the disaster, but there was nothing left to be done, the boats from the Bavaria having taken off all the men. The life-saving work took place at latitude 39:07 north, longitude 73:45 west."

Chief Engineer John J. Fogh was drowned and so were First Assistant Engineer W. R. Dodd, Second Assistant Engineer Christopher Nelson and Third Assistant Engineer Walter Hanan. William Davis, Marconi operator on the wrecked vessel, was among the rescued. Edward Feline and Juan Siguier, the wireless operators on board the Manuel Calvo, of the Spanish line, told an interesting story of the disaster.

The Manuel Calvo first sighted the Oklahoma at 3:30 o'clock on the afternoon of January 4. The Spanish steamship slowed down until she was within three-quarters of a mile of the wreck before three men were seen aboard.

Feline said that the men did not wave their hands or do anything to attract attention. Then, as the Manuel Calvo swung in behind the wreck at a distance of about half a mile, the watchers could see eight men. Feline sent a message to Sea Gate and it was intercepted by the Caribbean, the Georgic and the revenue cutter Seneca.

Captain Juan Bonet, of the Manuel Calvo, then ordered a boat lowered. At the time the sea was running high and a heavy wind was blowing from the north. The boat was manned by the first officer, Jesus Marrogui, and six sailors. They were lowered from the starboard amidships, but the sea was too rough for them. First a sea broke the boat's rudder and quickly it was swept toward the bows, where, even quicker, it was hurled under as a sea lifted the steamship. The boat was smashed, spilling the crew into the water. Several managed to cling to the tanks of the lifeboat and two men caught the rings that were thrown from the steamship's deck. Those who held to the tanks managed to catch the lowering gear as it swung and finally all six men and the first officer were hauled over the side to safety.

Half an hour had passed while these attempts to launch the boat and its loss had occurred and the Manuel Calvo drew off a bit as dusk approached. At 6 o'clock she backed still further out of range of the possible radius of drift from the wreck and received wireless messages from the Georgic and the Caribbean, stating that both vessels were steaming under forced draught for the Oklahoma.

Captain Bonet said that his position became precarious as darkness came on, because he was not equipped with a searchlight and had no means of ascertaining his proximity to the wreck. So he sent out wireless messages to the Caribbean and the Georgic, warning them of the danger of the wreck and proceeded under just enough speed to make headway until 8 o'clock in the evening, when the Georgic was sighted.

The captain of the Georgic asked him for the Oklahoma's position, and then informed him that the White Star line freighter would go to the distressed vessel's assistance.

After this exchange of messages, Captain Bonet resumed his course and headed for New York.

During the night the Caribbean steamed toward the wreck, but she did not reach it because she received a wireless from Captain Graalfs, of the Bavaria, announcing his rescue of eight of the Oklahoma's survivors.

Five more survivors of the Oklahoma were picked up in the ocean early in the afternoon of January 4, after drifting in a lifeboat more than six hours. To rescue them three officers of the Booth Line steamer Gregory risked their lives repeatedly by leaping fully clad into the icy waters of the Atlantic. Third Officer Roberts did not even remove his shoes when the lifeboat in which cowered the half-frozen seamen capsized alongside the Gregory. His companions in rescue were R. H. Buck, the chief officer of the vessel, and Second Officer Sidney Williams.

Eleven men were in the lifeboat sighted by the Gregory. Two of them were swept overboard as the boat pitched about in the waves. Three others drowned when the lifeboat upset almost alongside of the Gregory, just when succor was at hand. The sixth was hauled half way up the ship's side by Third Officer Roberts, who nearly lost his life rescuing the man from the water, when it was discovered that the man was dead.

Dr. Kirby Basset, the ship's doctor, called to Roberts that his effort was useless. As the third officer's strength was ebbing fast, he let go of the limp form in his arms. It splashed back into the sea from which he had struggled to save it.

The stories told by the men rescued by the Gregory confirmed that sent by wireless from the Bavaria by Captain Gunter, of the Oklahoma, that the latter vessel broke in two amidships, and that the sections drifted away from each other.

In the stern of the ship, from which those rescued by the Gregory escaped, were the engines, which kept pounding away after the mishap. Smoke poured from her funnel, while her propeller, partly out of water, raced madly. When the rear of the broken vessel settled and sank, almost thirty minutes after she broke in two, the blades were still spinning.

According to the narrative of the seamen, the Oklahoma, which was running light from here to Port Arthur, Tex., was picked up at either end by giant waves. While she hung thus suspended, a third great comber washed high over her side and settled with a deadening crash on her deck. The strain was more than the vessel could bear. Like a frail wooden bridge beneath a heavily loaded truck the Oklahoma sagged, cracked and broke into two.

The Oklahoma was owned by the Gulf Refining Company, of New York City.

MESSAGE TO EXPLORER MACMILLAN IN THE FAR NORTH

Through the Arctic regions on the night of December 24 last, a wireless message from the sponsors of the Crocker Land expedition sped to its leader, Donald B. MacMillan, and his companions, at Etah, Greenland, 1,600 miles away. It was a Christmas message from the American Museum of Natural History, the American Geographical Society and the University of Illinois, and was signed by Dr. Edmund O. Hovey, of the Museum, director of the expedition.

It was looked on as a good gamble that it would reach its source, and though the wireless outfit of the party is expected to have caught it, it is not powerful enough to send an answer, which is tantalizing to those who want to know about the expedition.

The message to MacMillan was sent to G. J. Desbarats, Deputy Minister of the Naval Service at Ottawa, and then forwarded to the wireless station at Fogo, Newfoundland, for its leap of 1,600 miles to Etah. It reads as follows:

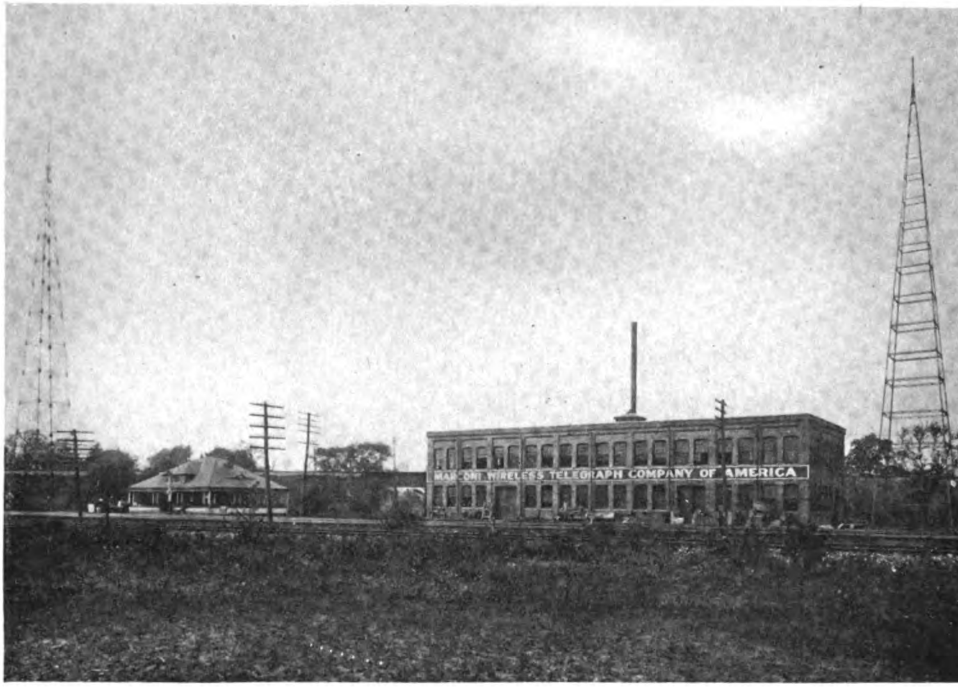
"Heartiest greetings and best wishes from Museum, Geographical Society and University of Illinois, and from family and personal friends of yourself and all your party. We are well and are confident of your success in spite of all difficulties, though no word from you has come through yet. "E. O. HOVEY."

Donald B. MacMillan

"We were encouraged by the reports of Roy Andrews, a Museum explorer," said Professor Henry Fairfield Osborn, president of the Museum, "to send a wireless message to the expedition, because Mr. Andrews, who was on the Adventuress in the Arctic last summer, was enabled to get even baseball scores by wireless, while not being able to send any long distance messages. We hope the message will reach its destination."

"We believe the wireless outfit at Etah is unable to get into communication," Dr. Hovey said, "but it will be able to take the message sent to it. The Canadian Government has arranged, however, to stand by every Tuesday evening from 10 to 11 p. m. for signals from Etah. When a station is established at Port Nelson, it will be possible, I am sure, for the Etah station to get in touch with us."

Another wireless communication containing messages from the members of Mr. MacMillan's family and personal friends was sent to the explorer on December 31.



Where the Wireless Sets are Made

A MOST interesting detail that strikes one who for the first time is surveying the manufacturing end of the wireless business is that practically all the American apparatus in commercial operation is made under one roof. This unique and enviable trade situation was brought about less than two years ago with the purchase by the Marconi Company of the assets of its only formidable rival and the establishment of a manufacturing plant at Aldene, N. J. At the time it was considered that generous allowance had been made for increased production as the business progressed, but so rapid has been the extension of commercial wireless telegraphy it has been necessary to run the factory continuously, day and night, for months at a time.

The location of the factory at Aldene was influenced by convenience to the New York headquarters, exceptional shipping facilities and ideal hygenic conditions. Its situation also permitted the erection of an aerial of no mean proportions, and the factory has been equipped to make exhaustive tests of new apparatus under actual working conditions, thus eliminating all chance of future breakdown. Perfect lighting arrangements were another important consideration, and no effort has been spared to provide sanitary and healthful quarters for the several hundred employees.

The building has been arranged with a view to greatest efficiency and economy of space; it is "L" shaped, with a floor area of 20,000 square feet. The testing department, transformer room, plating room, two large stock rooms and the power plant are located on the first floor.

The second floor contains the machine shop, tool rooms, research laboratory and the factory offices.

Ample protection is at hand in case of fire; the company maintains its own fire department with a full equipment of fire-fighting apparatus, and the two separate companies are given a fire drill twice a month.

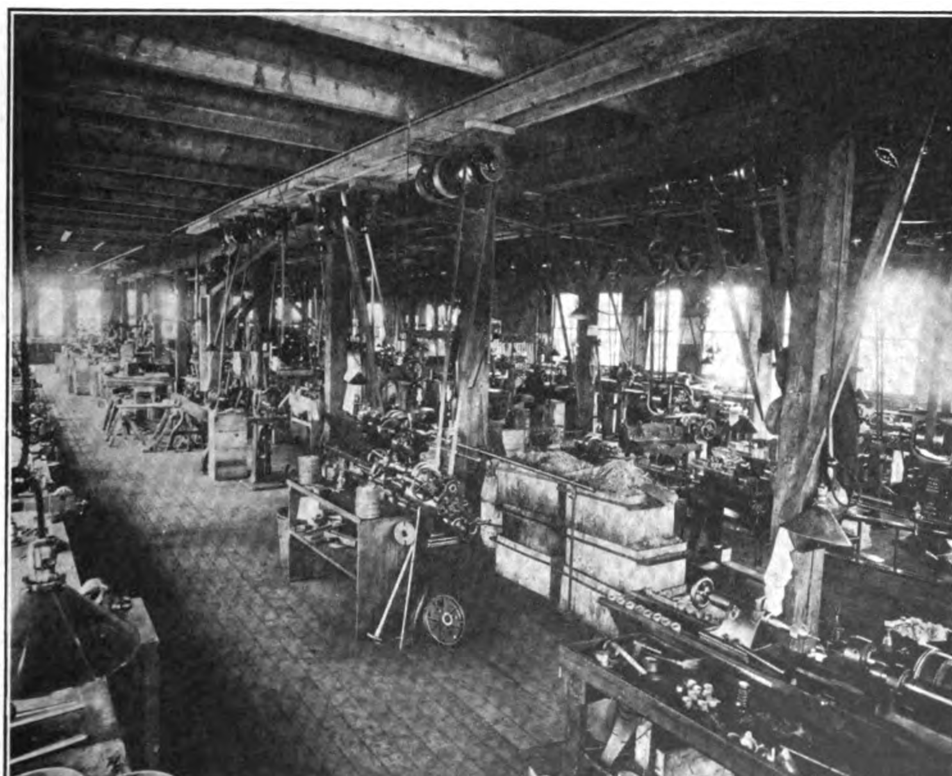
That the Marconi Company is engaged in the manufacture of wireless apparatus on a large scale is clearly indicated in the photograph showing a general view of a portion of the machine shop. Nearly a hundred different types and styles of machines are installed, and it is here that the numberless parts which go to make up the complete apparatus are machined and prepared for the various assembly departments.

The machine shop is in charge of a skilled foreman, whose extensive experience has given him an intimate acquaintance with the mechanical details of radio apparatus, and the specific work assigned to each man is closely followed to its completion under a new and comprehensive checking system.

Not all machine work is completed in this department. The more intricate parts of an equipment are turned out on milling machines, which cut, shape and form parts of irregular form and design. One of the photographs gives a general view of this department, and the trained mechanic will recognize it as being completely equipped and modern in every detail.

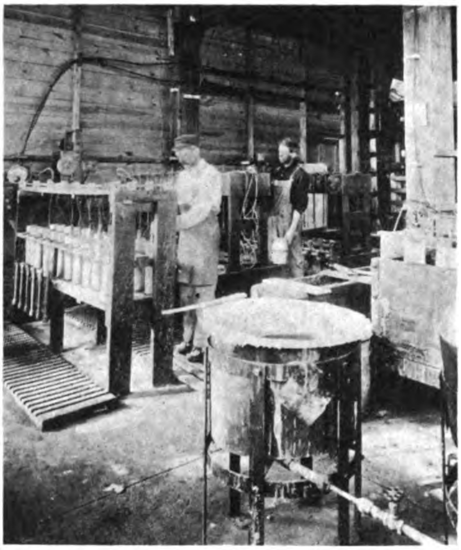
No manufacturing establishment would be complete without its precision department, and one of the rows of precision lathes is shown in a view of this department. It is here that those parts are made which require almost microscopically accurate machining, and are of too delicate a nature to be handled in the machine shop proper. The mechanics of this department are especially picked for their skill, and accuracy to the one thousandth part of an inch is part of their everyday work.

One of the most interesting features of the plant is its transformer department, in the photograph of which may be seen transformers in all stages of construction. Constituting a very important factor in wireless transmitting



A General View of the Machine Shop, Containing Nearly a Hundred Different Styles and Types of Machines apparatus, the windings of this device consist of many thousand feet of very fine wire, wound and formed into "pancake" coils. After winding they are stacked up in sections, taped with linen and impregnated with a high-insulating compound. This is done under vacuum requiring apparatus of special construction and manufacture, peculiar to the Marconi Company.

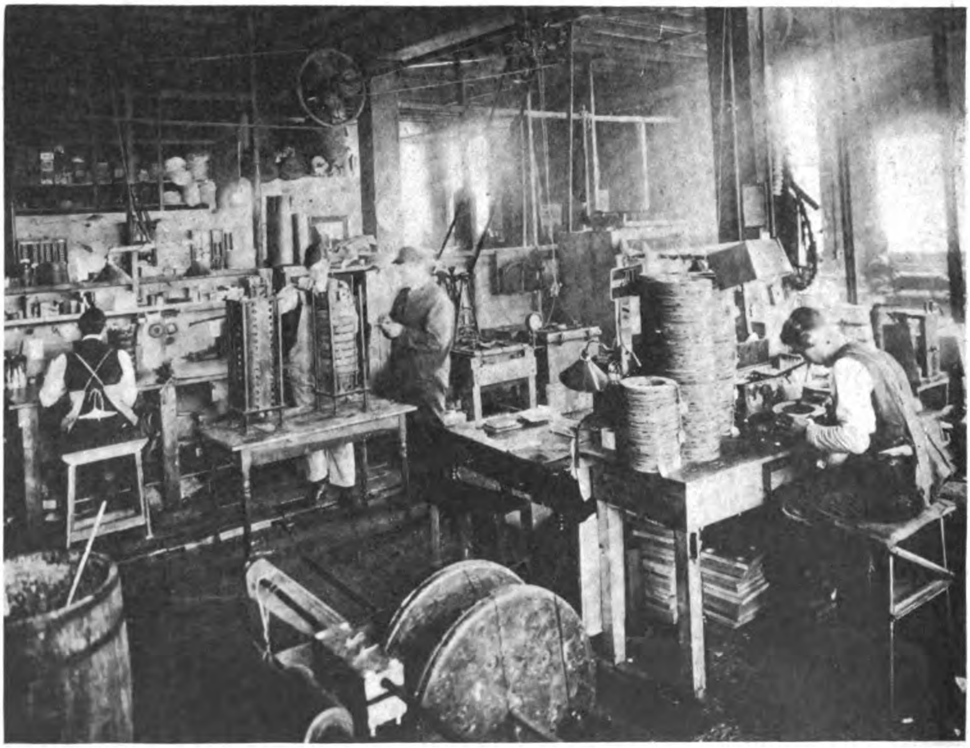
After the coils are passed through this process, they are baked in the special oven shown in the photograph for several hours at a very high temperature, making them strong electrically and mechanically.



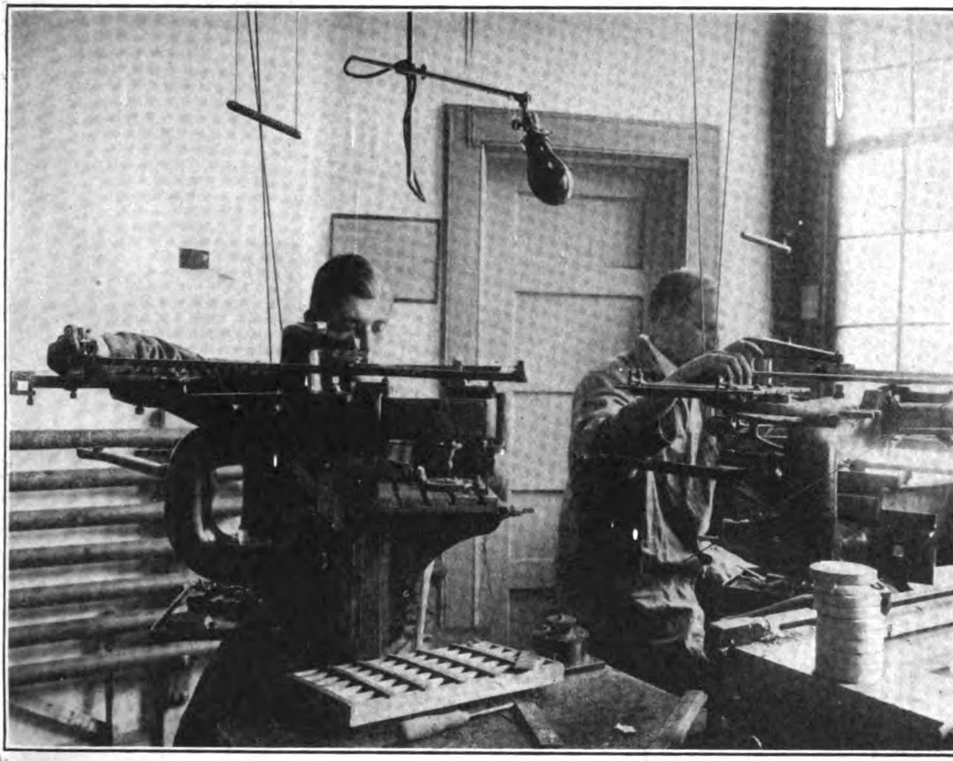
The Plating Room, where the Glass Condenser Jars are Copper-Plated Inside and Outside

The machine for winding the coils is also shown in the photograph (center), and to the right an employee is making an electrical test of one of the "pancakes" for any break which may have occurred. To the left of the picture is shown a transformer in process of assembly.

The power or electric light engineer will find many things of interest in this photograph, as the construction of these dry, high-po-



Where the transformers are built. In the center of the room may be seen the winding machines, on which are wound the small pancake coils. After being submerged in a tank of compound the coils are baked in a large oven, making them electrically and mechanically strong.

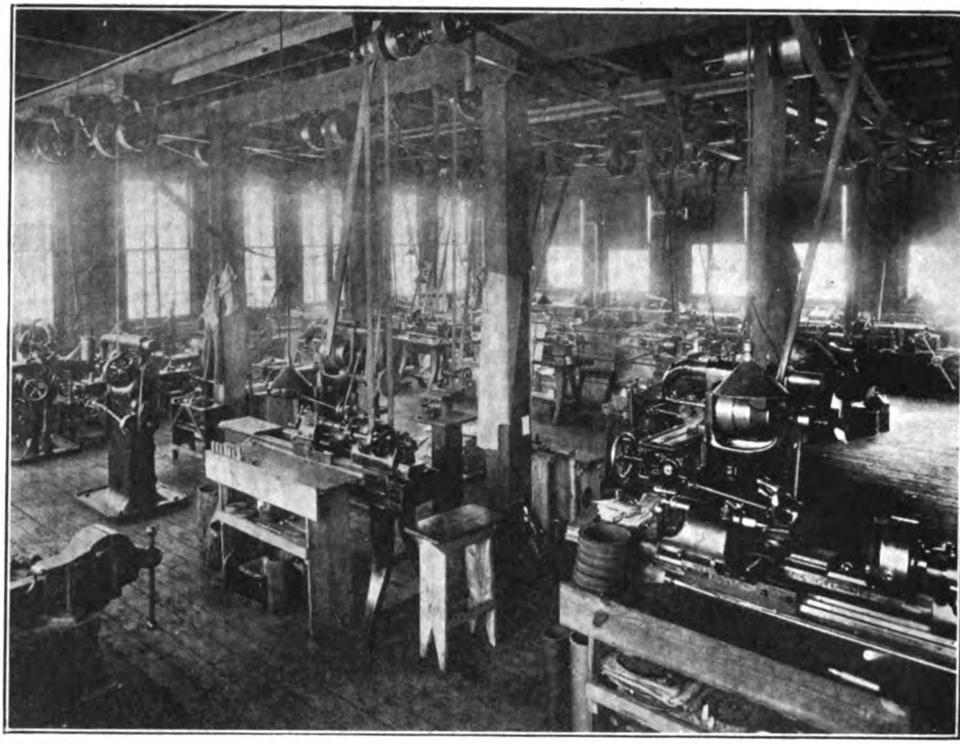


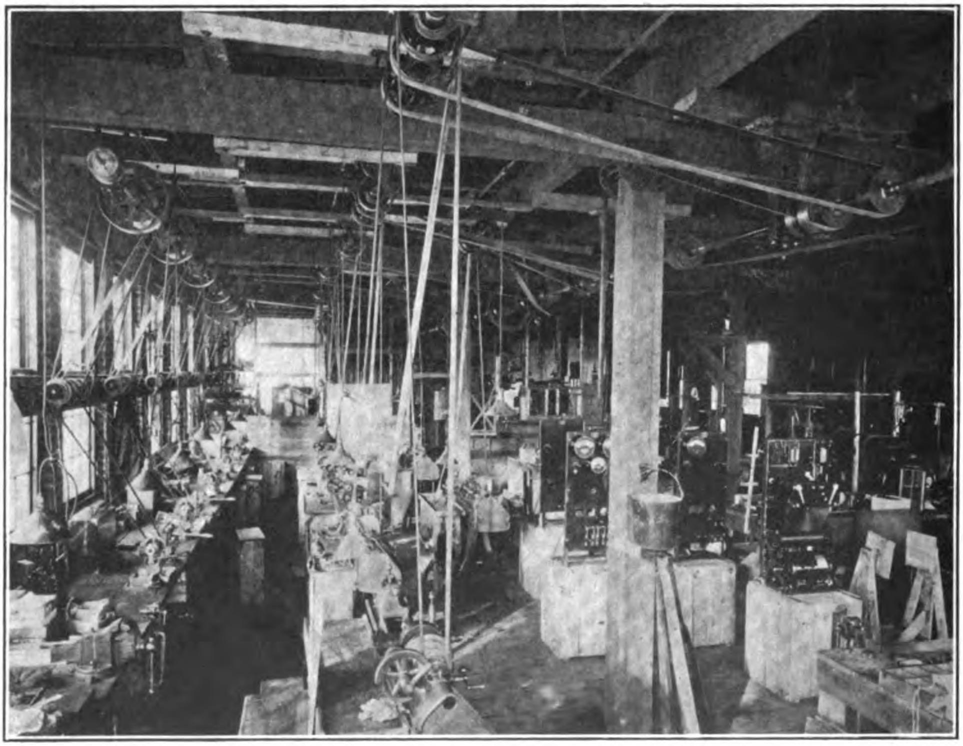
Many of the instruments require special markings, figures, letters and scales. Such work is done in the engraving department, on special machines of the pantograph type.

tential transformers has always been more or less a mystery.

In another view is shown the electroplating room, where glass jars are electrically coated inside and outside with copper to the thickness of one hundredth part of an inch. When completed, the jars are known in wireless telegraph language as condensers or leyden jars, and are one of the essential features in the production of wireless telegraph waves.

In this room all the apparatus is tested and inspected by a corps of experienced men.



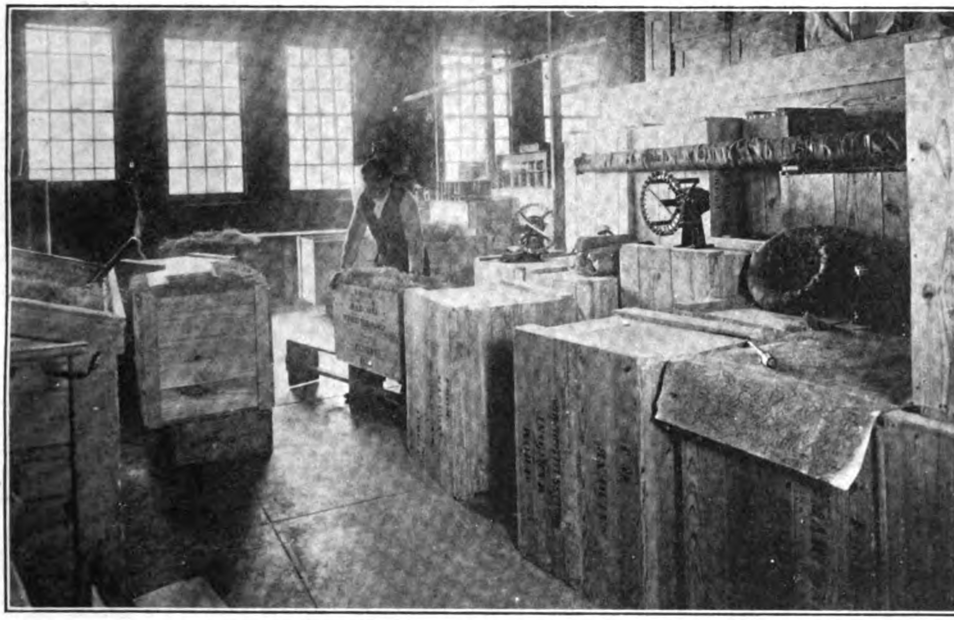


Above, a general view of the milling department, showing the large and small-sized machines. Below, a row of small precision lathes on which the small parts of the instruments are made.

Many of the instruments comprising a wireless equipment require special markings, figures, letters and scales, which facilitate the operation of the apparatus in commercial practice. Such work is done in the engraving department, a portion of which is included in the picture, showing two of the engravers at work.

Special engraving machines of the pantograph type are employed, permitting the work to be done rapidly and with unfailing accuracy.

After the radio equipment has passed through all departments, it is placed in the various stock rooms. All orders for material to be shipped are turned over to the ever-active shipping and packing department. This department draws orders for equipment on the various stockrooms, and many thousands of dollars' worth of equipment material pass through it each month. The packing and shipping department is located adjacent to the private railroad siding, allowing material to be directly loaded on the cars.



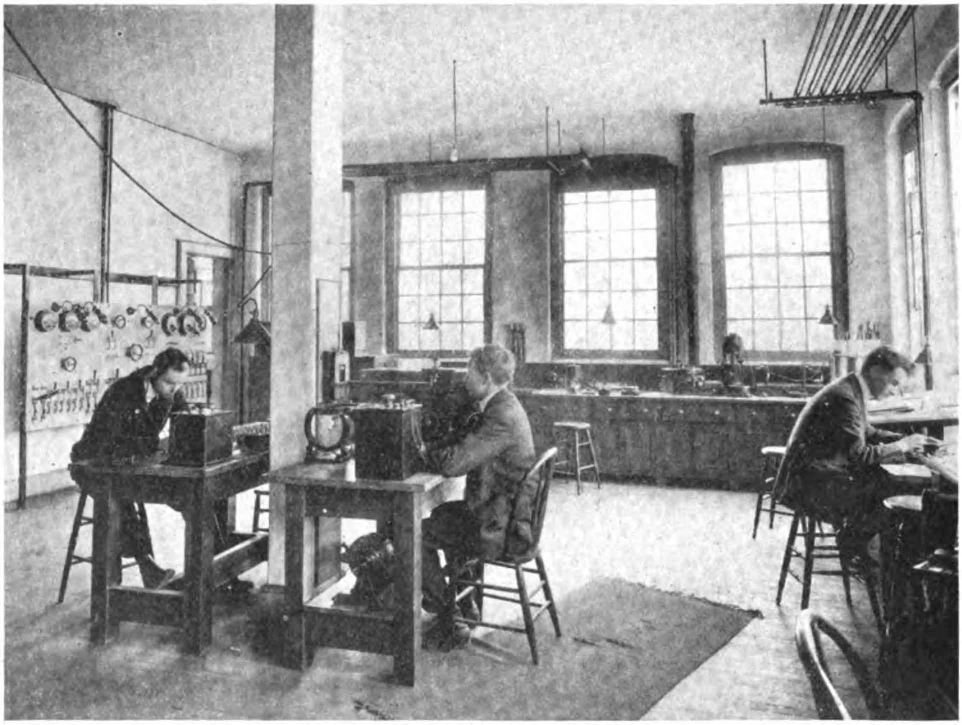
Orders for material to be shipped are turned over to the shipping department, through which many thousands of dollars' worth of equipment material pass daily.

No apparatus is placed in stock or shipped until it has undergone thorough inspection at the hands of the corps of experienced men. A partial view of the testing department is represented, showing various types of radio equipment previous to the exhaustive tests for efficiency and possible flaws.

This photograph shows some of the higher power wireless equipments on the floor previous to subjection to a series of practical tests. The results are carefully noted, and should any defects appear the apparatus is returned to the shops for correction of faults.

Of especial interest to our scientific readers, the photograph of the private research laboratory, operated under the guidance of the company's research engineer, shows where the original investigations are made, new ideas developed and new apparatus evolved. This laboratory is equipped with electrical instruments of such extreme precision that experiments may be conducted with absolute accuracy. Wave meters and special tuners are also calibrated in this department.

To the left of the photograph may be seen a large switch board, through which electricity is available at a pressure of 100 volts D. C., 100 volts, 60



The research laboratory, operated under the guidance of the company's research engineer, where the original investigations are made and new apparatus evolved.

cycle A. C., 500 volts D. C., 220 volts, 240 cycle A. C., 110 volts, 120 cycles A. C., and an extremely high frequency generator giving 300 volts at a frequency of 100,000 cycles. The department is thus fully equipped to carry on experiments with transmitting apparatus over a wide range of frequencies and voltages, insuring the efficiency of the factory's product.

THE SHARE MARKET

New York, January 22.

As predicted in the January issue, the upward turn in the stock market began a few days ago, and to-day securities have been carried forward with as much vigor as at any time since the beginning of the improvement now under way.

The advance, of course, has induced much profit taking with the professional traders, but this selling has not seemed to check the forward impulse. Many held the view that the rise had been proceeding at a too unusual pace, and its continuance could not confidently be looked upon, therefore the steadiness of the advance is all the more noteworthy.

The long-looked-for change in sentiment had its effect on Marconis, but for some reason unexplicable to the brokers, Canadians have not profited by the upward trend of the market, although English and American issues advanced several points.

Bid and asked prices to-day:

American, 5¼—5⅜; Canadian, 2—2⅜; English, common, 19—20½; English, preferred, 15—17½.

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, the College of the City of New York

ARTICLE V

A recent classification of alternating currents as forced and free is explained by the author in the article published in this issue. The various types of discharges in arcs and spark gaps are considered, the types of discharge being properly classified. The conditions of production of each of these types of discharge and the efficiency obtained are given. The modern Poulsen arc is considered in detail, together with its conditions of highest efficiency and ease of manipulation. A novel method of obtaining a steady flow of energy at wave lengths between 250 and 1,000 meters wave length by means of the arc is shown, and the larger arcs are described in construction and operation. The measurement of capacity at radio frequencies and moderate voltages, using forced alternating currents, is then discussed by the author.

IN the measurements so far considered we have employed radio frequency oscillations which may be called "free alternating currents." These have been referred to as "damped oscillations," but the newer term is preferable because it conveys the correct impression, namely, that the electromagnetic energy stored in its circuit becomes transformed into heat, radiated waves, or other forms of energy. It is, accordingly, one which is left to decay *freely*. We have produced such free alternating currents by means of buzzer or spark excitation circuits.

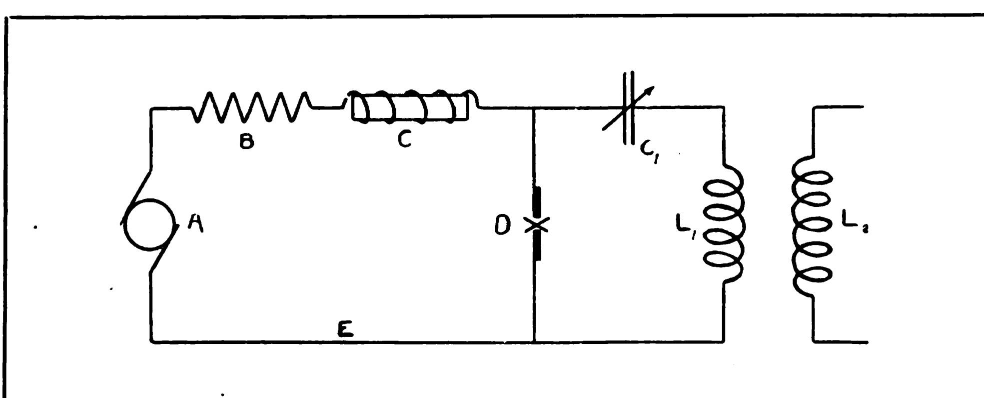


Fig. 23

we have an alternating current which is *not* being maintained by energy supplied from some other source, but one which is gradually diminishing in amplitude as

We propose now to employ an alternating current of constant amplitude. An alternating current of this description requires that energy shall be continually supplied to the circuit in which it flows to make up for the inevitable energy dissipation. We shall therefore call it a

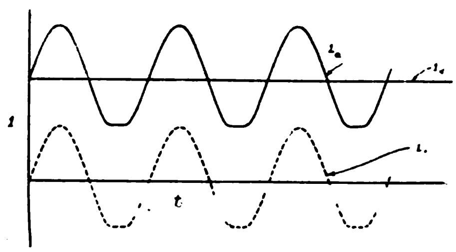


Fig. 24

"forced alternating current." It is quite easy to secure such forced alternating currents at audio frequencies, the ordinary alternator being an example of the appropriate form of generator. When radio frequencies of 20,000 cycles per second and beyond are required, the problem of obtaining such a current becomes difficult. It is hardly to be expected that such apparatus as the Alexanderson high-speed radio frequency alternator, or the Goldschmidt "reflector type" alternator, or the Arco audio frequency alternator with frequency transformers to bring the energy to radio frequencies, or any of the similar pieces of commercial apparatus, may be found in the laboratory equipment of the ordinary experimenter at the present time. We shall therefore confine ourselves in the detailed description of apparatus to the simplest available means of producing forced alternating currents of radio frequencies, namely, the Poulsen arc. Its construction, practical manipulation, and a valuable method of obtaining relatively short waves by its use will be considered.

We shall, however, first consider the phenomena produced by gap dischargers arranged as in Fig. 23. In this diagram, A is a direct current generator (generally of voltage between 200 and 1,000 volts), D the gap discharger, B a regulating resistance for controlling the flow of current through D, C a choke coil or reactor designed to steady the direct current flowing through D and also to prevent any radio frequency alternating current from flowing back into the generator, A. In some cases it is of advantage to place a second choke coil in the branch, E, of the supply circuit.

Shunted across the discharger is the circuit L_1 C_1. It is coupled inductively with L_2, thereby enabling any radio frequency energy to be transferred from L_1 C_1 to the energy absorbers connected to L_2. Following the usage recommended in the Preliminary Report of the Committee on Standardization, Proceedings of the Institute of Radio Engineers, Vol. 1, No. 4, December, 1913, we may call D an "arc converter," inasmuch as it is an arc used for converting direct to alternating or pulsating current. Arcs like this are divided into three classes, which we shall consider in order. The direct current referred to is that supplied by the generator, A, and the alternating current is that flowing in the circuit, L_1 C_1.

Type (1).—Those for which the amplitude of the (approximately) sinusoidal alternating current produced is less than that of the direct current. If we call the direct current i_d, and the current through the arc i_a. Fig. 24 shows the current curves plotted against time. It will be seen that i_a, the arc current, is the sum of the direct current supplied to the arc and the alternating (nearly sinusoidal) current flowing in the shunt circuit L_1 C_1. The arc current never reaches the value zero, as is also clear from the figure, because the amplitude of the alternating

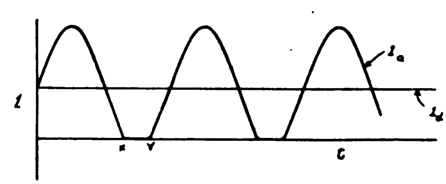


Fig. 25

current is less than that of the direct current. To produce currents of Type (1), the resistance and inductance in the direct current supply circuit must be large, the current through the arc small, and the effective resistance of the circuit, L_1 C_1, small. This last condition is in part equivalent to the statement that no circuit capable of absorbing *considerable* energy may be closely coupled to the circuit L_1 C_1.

The currents of this type being nearly sinusoidal are capable of giving very

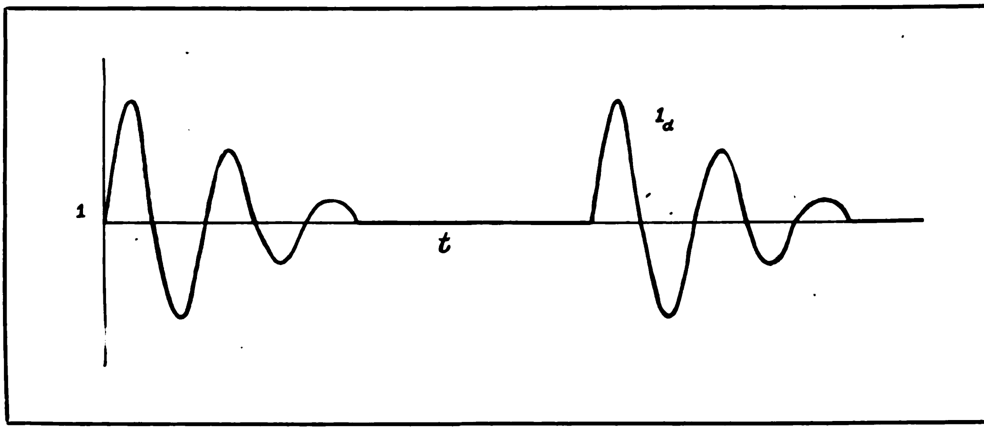


Fig. 26

sharp resonance effects, and may be useful in measuring work, and (rarely) for short range radio telephony. They are generally very steady and fairly constant in amplitude. However, as can be seen from the conditions of their production, only a very limited amount of energy can be thus obtained, and the efficiency of the whole arrangement may be as low as 5 or 10 per cent.

Type (2).—Those in which the amplitude of the (approximately) sinusoidal current is at least equal to that of the direct current, but in which the direction of the current is never reversed. These conditions are illustrated in Fig. 25. It is obvious that during the time represented by the space, XY, the arc is extinguished. During this time the voltage across the condenser, C_1, is gradually rising, until at Y its value is sufficient to cause the arc to start again. It is clear that, whereas in Type (1) the frequency of the alternating current produced is very approximately what would be expected in a circuit of the constants, L_1 and C_1, in the case of Type (2) this is not the case. For we must consider in this case that the supply circuit is capable of charging the condenser, C_1, at a limited rate, and that the period between successive pulses of current through the arc may be considerable. In fact, the period in question is very markedly affected by the length of the arc and the corresponding arc voltage.

In order to produce currents of Type (2), the supply current must be somewhat increased, and arrangements for absorbing a greater quantity of alternating current energy in the circuit connected to L_2 should be made. In addition, and this is a particularly important feature if considerable energy is to be drawn from the arc, special means are required to cool the arc powerfully, thus diminishing ionisation and consequent conductivity in the arc as much as possible. The means of cooling employed are very diverse. Some of them follow:

(a) The use of metallic electrodes, *e. g.,* copper, silver, aluminum.

(b) The use of an atmosphere of a gas of high cooling power, *e. g.,* hydrogen, alcohol, steam, moist hydrogen. Also rapid gas streams.

(c) The use of rotating electrodes.

(d) The use of powerful magnetic fields to quench the arc rapidly.

(e) Water or air cooling of the electrodes.

In addition, the arc discharge is sometimes divided so that several dischargers in series are employed, thus limiting the heating in each.

It may be immediately stated that the type of alternating currents used in practical radio telephony is almost always Type (2). This is because the energy which can thus be obtained is quite considerable. Ten or twenty kilowatts *actual output* seems to be somewhere near the upper limit at present. The efficiency of the arrangement is generally about 15 per cent, but under favorable conditions may rise to 20 per cent. or

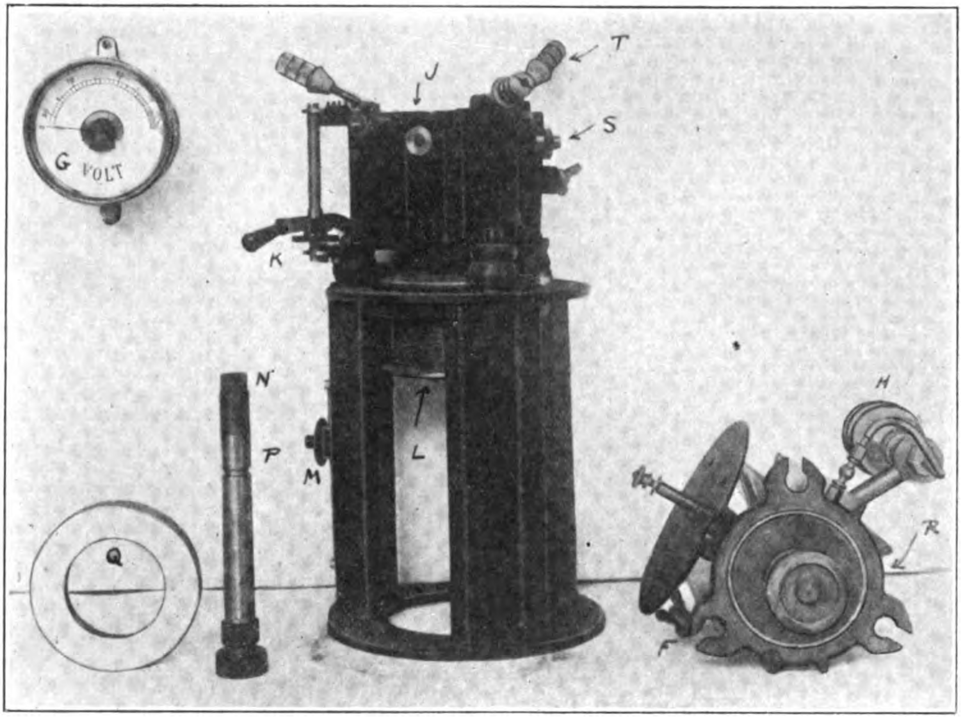


Fig. 27

even more. To realize the highest efficiency, it is desirable to reduce the control resistance, B, to a minimum, and this can be accomplished to a certain extent by the use of a generator, A, of proper characteristic, somewhat on the plan of the old Thomson-Houston arc light dynamos. The practical details and operation of these arcs are given further on in this article.

Type (3).—Those in which the amplitude of the initial portion of the free alternating current is greater than the direct current passing through the converter, and in which the direction of flow of the current is periodically reversed.

The arc current for this case is shown in Fig. 26. It will be seen that each train or group is separated from the next by a period during which no current passed through the gap. Generally speaking, alternating currents of this type are produced when the natural damping of the gap discharger (due to the rapidity of de-ionisation and loss of conductivity) is less than that required to produce alternating currents of Type (2). Discharges of this type are obtained in ordinary spark gaps, and usually in quenched spark gaps as well. The period of the current produced is very closely that to be expected in such a circuit as L_1 C_1, unless the damping of the gap is very high, in which case the frequency may be somewhat diminished. Currents of Type (2), and to a smaller extent those of Type (3) are capable of producing "impulse excitation" in the secondary circuit connected to L_2. That is, even if the period of the latter circuit is slightly different from that of the circuit, L_1 C_1, it is possible to excite in the latter circuit alternating currents of appreciably the period and damping which are natural to the latter circuit. This is a very valuable method for producing slightly damped free alternating currents for radio telegraphy, because by this method the reaction of the secondary circuit on the primary circuit, L_1 C_1, is, in effect, eliminated. Currents of very low damping, capable of yielding sharp resonance effects, can be thus obtained.

We pass now to a consideration of the

actual apparatus and methods of operation for the more important of these types of current, namely, Types (2) and (3).

Section 15.—THE POULSEN ARC. Essentially the Poulsen arc consists of an arc between a carbon electrode and a copper electrode, the copper electrode being connected to the positive side of a direct current line and the carbon to the negative side. It is usually not practical to run such an arc on 110 volts, because the drop across the arc (which may be from 70 to 120 volts in the smaller arcs with weak magnetic fields or no field at all) is too large a portion of the total voltage, and the regulating resistance cannot function properly to keep the arc current reasonably constant. The arc will flicker badly, and accurate work will be impossible. For arcs using up to about 2 kilowatts, supply energy of 220 to 250 volts may be used with satisfaction. For greater inputs, it is advisable to use 500 to 600 volts, or even 1,000 volts in the arcs absorbing 25 kilowatts or more. We shall consider first a small arc which is very useful for measuring purposes and radio telephony, being rather steadier in operation than the larger models. The arc in question, which is shown in Figs. 27, 28 and 30, is intended for an input of about 500 watts. The maximum steady output is from 30 to 50 watts.

Such an arc can be used at wave lengths from 1,000 meters *up* only, as it does not work at all well at lower wave lengths. However, by an ingenious arrangement which will be given, it is possible to draw a steady supply of energy at wave lengths as low as 250 meters from this type of arc. The regulating resistance, B, should be variable between about 30 and 150 ohms and capable of carrying about 5 amperes. It can be conveniently made of a lamp board rheostat. the resistance being readily varied by altering the number of lamps which are placed in *parallel* on the board. The choke coil, C, is of no great importance in the case of this small arc, the inductance of the line and generator being generally sufficiently high to prevent the radio frequency currents from "backing up" into the generator.

The arc itself is shown disassembled in Fig. 27. Here G is an 0-150 volt voltmeter, which is placed directly across the arc, and shows when the arc is burning steadily. P is the carbon electrode holder, consisting of an insulating (fiber) handle, an iron rod, P, and the copper springy holder of the carbon, N. P fits into the center of the coil, L, which produces a magnetic field, the lines of force of which run up the rod, P, and then spread outward radially to the iron ring surrounding the copper electrode, R. The coil, L, and the regulating resistance, M, are placed in series across the supply line. The radial magnetic field thus produced is not a powerful one, and its sole func-

Fig. 28

tion is to cause the arc to rotate slowly to fresh points on the electrodes, thus causing even wearing. It does not act as a powerful "blow-out." K is the handle which, when lifted, raises P into contact with R, thereby starting the arc. The arc length may be conveniently regulated by the small fiber hand wheel just below K. J is a peep-hole covered with mica for viewing the arc in operation, and S is a poppet spring valve for releasing the excessive

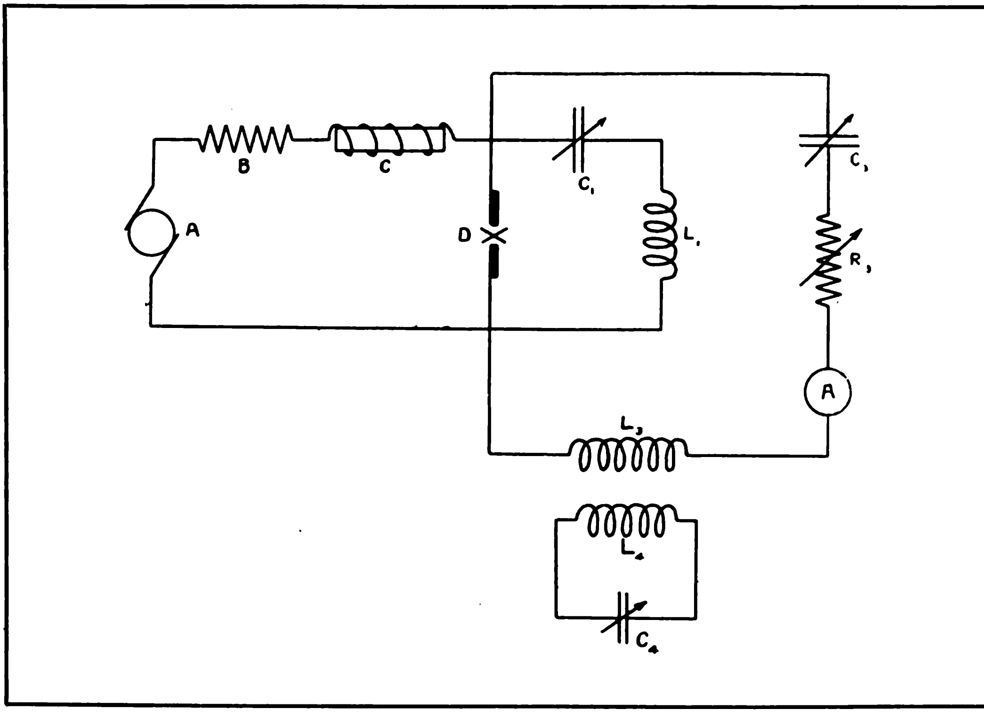


Fig. 29

pressure resulting from the explosion of the alcohol-air mixture when the arc is first struck. This valve is strictly necessary, and is provided in duplicate on each arc. T represents the screw clamps with lava insulating bushings, which hold the upper portion of the arc firmly in place on Q, a plaster of Paris separator faced with asbestos.

The upper part of the arc is shown to the right. H is the alcohol sight-feed cup, and a pipe which leads to a small hole in the center of the copper electrode, R. The iron rim of the copper electrode is visible. F, the binding post of the copper electrode, and the supporting face plate for the voltmeter can also be seen. The carbons used have a hollowed center with a small hole drilled outward and obliquely downward, thus providing for draining away excess alcohol. In Fig. 28 the arc is shown assembled. The cooling vanes on the arc will be seen. It may be mentioned that the carbons are about 0.5 inch (1.2 cm.) in diameter, and that the copper electrode is about 1.5 inch (4 cm.) in diameter to the iron rim. The arc operates in an atmosphere of alcohol vapor, about one drop being fed into the arc every 30 seconds. Denatured ("Pyro") alcohol is suitable, but the interior of the arc chamber requires cleaning less frequently if pure 95 per cent ethyl alcohol is used.

The capacity C_1 (Fig. 23) may appropriately be a variable oil condenser of range up to 0.002 or 0.003 microfarad. With an inductance of about 0.0009 henry for L_1, the usual range of wave lengths will be from about 1,500 to 2,200 meters. Inductances as small as 0.0003 henry can be used at L. Usually the direct current through the arc will be about 2 amperes and the current in L_1 C_1 from 1 to 2 amperes. The current in the circuit coupled to L_1 will, of course, depend on the resistance and other constants of that circuit as well as the closeness of coupling. In coupling it to L_1 it is convenient to start with a loose coupling and gradually make the coupling closer. It will be found that at a certain point the reaction of the secondary circuit on the primary circuit, L_1 C_1, and on the arc is sufficient to extinguish the arc, or at least to stop the production of alternating

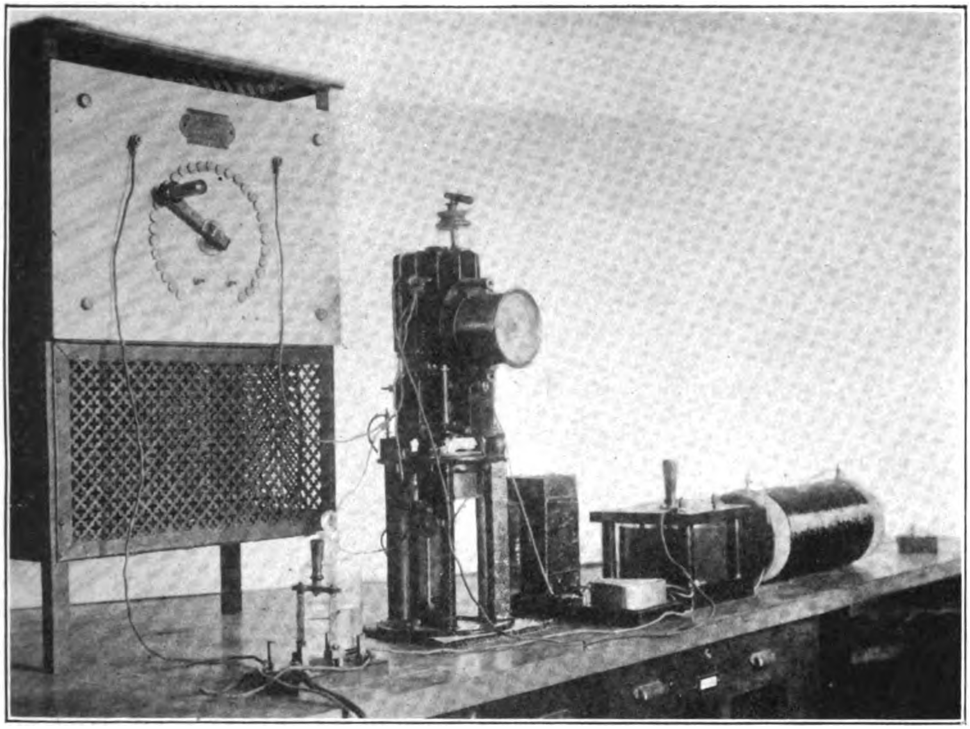


Fig. 30

current. This critical coupling marks the limit of available energy. It will also be noticed that as the coupling is increased, the voltage of the arc itself increases, rising as much as 50 or 60 volts at times.

Section 15A.—SHORT WAVE LENGTHS WITH THE POULSEN ARC. (Triple Frequency Method.) As Professor Zenneck pointed out some time ago, there is a tendency toward the formation of currents of three times the fundamental frequency in arc converters. Mr. Lester Israel has very kindly placed at my disposal his data obtained in the City College Radio Laboratory relative to the utilization of these triple frequency currents. The arrangement of circuits used is shown in Fig. 29. The arc, D, is shunted by two circuits, L_1 C_1 and L_3 C_3. The latter is to be adjusted to a wave length exactly one-third that of the former. That is, L_3 C_3 may be tuned to a range of wave lengths from 250 to 1,000 meters, and energy at those wave lengths drawn in the circuit, L_4 C_4, which must naturally be tuned to the corresponding frequency. It is found in practice that the best ratio of C_1 to C_3 is about 5 to 1. For purposes of observation, it is desirable to place an ammeter in the circuit L_3 C_3. The resistance R_3 *must* be inserted in the latter circuit for steady operation, and its value must be appropriate. A resistance of this description is best made of bare wire wound nearly non-inductively on ordinary porcelain knobs fastened to a supporting wooden base. The value of R_3 is from 3 to 5 ohms.

The effect of this resistance is to make the value of the alternating current in L_3 C_3 nearly independent of that in L_1 C_1. It is found that with the above-mentioned value of R_3, the current in L_3 C_3 is a *forced* current of triple frequency, and the tuning can be most readily accomplished by bringing L_1 C_1 to exactly the fundamental frequency. Variation of the wave length of L_3 C_3 within a range of about 10 per cent by tuning will merely change the current value in that circuit; beyond that change the triple frequency current disappears. If the resistance, R_3, be increased beyond 5 or 7 ohms, the circuit, L_3 C_3, draws too much energy, and the arc is extinguished. For best operation the circuit, L_1 C_1, should be so constructed as to have a minimum resistance, say not more than 1 or 2 ohms. Two alternative methods of procedure are suggested for manipulating this arrangement.

Method A.—(1) Tune the circuit, L_3 C_3, to the desired frequency, namely, that of the circuit, L_4 C_4. Place about 5 ohms in circuit L_3 C_3. (2) Tune circuit L_1 C_1 to a wave length three times that of the circuits mentioned. (3) In case the arc is extinguished (when the circuits are properly tuned), R_3 should be gradually reduced or the ratio of C_1 to C_3 increased.

Method B.—(1) Circuit L_3 C_3 is to be tuned to approximately the period of circuit L_4 C_4. (2) Tune circuit L_1 C_1 to approximately three times the wave length of circuit L_3 C_3, and continue this tuning until the current in circuit L_4 C_4 is a maximum. (3) Tune circuit L_3 C_3 further to increase the current in L_4 C_4 still more if possible.

It is of interest that, if the voltage across the Poulsen arc used in the ordinary and usual way were 60 volts, the best voltage across the arc when using this triple frequency method was found to be about 80 volts. Furthermore, when tuning to the triple frequency, the arc voltage tends to rise to about 90 or more. It is then generally of advantage to reduce the arc voltage to 80 by shortening the arc.

An entire assembly of the small Poulsen arc apparatus is shown in Fig. 30. The regulating resistance, B, is shown to the left, then the arc. Directly to the right of the arc are seen the choke coil, C, and an ammeter, which is in the direct current circuit. To the right, the variable oil condenser and the inductance, L_1, are visible. A useful adjunct is also shown, namely, a single turn of heavy copper wire bent into circular form, its terminals connected to a low voltage tungsten lamp. It is of great assistance in bringing the arc to proper adjustment. Tungsten lamps are preferable for this purpose because they begin to glow when only a small portion of their rated energy is supplied to them, and they will stand considerable momentary overloads without destruction.

In working with the Poulsen arc it must be admitted that the results obtained will depend very largely on the skill of the manipulator. Once the arc has been warmed up by the pasage of current through it for a few minutes and the alcohol has been vaporized, the adept operator will frequently start the alternating current very readily by adjusting B and C_1. The arc operates most steadily when no great amount of energy is drawn from it, a condition readily fulfilled in measuring work.

In Fig. 31 is shown a larger type of arc, capable of developing about 600

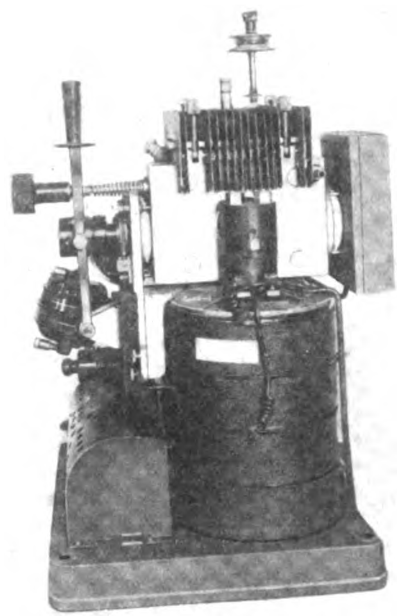


Fig. 31

watts radio frequency energy. It is characterized by an extremely powerful magnetic field across the arc, which may raise the arc voltage itself from 200 to 400 volts. The carbon electrode rotates by motor power. An arc of this type is intended for use on about 500 volts and 7 or 8 amperes. The field magnets are placed directly in series with the arc itself, thereby acting partly as resistance and partly as choke coils as well. Their ohmic resistance is 33 ohms in the arc shown. Two small supplementary *air-*

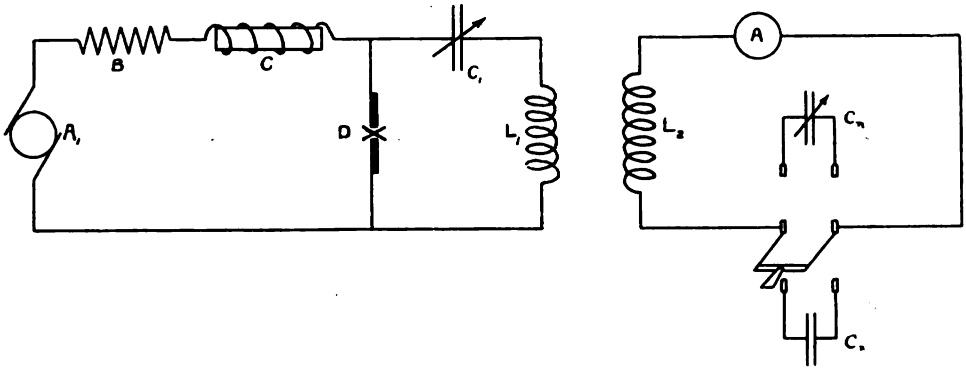


Fig. 32

core choke coils are provided in the direct current line. The distributed capacity of the bulky field magnet windings might permit the passage of some of the radio frequency energy were these air-core single layer choke coils not provided and the high voltage developed might then pierce the field magnet windings. The arc shown in Fig. 28 weighs about 15 kg. (35 lbs.); that of Fig. 31 about 150 kg. (350 lbs.). The larger arcs, because of the intense magnetic field in which they operate, never give quite as steady a flow of energy as the smaller arcs, and there are continued slight changes of wave length in the emitted energy which, in effect, introduce a small damping and diminution of the resonance effects as compared with a true forced alternating current of single frequency.

The condenser, C_1, must be designed for this work. It is to be noted that the voltage across the condenser may easily rise to two or three times the direct current line voltage. If the circuits are touched, the shock obtained is not particularly severe, but a disagreeable burn is produced unless the current-carrying wire is *firmly* grasped. The usual Tesla coil resonance effects and single wire lighting can be shown very beautifully on the larger arcs.

We shall defer the consideration of the Moretti arc, the Chaffee arc and the Scheller quenched spark gap for the present.

Section 16.—MEASUREMENT OF CAPACITY AT RADIO FREQUENCIES AND MODERATE VOLTAGES, USING THE UNDAMPED ALTERNATING CURRENTS. The method is identical in theory with that given in Section 9 of Article 2 of this series, with the exception that the "undamped" currents are used. Consider Fig. 32, which gives the circuit diagram for this method. As will be seen, the secondary circuit contains either the unknown condenser, C_x, or a variable known as condenser, C_n. In each case the circuit is brought to resonance, as indicated by the ammeter, A. To bring the circuits to resonance, it is convenient to vary L_2, C_1, or L_1. Obviously, under the conditions mentioned above, $C_x = C_n$.

If a telephone receiver is to be used as an indicator, a tikker must be added. The tikker is merely a make-and-break contact which intermittently connects the telephone to a large "storage" condenser placed in the circuit. The tikker contact is best made of gold wires, though a rotating wheel with a wire contact across it has also been successfully used by Dr. Austin. The coupling to the circuit, L_1 C_1, must naturally be very loose if the telephone is used, or the sound obtained will be excessively loud. The tikker is not recommended for this method because the ammeter far exceeds it in operating simplicity under these conditions, and practically equals it in accuracy. The accuracy of the experiment will be found to be 0.5 per cent without any unusual precautions. In fact, these "undamped" currents naturally lead to very accurate results, because of the sharpness of the resonance effects.

This is the fifth article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The sixth will appear in an early issue.

French Radio-Phone Apparatus

By H. WINFIELD SECOR

THE accompanying illustrations show ingeniously constructed wireless telephone apparatus of French manufacture.

In Fig. 1 is pictured a novel form of arc generator for producing the undamped oscillaions. The power of this unit is sufficient to send radiophonic speech over a distance of 18 to 30 miles, depending upon the size of aerial may be utilized. Water is circulated about the positive electrodes, assisting cooling. The arc takes place under a powerful magnetic field, supplied by the electromagnet coils E, Fig. 2. The magnet coils are excited by an independent circuit taken from the potentiometer resistance R, at points R and C′. Hence the strength of current supplied the magnet coils is readily adjustable.

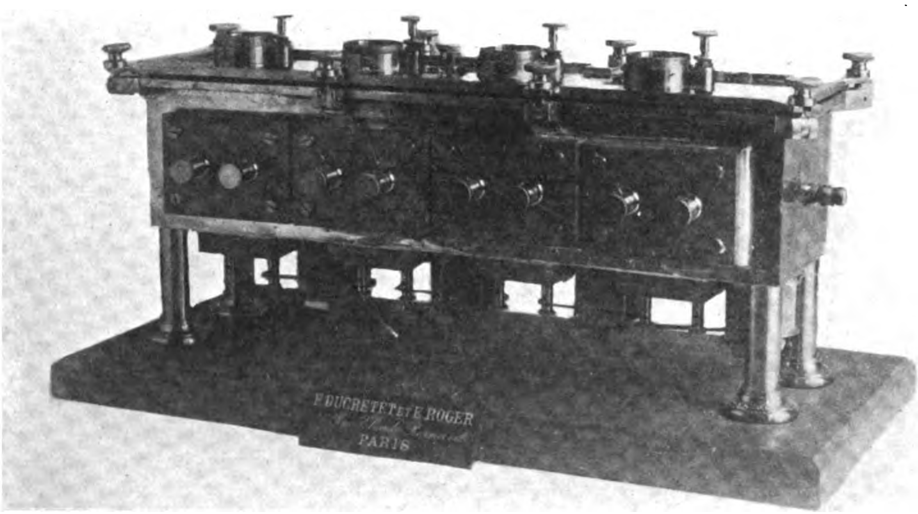


Fig. 1

employed and other physical conditions.

The arc is unique in several ways. It is composed of 4 individual arcs connected in series and is designed to be excited from 350 to 450 volts direct current circuit. The connections are clearly shown in the diagram, Fig. 2. The arcs are surrounded by gas chambers and hydrogen or illuminating gas

The arcs are provided with glass peep holes and safety valves to relieve the pressure, which sometimes reaches a high value in a short period of time. The ammeter A′ measures the quantity of current taken by the arcs. The amount of current may be varied by moving the slider C, on resistance coil R. Two choke coils are inserted in

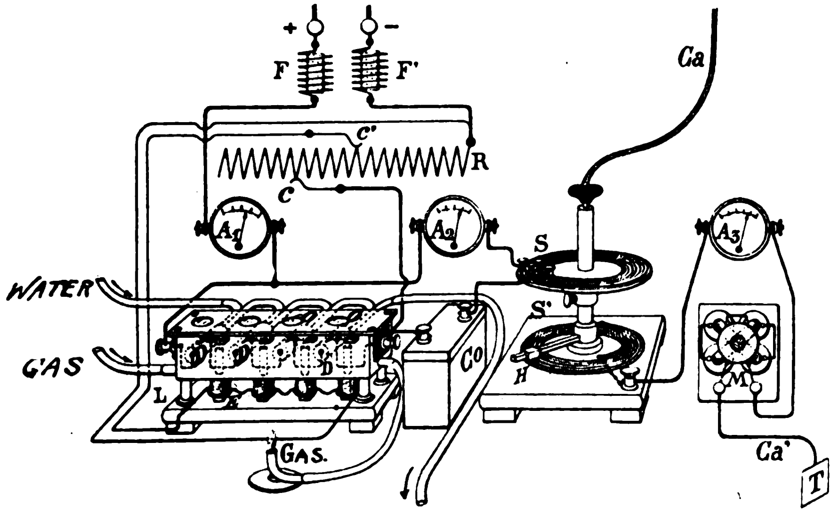


Fig. 2

series with the supply mains at F and F'. These prevent the high-frequency oscillations produced by the arc from surging back through the feed wires. A gas flame is lighted on an exhaust pipe taken from the arc chambers, tending to promote a good circulation of gas through and around the arcs.

The closed oscillating circuit shunted around the 4 arcs includes the high-potential condenser Co, hot wire ammeter A2, and the primary coil of an oscillation transformer S. Various numbers of primary turns may be used by attaching the lead wires to the different binding posts provided, as shown in Fig. 2. The co-efficient of coupling between the primary and secondary S' of the oscillation transformer is variable by raising or lowering the primary coil. It may be clamped in any desired position by a thumb screw. The coils or spirals of this transformer are of copper strip; a rotating arm is provided which permits of gradual variation of the inductance in use. The aerial is connected through the lead wire Ga to the upright metal standard of the oscillation transformer, which in turn is connected to the secondary contact arm already mentioned.

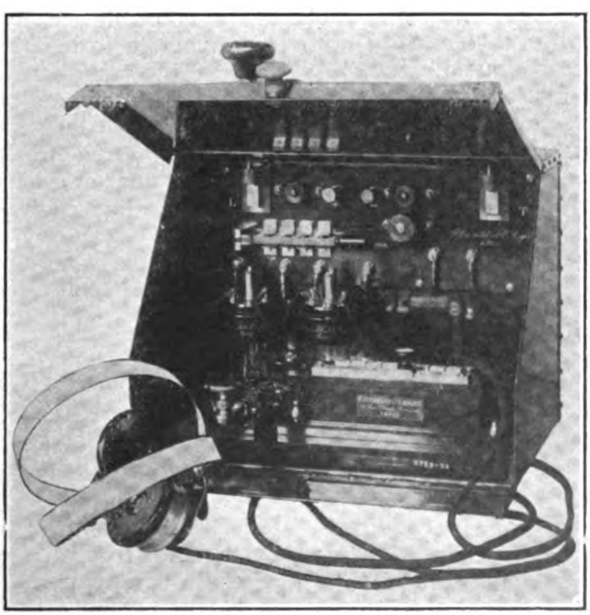


Fig. 3

The secondary of the transformer is connected in the aerial circuit; also the hot-wire ammeter A3, and the radiophone transmitter M, which consists of 4 microphones. The four separate transmitters are mounted horizontally on a wooden upright or frame, and their sound chambers joined together by equal lengths of metal tubing. A single mouth-piece terminates the four connecting tubes, and thus they are actuated simultaneously by the air-vibrations of the voice. The four microphones are usually connected in multiple, but are readily connected in series for other experiments.

The receiving apparatus is of the portable type (Fig. 3), and consists of two adjustable electrolytic detectors, aerial switch, potentiometer, switches and telephone receivers.

LOUISBURG STATION ON HISTORIC SITE

In order to handle the wireless traffic across the Atlantic, the Canadian Marconi Company has erected a new high-power station at Louisburg, N. S. This station, which is intended to work the duplex system in conjunction with those of the English Marconi Company at Letterfrack and Clifden, Ireland, is now in full operation.

Louisburg, which has a population of about 2,000, was at one time of little commercial importance except as a cod-fishing centre. In recent years, however, it has been developed to some extent by the Dominion Coal Company, which uses it as a winter port. The people of Louisburg assert that this port is the nearest harbor to Great Britain on the American continent, and are anxiously waiting for it to come into its own. The Sydney and Louisburg Railway, which serves the town, is a private line connecting with the Intercolonial and furnishing transportation facilities between the Louisburg wireless station and its power plant at Glace Bay.

The town was founded in 1715, receiving its name from Louis XIV. Under the French régime it was second only to Quebec and shares the distinction with that city of being a birthplace of French influence in Canada. In those days Louisburg was a place of gaiety, being the mecca of the elite in the French settlements. These conditions were, however, speedily changed when the town was lost to the French and the citizens were exposed to the attacks of their jealous neighbors in the British stronghold, Halifax.

The Louisburg fortress, which was built by the French, had great strength, and during the struggle for supremacy on the American continent between France and England it was the object of repeated attacks, resulting in frequent change of ownership. In 1745 it was captured by the American Colonists assisted by the English fleet, only to be surrendered again when peace was declared. The war was renewed, however, and Louisburg was lost by the French in 1758, when it was recaptured by a British land and sea force under General Amherst and Admiral Boscawen.

The only relics of the town's former greatness are in the ruins of the fortress. These make a striking contrast to that wonderful product of modern invention and industry—the wireless station—which has been erected within a stone's throw.

The station represents the last word in wireless high-power land equipment, embodying all the latest improvements in that branch of the art. It is the first station in the world to work with the duplex system, which permits the simultaneous transmission and reception of messages at the same operating house. An equally important invention utilized in the station is the automatic transmission device, by means of which it is possible to handle messages at the rate of 100 words a minute.

All the members of the operating staff of the Glace Bay Station have been transferred to Louisburg, where excellent quarters have been provided for them. The engineers, however, remained at Glace Bay, where the transmitting apparatus, which is operated from the Louisburg station, is located.

WIRELESS FOR HUERTA, SAYS A REPORT

It is reported that a wireless telegraph station will be erected in Mexico City to enable Provisional President Huerta to maintain communication with the Federal troops operating against the rebels in various parts of Mexico. General Huerta finds it necessary to use wireless telegraphy, as the ordinary telegraph wires are so frequently cut.

INSTRUCTION TO BOY SCOUTS

By A. B. COLE

CHAPTER VIII

Electromagnetic Oscillations and Waves

SINCE all modern wireless telegraph apparatus depends on the generation and propagation of electromagnetic waves, it is essential that the operator be at least familiar with the elementary principles governing them.

In practice, electric oscillations are set up in a circuit by means of the peculiar discharge of a condenser. From this circuit they may be transferred to another by electromagnetic induction, and from the second circuit the electromagnetic waves generated by them are radiated into space.

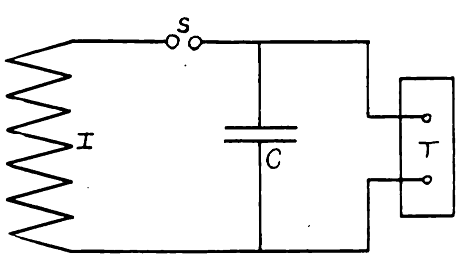


Fig. 40—Simple Oscillation Circuit

A simple circuit for the production of the oscillations is shown in Fig. 40, where (C) is a condenser, (S) is a spark gap, and (I) is a coil of wire. All coils of wire in which adjacent turns are insulated from each other possess a quality known as inductance when alternating or varying currents are caused to flow through them, and they are termed inductance coils, or inductances.

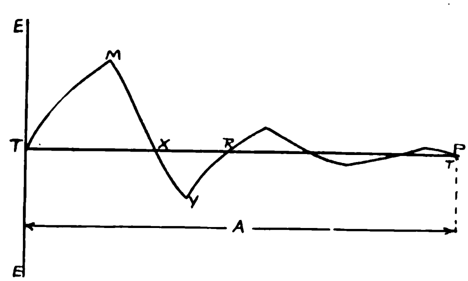


Fig. 41.—Condenser Discharge

In Fig. 40 the condenser (C) is connected to a transformer or spark coil (T), whose purpose is to charge it to a high potential. When (T) is set in operation, a discharge passes across the gap, which seems to the eye to be a continuous spark, but this is not the case.

The actual condition is shown by the diagram in Fig. 41, where the line TT represents time, and the line EE represents the potential of the condenser, the curve above the line indicating positive potentials, and that below representing negative potentials.

As the coil begins to charge the condenser, the potential of the latter rises from (T) to point (M). As soon as the potential has reached this point, however, it is sufficient to break down the resistance of the spark gap, and the condenser discharges across the gap, which act is shown by the curve falling

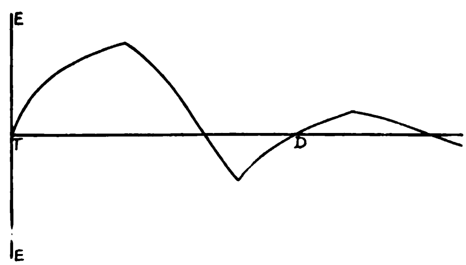


Fig. 42.—Increased Wave Length

to the point (X), which indicates zero potential. But this is not the stopping point, for the potential, as shown, falls below zero; in other words, the polarity of the condenser reverses and the potential increases in the opposite polarity untll it reaches point (Y). From this point it again falls to zero, and continues this change of potential and polarity until the action comes entirely to rest at point (P). These reversals of polarity and potential are called oscillations.

As soon as the coil again charges the condenser, the same series of oscillations also occurs again. Each spark discharge therefore is represented by the part (A) of the diagram.

So many spark discharges occur per second that the eye cannot follow them and they seem like one continuous spark, and for each spark there are many oscillations. A semi-oscillation is represented by the curve from (T) to (M) to (X).

When the oscillations are caused to flow along the aerial wires, they result in the radiation of electromagnetic waves by the wires, and the waves may also be represented by the same kind of diagram or curve as the oscillations.

The distance traversed by an electromagnetic wave in the time in seconds represented by line TR is the length of the wave, or the wave length. If a condenser having a greater capacity were substituted for (C) in Fig. 40, or if an inductance coil having more turns, or a greater inductance were substiuted for (I), the wave length of the circuit CSI would be increased, and its oscillation diagram would be somewhat like that shown in Fig. 42, where the time of a complete oscillation is shown by the line TD.

Thus the wave length may be increased by increasing the capacity or the inductance of a circuit, or both. If all stations had the same wave length it would be practically impossible for one to hear signals of any other one if all were transmitting at one time within a limited radius, and the method of changing wave lengths provides a means whereby a number of stations can all work at the same time with little or no interference, providing that they all send out a wave of one particular wave length only, which would be termed a pure wave. In many stations, however, two or more different wave lengths are transmitted, and this is the cause of the difficulty often observed in trying to "tune" such a station out. This fact was the cause of the wireless law which provides that stations use a fairly pure wave for transmitting.

When the oscillations last for only a short time, as in Fig. 41, and die away rapidly, they are said to be highly

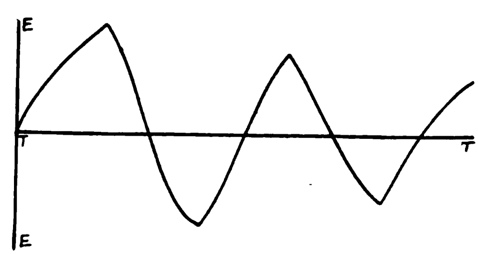


Fig. 43.—Slightly Damped Oscillations

damped, and when they continue for some time, as in Fig. 43, they are said to be slightly damped. A series of oscillations which would continue for practically an indefinite period of time would be called undamped.

The damping effect is due largely to the rapid radiation of the energy of the oscillations by the aerial. This effect is most apparent where the aerial and ground are connected directly across the spark gap, as shown in Fig. 44, where no helix or condenser is used. A station thus arranged would transmit a highly damped wave, which would be extremely difficult to "tune out," and this type of wave is no longer permitted by law where the station is capable of sending beyond the State border. This

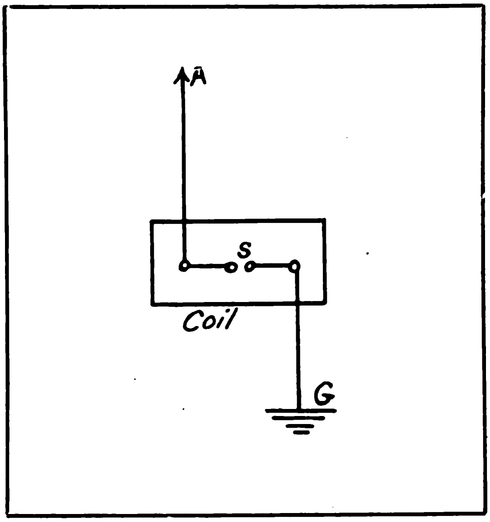


Fig. 44.—Untuned Transmitter

connection gives best results, however, in portable sets, as the transmitting range is greater and there is less adjustment than where a tuned set is used, unless the latter set is carefully tuned, which requires considerable time and patience. For this reason it is recommended that untuned sets be used for the field work of our readers, and in the following descriptions of sets we have arranged them in this way.

The Transmitting Set

Referring to Fig. 40, we may now complete the transmitting set, which is of the tuned variety, by arranging to transfer the energy of the oscillations from the inductance coil (I) to the aerial. This is done by placing another or secondary winding around (I), but separated from it. The method of connecting this coil to aerial and ground is illustrated in Fig. 45, which shows a complete transmitting set. The circuit CSI is known as the closed oscillation circuit, and the circuit ABG is the open oscillation circuit. The necessary capacity for the open circuit is provided by the aerial, which acts as a condenser.

When the open circuit has been adjusted to the same wave length as the closed circuit, by varying the inductance of (B) the two circuits will be in "tune," and the greatest possible transfer of energy from (I) to (B) will result. This variation is accomplished by using more or less turns of wire of the coils, and is generally done by the use of clips, which will make contact with any part of the wire.

The Receiving Set

In Fig. 46 we illustrate the method of connection of a complete receiving set, and would call attention to the similarity between this and the tuned transmitting set shown in Fig. 45. In each case we have an inductance coil with two windings. In the transmitting set this is called an oscillation transformer, and in the receiving set a receiving transformer. The open oscillation circuit of the receiving transformer is ABCG, and

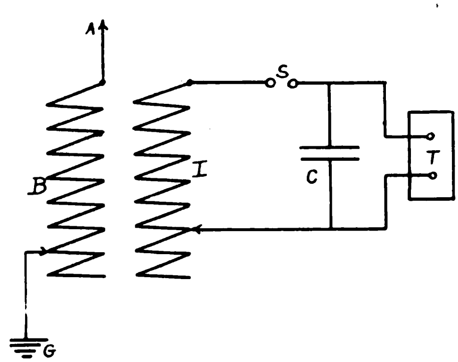


Fig. 45.—Complete Tuned Receiver

the closed circuit is EFC. Each set has a condenser (C). In place of the transformer or coil of the transmitting set we have a detector (D) in series with a small condenser (H), and across the detector a telephone receiver, or better, a pair of receivers (T) are connected.

Any electromagnetic waves impinging upon the aerial of the receiving station are converted into oscillations which travel up and down the circuit ABCG, and set up similar oscillations in the secondary of the receiving transformer by magnetic induction. These oscillations affect the detector (D), which in turn causes currents corresponding to the oscillations to flow through the receivers (T).

The open circuit is adjusted to the length of the incoming wave by changing the inductance of the primary through the aid of the movable contacts or clips (B) and (C). The closed circuit is placed in tune with this circuit by means of the sliding contact or switch (F) and by variation of the capacity of the condenser (C).

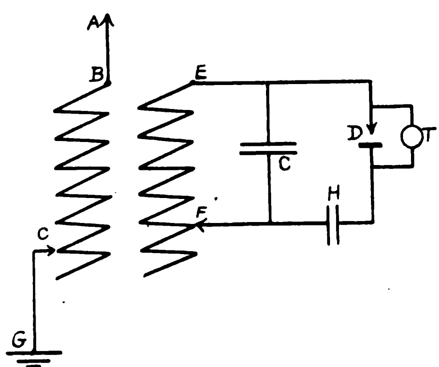


Fig. 46.—Tuned Receiving Set

Generally in large stations this condenser is so built that its capacity may be varied gradually from zero to maximum at will, and for this reason it is called a variable condenser. A condenser whose capacity cannot be changed is known as a fixed condenser. A variable condenser is, of course, desirable, but in many cases its increased cost over that of a fixed or adjustable condenser prohibits its use by beginners. Good results can be obtained by the use of an adjustable condenser, which is built in sections, so that several steps of capacity may be available.

NOTE.—Referring to the diagram Fig. 46 —— members of Boy Scout Wireless Divisions will secure much better results if the telephones (T) are connected around the fixed condenser (H), rather than around the detector.—*Technical Editor.*

This is the fifth installment of instruction for Boy Scouts. The fifth lesson by Mr. Cole will appear in an early issue.

NEW YEAR'S DINNER ATOP OF A MAST

"Boys, finish this mast by Wednesday and you eat your New Year's turkey off the last diaphragm plate," was the promise made in December last by Foreman Holliday to the expert riggers of crew No. 1, who are erecting the masts at the Marconi Trans-Atlantic Wireless Station, New Brunswick, N. J.

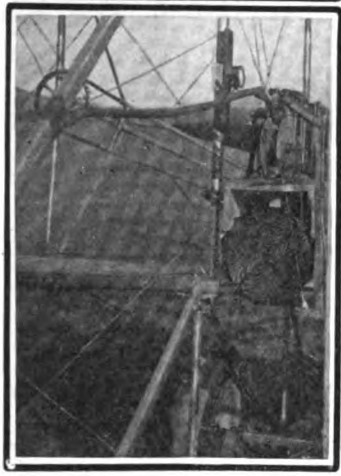
Three crews of riggers in the employ of the J. G. White Engineering Corporation had been fighting for several weeks to demonstrate their prowess in the air. Each crew began work on the same day, and the contest to gain the height of 400 feet began. These masts are not like the large frames of the modern skyscrapers. They consist of a hollow cylinder 42 inches in diameter, made up of half sections fifteen feet long for an elevation of 195 feet; the remaining 205 feet are 30 inches in diameter, made up of half sections ten feet long. All the flanges are bolted, and high-grade work is essential.

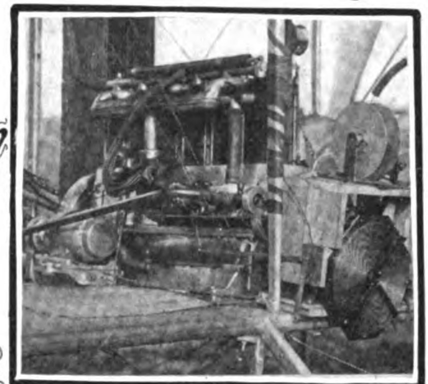
One crew gained a section, only to lose it in the next hour. Crew No. 2 finished the first mast with a lead of one section, and crew No. 1 stopped but a moment, as the flag was hoisted on timber top-mast of their rival's mast. Each crew started a second mast with crew No. 1 one section behind. Three days before New Years, crew No. 1 had 170 feet to go; to work faster at such a dangerous height seemed impossible. Then Holliday announced his turkey-dinner plan, and the men renewed their efforts.

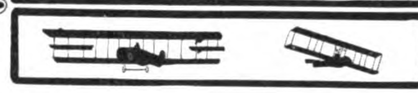
On Monday they raised sixty feet and gained half a section on crew No. 2. On Tuesday seventy feet and no gain was the result. On Wednesday morning, December 31, at 11 o'clock the crews were even, and had one section to go. At half past twelve o'clock a shout was heard from the erection cage of crew No. 1—the mast was completed.

At 1 o'clock sharp an automobile pulled up to the foot of the mast and unloaded three large market baskets, which were hoisted to the top of the mast. There, upon the thin thirty-inch shelf, the four riggers and their foreman spread their New Year's dinner.

Apparatus for Army Air Craft







PORTABLE wireless equipments are among the latest devices to aid signal work in the United States aviation squad. Before the field wireless set became a reality, messages could be exchanged with aeroplanes in flight only when the machines were in sight of the observer. It is now possible, however, to communicate with an aeroplane in motion even when it is out of sight and as far away as fifteen miles.

The outfit operates on the quenched-spark system, with a transmitting range under ordinary conditions of thirty miles. The generator is geared to a double hand crank and with two operators can be run at very high speed, giving an output of ⅛ of a kilowatt.

The transmitting apparatus is mounted in a reinforced trunk for convenient transportation, with suitable means for making the outside connections. The outfit may be set up in a few minutes.

The radio apparatus used on the signal aeroplanes is a modified form of the field outfit. The generator is friction-driven from the flywheel of the engine, and the antenna is of the hanging wire type contained on a reel so that it can be let out or taken in at will.

As far as is practicable, the set is made interchangeable part for part with the field apparatus. This enables an operator of the field signal corps to operate the aeroplane outfit when carried as a passenger in a machine. The machines are of the double control type and a message can be sent by either operator. When the ajustments are once made it is not necessary to disturb them except in case of accident. The total equipment for an aeroplane weighs about seventy-five pounds. It has a radius of action of thirty miles.

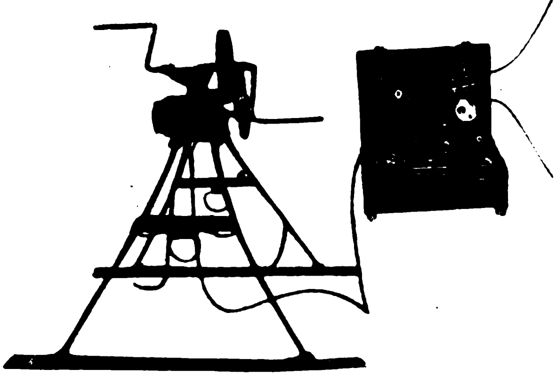
During recent tests by the signal corps the radio set illustrated in this article was used as a constant means of communication between the aeroplane and the ground for periods of time varying from fifteen to seventy-five minutes. Not the slightest difficulty was encountered in receiving messages at a height of half a mile, and messages were sent from a machine to the ground from an altitude of 1,500 feet. These figures are the results of tests extending over a period of several days, and are not merely the reports of special extraordinary performances.

That the person ambitious to become an aviator in the service of the United States has to have a considerable knowledge of air craft and how to manage them is shown by the test which it is necessary for him to undergo before he is able to obtain an aviator's certificate. The test is as follows:

Cross country flight of at least twenty miles at a minimum height of 1,000 feet. Make a flight of at least five minutes' duration with the wind blowing at the rate of at least fifteen miles per hour. Carry a passenger to a height of at least 500 feet and, on landing, come to rest within 150 feet of a previously designated point, the engine being completely cut off prior to touching the ground. The combined weight of the passenger and pilot must be at least 250 pounds. Execute a volplane from an altitude of at least 500 feet with the engine completely cut off, and cause the aeroplane to come to rest within 300 feet of a previously designated point on the ground. Make a military reconnaissance flight of at least twenty miles for the purpose of observing and bringing back information concerning features of the ground or other matter which the applic nt is instructed to report upon. This flight must be made at an average altitude of 1,500 feet.

If the applicant passes this test, he is given a certificate signed by the secretary of war, chief signal officer commanding and the adjutant general.

Captain J. H. Worden, of the Federal Mexican army, is said to be the first aviator to take part in actual warfare on the Western hemisphere. He has positive ideas regarding the character of the men to be chosen for military aviators. He advocates detailing men "of an age to warrant mature judgment and self-reliance at critical moments." They should not be men who are "attracted by the temporary glory and publicity of being an aviator," in his opinion.



Field Radio Pack Set and Generator

In pointing out the utility of the aeroplane as a director and observer of artillery fire, he said: "When the artillery fire is directed upon a point directly within sight of the gunners, the aeroplane would be of very little service, but where there is a mountain intercepting the aeroplane will prove indispensible. He calls attention to a battle fought in Mexico at Bachimba, between Chiuahua and Torreon, and declares that "the rebels were entrenched upon all the really strategic points, so that the attacking Federal forces were at a disadvantage; the artillery used up over $100,000 worth of ammunition, yet at the termination of the battle there were less than 300 men killed, and most of these were victims of close infantry fire." He asserted that the Mexican gunners in the battle were not poor marksmen, but that "the topography of the country made it necessary to place the artillery at a point where a view of the enemy's batteries was intercepted by a big hill upon which the infantry fighting took place."

Buzzer Outfit

He says in conclusion: "It is easy to understand the difficulties attending the directing of the firing and the consequent small damage done; but add to the moral effect these guns did have, the effect they would have had if the firing had been accurate, as it could have been by the aid of a well-trained observer directing the fire from overhead, and the battle would have been quick, decisive and probably final."

The militia, too, has adopted the use of portable wireless outfits in aviation work, having employed them to advantage in manoeuvres.

From and For those who help themselves

Experimenters' Experiences.

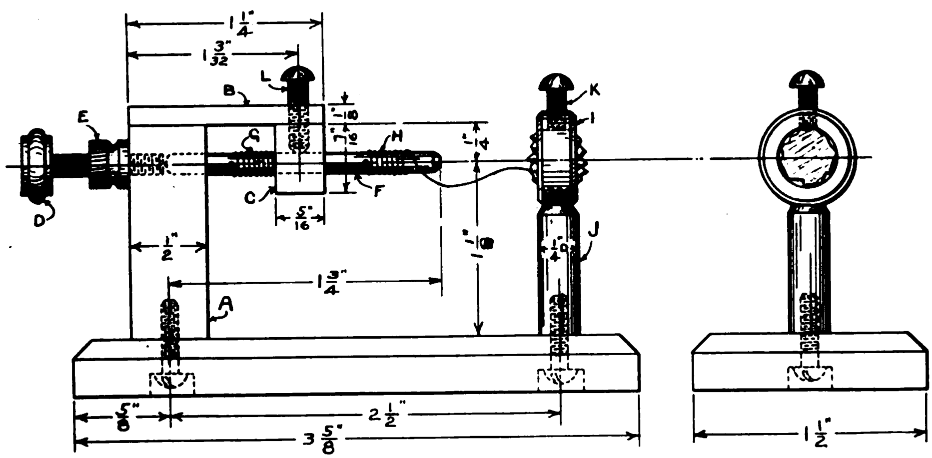
FIRST PRIZE TEN DOLLARS

A Galena Detector Which Has Given Excellent Results

I have found that the Galena detector, which I am about to describe, has given better results than any I have used.

As shown in the accompanying diagram, the base is made of oak, or other hard wood, and can be constructed to suit the size of cabinet. Brass upright A, having dimensions ½" by ¼" by 1⅜", is drilled to receive adjustment screw D. Nut E is taken from a dry battery and is soldered in line with hole. B is a piece of brass ¼" by ⅛" by 1¼", and is tapped at one end to receive set screw L. This is soldered to top of A, as shown in the sketch.

C is a piece of brass 7/16" by ¼" by ¼", drilled at the center to receive pin F. Another hole is drilled in the top of the pin hole to receive the set screw, and is soldered to piece C. F is a pin 2 by ½ inches, which slides back and forth and is kept in tension by spring G and set screw L. G is a small spring which keeps a pressure on the pin. H is a piece of No. 36 B and S copper wire used to make contact with the galena. I is a round brass nut screwed onto brass stud H, and is tapped on top to receive set screw. The set screw is used to hold the detector mineral in place. J is a piece of brass ½" by ¼" by ¾", to hold the galena holder.



Screws and parts can be made according to the supply of material on hand in the shop.

Edw. Dorst, New York.

SECOND PRIZE FIVE DOLLARS

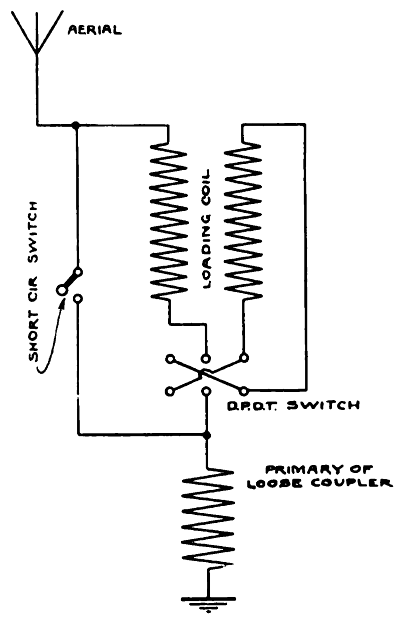
A Loading Coil without Taps or Dead Ends

Loading coils, or adjustable inductances without taps, slides, or dead ends, are not new. Most experimenters are familiar with the "variometer," which consists of two coils connected in series, with the inner coil mounted on an axis so it can be turned at any angle with the outer coil. As many experimenters have not a clear idea of the action of this "variometer" type of inductance, a few words may not be amiss. With the turns of the inner coil going in an opposite direction to those of the outer coil, and the planes of the two coils parallel, the effective inductance is a minimum. This is due to the fact that in this position the magnet field of the inner coil opposes the magnetic field of the outer coil. As the angle between the coils is increased by rotating the inner coil on its axis the effective inductance increases, and at 90° the magnetic fields are perpendicular, and have no effect on each other. In this position the effective inductance is the same as the inductance of the inner coil plus the inductance of the outer coil.

As the inner coil is rotated from 90° to 180° the turns of both coils run in the same direction, the magnetic fields assist each other, and the effective inductance increases. At 180° the two coils are parallel, their turns run in the same direction, and the effective inductance of the "variometer" is the maximum.

The adjustable inductance, which I am about to describe, is identical in principle with the "variometer" referred to, but it is built like an ordinary loose coupler without any taps or slides on either of the windings. The advantages of this construction over the "variometer" type of inductance are, (a) simplicity, (b) cheapness, and (c) great range of inductance.

To build this type of loading coil procure two cardboard tubes, one of slightly smaller diameter, so that it will slide within the other. Wind the larger tube with several turns of insulated wire, and wind the smaller tube with slightly smaller wire, so as to get more turns in the same winding space. For the best results the writer recommends that each coil have the same value of inductance, so that with tight coupling, and the turns of the inner coil running in an opposite direction to those of the



outer coil, the effective inductance of the loading coil will be zero. The ends of the two coils are then connected up as per the diagram. The short-circuiting switch does not necessarily have to be used if the loading coil is properly designed, but some prefer not to have the resistance of the two windings in the aerial circuit when the loading coil is not needed.

The explanation of the action of this loading coil is as follows: If the inner coil has the same inductance as the outer coil, and the turns run in opposite directions, the effective inductance of the loading coil is zero with tight coupling. The effective inductance increases as the inner coil is pulled out from the field of the outer coil, and the total inductance is the same as the inductance of the inner coil plus the inductance of the outer coil when the coupling is very weak; that is, when the inner coil is pulled out far enough to be entirely out of the field of the outer coil. If the turns of the inner coil are reversed by the D. P. D. T. switch, the turns will all be running in the same direction. As the coupling between the two coils is tightened the effective inductance increases. The maximum effective inductance is reached when the coupling is tightest, that is, when the turns of the inner coil are directly beneath those of the outer coil.

A practical example and the formula necessary to calculate the inductance of each coil follow:

$$L = \frac{(5 \times D \times T)^2}{\frac{M + D}{3}} \qquad (1)$$

In which L = inductance in centimeters.

D = diameter of the coil in inches.

T = the number of turns of wire on the coil.

M = the length of the coil in inches; that is, the number of inches of winding space.

Let us suppose the outer coil is to have 100 turns of wire in a winding space of 4 inches, and suppose the diameter of the coil is 4 inches. Then D = 4 inches, T = 100, M = 4 inches. Substituting in the formula

$$L = \frac{(5 \times 4 \times 100)^2}{\frac{4 + 4}{3}}$$

= 750,000. centimeters.

Now, suppose the inner coil is 3½ inches in diameter. The winding space (M) should be the same in both coils, and the inductance should be the same.

Therefore, L = 750,000., D = 3½ inches, T is unknown, M = 4 inches.

Substituting in (1)

$$750{,}000. = \frac{(5 \times 3\frac{1}{2} \times T)^2}{\frac{4 + 3.5}{3}}$$

Or T = 113. turns.

From an examination of the wire tables we find that No. 20 S. C. C. magnet wire is the proper diameter to give 100 turns in 4" of winding space. Likewise, No. 21 S. C. C. magnet wire is seen to be the proper diameter to give 113 turns in 4" of winding space. Therefore, the larger tube is wound with 100 turns of No. 20 S. C. C. magnet wire, and the smaller tube is wound with 113 turns of No. 21 S. C. C. nagnet wire. The writer recommends the sizes and dimensions given in the practical example as being most suitable for the experimenter. The maximum effective inductance of the loading coil described in the practical example is about 2,225,000 centimeters, or 2.25 Milli-Henrys. For very long wave lengths, over 2,000 meters, it is entirely practical to use two or more of the loading coils described.

HARRY V. ROOME, California.

NOTE.—While the method described for obtaining variations of inductance is not distinctly new, it should be of interest to amateurs who have a hazy conception of a variometer. The great objection to the method is, as the writer hints, that the ohmic resistance of the wire is present at all wave lengths and, unless the wire has a high degree of conductivity, the energy losses may be objectionable.

The formulæ given for the calculation of inductance, while somewhat crude for precision work, is sufficiently accurate for amateur needs.—*Contest Editor.*

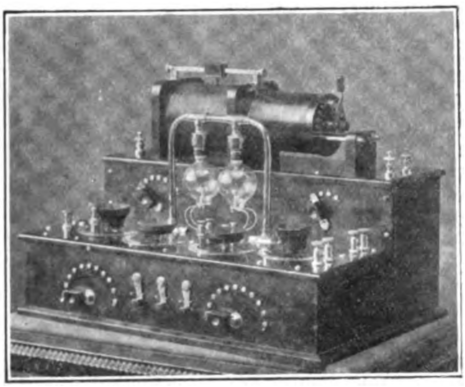
THIRD PRIZE THREE DOLLARS

A Description of an Audion Amplifier

This is a description of an audion amplifier. I constructed the device, a photograph of which is published herewith, after reading How to Conduct a Radio Club in the January issue of THE WIRELESS AGE. Since the apparatus has found favor among amateurs who have seen it I thought it would be well to place a description of it before all wireless enthusiasts, for it may be of assistance to them in making a similar device.

It is not necessary for me to go into details, as all points were fully covered in the January article, the hook-up appearing in that issue being used. Referring to the photograph accompanying this article, the right and left-hand knobs are connected to the variable condensers, while the two middle ones operate the filament rheostats. The four binding posts on the right allow connections to the small storage cells, which light the filament. The two binding posts to the extreme left are the terminals for the head-phones.

I am using the secondary of an 8-inch spark coil as an auto-transformer, connections for which are located at the right of the secondary of the "loose coupler." Two binding posts are located to the left of the primary of the receiving transformer, allowing connection to the earth and antenna.



Directly underneath the "loose coupler" are placed two distinct sets of flashlight batteries, each set consisting of 36 cells. Connections from the audions to each set of cells are made through the multiple point switches on the front of the cabinet. The connections are so arranged that 12 cells are always in the circuit, the remaining number in use being determined by the multiple point switches. Three switches are mounted on the front of the case; the one on the right is connected in series with the filament of the No. 1 audion; the one on the left closes the circuit with the filament of audion No. 2. The middle switch makes connection to a fixed condenser in shunt with the head-phones.

My aerial consists of a single wire from the top of a chimney 200 feet in height. I can hear the time signals from Arlington 10 to 20 feet behind the closed doors of my station. I can read the signals from Cape Cod when standing 12 feet distant from the head-phones.

As I stated before, I am using the secondary of an 8-inch spark coil as an auto-transformer. Of course, it has a primary winding, and as a matter of experiment I connected a microphone transmitter in series with 3 dry cells to the primary winding. I was certainly surprised at the result. I placed an alarm-clock some 20 feet from the microphone, and the ticks produced in the receiver reminded me of a blacksmith shop. The sounds from the whistle of a ferry-boat about 500 feet from my station were intensified to such an extent that they made my ears ring. I also heard plainly conversation taking place next door through the walls. All this was heard while receiving wireless messages.

Amateurs should experience no difficulty in constructing this device, and if the work is properly done they may expect exceptional results.

F. J. SUCHANEK, New York.

NOTE.—The apparatus shown in the photograph accompanying this article is entirely of amateur construction, and should be an incentive to students of wireless telegraphy to produce work of equal merit. The results obtained from the microphone are particularly interesting, and it would sometimes seem that audions are more responsive to audible frequencies than to the very high frequencies generally employed in radio work.—*Contest Editor.*

FOURTH PRIZE SUBSCRIPTION TO THE WIRELESS AGE

An efficient Loose Coupler

This is a description of a loose-coupler which entirely eliminates the "dead-end" effect and allows accurate tuning without the use of sliders.

The following materials are necessary:

One square brass rod 21½ by ⅜ inches; 2 round brass rods 14¾ inches long and 3/16 inches in diameter; ½ pound No. 22 S.C. copper wire; ¼ pound No. 28 S.C. copper wire; 4 binding posts; 3 helix clips; 1 cardboard tube 6¼ inches long and 4½ inches in diameter; 1 cardboard tube 6 inches long and 3⅞ inches in diameter; 42 brass machine screws and nuts; 15 brass washers; 1 board 16 by 6½ by 3 inches (base); 2 boards 6½ by 5½ by ½ inches (front and back of primary box); 2 boards 5½ by 5 by ½ inches

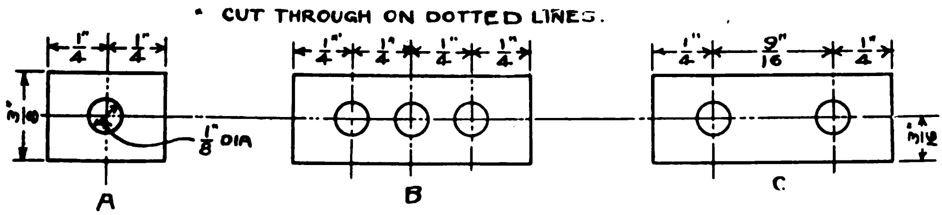


Fig. 1

(sides of primary box); 1 board 6½ by 6 by ½ inches (top of primary box); 1 board 6 by 3 by ½ inches (support of sliding rods); 2 round boards 3¾ inches in diameter, ½ inch thick (ends of secondary tube).

The boards are preferably made of mahogany. A 4½-inch hole ¼ inch from the bottom and from either side is cut in one of the 5½ by 5 by ½-inch boards, and a corresponding groove, ⅛ inch wide and ¼ inch deep, is cut in the other board to receive the primary tube. When the boards are cut to the required dimensions they should be sandpapered and given two or three coats of a suitable stain.

The primary should be wound in the following manner: Begin winding the No. 22 wire around the larger tube

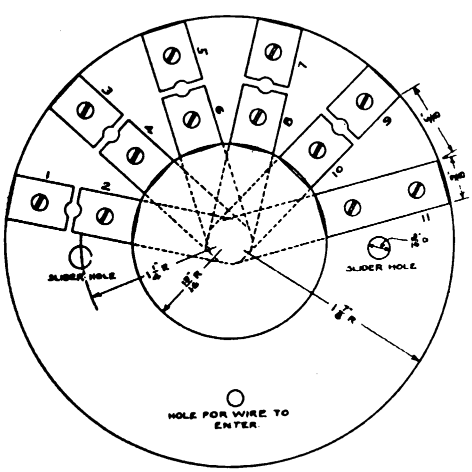


Fig. 2

about ⅜ of an inch from one end. Leave six inches for connection, wind 16 turns and again leave six inches. A good method to prevent the wire from unwinding is to punch two holes in the cardboard with a pin and push the wire in one hole and out the other. Wind 8 divisions of 16 turns each, and then wind 7 divisions of 2 turns each, making a total of 142 turns.

From the square brass rod cut off 19 pieces one inch long, drill three ⅛-inch holes in each, and then cut each in half, as shown in B, Fig. 1. Cut and drill two pieces like A and one like C. The primary plates are arranged as in Fig. 3, and are fastened to the top of the primary box with machine screws and nuts. A washer is placed under the head of a screw in every other plate to aid in tuning, as will be shown later. Plate No. 1 is connected to the beginning of the first division, No. 2 to the

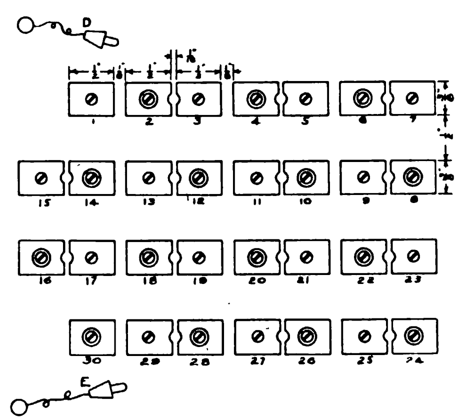


Fig. 3

end of that division, No. 3 to the beginning of the next division, etc.

When winding the secondary arrange the brass plates on one of the 3¾ inch in diameter boards, as shown in Fig. 2, and fasten them to the board with machine screws and nuts. Slip this end just inside the secondary tube, and tack the tube to it. Leave about 16 inches of the No. 28 wire to run through the hole in the end, attach to the binding post and wind 37 turns around the tube. Push the end of this division through a pin hole in the tube and connect it to plate No. 1. Wind the wire in six divisions of 37 turns each, as shown in Fig. 5, making a total of 222 turns.

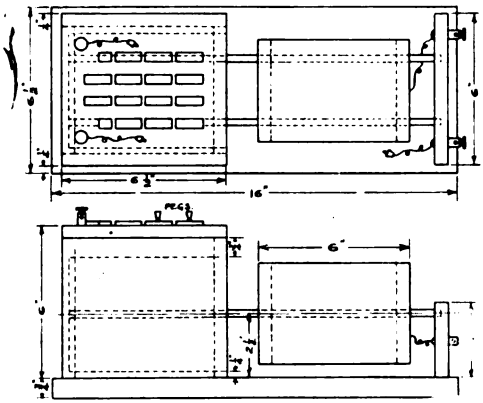


Fig. 4

Be careful to wind the wire in the same direction around the tube. When the wiring is finished, slip the other round board into the open end of the secondary, and tack the tube to it.

3/16 of an inch in diameter. Beginning at the middle, it should taper down at one end almost to a point. These pegs are to make connections between the brass plates.

When tuning the primary the clip D (see Fig. 3) is attached only to the plates which have no washer and are in the two rows nearest the clip D, while the clip E is attached to the plates which have a washer and are in the other two rows. All intervening holes between the plates are filled by pegs. For instance, if clip D is on plate No. 11 and clip E on No. 18, the holes between 12 and 13, 14 and 15, and 16 and 17 are filled by pegs. Clip D controls the primary in steps of 16 turns each, E in steps of 2 turns each. In this manner any even number of turns from 2 to 142 may be used. In the secondary the clip is attached to the plates on the outside circle only and the holes to the left filled by pegs, thus controlling the secondary in steps of 37 turns each. For instance, if the clip is on No. 7 the holes between 6 and 5, 4 and 3 and 2 and 1 are filled by pegs.

Fig. 5 gives the diagram of connections. When the D.P.D.T. switch is to

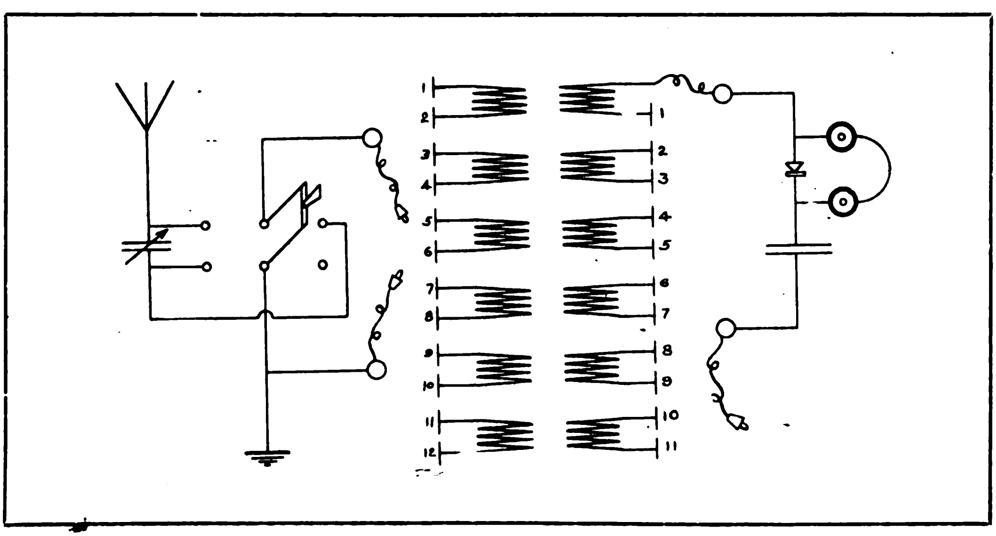


Fig. 5

Next assemble the parts as shown in Fig. 4. Make 19 pegs out of brass rod. Each peg should be one inch long and

the left, the set is more responsive to long wave lengths; and when it is to the right, the set is more responsive to short wave lengths. This arrangement coupled with the selectivity of the loose-coupler will allow the operator to tune to almost any desired wave length.

GRANVILLE B. SMITH, New York.

NOTE.—It is evident from amateurs' communications that they are much concerned with the dead end losses in receiving tuners. We have therefore printed this article. We must, however, take exception to the statements that the "dead end" losses are "entirely" eliminated, for the very reason that these losses are present to a certain extent, even when the unusual turns are metallically disconnected from the remainder of the turns. The construction of the tuner in question assists in doing away with the "dead end" effect and undoubtedly will give sharper tuning than the average amateur tuner.—*Contest Editor.*

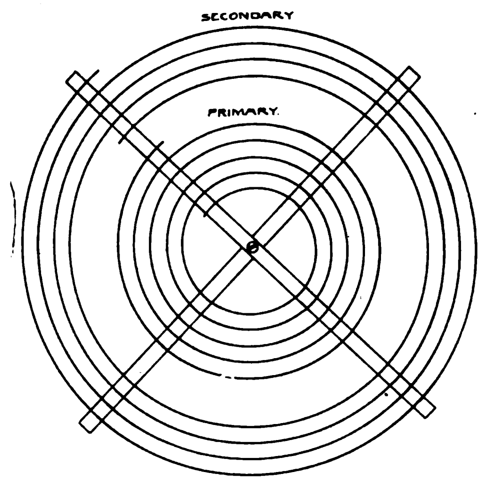


Fig. 2

HONORABLE MENTION

An Oscillation Transformer

The new wireless law says that the wave emitted must be pure and sharp. To accomplish this an inductive helix, or oscillation, transformer must be employed. A very simple and efficient one can easily be constructed in the following manner:

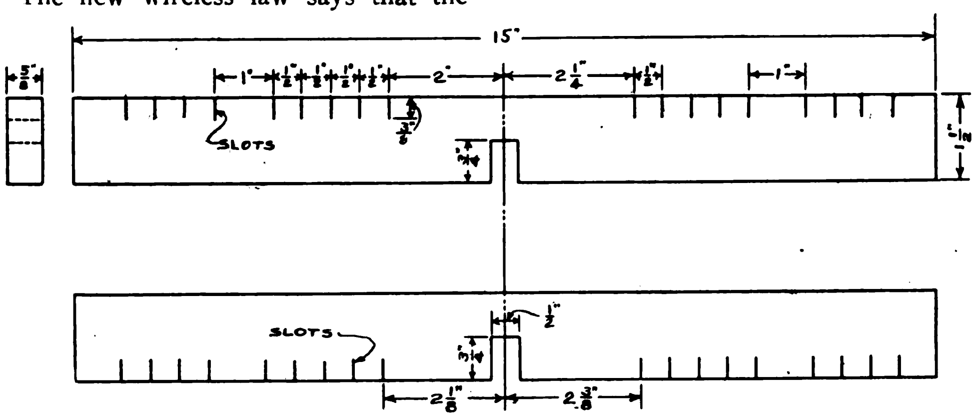


Fig. 1

Procure two pieces of hardwood 15 by 5/8 by 1 1/2 inches, and with a fine back saw, saw slats as shown in Fig. 1. Make a joint at the center and glue the pieces together as in Fig. 2. Fill in the slots with brass ribbon 1/2 inch wide, as shown in Fig. 2, until there are five turns. This is the primary.

Spacing off as in the diagram, put on four more turns. This is the secondary. If the slots are cut with a good back saw, the brass ribbon will be held tightly without any other fastening than that of the wood itself.

The transformer is designed to be mounted directly on the wall. Connections are made by ordinary helix clips. The writer has used this oscillation transformer, and has found it will limit a wave complying with the Government regulations.

I. RABI, New York.

HONORABLE MENTION

The Best Form of Crystal Detector

The best form of crystal detector is the "Catwhisker Type." Any mineral may be used in it with equal advantage.

Figs. 1 and 2 show a detector of this type.

A and A¹ = a couple of double binding posts.

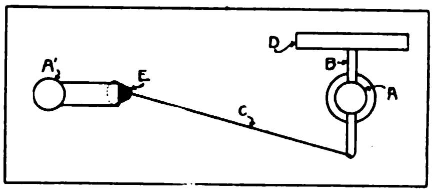


Fig. 1

B = piece of No. 12 copper wire 3 inches long.

C = a piece of No. 22 copper wire 6 inches long.

D = rubber knob.

E = crystal to be used.

F = a piece of spring brass 6 by ½ inches, bent double and held under A¹.

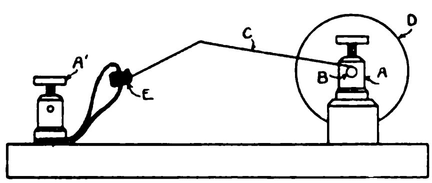


Fig. 2

By turning D the wire C may be moved upward or downward. No 22 wire is about right for silicon, but different sizes of wire should be used with different minerals.

F should be notched at each end to hold the mineral firmly. My experiences have proven one of these detectors to be the best obtainable.

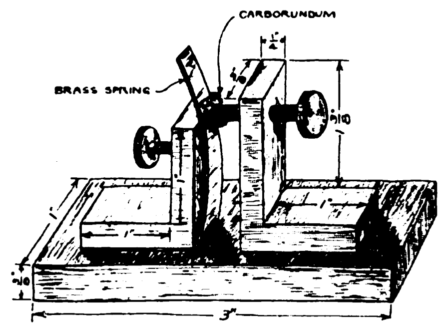
MAURICE WINGLEMERE, Michigan.

HONORABLE MENTION

Mineral Detector Stand

In the accompanying illustration, a simple detector stand which can be made at a very small cost is shown. It consists of but four pieces as shown: a hardwood or fiber base; two brass or copper standards, and a piece of spring brass.

The base is 1 inch wide, 3 inches long and ⅜ of an inch thick. The brass standards are each ¼ of an inch thick and ⅜ of an inch wide; the legs of one are 1 by 1 inch; the legs of the other are 1 by 1⅜ inches. A hole is drilled ¼ of an inch below the top, and in the center of each standard with a No. 31 twist-drill, and tapped with a No. 8, 32 thread tap and a brass screw, ¾ of an inch in length, fitted therein. Two holes are drilled in the bottom legs of each standard, with a No. 10 twist-drill and countersunk to admit brass screws, with which the standards are fastend to the base.



A piece of thin spring brass ⅜ of an inch wide and 3 inches long is bent at right angles at a point 1 inch from one end. It is placed under the short standard and scribed for the two holes through which the holding down screws pass, and which are drilled with a No. 10 twist-drill.

The stand is now ready for mounting and the standards are placed on the base, facing each other, ⅜ of an inch apart. A piece of carborundum or silicon is placed between the spring and the upper screw. The tension is adjusted by the lower screw. One of the holding-down screws in each standard can be replaced with a threaded or screw point binding post, insuing a better connection.

This detector is very sensitive, and I have obtained excellent results with it.

WILLIAM ROSENFELD, New York.

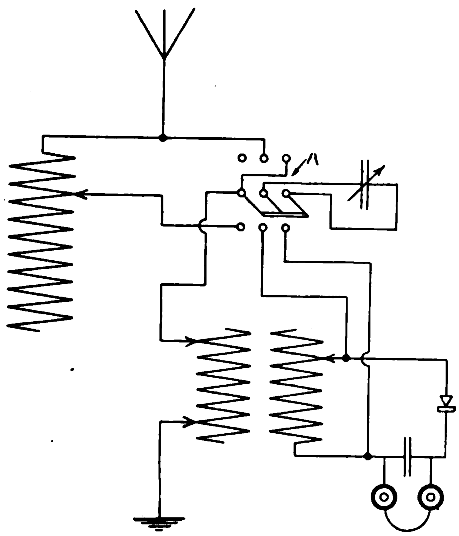
Note.—A detector stand of this type is cheap and easy of construction. It is, however, more suited to carborundum crystals than to silicon perikons, etc., requiring lighter adjustment.—*Contest Editor.*

HONORABLE MENTION

A Brand New Hookup

I have devised what I believe to be a new hookup for changing from long to short waves with a minimum amount of effort.

In receiving long waves, a loading coil in the primary and a variable con-



denser across the secondary is the accepted method, while short waves require the condenser in series with the primary and the "loader" is cut out of the circuit. With most switching arrangements two or more switches are operated to accomplish this change. My sketch shows that it can be done with a single "twist of the wrist."

By looking at the figure accompanying this article it is evident that when switch A is up the condenser is in series with the aerial and the loading coil entirely out of the circuit. If the switch is thrown downward the set is in a position to receive long wave lengths.

For best results, the condenser should be of fairly high capacity and the loading coil possess no dead ends. This will be appreciated by most amateurs, and by adopting it they may increase the flexibility of their sets.

THOMAS BENSON, Pennsylvania.

HINTS FOR IMPROVING RECEIVING STATIONS

A sensitive detector is a necessity in a first-class receiving station, and I intend to describe some methods of improving its efficiency.

The resistance of nickel is high. Therefore, nickel plating of parts of detectors should be avoided because the current tends to travel through the nickel rather than through the more conductive metal of which the detector is constructed.

The sensitive adjustment of the electrolytic detector can be increased by placing a small piece of cotton in the acid solution. Then, by adjusting the platinum point so as to have a fine thread adhere to it, a circuit from the point, through the wet thread to the solution will be formed.

I have noticed several cases in which detectors using battery current were wrongly connected. To get the best results the current must flow in a certain direction, which is found by experiment; the proper direction gives the best signals.

All detectors should be kept free from dust and other foreign matter. Crystals should be occasionally washed in gasolene. (Keep away from all flames while cleaning.)

The table published in this article is a list of common crystals used as detectors with their best contacts and points, as found in my experience. The tellurium-galena combination will be a surprise to some if they try it, because of its great sensitiveness. The table follows:

CRYSTAL DETECTORS

Mineral	*Contact*	*Point*
Carborundum	Very heavy	Large and blunt
Silicon	Light	Blunt and fine
Molybdenite	Heavy	Blunt
Galena	Very light	Blunt and fine
Iron pyrites	Light	Blunt and fine
Perikon	Light	
Tellurium-galena	Light	

Whenever possible dead ends should be eliminated in all tuning instruments. It is best to make connections of stranded wire, because of the "skin effect" of high-frequency currents.

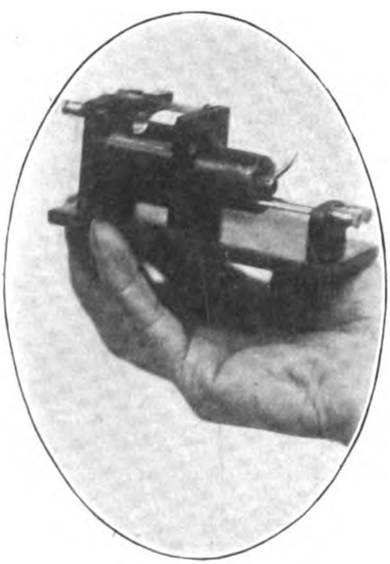
If the amateur intends to receive messages and not to send, it would pay him if possible to increase the size of his aerial. With a 6-wire aerial, about 120 or 150 feet long and 60 feet high and a sensitive receiving set it should be possible to receive messages from a distance of two thousand miles provided the conditions are right. For best working the "ground" should be copper or zinc plates surrounded by charcoal or moist earth.

A. R. RADOM, Connecticut.

NOTE.—Many inquiries from beginners as to the best contacts to use with various crystal detectors are received by THE WIRELESS AGE. In reply we herewith publish results obtained by one amateur. Beginners would do well to make similar observations.—*Contest Editor.*

SMALLEST RECEIVING TRANSFORMER

The accompanying photograph shows the smallest operative receiving transformer that has come to our notice. Its base is 4½ inches long by 2 inches wide. Its overall height is 2 inches. The primary winding, which is of No. 30 enameled wire, is 1½ inches long and 1⅛ inches in diameter. The single slider of the primary is made of hard rubber, and has a phosphor bronze contact spring. The secondary is 1½ inches long and ⅞ inch in diameter, and is wound with No. 32 single silk-covered wire.



The sections of the secondary winding are brought out to the contact points of a miniature switch, which have a diameter of 1/16 inch.

This miniature tuner is an exact model of the standard types on a very small scale. It was built by Mr. Joseph Stanley, of New York City, and he claims that with it the received signals are equally as strong as with a transformer of regular size. The range of wave length was not given.

WIRELESS TELEPHONE A FACT SOON—PROF. THOMSON

Declaring that the wireless telephone will soon be a fact, and that communication by this means between Europe and the United States may soon become practicable, Professor Elihu Thomson, inventor of electrical devices in use all over the world, addressed an audience upon the subject, "The Wireless Transmission of Electrical Energy," in the Edison Auditorium, No. 44 West Twenty-seventh street, on the evening of January 20.

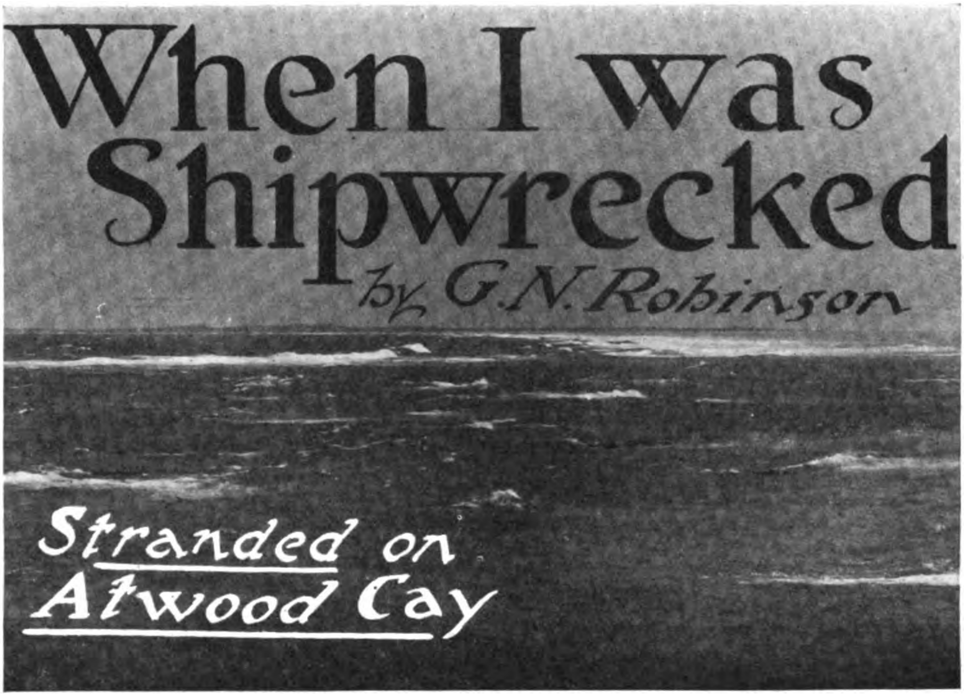
"The success of the wireless telephone," said Professor Thomson, "depends upon our ability to control the voice waves and to vary in accordance therewith the energy given out by the transmitting antennæ, and to do this with a fairly good output of energy. Much progress has been made in this department of wireless work, and such telephony between Europe and America may yet become practicable.

"Methods are being worked out whereby it may be possible to mould outputs of many kilowatts of energy so as to have them vary with the voice waves, and when this is done many problems the solution of which now seems remote may be solved and the results prove of great practical value to the world."

Professor Thomson told of his experiments with the transmission of wireless energy when, with E. J. Houston, he taught in the Central High School in Philadelphia in 1875. He used an induction coil with automatic interrupter for the primary circuit, and then gave a technical description of the results, one of which was the discovery that at a distance of several stories from the coil sparks were emitted by placing two points of carbon together near a doorknob. This proved that waves were in ether and demonstrated a principle which ultimately was developed in a highly satisfactory manner.

WIRELESS AGE WORRIES:

THE EFFICIENCY OF THE POLICE WOULD BE INCREASED 100% IF EACH PATROLMAN WAS EQUIPPED WITH WIRELESS



HOW'D you like to be shipwrecked on the shores of an island in the West Indies, have an adventure with pirates and spend Christmas and New Year's on a vessel that was stranded more than a thousand miles away from home? That's what happened to me.

This experience, it seems to me, belongs in a chapter of "Robinson Crusoe," or one of Robert Louis Stevenson's books, instead of in the life story of a wireless operator. A conversation overheard a short time ago while I was turning in my reports at the Cliff street headquarters in New York recalled my adventures, my attention being caught by remarks from a group of operators lounging in the static room—so called because static means a disturbance in the atmosphere, making a considerable noise, interfering with business and acknowledged a general nuisance.

Discussions in the static room may range from a review of a captain's characteristics, merit and disposition to the value of a passenger's pet dog. On this occasion the talk had turned to shipwrecks. None of the members of the group had figured in marine mishaps, and they speculated on what they would do if they were aboard a vessel in distress. To set down on paper their opinions of how a wireless operator should act when Neptune is clamoring for the destruction of lives and craft would add little to the interest of my story. It is enough to say that I was sufficiently moved by the conversation to isolate myself in my lodgings during part of my sojourn ashore and scratch off the narrative of how the steamship Prinz Joachim was wrecked off Samama Island, better known as Atwood Cay.

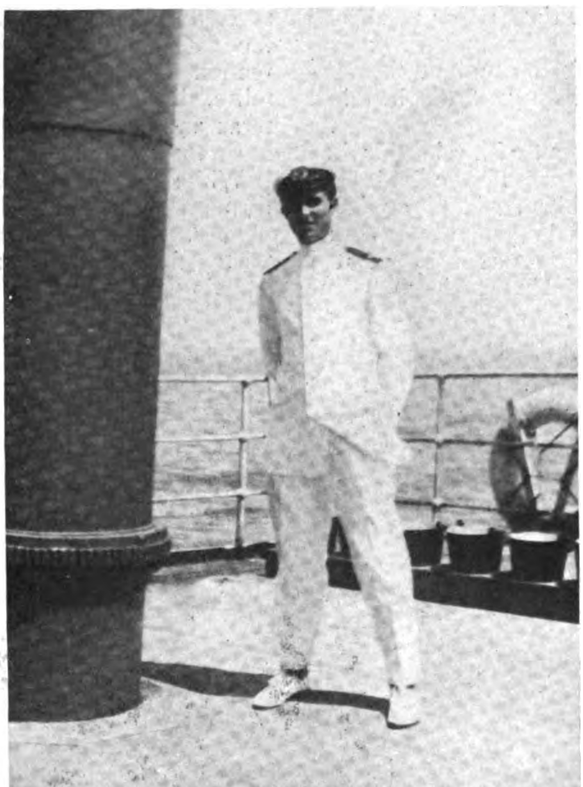
The voyage which was to prove so eventful began on November 18, 1911. When the Joachim, owned by the Hamburg-American line, left her pier in New York on that date she had among the passengers on board William Jennings Bryan, now Secretary of State. He was bound for Panama. Because this always active figure was a passenger, I anticipated that I would be kept busy during the trip, and I carefully tested the wireless apparatus aboard the Joachim before she left port.

It was perhaps an omen of the ill-fortune to follow that my aerial was carried away by the wind while we were making our way out of the harbor. The big spreader, with its four wires, came to the deck with a loud crash, barely missing one of the passengers.

The accident disturbed me not a little, because I had planned to make a good showing on long distance work. For two hours the chief officer, ten deck hands and myself worked until we succeeded in untangling the wires. We spliced the leads in several places and improvised a bridle, and I was finally able to work the set again.

During the early days of the voyage I handled considerable press matter, although I did not accomplish any results worth mentioning in long distance work. In the days of which I am writing the greater part of wireless communication took place between the land stations and the ships off shore. Yet it was customary for the old station at 42 Broadway to communicate with craft one or two thousand miles away.

But communication of this description was somewhat of a hazard, and on this voyage the nearest communicating station, after leaving the wireless zone of Cape Hatteras, was more or less a matter of good fortune until we reached a point south of Cuba, in the radio region of Guantanamo and Kingston. It was impossible to work the stations at the latter places while north of Cuba, because of the hills; consequently it was necessary for the ship operators to make arrangements with stations in the north to work with them at specified times in the early morning hours. I had arranged with Charley Hahnes, working the night trick in New York, to take my business every morning at four o'clock.



An unconventional portrait of Operator Robinson, whose unusual experiences told here are epitomized in his opening remark: "How'd you like to be shipwrecked on the shores of an island in the West Indies; have an adventure with pirates and spend Christmas and New Year's on a vessel that was stranded more than a thousand miles away from home? That's what happened to me."

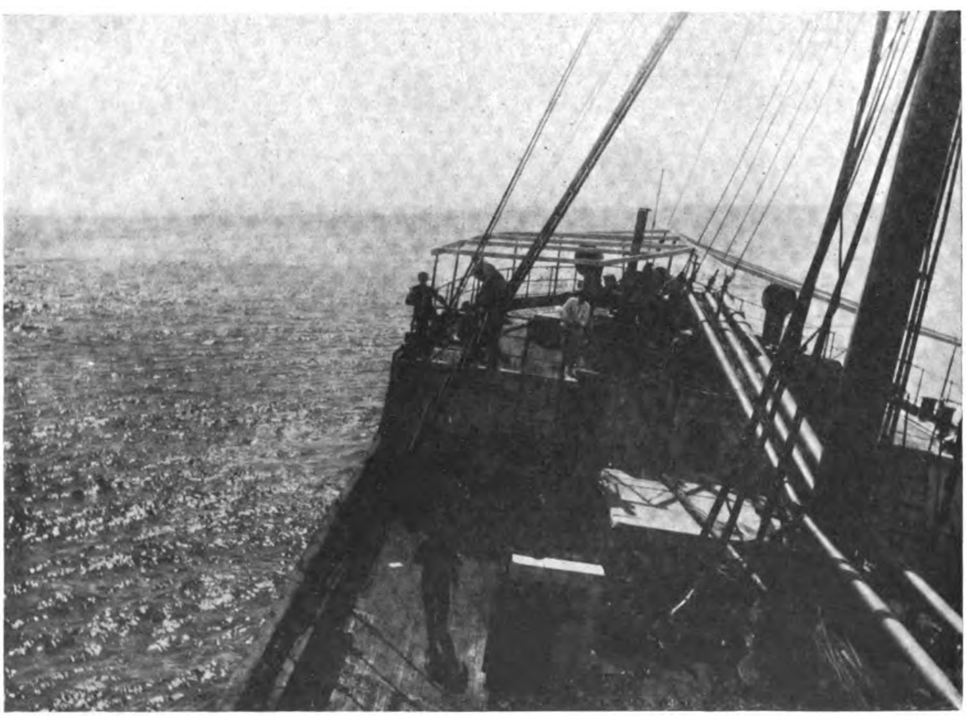
Tumbling out of bed at four o'clock on the third morning of the voyage to keep my schedule with New York, I found that the static was so bad that I could not even hear the high-power station at Key West, Fla. Despairing of establishing communication, I turned in again. Later in the morning I succeeded in working with the steamship Zacapa, one of the United Fruit Company's line, bound north, and giving her most of my traffic because I believed that I would be unable to communicate directly with New York. I also worked the steamship Panama, bound south. We were due to sight Watling Island (San Salvador) that night, the 21st. The Watling Island light failed to make its appearance at the time it was looked for, however, and Captain Fey, our commander, ordered that the vessel steam at half speed and directed that a sharp lookout be kept.

When I turned in at midnight he was on the bridge in his oilskins, for it was drizzling. Perhaps if I had known what was before me my slumber would not have been so peaceful. As it was, I enjoyed an excellent rest till fifteen minutes to four o'clock in the morning. At that time I was awakened by a slight jar. I had set my alarm clock for four o'clock and at first believed that the ringing of the bell had aroused me.

I started to get out of my berth, when the ship trembled as if she had been struck a terrific blow, slid along for a short distance and then came to an abrupt stop. Partly dazed by what I dimly realized had happened—that some sort of a mishap to the vessel had occurred, I was sure—I leaped to the floor of the cabin. As I did so I heard a loud pounding on my door and opened it to find the captain facing me.

He was somewhat excited, and told me in a quick, snappy way that the vessel was aground; that he wanted me to stand by and call for help. I made haste to carry out his orders, although at the hour and the position we were in I thought the possibility of picking up any one was slight indeed. The nearest station was Guantanamo, almost five hundred miles away, back of the Cuban hills, and in the other direction was Key West, eight hundred miles distant. I reckoned Cape Hatteras and New York as possibilities almost too remote to be considered.

While these thoughts were racing through my brain, I picked up my phones. For thirty seconds at least I "listened in"; I could not hear a sound. Starting my motor, I then sent out the S O S call for about two minutes, sign-



I was deeply impressed with the calm bearing of Mr. Bryan in the midst of the possible peril. Daylight was just breaking, and in the distance could be seen the dim outlines of Samama Island. The Secretary of State jokingly remarked that if the worst came to the worst we could land on the island, start a republic of our own, and he would run for President.

The seas ran higher than ever the following day, and at daybreak the Joachim was pounding hard. The waves would lift her up a few feet and then she would settle with a crash that was alarming.

ing S P, the call of the ship, at frequent intervals. The crystal of my set, I suspected, was out of adjustment from the shock when the vessel went aground, and then, too, I had a patched-up aerial. The outlook for receiving a response to my call appeared decidedly unfavorable.

Behind me stood Captain Fey and Mr. Stege, the chief officer. The captain was writing on a pad and he gave me the following message to send:

ASHORE SAMAMA ISLAND, 60 MILES SSE., WATLING ISLAND. WANT IMMEDIATE ASSISTANCE.

I repeated this message several times and then signed off. Great was my astonishment and unrestrained my delight when, my motor having stopped, I heard Charley Hahnes at 42 Broadway, in far away New York, giving me O. K. It was as if we were in the shadow of the Statue of Liberty instead of 1,100 miles away.

Hahnes' O. K. obviously brought relief to the captain and chief officer. They realized as well as I did that if New York could hear me, I would be able to get into communication with other stations. Soon afterward Hahnes said that he had telephoned the news of the accident to Captain Jarka, superintendent of the Hamburg-American line. The superintendent expressed a wish for more details and Captain Fey dictated another message to me, in which he said that he didn't know whether or not the vessel was safe for the time being, and that he wanted help immediately.

Following this message, Hahnes worked his set to some purpose, and, as I afterward learned, the Revenue Cutter Service and the Navy Department soon knew of our plight. By this time I was in touch with all the stations from New York to Key West. I worked Key West and sent an official message to New York, signed by Captain Fey, in which Key West was told to rout out Guantanamo. I had been unable to obtain a response from Guantanamo, but I afterward found out that the operator there heard me, but he could not answer because of a balky gasolene motor. However, he sent a tug to our aid ten minutes after he received my distress call.

While I had been working my set, many of the passengers were running here and there about the vessel like frightened sheep. Everything was in confusion. One man attempted to lower a life boat without assistance and lost control of one end when the craft was suspended in the air. A junior officer and one of the stewards were in the boat, and they were thrown into the water. They were rescued without much difficulty, and, in the meantime, the second officer and a boat's crew had taken soundings and reported that we were well up on a reef. The forward holds were found to be full of water.

The captain decided, however, that there was no immediate danger and determined to keep the passengers on board until help arrived.

I was deeply impressed with the calm bearing of Mr. Bryan in the midst of the possible peril. He came to my room, apparently unmoved and cheerful, to ask what I had done to bring aid. Then he wrote a message to his brother in Nebraska, which I managed to transmit to Key West; then he went to join the other passengers on deck. Coffee was being served, and he tried to cheer them by talking. Daylight was just breaking, and in the distance could be seen the dim outlines of Samama Island. The Secretary of State told several anecdotes and jokingly remarked that if the worst came to the worst we could land on the island and start a republic of our own. He added that he knew something of politics and would run for President. Mr. Bryan's efforts to entertain put every one in good humor, and the most fearful among the passengers began to take a more optimistic view of our predicament.

My endeavors to get into communication with other ships met with success a few hours afterward. About seven o'clock my calls were answered by the steamship Olinda, bound from New York to Antilla, Cuba. The captain of the Olinda answered that he would come to our aid, but asked us to try to reach some other craft nearer to us. While I was talking with the Olinda, the operator on the Seguranca, going from the south side of Cuba to Nassau, asked what the trouble was. Captain Fey sent a message to Captain Jones of the Seguranca, asking help, and the master of the Seguranca replied that he was on his way to the Joachim. The captain of the Olinda was then told that we had found a rescuing ship and he proceeded on his course.

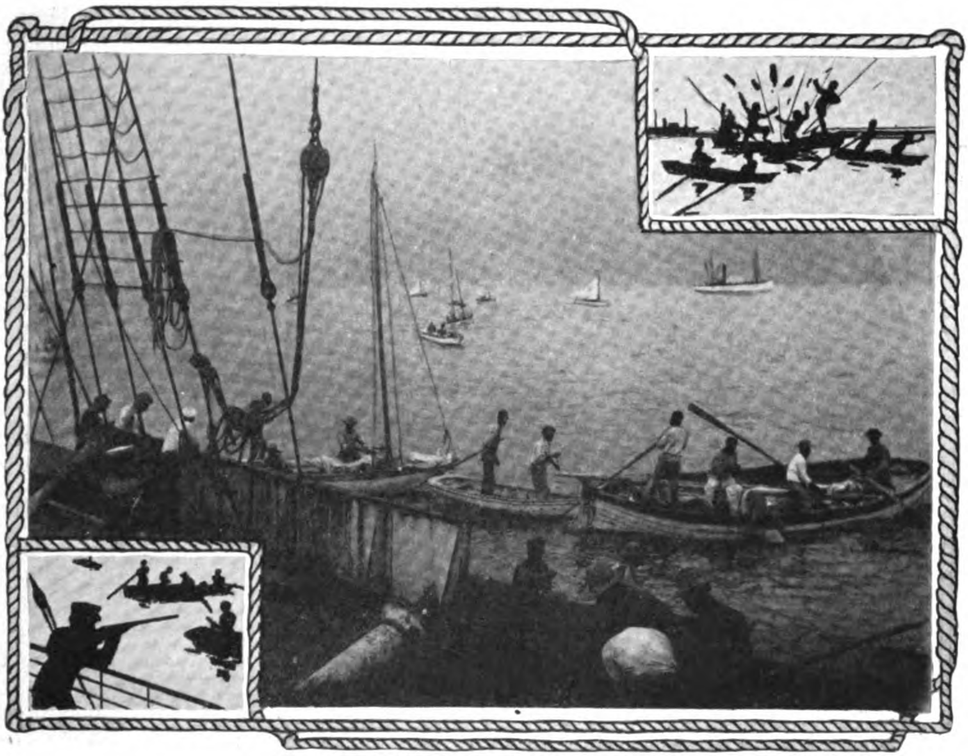
The Seguranca was sighted at fifteen minutes to two o'clock in the afternoon, and the work of transferring the passengers began. I went in the first boat, Captain Fey having asked me to give the details of the wreck to Operator Bernstein on the Seguranca, so that the latter could make a full report when he arrived in New York. By the time I had finished telling my story to Bernstein the transfer of the passengers had been completed. and the crew and officers of the Joachim were ready to return to the stranded vessel.

The Seguranca was a considerable distance away from the Joachim, and when our boats started to return the men at the oars faced a long pull. It had started to rain and the boats made poor headway in the high seas. I was steering the boat in charge of the chief officer, the oars being in the hands of four stewards. None were skilled oarsmen, and it was only due, in my opinion, to the vigorous language the chief officer addressed to the stewards that we made any headway whatever. For my part, I had all I could do to keep the boat headed in the right direction.

At dusk we were still four miles away from the Joachim, and three of our boats were out of sight. Red lights were burning to guide us, and we finally managed to get near enough to the ship to catch a line. But even then our troubles were not at an end, for the waves were sweeping completely over the after part of the vessel. By waiting until we were lifted on top of a wave, and then jumping to the deck, we got aboard, one by one. Fortunately, all of us escaped injury, but within ten minutes after we had reached the deck our small boat was smashed to pieces. After I had recovered from my exhaustion, induced by the trip from the Seguranca to the Joachim, I found that it had taken us more than six hours to traverse the six miles between the two vessels.

Three other boats came straggling alongside the Joachim soon afterward, and at one o'clock the next morning all were accounted for except the three which we had lost sight of soon after leaving the Seguranca. We learned afterward that the men in these boats had been picked up by a Cuban steamship.

The seas ran higher than ever the following day, and at daybreak the Joachim was pounding hard. The waves would lift her up for a few feet and then she would settle with a crash that was alarming. Early in the morning Captain Fey ordered me to send out the S O S call again. I received an answer from the Admiral Schley, saying that she was a few miles south of Fortune Island and would reach us about half past one o'clock in the afternoon. The Schley hove to within a few hundred feet of the Joachim fifteen minutes after the time she was expected to arrive, and forty-three of the crew from the grounded ship, including two stewardesses, were transferred to the former craft. Capt. Jensen, of the Schley offered to stand by to take off the rest of the ship's company if the weather became more threatening, but Captain Fey said that the barometer was rising and he had determined to remain aboard, as he believed there was a chance to salvage the vessel.



Then the pirates made their appearance. Although not of the Captain Kidd type, they were a source of much annoyance to us. The second officer was on guard, armed with a rifle, while the third officer had a shotgun. The pirates persisted in advancing. They were warned to halt, and several shots were fired from the deck.

With the Joachim still at the mercy of the seas, the Schley steamed away. A great sense of depression seized me as I watched her disappear. The waves had subsided to a great extent, but there was little to induce high spirits in the prospect of remaining on the vessel.

I had little time to brood over my lot, however, for the next morning at eight o'clock the Vigilancia, of the Ward Line, called me. She said that she had the majority of our passengers aboard and was bound for Kingston; the plan of her captain was to stop en route and transfer the baggage of the passengers from the Joachim to the Ward liner. At the time the message was sent the Vigilancia was eighty-five miles north of Watling Island. I worked my set all day in communication with the United States cruiser North Carolina and received several dispatches from New York, one of which was a message of congratulation to Mr. Bryan on his rescue.

It was almost seven o'clock in the evening before we sighted the lights of the Vigilancia. Captain Curtis, commander of the Ward liner, hove to within three hundred yards of our stern and sent boats to get the baggage. This was transferred without incident until the last boat load left the side of the Joachim. The men had piled too much into the small craft, and when it reached the Vigilancia it overturned, throwing the occupants into the water. The men made a wild scramble for safety, their movements being hastened by the sight of several man-eating sharks.

And now I have arrived at the point in my story where the pirates made their appearance. Although not of the Captain Kidd type, they were a source of much annoyance to us. Known as Bahama pirates, it is the custom of these natives of the islands to watch for ships that pile up on the rocks, and steal as much of the cargo as they can carry away.

While the members of the Joachim's crew were jettisoning her cargo one day several schooners from the islands arrived. Immediately afterward the waters became alive with small boats manned by the islanders. Several of the craft approached the sides of the Joachim, and their occupants tried to board us.

The second officer was on guard armed with a rifle, while the third officer had a shot-gun. Undaunted by the threatening attitude of those aboard the vessel, the pirates persisted in advancing. They were warned to halt.

Even then, they did not stop pushing forward, and several shots were fired from the deck of the Joachim. At first the officers were careful to fire into the air, in order to avoid wounding the islanders, but it was later necessary to plug some of the boats full of bullet holes before their occupants decided that it would be wise for them to take covetous eyes from the cargo of the Joachim.

Notwithstanding our antagonistic attitude toward the natives, we were troubled from time to time by them during our stay on the shores of Samama. They received a well-deserved scare, however, when the United States cruiser North Carolina and the revenue cutter Algonquin arrived. The big cruiser loomed into view from the north almost simultaneously with the appearance of the revenue cutter to the south. The pirates saw the vessels as soon as we did, and made haste to scurry to their schooners and sail away.

Recovering from their fright a short time afterward, they returned to the scene of the wreck. Evidently the temptation to obtain what they could of the vessel's cargo overcame their fear of the North Carolina and the Algonquin. The wrecking tug Premier had arrived, and Captain Johnson, the wrecking master, threw considerable of the less valuable portion of the cargo over the side.

One case hurled overboard contained explosives, and the natives, eager to obtain possession of it, raced toward the floating object. The case was some distance away from the ship when they reached it, and a general scramble to obtain possession of the prize resulted.

One of the natives, evidently anxious to open the case, struck it with an axe. A terrific explosion rent the air, and a second later a few scraps of wood tossing on the disturbed waters were all that remained of the boats and men. The remainder of the pirates beat a hurried retreat from the vicinity, and we learned afterward that they believed the Algonquin had fired a shot at them.

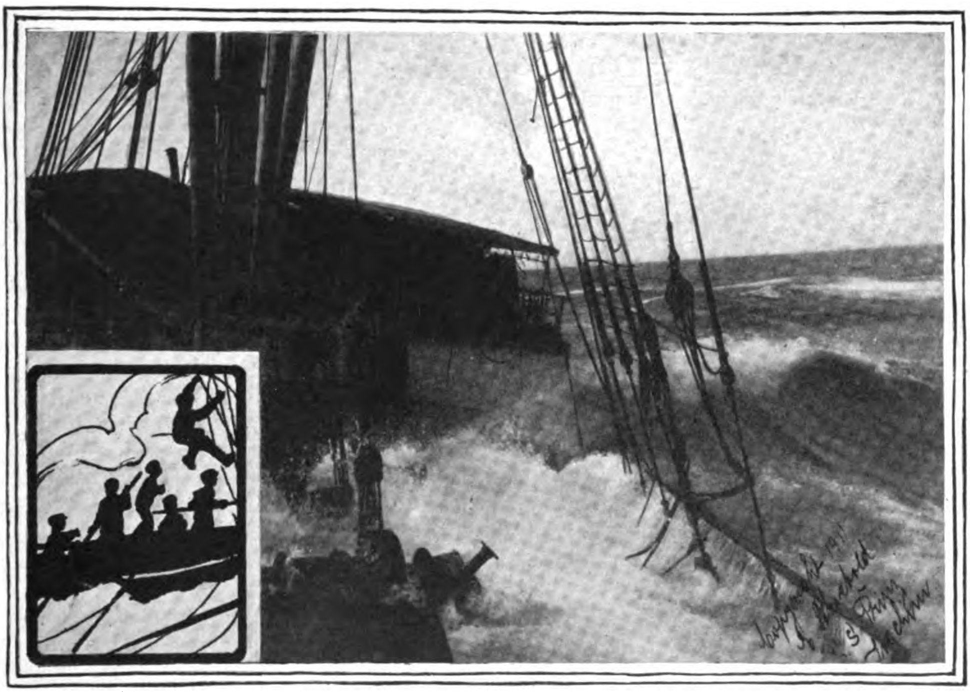
Strong winds kicked up a rough sea during the next three days, and the Algonquin and the Premier were compelled to remain under the lee of the island. On the third day the waters became calm enough for the vessels to approach us again, and the captain of the Algonquin announced that he intended to return to San Juan unless Captain Fey wished the revenue cutter to remain. Accordingly, the Algonquin steamed away from Samama; but not before her commander had left with us half a dozen rifles and as many revolvers.

To my mind, this narrative has quite enough of storms and blows in it, but it would not be complete if I did not mention that the gale kept up for two weeks following the departure of the Government vessels.

Christmas and New Years aboard the Joachim were made notable events. One of the stewards went ashore a few days before Christmas and obtained a fir tree; this he decorated and surrounded with a miniature snow village built on one of the dining tables in the saloon. Our tanks had been destroyed, and we had no fresh water, but there was a plentiful supply of beer and soda water aboard. Several of the men went ashore to shoot ducks, and were so successful that we had enough fowl for all the members of the ship's company, and a general jollification followed.

The Joachim was floated about the middle of January, and a few weeks later we started for New York. We encountered another storm en route, but proceeded under our own steam, although a line was made fast to the wrecking tug Relief, which had come from New York to convoy us.

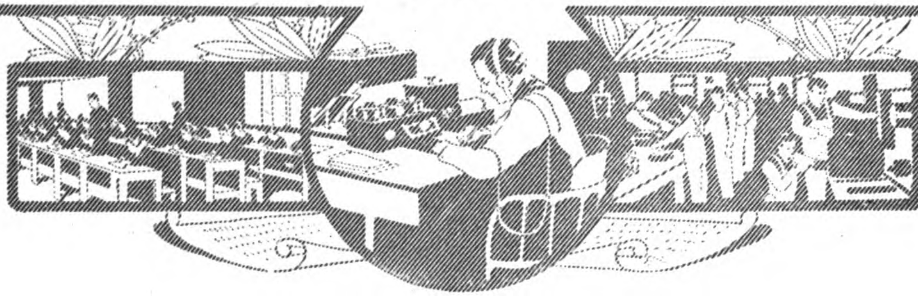
It was a very hard blow, but we came through it safely. I was mighty glad to see the good old New York skyscraper line and know that my adventures were ended.



The waves were sweeping completely over the after part of the vessel. By waiting until we were lifted on the top of a wave, and then jumping to the deck, we got aboard, one by one.

So far as I am concerned, the others who clamor for shipwreck experience are more than welcome to my future share, whatever that may be. Everything turned out all right in the incident I figured in, but there were a lot of close calls, hours of suspense, and excitement enough to last me for some time to come. I would not have missed it for anything on earth, but I am not exactly eager to repeat the experience. At least, not right away!

WIRELESS ENGINEERING COURSE



By H. SHOEMAKER
Research Engineer of the Marconi Wireless Telegraph Company of America

CHAPTER XIV

Electrical Oscillations

THE production of sustained oscillations or those having no decrement, is not so simple as the production of damped oscillations. They can, however, be produced by the discharge of the condenser through a direct-current arc, between carbon electrodes or between metallic and carbon electrodes.

The direct-current arc has a resistance which decreases with an increase of current, and is said to have a negative characteristic. This decrease of resistance with an increase of current is greatest for certain values of current through the arc, so that with a certain current value a slight variation of current will cause a great variation of resistance. If the supply of current to the arc is limited so that the current can not vary with this variation of resistance, the potential across the arc will vary if anything happens to disturb the resistance of the arc. In the diagram shown in Fig. 58 G is a direct-current generator, or any other source of direct current, R R′ are resistances, of such value as to maintain the proper current value through the arc S.

These resistances can be wound inductively to advantage, as they will then tend to prevent any sudden variation of current through the generator. The arc S is connected to condenser K and inductance L. Another inductance L′ has one of its terminals connected to the aerial A, and the other terminal to the ground E. This figure is an elementary diagram of a complete wireless telegraph transmitter, providing a key is inserted in either the open oscillating circuit or the closed oscillating circuit for the purpose of signaling.

The operation of this circuit is as follows:

An arc is started between the carbons by bringing them together and then separating them slowly. As soon as this arc is of proper length the condenser K starts to charge; this robs the arc of some of its current, which in turn increases its resistance. The increase of resistance causes the potential across the arc to rise, and the rise of potential causes the condenser to take more current. As the current flowing out of the generator through the arc is limited by the resistances R and R′, this increase of potential and increase of resistance of the arc continues until the potential across the arc is the same as that across the generator, or nearly so.

The condenser now starts to discharge back through the arc. This increases the current through the arc, and consequently lowers its resistance, and also its potential, until the condenser ceases to discharge any more current through the arc. The condenser discharge through the arc has increased the current through the arc and lowered its resistance to a much lower extent than it could be lowered from the current flowing from the generator. The condenser now begins to charge again, robbing the arc of its current and increasing its potential; this process is repeated continuously as long as the arc has a proper length. The inductance in series with the condenser has the effect of giving this circuit inertia or a definite time period.

The time period of the oscillation produced by this method is not, however, solely dependent on the $\sqrt{LK}$, as is the case with damped oscillations. The length of the arc and the current flowing through the arc have a slight effect on the period of the oscillations.

When an open arc is used it is impossible to produce oscillations having a frequency over fifteen or twenty thousand. But when this arc takes place in an atmosphere of hydrogen or a gas containing hydrogen frequencies as high as 1,000,000 can be produced. This is probably because hydrogen has a greater heat-conducting power than air.

This form of producing sustained oscillations has not come into commercial use to any great extent at present. This is due to the limited amount of energy which can be used and also the critical adjustment necessary to maintain its operation.

Alternating-current generators which give a frequency as high as 100,000 cycles with an output of 2 K. W. have been constructed and used. These generators have 600 poles and operate at a speed of 20,000 R. P. M. They are troublesome to operate, and for this reason have not as yet come into commercial use.

The superiority of sustained or continuous oscillations over damped oscillations has been given sufficient proof to warrant further investigation and development along this line. With this type of oscillations, resonant phenomena are much more marked than with damped oscillations. The problem of tuning the receiver and transmitter together is considerably simplified by their use.

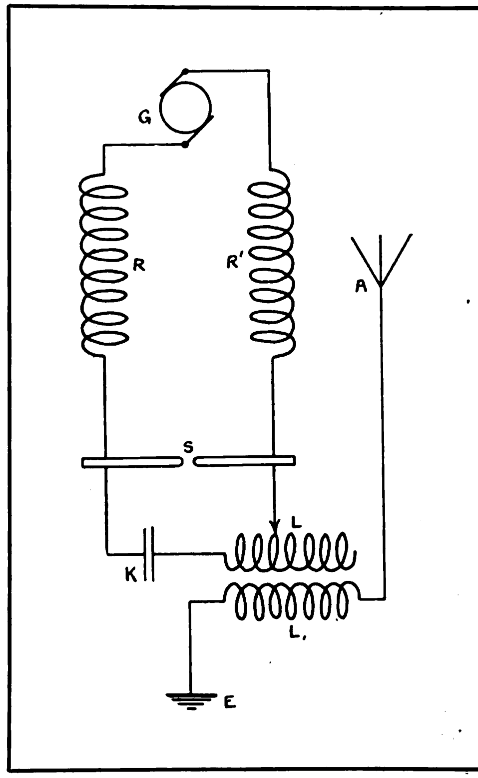


Fig. 58

The electro magnetic waves radiated from the antenna are also continuous, and when audible receiving apparatus is used no audible sound will be heard, unless one of the oscillating circuits or the telephone circuit is interrupted. In that case, the note, or sound in the telephone, will be due to the interrupting device. The sustained oscillations produce a continuous flow of energy, and consequently a continuous effect on the detector.

This fact has been taken advantage of for telephoning, in which case a telephone transmitter is inserted in the radiating circuit of the transmitter, which varies the intensity of the radiated waves in accordance with the sound waves produced when the transmitter is spoken into. This, in turn, causes the detector at the receiver to vary the current in the same manner, thus reproducing speech or sounds.

Receiving Aparatus

In Fig. 50, Chapter 12 (a preceding article), I have shown an elementary diagram of the simplest form of receiving circuit. This form of circuit is not used in practice at the present time. Instead of inserting the detector in series in the open oscillating circuit, as shown in Fig. 50, the general practice is to use an open circuit, as shown in Fig. 59, where A is the antenna, L a variable inductance, and E the ground. K is a variable condenser connected in series between L and E, for the purpose of reducing the natural period of the open circuit. The condenser is not necessary except where the wave length of the received waves is shorter than the wave length of the circuit. This shortens the wave length of the circuit because it puts a capacity in series with the capacity of the aerial, thus lowering the total capacity of the circuit.

The variable inductance L′ is inductively related to L, and has its terminals connected to the detector D through condenser k. To the terminals of condenser k is connected the telephones T, potentiometer P and battery B. If the detector used does not require batteries for its operation, then the potentiometer and battery may be eliminated.

As the open circuit can be constructed with a small amount of resistance, the damping in that circuit can be kept low. When oscillations are taking place through the inductance L, they induce oscillations in the inductance L′. If the resistance of the detector D is low enough and the inductance L and capacity k are adjusted for resonance with the open circuit, then a maximum response will be obtained in the telephones T. If, however, the detector D is of high resistance, that is, 1,000 ohms or more, then the closed circuit will not resonate, but there will be a maximum current flowing through the detector when L′ and k have the proper values. In that case the current flow will depend on the resistance, and not on the capacity and inductance. The circuit is still tuned, although it is not a resonant circuit. The maximum tuning effect can then be obtained by proper adjustment of the open circuit.

Fig. 60 is a diagram of the circuits generally used in wireless receiving apparatus at present. A is the antenna, L^2 is a variable inductance, and L is another variable inductance, which is also the primary of an oscillation transformer. K is a variable condenser and E the ground connection. These elements are all in series and constitute the open oscillating circuit. L^2 is used to increase the natural period of the open oscillating circuit without increasing L. K is used to decrease the natural period of the open oscillating circuit. The open oscillating circuit is adjusted to resonance with the received waves; then the closed oscillating circuit comprising the inductance L′, which is in inductive

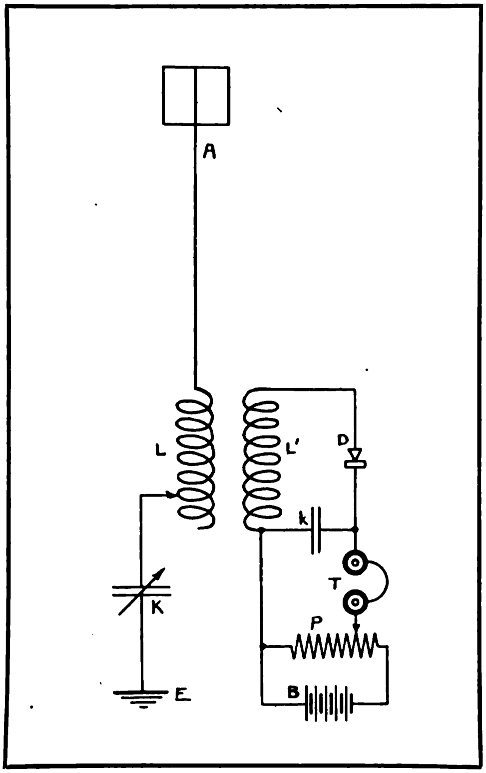


Fig. 59

relation to L, and the variable condenser K′ is adjusted to have the same time period as the received waves.

The latter circuit is of low resistance

and consequently small damping. By adjusting the inductive relation of L and L′ the reaction of one circuit on

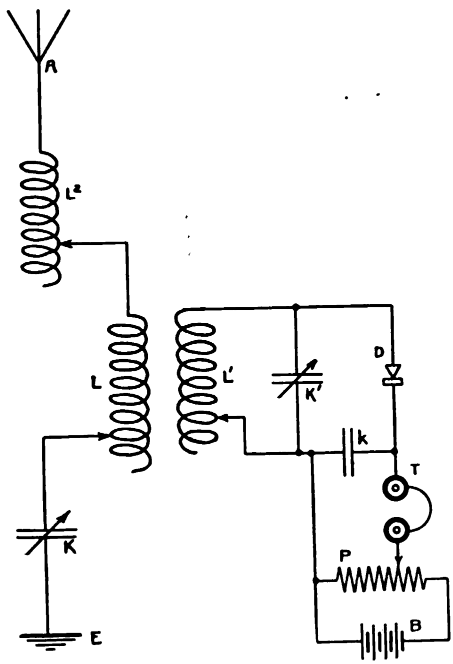


Fig. 60

the other is reduced to a minimum, so that sharp resonance is obtained in the closed circuit. This causes an excessive rise of potential at the terminals of the condenser K′. To the terminals of condenser K′, and in series with each other, are connected the detector D and the condenser k. To the terminals of the condenser k are connected the telephones T and the potentiometer P and battery B. When oscillations are taking place in the closed circuit the detector D is subjected to an oscillating potentional across K′.

This causes current to flow through the detector and condenser, which either varies its resistance and causes the battery current to fluctuate through T, or is rectified by the detector D; in the latter case the oscillating current itself is used to operate the telephones. It can be readily seen that the high frequency current itself, even if it were able to pass through the telephones, could not cause an audible response. If it is quickly rectified, however, we get a number of small impulses in the same direction, which affect the telephones. The detector should be of high resistance, so that it will not take energy from the closed oscillating circuit too rapidly.

The value of the inductance and capacity used in the different circuits depends entirely on the range of wave length which it is desired to operate with, and also on the resistance of the detector used. These values, in practice, are generally determined by experiment. In fact, it can be said that the higher the resistance of the detector the smaller should be the capacity of the condenser K′ and the larger should be the inductance L′. The effect of this is to increase the potential across the detector D.

I shall not attempt to describe the numerous kinds of detectors in general use at the present time, but will refer the reader to "Principles of Wireless Telegraphy," by G. W. Pierce, in which these detectors and their characteristics are fully described. For those desiring to go into the question of wave propagation, the reader is referred to Chapter 5, "Principles of Electrical Wave Telegraphy," by J. A. Fleming.

THE END

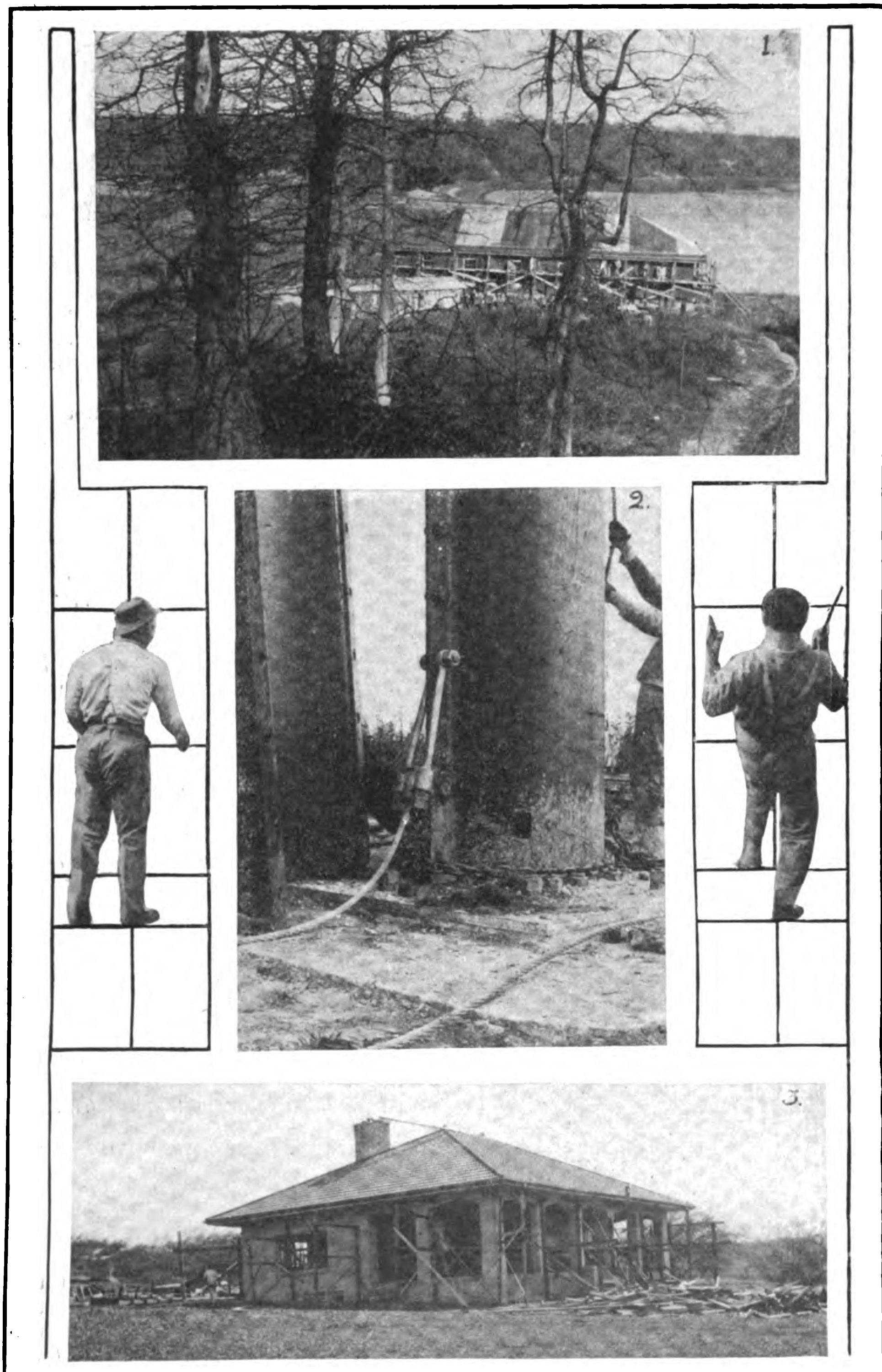
This course commenced in The Marconigraph, issue of December, 1912. Copies of previous lessons may be secured. Address Technical Department, THE WIRELESS AGE.

U. S. STATIONS IN ALASKA

Lieutenant Edwin H. Dodd, of the United States Navy, radio officer in charge of the expedition which established permanent wireless telegraph stations in Alaska, has made a report which is in part as follows:

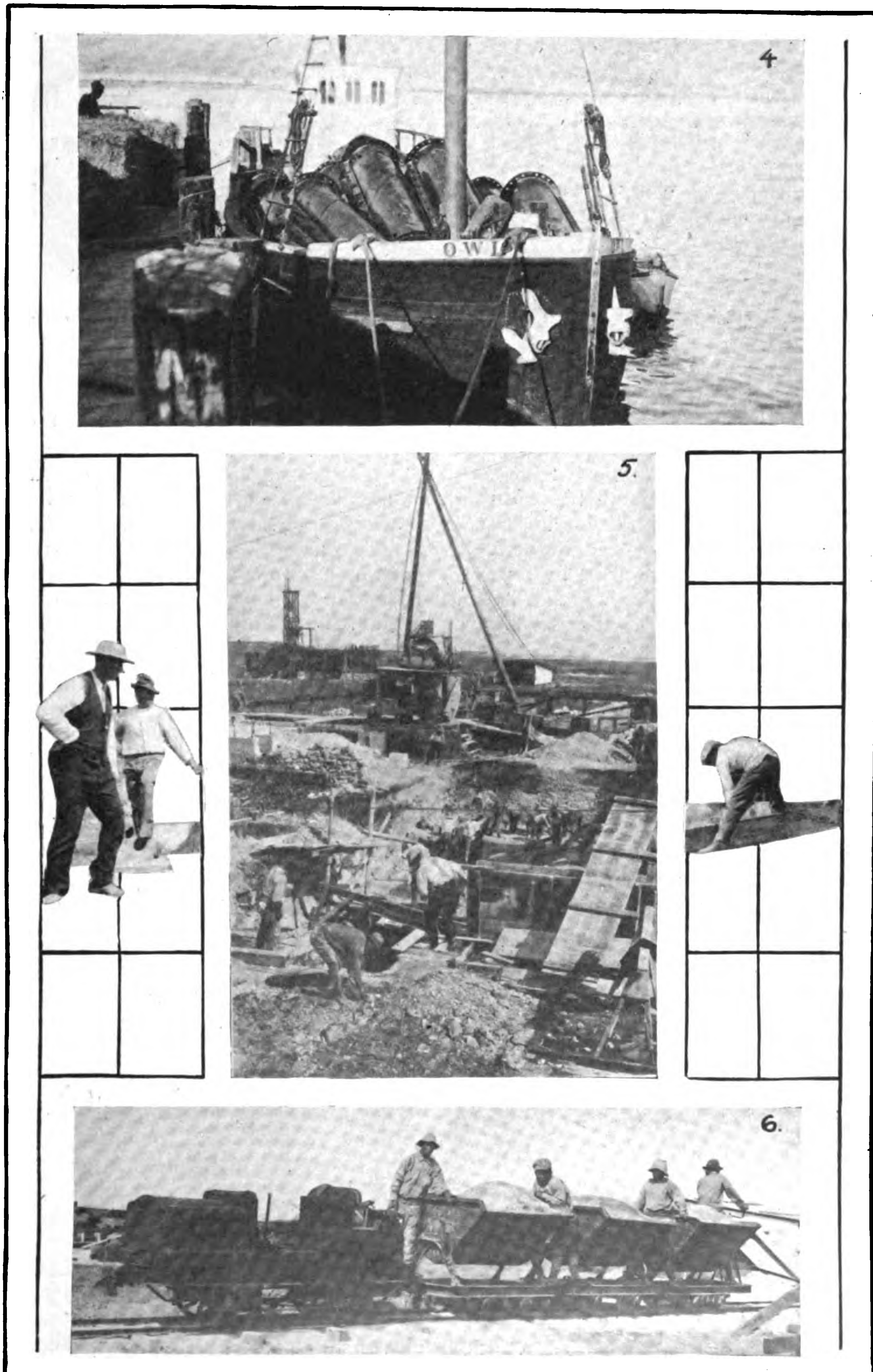
"The importance of the Alaska stations will increase from year to year. Unalaga can be a relay station from the United States to Japan and Siberia. Communication with the former has already been established via Otchisi. Dutch Harbor is the farthest point to the westward at which a weather observer is stationed, and the daily reports from that station are of great assistance to forecasters in making weather predictions for the Pacific coast."

Latest Pictorial Reports



(1) *The operating building at the Belmar receiving site is now awaiting the roof tiling, as may be seen in this view taken from the hotel.* (2) *An illustration of the simple and effective way the mast stays are secured.* (3) *A typical residence as it nears completion.*

on the High Power Chain



(4) *One of the methods of transportation employed in delivering mast sections to the Honolulu sites.* (5) *Condenser pit excavations made under difficulties.* (6) *An illustration of the ingenuity of the Marconi engineers; the chassis of an automobile transformed into a locomotive.*

CHAPTER VII

DETERMINING THE WAVE LENGTH OF THE RECEIVING CIRCUIT

THE method for obtaining the wave length of a distant transmitting station at a receiving station is shown clearly in Fig. 21. An inductively coupled tuner is represented by its primary and secondary windings and it will be noted that in reality the secondary

Inasmuch as the circuit contains a variable condenser and a variable inductance it is comparatively easy to construct a table giving the wave length of the receiving circuit at any given adjustment of either the variable condenser or the variable inductance.

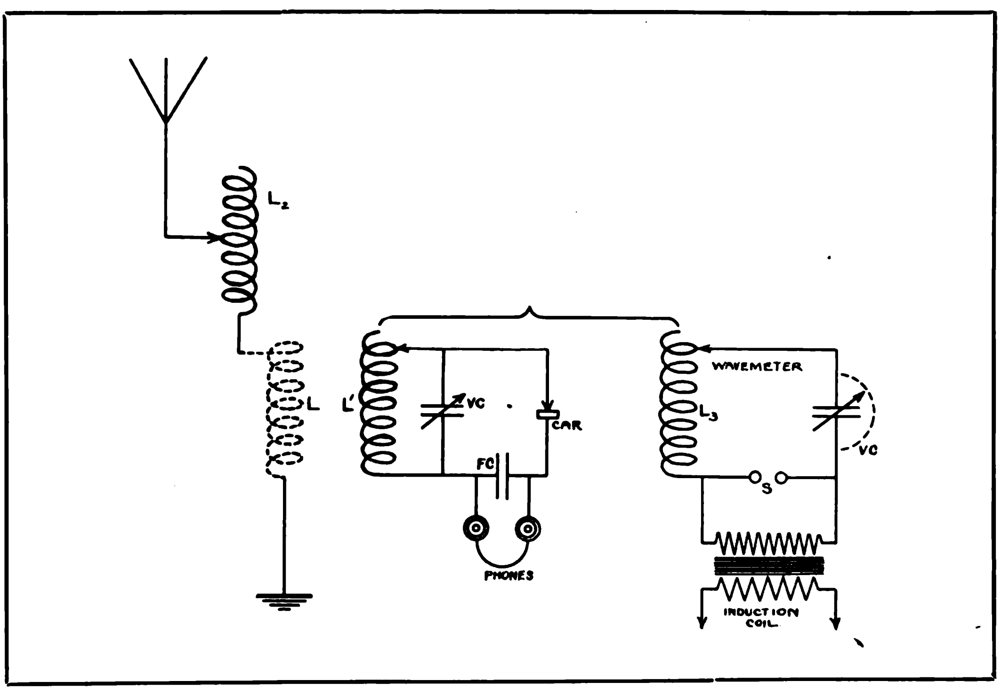


Fig. 21

circuits of a receiving tuner are not unlike the circuits of a wavemeter, i. e., consisting of a variable condenser in shunt to an inductance coil.

When this reading is taken the coupling between the primary and secondary of the receiving tuner must be "loosened" up as far as possible for the

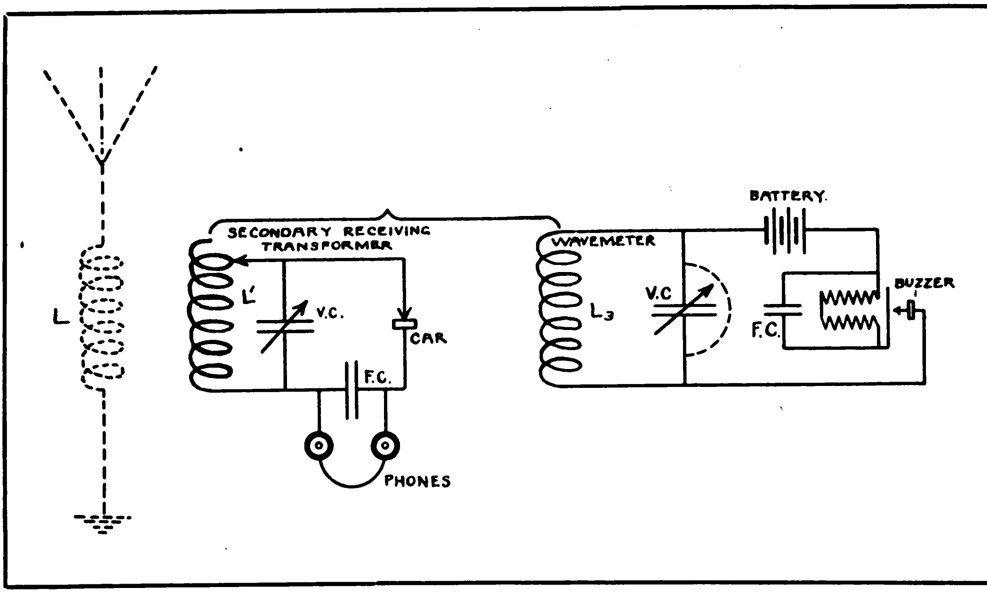


Fig. 22

signals still to be read. By reference to the table the wave length of the distant transmitting station is obtained, it being understood that the antenna and the inductance included in the open circuit are of such combined value as to be within the limits of the wave lengths it is desired to receive.

As before stated, the coupling between the primary and secondary circuits of the tuner must be made as loose as possible, for if this is not complied with, the degree of coupling between the primary and secondary circuits will influence the effective self-induction of the local circuit to the extent that the wave length readings are not apt to be accurate. The smaller the degree of coupling when taking the readings, the more accurate will be the determination of the distant transmitting station's wave length.

To present a typical case showing the calibration of the secondary circuit of a receiving transformer, herewith is furnished a table showing the wave length adjustments possible in the closed circuit of the Marconi Type "E" tuner. Calibrations are not given for all the points on the scale of the variable condenser, but are sufficient for general commercial work.

CONDENSER SCALE

Points on Inductance Switch	C_0	C_1	C_3	C_5	C_8	C_{10}
1	300	350	390	400	440	500
2	425	460	575	650	750	1000
3	600	700	850	1025	1100	1340
4	790	900	1100	1285	1400	1590
5	950	1035	1275	1460	1650	1920
6	1100	1150	1425	1625	1875	2175
7	1240	1395	1550	1790	2095	2475
8	1330	1450	1675	1925	2300	2660
9	1425	1600	1825	2090	2490	2825
10	1490	1720	1820	2275	2650	3000

It will be evident from the table that a given wave length adjustment may be obtained with two or more values of inductance and capacity.

For example—the 1,100-meter adjustment may be secured with:

(1) Six points in use on the inductance coil and the variable condenser at zero.

(2) With four points on the inductance and the third division on the condenser scale.

(3) With three points on the inductance coil and the variable condenser at division 8.

The arrangement to be used (1, 2 or 3) depends upon the degree of coupling. If "loose coupling" (to prevent interference) is desired use arrangement (3). For a tighter coupling (2) or (1) may be employed.

Operators at present in the employ of the Marconi Wireless Telegraph Company of America can make use of the foregoing table in adjusting the Type E tuner to a definite wave length.

Receiving sets are for the present rarely calibrated directly in wave lengths and if no table is furnished, adjustments of the tuner for resonance are best obtained by practice; this, however, is not difficult, as all coast stations communicating with ships carry on correspondence at a wave length of 600 meters and, after an operator has once determined the adjustments on the tuner for the 600 meter wave, it is easy to judge the values of inductance and capacity to use in either circuit for longer or shorter wave lengths.

If a wavemeter is at hand it may be used to determine the wave length of a distant station from the adjustments at

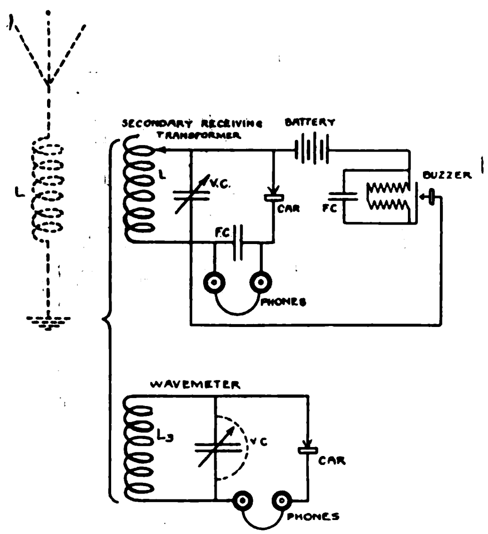


Fig. 23

the receiving station, as shown in Figs. 21 and 22.

The secondary of the receiving tuner circuit is adjusted to the highest point of intensity of signals from the distant transmitting station by means of the variable condenser, *VC*, and the variable inductance, *L'*. To the right of the secondary is shown the circuits of a standard wavemeter in series with which is placed a micrometer spark-gap, *S*. The wavemeter is energized by means of a

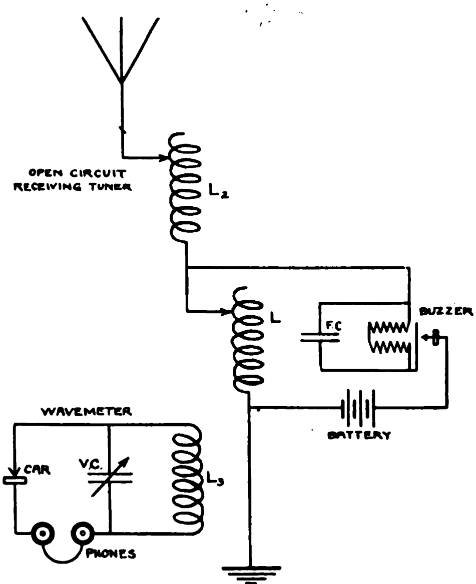


Fig. 24

small induction coil, the secondary of which is connected to the spark-gap, *S*. When the coil is in operation, high frequency oscillations are set up in the wavemeter circuit and are to some extent radiated. The wavemeter is then placed near enough to the secondary circuit to act upon it inductively and the variable condenser of the wavemeter altered until a maximum of sound is obtained in the headphones of the receiving set.

At the point where the maximum sound is obtained, resonance between the wavemeter and the local circuit of the receiving set is indicated, and therefore it is only necessary to note that wave length reading in meters on the wavemeter to determine the wave length to which the receiving set is adjusted. The wavemeter may be used in this manner to test the sensitiveness of the detector. It should be placed some distance from the tuning circuits.

The presence of the spark-gap in series with the wavemeter introduces damping in the circuit and does not allow the accuracy of reading which otherwise might be obtained. More accurate readings are secured by the method shown in Fig. 22, where it will be noted that the wavemeter is excited by a buzzer and battery cells, rather than by an induction coil.

It should be observed that the circuit of the buzzer is made through the wavemeter, and when the buzzer is in operation a change of lines of force takes place through the wavemeter coil, causing the condenser of the wavemeter to be charged and then discharged through the circuit. Thus, high frequency oscillations are set up in the wavemeter and may be recorded on the receiving tuner detector, as previously described. Accurate readings may be taken by this method, provided all is in proper adjustment.

In making tests of the wave length received, the latter method may be reversed; the circuits for this are indicated in Fig. 23. The receiving tuner is adjusted to the greatest intensity of signals and then the buzzer circuit is used to excite the receiving tuner circuit. The carborundum crystal and head phones are now connected to the wavemeter in the regular manner. The local circuit of the receiving tuner now becomes the transmitter and the wave length may be read directly upon the wavemeter.

The wave length of the open oscillatory circuit of the receiving tuner can be read in the same manner as shown in Fig. 24. The buzzer circuit is connected to the coil of inductance (whatever amount of inductance is in use in the open circuit) and when the buzzer is in operation high frequency oscillations traverse the antenna, which may be read directly upon the wavemeter.

Test Buzzers—Test buzzers are often used to determine the adjustment of a receiving outfit for the most sensitive adjustment without necessarily receiving signals from a distant transmitting station. The device is shown in Fig. 25, near to the tuning circuits, and consists of an ordinary buzzer with a condenser shunted around the vibrator. It is in reality a miniature transmitting set, sending out highly damped waves, which, in turn, induce currents in the receiving tuner circuits, enabling the operator to secure a maximum degree of sensitiveness in the detector adjustment. Sometimes a small coil of wire is connected in series with the condenser, and this coil is placed in inductive relation to some part of the receiving circuit.

In General—In the general operation of all receiving tuners, operators will find it of great value to take note of the best adjustment for any given land or ship station. This is easily possible, for all receiving tuners have empirical scales on the variable inductance and the variable capacity. By reference to this table the apparatus may be adjusted in advance to the particular wave length of a distant radio station.

The importance of this is obvious; suppose after the operator had finished communication with some ship or land

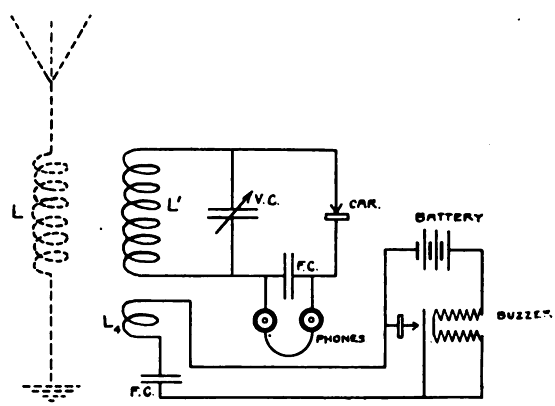


Fig. 25

stations at 600 meters and then desired to tune the receiving apparatus to the 1,650-meter wave of Cape Cod, it would certainly tend to greater efficiency to be able to preadjust the apparatus rather than simply "feel around" for the particular receiving tune.

(*To be continued*)

SUSPENSION FOR OPERATOR

The United States Department of Commerce recently suspended for a period of thirty days the license of a wireless operator who had been found asleep at his post three times during the voyage of the steamship on which he was detailed.

A Unique English Relay

By FRANK C. PERKINS

A MOST interesting type of telephone relay, which it is claimed may be applied to wireless, has been devised by S. G. Brown, of London, an American whose native city is Chicago. The relay has been developed along quite new lines. It takes as its basis the researches of J. J. Thomson, Earhart, Kinsley and others, with regard to the flow of electrons across a microscopic air gap between two conducting surfaces at different potentials.

This English telephone relay has been used on the electrophone system, and by its aid, and on clamping the reed with a piece of rubber, the speaking and music from the theaters are rendered with loudness and greater clearness than it is possible to obtain with the telephones supplied by the Electrophone Company. By adding a loud-speaking device with trumpet the sounds may be heard at some distance in the room.

Fig. 1

The accompanying illustration (Fig. 1) and drawing (Fig. 2) show the construction of the instrument with the brass cover removed. It will be noted that N is a permanent magnet, continued by soft iron poles right up to but not touching, the steel reed P. Two sets of coil windings are wound around the soft iron pole extensions H and K. The telephone currents to be magnified circulate round the winding H, and by thus varying the magnetism set the reed P on variation. M O are the top and bottom metal contact pieces, which are opened to an infinitesimal degree to form a microphone by the fine adjusting screw W, and the action of the local current passing through the contact and round the winding K. It is by the action of the local current operating through this winding that the conduction space is formed, and afterwards the microphonic adjustment maintained.

It is claimed that so good is the automatic adjustment that the instrument may be turned upside down without scarcely any noticeable alteration in the value of the local current and without any effect on the working of the relay. The regulating winding K must not act when H is traversed by the rapidly varying telephonic current; this is brought about by surrounding the iron under the coil by a closed circuited copper sheathing. Eddy currents set up in this sheathing circuit by mutual induction destroy the self-induction of the coil.

It is stated that in earlier instruments the lower contact o was carried by a thin iron disc; the relay was then very susceptible to outside noises. For this reason a reed is now used, for it exposes such a small surface to the air that it is practically unaffected by extraneous sounds.

It is claimed that this relay will magnify the very feeblest telephone currents. Speech or signals that are too faint to be heard in the ordinary bell receiver may be heard clearly when employing the relay. If a watch be held against the ear-piece of a Bell telephone the inducted currents produced will reproduce when passed through the instrument, the ticking in the receiver attached. This is a severe test.

This property of magnifying feeble telephone currents has made this new relay useful in wireless telegraphy. On replacing the telephone by the relay and telephone used, the increased sensitiveness thus obtained doubles the distance over which it is possible to receive signals. Its utility in this direction has been tested by the Admiralty and Post Office. In a wireless receiving station messages too weak to be heard when listened for with the relay in circuit, were easily read. At the invitation of Mr. Marconi, Mr. S. G. Brown took two instruments to the Haven Hotel, Poole. In one of the tests (Clifden, in Ireland, sending with the Marconi musical spark) the signals were heard in the telephone directly connected to the wireless receiver, as a faint, but clear and pleasing, series of musical notes. But, with two relays working joined to the system in series, the signals were rendered loud enough to be heard clearly by every person in the room, and an operator listening at a distance of several yyards from the instrument could have deciphered the message. The relay is not easily affected by extraneous noises and vibration. It can thus be carried on board ship and worked in all weathers.

In reference to its utility on ordinary telephone lines, speech may be magnified many times in loudness without preceptible loss in the articulation, and it will work with large currents to a point at which the Bell receiver in its local circuit is responding with uncomfortable loudness. In experimenting over a 20-pound standard cable under water and speaking but one way, it has been proved that when the relay is applied 30 miles may be added to any length through which it is possible now to speak direct. For instance, supposing the length of the core for direct speaking to be 20 miles, this may be increased to 50 miles for the same loudness and approximate clearness when the relay is in circuit either as a single

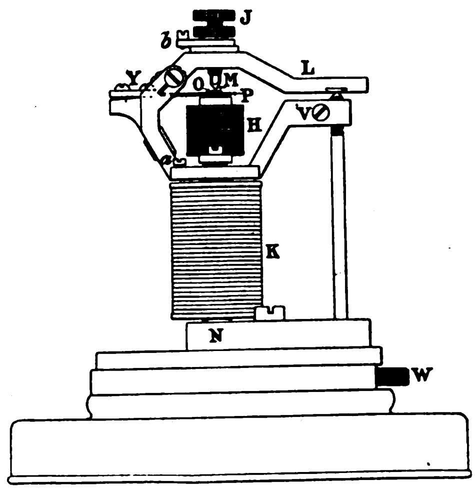


Fig. 2

repeater at the end of the first 20 miles, or as a receiver at the end of the 50 miles.

It is stated that these tests prove that the telephone currents are increased by the relay in strength to the extent of something like twenty times. If greater magnification than can be obtained with one relay is required the simplest method would seem to be to employ two relays working in tandem. Their combined power would then be 400 times. In the majority of cases it is not necessary to add to the natural electrical damping of the reed, but if a piece of soft rubber be made to touch it the voice can be transmitted with greater clearness even than if the conversation were taking place ordinarily in a room. This may be due to the complete absence of echoes.

Advocating Wireless for All Lake Boats

WIRELESS for every steamer on the Great Lakes, passenger and freight, now seems to be the idea of the House Committee on Merchant Marine and Fisheries, before which the passenger steamboat men of the Great Lakes, the bays and sounds are laying their protests against the La Follette seamen's bill. This is indicated by the well-evidenced inclination of the committee so to amend the seamen's bill for all classes of steamers, saving, of course, river and harbor steamers, as to require a wireless outfit.

The questions asked generally by the committeemen show them to be in serious doubt as to the real value of the La Follette bill as a provision for the greater protection of life at sea. The committee is laying great stress on the danger of fire, and is permitting the vesselmen to bring out the fact that the measure championed by Senator La Follette and passed by the Senate makes no mention of fire protection or wireless.

The vesselmen are being questioned closely on both these matters, and it is a general observation by the witnesses that fire is the thing most feared at sea. The vesselmen are unanimous that wireless is the thing imperatively needed on all ships. They put it: "What good is wireless on one ship if she is unable to use it for communicating with other ships from which she might need aid?"

Several of the witnesses have declared that a general provision for wireless would be of far more effectiveness for the safety of life than any provision calling for "100 per cent life boatage."

The passenger steamboat men of the Great Lakes have shown some reluctance to emphasize this subject. They have stated to the committee that they are passenger steamboat men, and not freight-boat men. They have insisted that they preferred to confine the discussion to their own boats, especially as the subject of protest has been limited to the safety provisions of the seamen's bill.

Full credit has been given the lake freighters for carrying 100 per cent lifeboats at the present time. The passenger steamboat men insist they have played more than fairly by the freighters and their operators, and they have insisted that as things stand the freighters will not have to make any changes in their equipment, even though the seamen's bill passes in its present form.

The committee holding the hearings seems to take the view that when it comes down to a question of real safety fire should be given consideration, and the Congressmen seem inclined to act along this line, excluding the lakes, at least, from the lifeboat requirements on the 100 per cent basis and amending the bill further to take precautions against fire and to insist on wireless for all ships.

Testimony was given by A. A. Schantz, general manager of the Detroit & Cleveland Navigation Company.

Schantz stated that all of the ten boats of his line have carried wireless from the outset without having been required to install it by the Government.

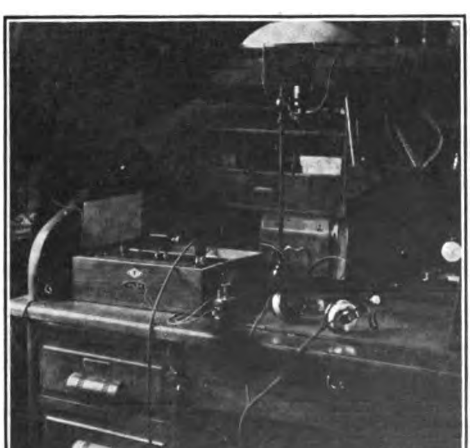
In conclusion he stated that the only things feared on the lakes are fire, fog and snow. The passenger boats do not run in winter, and so are free from the perils of snow. Fog is met by slowing down and by constant fog whistling. Fire, he explained, is guarded against by the best fire preventive and fire-fighting apparatus possible to install, adding that "for further protection we believe that wireless for all steamers will give us greater protection than any other measure."

Time Signal Station at the Hamburg Observatory, Bergedorf

German Wireless Time Signal Stations

THE first wireless astronomical time signals were tried in 1906, and the first regular wireless time signal service was established in 1907 at Camperdown wireless station, near Halifax. In 1910 wireless time signal service was placed in operation between Paris, German Norddeich wireless stations and the Imperial Marine Observatory at Wilhelmshaven.

The wireless time signal equipment of the Hamburg Observatory at Bergedorf, Germany, seen in the accompanying illustrations, is under the direction of Dr. R. Schorr, who established this wireless installation in August, 1911. The antennæ consist of copper conductors of two millimeters stretched in a horizontal position, the total length of these aerial wires being 320 meters. They are located at a height of from 8 to 15 meters from the earth.

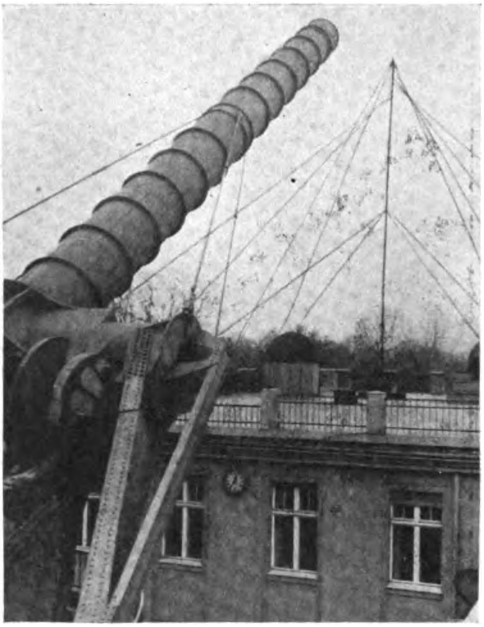


Receiving Apparatus of the Signal Station at Mülhausen, in Elsass

The wireless receiving equipment used is that of Mr. Erich F. Huth, of Berlin. This apparatus measures 180 mm in length and 170 mm in width, with a height of 260 mm; and includes a thermodetector and double-head telephone receivers of high resistance. A small transmitting equipment of 2,000 meter wave length is utilized at Norddeich and Paris. The total weight of the apparatus is only 5.5 kilograms. The distance between Norddeich and Bergedorf is about 200 kilometers, while the distance between Bergedorf and Paris is fully 730 kilometers.

The Berlin wireless signal installation at the Treptos Observatory includes a mast 18 meters high carrying the antennæ with wireless instruments of the Normalzeit Gesellschaft. At the municipal Technical School at Mülhausen, in Elsass, Germany, there is a wireless time signal station under the direction of Dr. Hans Zickerdraht. This wireless is so arranged that any wave length may be used from 200 to 2,500 meters. Time signals are sent at intervals day and night, although usually not more than four signals are transmitted in 24 hours.

Wireless Equipment of the Hamburg Observatory



Time Signal Station of the Treptos Observatory

WIRELESS LAWS IN NEW ZEALAND

The Governor of New Zealand has been empowered to require that ships registered within his jurisdiction and carrying passengers shall be equipped with apparatus for transmitting messages by wireless telegraphy. The regulations specify that every steamship registered in New Zealand and carrying passengers, engaged in foreign or intercolonial trade, except steamships trading to the Auckland, Chatham or Campbell Islands, and every home-trade steamship which is authorized by her ordinary survey certificate to carry not less than 150 passengers at sea, shall not attempt to leave any New Zealand port unless she is equipped with an efficient apparatus for radio communication in good working condition.

The range of the apparatus, it is specified, must not be less than 100 miles, day or night. The regulations stipulate that the power necessary to transmit signals shall be at all times available for the use of the wireless operators.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

A. L., Bar Harbor, Me., writes:

Ques. (1) I have an aerial 90 feet long, 85 feet high, 7 wires 2 feet apart; Clapp Eastham receiving set, consisting of loose coupler, 2 variable condensers and a Perikon detector. I hear nearly all stations between here and Key West, Fla., and have heard Colon, Panama, once. Could I do as good or better work with the aerial 180 feet long, 4 wires 4 feet apart, same height?

Ans. (1) Undoubtedly you will be able to do better work with longer antenna. It will enable you to receive the longer wave lengths more readily. It will, however, decrease your range when receiving 200-meter amateur wave lengths.

Ques. (2) My sending set consists of a 250-watt transformer, oscillation transformer, Clapp Eastham 2-section condenser, rotary spark gap; length of the lead-in, 54 feet; length of ground wire, 6 feet. I use 110 volts alternating current with the transformer. Will you please give me the total sending distance with the aerial?

Ans. (2) Your query is not plain and you have not given us the full dimensions of your antenna. Do you intend to use this set with the 180-foot flat top aerial? If so, your transmitting set will not comply with the law, having a wave length greater than 200 meters. Your sending range is approximately 45 miles (with the 90-foot aerial).

Ques. (3) Will you please give me the size of aerial to reduce to 200-meter wave length?

Ans. (3) If you desire to emit a wave length of not more than 200 meters, the natural wave length of your antenna should be less than 200 meters—roughly, 160 meters. An aerial of such dimensions will allow a few turns to be connected in series for the transference of energy from the condenser circuit. An aerial 56 feet in length and 40 feet in height, consisting of 4 wires 2 feet apart, will have a neutral wave length of approximately 160 meters.

Ques. (4) Are Key West, Fla., and Colon, Panama, good amateur working results for this location?

Ans. (4) The average amateur working at night during the winter months does not do any better.

Ques. (5) Has the apparatus or the spark at WCC been changed? The spark sounds more "cracky" than usual.

Ans. (5) The pitch of the note has been lowered.

* * *

H. M. R., Jasper, Mo., writes:

I understand that 4 watts per mile (overland in day time) are allowed in transmission with an open core transformer and about 8 watts per mile for a closed core transformer. In other words a half K.W. open core transformer is supposed to transmit about as far as a 1 K. W. closed core transformer. If this is the case, why does the condition described exist? Which is the better for the use of an amateur limited to 1 K. W.?

Ans.—You have been misinformed. While the transformer is a dominant feature in a transmitting set there are other conditions in the case, external to the transformer, which determine the distance covered. The two types of transformers, provided they were properly designed, should be equally efficient. For complete data as to the distance you may expect to cover with a given amount of antennæ current, we refer you to the appendix in the Naval Manual of Wireless Telegraphy for 1913 by Commander Robison. Replying to the latter portion of your query, we have not yet seen a set operating on a wave length of 200 meters consuming 1 K. W., even with the set operating at a spark frequency of 1,000 per second. A watt meter in the primary circuit indicated but 750 watts.

* * *

E. B. K., Tutuila, Samoa, asks:

Ques. (1) How many points does a 10-inch wheel on a rotary gap require, operating on 60-cycle alternating current? I have a wheel that has 12 electrodes and a speed of 2800 or 3000 R.P.M. The spark seems to take place before the moving electrode gets even with the stationary electrode, and as my wheel was constructed of hard rubber, it did not take long for the spark to pierce the rubber. Can you explain this?

Ans. (1) If you will make the brass points in the disc project at least 1½ inches on either side of the disc, you will remove the discharge to a point where it will not pierce the hard rubber. When using a rotary gap the spark discharge invariably takes place before the points are opposite one another, due to the fact that the spark breaks down at the maximum potential of the condenser. In other words the potential of the condenser is so high that it is not necessary for the electrodes to be opposite each other for discharge. Ten points equally spaced around the disc should be quite sufficient at a speed of 3000 R.P.M. You will find it much to your advantage to have some means at hand for increasing or decreasing the speed of the motor.

Ques. (2) At present my set is direct coupled, but I am constructing a loose coupled oscillation transformer, the closed circuit of which is wound with No. 6 wire and the open circuit with No. 3 wire. I shall also have a loading coil in the aerial circuits. The ship is equipped with a loop aerial which I intend to change to the inverted "L" type. Do you think that the arrangement described will help my set, and have you any suggestions to make? The set is of 2 K. W. capacity.

Ans. (2) There will be no great advantage in constructing an inductively coupled oscillation transformer. You can secure loose coupling with the ordinary direct coupled helix. We do not understand your query about the looped aerial. You, of course, understand that an aerial may be of the looped type whether it is of the inverted "L" type or any other type.

* * *

J. A. W., Waterbury, Conn., asks:

Ques. (1) Did the Titanic communicate without relaying directly with Cape Race when signalling for help?

Ans. (1) Yes.

Ques. (2) What is the longest distance the station at Arlington, Va., has communicated?

Ans. (2) We understand that the signals have been read at a distance of 4,000 miles, but the everyday range is not more than 1/3 of this.

Ques. (3) At what rate of speed does Sayville send?

Ans. (3) About 15 words per minute.

Ques. (4) How many words per minute does Cape Cod send?

Ans. (4) Eighteen to 20 words per minute.

* * *

H. E. W., Bay City, Mich.:

The data for the transformer you desire to obtain will appear in an early issue of THE WIRELESS AGE, in the series of Instructions for Boy Scouts. Referring further to the Thordarson transformer, you should communicate directly with the concern making that apparatus.

Answer to Query No. 2: There is no distinct advantage to the "doughnut" type of oscillation transformer, except that it allows a loose coupling to be easily obtained.

Answer to Query No. 3: The natural wave length of your antennæ is approximately 250 meters.

* * *

H. H. H., Medical Springs, Ore.:

Ques. (1) I have a 6-inch induction coil made for X-ray work; it has but one secondary terminal. How can I adjust it to use it for wireless?

Ans. (1) Why not communicate with the makers of the coil? The majority of X-ray coils are furnished with two secondary terminals. Automobile ignition coils that are very often furnished have but one secondary terminal, the other high potential terminal being connected to the primary circuit, which is in turn connected to the frame of the machine. Since, however, this is a 6-inch coil, it is likely that our explanation is incorrect.

Ques. (2) Is a 325-foot lead-in too long for a 150-foot aerial having 6 wires and 2 lead-in wires?

Ans. (2) Yes. This is decidedly abnormal construction for wireless telegraph antennæ.

Ques. (3) As I have only direct current source of supply, where can I obtain a 1 K. W. open core transformer with an interrupter of some kind?

Ans. (3) We never heard of a 1 K. W. transformer with an interrupter. Transformers having interrupters are known as induction coils. There is considerable difference in the proportionment of windings (primary and secondary) between a transformer and an induction coil. If you desire to handle 1 K. W. through an induction coil, you will require a water-cooled electrolytic interrupter.

Ques. (4) Can I take alternating current from a direct current generator?

Ans. (4) Certainly. If you tap off a pair of leads from the commutator segments directly under two brushes of opposite polarity and then connect these two wires to a pair of slip rings on the other end of the armature, you will secure alternating current of a lower potential than that of a current generated on the D. C. side. You will then have a self-excited alternating current generator. Since D. C. generator windings differ, you should have this work done by some reputable electric company.

Ques. (5) Would this 6-inch X-ray coil be as efficient as a regular wireless coil?

Ans. (5) It is not likely. The potential is rather too high.

* * *

E. W. S., Aurora, Ind., writes:

We hear a station at night sending press to Sayville, seeming to sign "BIT." Where is this station, if there is such a station working with Sayville?

Ans.—We are not aware that Sayville is in communication with such a station, although some long distance experimental work is being done at that point. "BIT." is the H. M. S. S. S. Christopher, of the British Admiralty.

* * *

N. S., Ithaca, N. Y., writes:

Ques. (1) Does a long ground lead increase or decrease the wave length of a receiving station?

Ans. (1) It increases the wave length.

Ques. (2) What transatlantic steamships use Marconi apparatus, and what companies use Telefunken apparatus?

Ans. (2). We cannot answer this question fully, as it will require too much space. The Telefunken system is employed on ships flying the German flag. The Marconi apparatus is used on ships of all other nations.

Answer to Query No. 3: We are not familiar with the conditions surrounding the Federal Company's San Francisco-Honolulu long-listance work. You should communicate with the company.

The information requested in Query No. 4 is not available for publication.

Answer to Query No. 5: Operators must be 18 years of age before they can obtain employment with the Marconi Company.

* * *

A. B., Seattle, Wash.:

The information you request concerning the Marconi multiple tuner is not available for publication.

* * *

V. R. P., New York City, writes:

Please give formula for calculating inductance and wave length of a loose coupler.

Ans.—The wave length of an oscillatory circuit is equal to $59.6 \sqrt{L.C.}$

Where L = the inductance in cms.

And C = capacity in mfds.

A simple formula for calculation of capacity has been given in previous issues of THE WIRELESS AGE. A simple formula for calculation of inductance suitable for amateur needs is given in the experimental department in this issue. All told, however, you will find it far more desirable to purchase a wave meter than to make these calculations.

Ques. (2) Is it practicable and desirable to use one or two turns on the primary of the receiving tuner for minimum wave length? How many turns should be used in the secondary for the same minimum wave length?

Ans. (2) It is possible to transfer energy with two turns in a primary circuit, provided the turns of the secondary are not too far off. Approximately, the minimum amount of turns in the secondary using receiving tuners of the average size should not be less than six or eight.

Ques. (3) What would be the probable capacity of an inverted type of aerial composed of four No. 14 B. & S. gauge galvanized iron wires, spaced two feet apart, length of flap top, 80 feet; length of lead-in, 70 feet. What would be the probable inductance and the resistance?

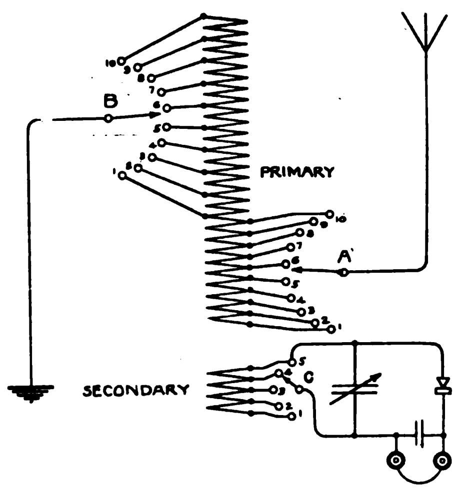
Ans. (3) We do not advise the use of galvanized iron wire for aerials. The capacity of an aerial such as you describe will be approximately 0.000349 mfds., the inductance 62390 cms. If your antenna was constructed of copper wire the effective ohmic resistance would be approximately about 9 ohms.

Answer to Query No. 4: A ground lead 40 feet in length will have the effect of decreasing the transmitting range, but will not so seriously affect the signals being received.

J. W. S., Ivoryton, Conn., writes:

I am building a "loose coupler" for receiving transformer; primary has a tube 4½ inches long and 5¼ inches in diameter, and is to be wound with No. 20 enameled wire; secondary tube 4½ inches long, 4¾ inches in diameter, to be wound with No. 28 wire; secondary to slide inside of primary. How would you advise me to wind them so as to use switches, that is, how many points should I use on the secondary and primary? What is this so-called "dead-end" effect? Would you advise me to use this method, or would it work equally well with taps taken off wire without cutting off complete sections of the windings not in use? I myself believe switches are preferable to sliders.

Ans.—When using a receiving tuner with such small dimensions you need not take into



account the "dead-end effects." While they are probably present, the loss occasioned is of such small value that it need not be taken into account.

Switches are undoubtedly better than sliders. but a switch designed to simply throw into use the turns desired is unnecessarily complicated and expensive to construct.

For the primary coil you should use a switch allowing one turn to be cut in at a time. The windings on the secondary may be divided between the 5-point switch, particularly if you use a variable condenser in shunt with the receiving transformer. Arrangement of the switches is shown in the accompanying diagram.

In the primary circuit switch A has ten points, each of which are connected to the first ten turns of the primary. Switch B has ten points, each point adding ten turns to the circuit, or whatever number fits your particular case. Switch C has five points which, as before stated, may be equally divided between all the turns of the secondary.

As regards the dead-end effect, see the article in the November issue entitled Kolster Addresses Radio Men.

THE WIRELESS AGE

Statement of the ownership, management, circulation, etc., of THE WIRELESS AGE, *published monthly at New York, N. Y., required by the Act of August* 24, 1912. *Editor, J. Andrew White,* 456 *Fourth avenue, New York; Business Manager, John Curtiss,* 456 *Fourth avenue, New York; Publisher, Marconi Publishing Corporation,* 456 *Fourth avenue, New York.*

Stockholders holding 1 *per cent. or more of total amount of stock, Marconi Wireless Telegraph Company of America,* 233 *Broadway, New York City. Known bondholders, mortgagees, and other security holders, holding* 1 *per cent. or more of total amount of bonds, mortgages, or other securities: none.*

JOHN CURTISS,
Business Manager.

Sworn to and published before me this 2d day of October, 1913.

B. N. Swift,
Commissioner of Deeds,
New York City, No. 163,
New York Register, No. 15,104,
Commission expires April, 1915.

MARCH, 1914

THE RADIO REVIEW

OUR always greatly revered and recently rejuvenated contemporary, the New York Tribune, throws some light on one of the most distressing details surrounding the heroic self-sacrifice of Operator Kuehn, of the Monroe.

A Touching Incident in Connection with the Monroe Disaster

Following the publication of a letter from one of its readers, the subject of which was "The Heroism of Kuehn," a letter containing a check for five dollars was received from Mrs. H. G. Hollenberg, secretary of the Harmony Club. The sender requested The Tribune to turn over the money to the family of Ferdinand Kuehn, the young wireless operator, who gave his life-belt to a woman passenger and perished when the Dominion liner Monroe went down.

In her letter Mrs. Hollenberg told of the circumstances under which the young man had been reared and how his mother, a highly educated Frenchwoman, and his father, a well-bred German, had struggled to educate him and train him to be honorable above all things. The writer sent the check to the newspaper, she said, for the reason that she had lost track of the family for the last few years, and did not know the address.

When a reporter called at the home of Ferdinand Kuehn to deliver the contribution he was met at the door by the mother of the young man.

Mrs. Kuehn, a sweet-faced woman of middle age, greeted the caller in a soft voice, in which there was slight French accent.

"You gave me a start," she said. "Every time I hear a footstep I feel it must be my boy coming home. Even yet I cannot believe that it is all true—that he is gone. Oh, I know I am foolish to go on so, but he always was so gay and happy and so glad to get home, it doesn't seem possible that he can be taken away."

Then a proud light came into her eyes and a tender half smile seemed to dispel some of the sadness in her face.

"He was a real man, wasn't he? What he did, and the wonderful self-sacrifice of it help me to bear this grief. But he always was a good boy. He never failed to make a friend of any one with whom he was associated. Before he went to the Monroe he was on the Jefferson, and the captain of the ship often would come up here to see Ferd.

"What we are to do I don't know. My boy was our mainstay, and I have had to beg him to keep even a small amount of his wages for himself. See, here are some pictures, taken on the boat. Hasn't he got a generous look in his face?

"It was kind of your reader to send this money, and I shall write and thank her. One has to think of money, no matter what happens; isn't it true?

"Mr. Kuehn is in such poor health that he can do very little work, and, while I am doing all I can, it is hard for me to find employment which will allow me time to look after my husband and my little ten-year-old girl. I don't like to ask for charity and haven't done so. But it is not easy."

How Wireless Solves Surveying Problems

IN surveying the wilderness wireless telegraphy is proving invaluable; according to official reports, the French have used it with much success in Africa, and now it is to solve the vexed question of the frontier between Brazil and Peru. Much of the world, it should be understood, has been surveyed with some accuracy in pieces, but not as a whole, much as though one had a plan of a house without knowing exactly where it stood. The great problem is to bring these parts into relation, and here wireless is invaluable by furnishing the exact Greenwich time, which a chronometer can carry only approximately. In Brazil the ingenious plan has been adopted of using great trees as masts for receiving stations, and thus a great number of points can be accurately fixed as a basis for triangulation. To get great precision in flashing the time the chronometer at one end uses standard time and the other astronomical time, which is a trifle quicker because the star year is shorter than the solar year. In flashing seconds the best of the two corresponds every three minutes, and the rest of the time is in syncopation, and by this temporal application of the vernier principle comparison has been made to a 50th of a second, which in that latitude would mean only about 10 yards of error in the longitude; when all the sources of error are allowed for it is believed by Colonel Woodroffe, chief of the boundary commission, that the error is less than 100 yards. In its work the commission uses a new instrument, the "astrolabe," invented by the French savants Claude and Driencourt, which weighs no more than a theodolite and gives latitude observations correct to a quarter of a second of arc, instead of six seconds, a gain of 24 fold in accuracy.

Guarding Against Another Titanic Disaster

MOTOR-BOAT ice scouts form the latest scheme adopted by trans-Atlantic shipping companies in London as a means of circumventing ice perils during their voyages in the North Atlantic. The new Allan liners Alsatian and Calgarian are the first ships to be equipped in this way. Each of them is to carry on her next voyage two motor boats each of the size of a lifeboat, fitted with 30 horse-power motors and with wireless and submarine signaling apparatus.

The plan is to send these ice scouts ahead during foggy weather to report to the liners by wireless telegraphy the whereabouts of ice and other dangers. The motor boats will also be available for towing life-boats in the event of the abandonment of a liner. The Aquitania, of the Cunard Line, is to carry four of these craft, and other trans-Atlantic steamers are to be similarly equipped.

The Increase in Message Traffic

WIRELESS messages numbering 285,091 were sent in the United States in 1912, according to a census report recently given out. This is an increase of 84.4 per cent. in five years. The total income of the four companies for 1912 was $669,158, compared with $106,791 for five companies in 1907. There were 958 employees, who received $393,606 in wages.

The totals include only the plants operated for commercial purposes. All plants in the insular possessions are excluded. The amount expended for construction and equipment increased $888,156, or 280 per cent. over 1907, and the number of employees 782, or 444 per cent.; the increase in salaries and wages being $311,835, or 381 per cent.

Wireless Possibilities May Halt Telegraph-Telephone Acquisition

REPRESENTATIVE STEENERSON of Minnesota has made a suggestion that has caused the Democratic leaders to halt in their plans to have the Government acquire the telegraph and telephone lines of the country. In a speech in the House Mr. Steenerson made the statement that the present method of communicating by wire would become obsolete in a few years. He declared that the wireless system is reaching a stage of development which would obviate in the comparatively near future the necessity for the use of the equipment now utilized by telephone and telegraph lines. As it would take a billion dollars to acquire control of the existing wire lines, it is altogether probable that Mr. Steenerson's suggestion will lead to an inquiry to determine the exact scientific status of radio communication. Mr. Steenerson has presented a resolution apropriating $100,000 to enable the Postmaster-General to experiment with wireless telegraphy on a commercial basis. Mr. Steenerson firmly believes that if the experiment is made the Administration will abandon its plan to acquire the telegraph and telephone lines by condemnation, and that in time the Government will develop the wireless system to a point where it will be able to handle all the business of the kind required by the needs of the country.

THE EDITOR.

The Monroe Disaster

In which the Marconi Tradition was again upheld when Operator Kuehn laid down his life for another

DEEDS of heroism and bravery in time of peril alleviate in a measure the horror of a marine disaster in which almost half a hundred persons perished. Again, the wireless operators—faithful guardians through the day and the night—proved that they could be tried in calamitous extremities and meet the test unflinchingly. One, in particular, distinguished himself by his valor, and the account of how he gave his own life to save that of a woman stands out prominently in the annals of self-sacrifice.

And the ever-indispensable wireless, too, operated on a sinking vessel, faithfully performed its great service to humanity. With only ten minutes to spare before the waters swallowed up the ill-starred craft, a far-reaching appeal was sent out over the ocean. There was just time to flash the S O S and give the location of the disaster, but that brief message was sufficient to convey the information that lives were in danger and help was needed.

Forty-nine human lives—twenty-five passengers on the Old Dominion line steamer Monroe and twenty-four of her crew—were claimed by the sea early on the morning of January 30 last, when the Nantucket, a smaller ship of the Merchants and Miners Transportation Company, reaching for Norfolk, Va., from Boston, came into collision with the Monroe in the heavy fog. The vessels were off Hog Island, sixty miles from Cape Charles; the Monroe, bound for New York, barely five hours out of Norfolk.

The Nantucket did not escape undamaged. Her bow was crumpled up and she began to leak in an alarming manner. A temporary patch was placed over the rent and she stood steadfastly by while her searchlight swept the sea in search of the victims of the accident. Not until all hope of effecting rescues was gone did she leave the scene of the disaster.

"Women and children first!" was the order of Captain E. E. Johnson, of the Monroe, as he stood by the sinking vessel in command of one of the three lifeboats which it was possible to launch. The women, for the most part protected by life preservers which the faithful blacks had helped them to adjust, were floating about in the still, icy waters, and Captain Johnson and First Officer Horsley, who commanded another boat, moved slowly around in the mists of the fog, picking them up, guided only by the dim gleam of the searchlight from the Nantucket, which had backed away from the sinking Monroe. Twelve minutes after the vessels had struck the Monroe had turned over and sunk, bottom uppermost.

It was the first death-dealing accident to befall a vessel of the Old Dominion line in almost fifty years of its existence, and old sailors declared it the worst disaster in coastwise traffic in a half century.

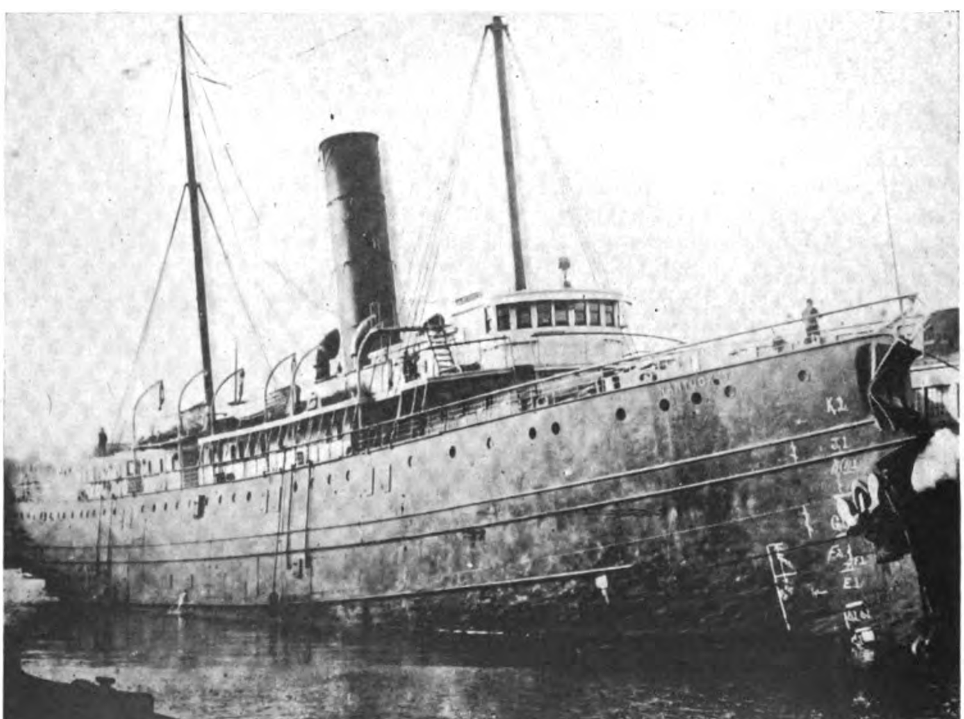
The nose of the Nantucket had torn clear through till it reached the midriff of the Monroe before her captain was able to back away. A moment later the lights of the Nantucket, which was heavily laden with freight and carried but two passengers, could be discerned.

But Captain Johnson was not looking for them. He had been on the bridge, and when the crash came he hastened below and hustled the stewards to get the passengers out of their cabins and up on the boat deck.

Then Captain Johnson hurried to his lifeboats. Already the Monroe was filling on the starboard side and listing heavily. Second Officer Gately ran below to ascertain the extent of the damage. He did not come up till the ship went down, and then he floated around for hours on a ladder.

The captain found that all four boats on the starboard side were useless. Of those on the port side, one had been crushed. He and First Officer Horsley bestirred themselves to get the others off.

Vainly the stewards, by Captain Johnson's orders, and vainly the other officers tried to persuade the passengers to go up to the boat deck. Most of them, huddled



The Nantucket, of the Merchants and Mariners Transportation Company, did not escape undamaged when she came into collision with the Monroe. Her bow was crumpled up and she began to leak in an alarming manner. A temporary patch, however, allowed her to reach port in safety.

together in their nightclothes, a few having seized blankets, would not leave the promenade deck. Yet the boats were up above, and that is why Horsley and Johnson could only get eighteen people in their boats when they launched them.

There was no confusion, no screaming. Everything went along in peaceful, almost orderly fashion, the negroes helping the whites into the life preservers and urging them to get above to where the boats were.

Five minutes had passed when the boats were launched—then came the first big lurch of the Monroe and half the passengers and crew were thrown bodily against the bulwarks, some of them suffering injuries that led to death later.

Steadily the ship careened, till her deck was almost vertical and her port side was facing the fog-obscured sky. The men helped women climb to the top, where they settled themselves on the upturned side.

The darkness was now complete, save for the glimmer of the Nantucket's lights. The dynamos of the Monroe had both given out, and not a light was burning on her.

Slowly the ship began to settle, and presently those who still clung to her side—many having been washed off or having slid into the sea from sheer inability to hang on—decided that unless they were going down with the ship they had better get out to where the lifeboats were trying vainly to reach the vessel—afraid to come too near, yet desperately anxious to reach those who were in the whirl of the waters about the ship.

Then came the searchlight of the Nantucket playing directly on the dying Monroe. That light, almost blinding in its intensity when reflected from the wet sides of the ship, decided those who were still clinging. They slid off and the sea became alive with drowning men and women.

Chief Engineer Oscar Perkins had tried in vain to keep the lights of the Monroe going for another minute or two. He did succeed, in fact, in getting the second dynamo started, but the lights merely flickered and went out. Perkins jumped into the sea.

The Monroe turned till her keel was almost uppermost, and it seemed to some

Ferdinand J. Kuehn, who gave his life preserver to a woman passenger, and went to his death in the icy water, is here seen at the key in the wireless cabin of the Monroe. His heroic self-sacrifice was in keeping with the altruism that characterized his entire life.

of those who were rescued that they heard at that last moment shrieks from some that never got out of their staterooms.

Then the Monroe sank, but in the oily, fog-laden waters she went down with just a sough. The water where she found her grave is sixteen fathoms.

The light of the Nantucket was playing around the waters now, guiding Captain Johnson and Officer Horsley and also two boats which had been put off from the Nantucket to where the Monroe's people were feebly striking out for life.

The boats in charge of Captain Johnson and First Officer Horsley and those from the Nantucket scoured the waters, picking up as many as possible of the men and women struggling to keep afloat. Two life rafts that had floated from the

Monroe also served to aid the work of rescue. Those who were taken from the sea were placed aboard the Nantucket. Several died from exposure after they reached the ship.

Ferdinand J. Kuehn, chief wireless operator on the Monroe, was in the operating room when the collision occurred. He told R. S. Etheridge, his assistant, who was off duty, of the accident and sent out the S O S Call. Etheridge came to the wireless room with life preservers, one of which was put on by Kuehn. Etheridge sent out an S O S, giving the position of the Monroe, and while he was at the key the dynamos died. Etheridge then dashed for a lifeboat and was picked up by the Nantucket.

Another snapshot of the heroic wireless operator, taken aboard the Monroe shortly before the disaster occurred.

Kuehn was standing on the deck when a woman ran toward him. He stopped her as she was passing.

"Where is your life preserver?" he asked.

"I have none. Oh, I am lost!" she replied.

Kuehn quietly took off his preserver and fastened it upon her. Then he led her to the rail and helped her over.

Captain Johnson made the following statement concerning the death of Kuehn:

"Kuehn was standing by lifeboat No. 3 with a life preserver on and was about to leave the vessel. At that moment a woman passenger came along and Kuehn took off the life preserver and fastened it around her. After seeing her safely off the vessel he missed his footing and fell into the water. He managed to keep afloat for a while, but the water was too cold and he finally sank, having given up his life to save another."

Etheridge, Kuehn's assistant, was in his berth when the accident occurred. In speaking of the disaster Etheridge said:

"I immediately got up and placed what clothing possible on myself, Mr. Kuehn having called me. He went back to the radio room and sent out distress signals. In the meantime I made my way to him with lifebelts and relieved Kuehn, so he could place one on himself. After doing this I advised him to make for the lifeboats.

The Monroe, the most luxuriously appointed vessel of the Old Dominion Line, sank ten minutes after she was rammed by the Nantucket in a heavy fog off the Virginia coast.

"The S O S calls, giving the position of our boat, were continued by me. Then the ship's current gave out. After all available means were used, and knowing the immediate danger, I went back on deck.

"I assisted in getting three boats ready and made a jump for the last one lowered. We cleared the Monroe and at once went to the assistance of those who were still afloat, rescuing about twenty-five. The same boat made another trip and picked up several more people.

"The operating staff of the Nantucket should be complimented on its good work. They were badly handicapped on account of the continuous blasts of the whistle. When the Nantucket struck the Monroe the impact caused the aerial to fall. It was put in working order after great difficulty.

"The Nantucket sounded distress calls from about 2:30 to 3 A. M."

Details of the accident revealed that the Monroe sank ten minutes after the collision and consequently there was only time to give the call letters, S O S, and the position of the vessel. The calls were picked up by Operator Rosenfield at the Virginia Beach station.

The force of the collision bent the foremast on the Nantucket and the forward stay fell over the side, causing the wire ropes holding the antenna to part. Aboard the Nantucket were A. Doehler, senior wireless operator, and F. L. Smith, his assistant. When the antenna fell they rigged up a rope halyard and hauled it back to the top of the foremast. It was also necessary to clear the smoke-stack of the wires, and in order to do this Smith climbed on to the funnel. Wireless communication was established at fifteen minutes after two o'clock in the morning, and from that time till the Nantucket docked at Norfolk at half past one o'clock in the afternoon her wireless apparatus was almost constantly in operation, her distress calls being picked up by both ship and shore stations.

Kuehn, who was twenty years old and a son of Mr. and Mrs. Abraham Kuehn, of New York City, was highly esteemed in the Marconi service. He became interested in electro-mechanics when a student in a high school in the Bronx. In his early years he learned the principles of wireless telegraphy sufficiently to install a set in his own home. His schoolmates, as well as the children of the neighborhood in which he lived, still remember how industriously he worked at the construction of the first wireless apparatus he ever used.

Ambitious to become proficient as a wireless telegraph operator, Kuehn entered the telegraph department of the Paine Uptown Business School, in New

A. Doehler, senior wireless operator, and F. L. Smith, his assistant on the Nantucket, rigged up a rope halyard and replaced the fallen antenna when the force of the collision brought it down.

York, on August 15, 1910. He pursued his studies from that time until he was graduated on January 11, 1911. Upon his graduation he obtained employment as a commercial operator. He was detailed to duty on the steamship Denver, of the Mallory line, and was afterwards assigned to the Jefferson, of the Old Dominion line. When the latter vessel was placed in dry dock for repairs about a month before the Monroe sank, Kuehn was transferred to the ill-starred craft. At the time of the collision he was making his second trip on her. His father has been in ill health for a considerable time and the young man was planning to send the elder Kuehn on a vacation and meet the expenses himself.

MEMORIAL·FOVNTAIN·TO
WIRELESS·OPERATORS·LOST·AT·SEA

This fountain, with the granite seats and cenotaph and the surrounding evergreens, will be soon erected at the base of the Tower of the Barge Office, in Battery Park, New York. It was designed by the firm of Hewitt & Bottomley, architects. The drawing for it, reproduced above, was chosen by a specially appointed committee from twelve drawings submitted in competition. Many monuments have been put up to the memory of the victims of the Titanic disaster, but among them all this one is especially interesting because the majority of the contributions for it have been subscribed in small amounts by Marconi operators. The design is classic. The fountain itself is a large white basin with a central jet of water. It has been most suitably and beautifully placed in Battery Park overlooking the harbor and in sight of numberless ships that daily pass the point of Manhattan Island. The cenotaph contains the following inscriptions:

IN MEMORY OF WIRELESS OPERATORS LOST AT SEA AT THE POST OF DUTY
Jack Phillips, S. S. Titanic, April 15, 1912, Atlantic Coast
George C. Eccles, S. S. Ohio, Foundered 1 A. M., August 26, 1909, Pacific Coast
Stephen F. Sczepanek, S. S. Pere Marquette, Car Ferry No. 18, Lake Michigan, September 9, 1910
Laurence Prudhunt, S. S. Rosecrans, January 7, 1913, Pacific Coast
Donald Campbell Perkins, S. S. State of California, August 18, 1913, Pacific Coast
Ferdinand J. Kuehn, S. S. Monroe, January 30, 1914, Atlantic Coast

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, the College of the City of New York

ARTICLE VI

The calculation and construction of inductances are described, formulas for circuits containing inductance are given, and a method of measuring large inductances is treated.

III. MEASUREMENTS OF INDUCTANCE

General Considerations

SECTION 17. Standards of Inductance; Their Calculation. Standards of inductance for low or audio frequencies are usually constructed by winding "litzendraht," that is, multiply stranded wire, on marble or serpentin cores (preferably the former, because of its freedom from traces of iron). The advantage resulting from the use of litzendraht is that the current distribution throughout the current-carrying conductors remains uniform, even when the frequency increases considerably. This is not the case for solid wire, particularly that made of copper or of any other good conductor; for in solid wire the current at high frequencies deserts the central portion of the cross-section of the wire and crowds to the surface. Not only is the effective resistance of the wire thus changed, but the inductance of the coil of wire is also altered (diminished). The core of a standard inductance should always be a rigid non-conductor, and the wire should be immersed in melted wax in a vacuum after winding on the core and solidly inbedded so that there will be no alteration in the dimensions of the coil as time elapses.

For audio frequencies, the standards of inductance may be multi-layer coils without any noticeable error resulting from changes of frequencies of the current passed through them, but for radio frequency standards (20,000 cycles per second and up) the coils should be single-layer helices. The inductance of such helical coils and their change of inductance with frequency can be readily calulated.

There are a great number of formulas for calculating the inductance of various types of coils, and lack of space forbids our recapitulating them here. A complete set of such formulas in very convenient form is given in a publication of the Bureau of Standards, namely, the reprint of Volume 8, Number 1, of the Bulletin of the Bureau of Standards, entitled "Formulas and Tables for the Calculation of Mutual and Self-Induction (Revised)." The experimenter is particularly referred to Nagaoka's formula for the inductance of a solenoid or helix on page 119 of that publication, and the accompanying tables on pages 223-225. These tables, in conjunction with the formula, are very well adapted to logarithmic or slide-rule calculation. In the same publication the increase of resistance and the decrease in inductance of straight wires are given on pages 172 et seq. The influence of frequency upon the self-inductance of coils is given in Reprint Number 37 of the above Bulletin by Prof. J. G. Coffin. It is there shown (page 290) that the

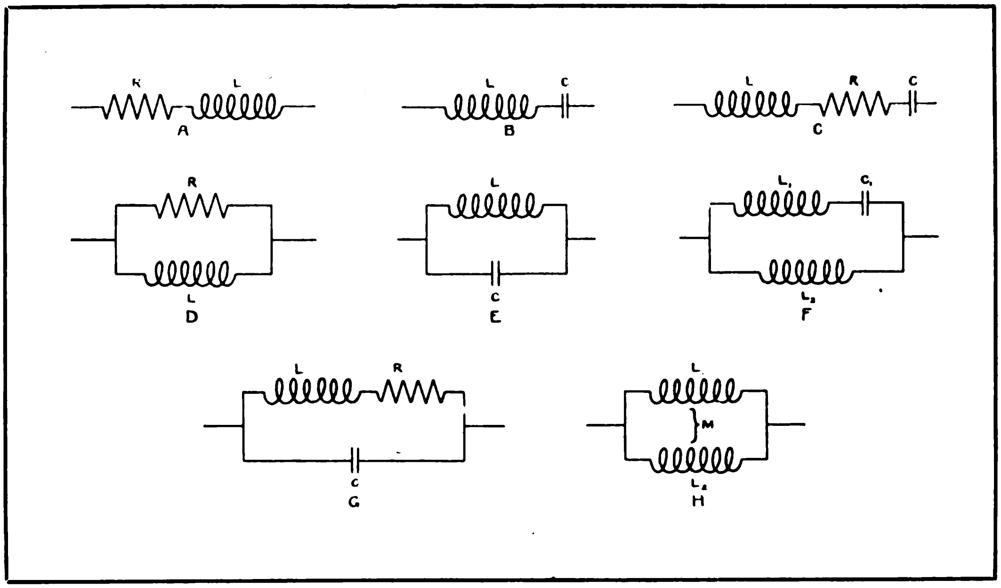


Fig. 33

greatest possible change in inductance (that is, the difference between L_0, the inductance for zero frequency, and L_∞, the inductance at infinite frequency), is given by

$$L_0 - L_\infty = \frac{8}{3} \pi^2 N^2 r_1 d$$
$$= 26.2 N^2 r_1 d \qquad (37)$$

where N is the number of turns per cm., r_1 the radius of the core on which the coil is wound, and d the diameter of the wire of the coil. The change in inductance will be given in centimeters of inductance, there being 10^9 (= 1,000,000,000) cm. to one henry. This change of inductance is the *greatest* which can occur (due to change in frequency), and therefore marks the maximum effect of that sort to be expected at the very highest frequencies.

An inductance always has an electrostatic capacity relative to its surroundings, and this capacity will vary unless the inductance is enclosed in a metal case (of carefully arranged metal sheet, which shall not permit eddy currents). However, the change due to this error is, in general, so small that at low frequencies it may be neglected for air core inductances up to 0.1 henry. At higher frequencies (say 20,000 and above), the influence of this dielectric shunt path may be very serious. Such capacities to ground between inductances or other parts of radio apparatus may give rise to peculiar effects. Thus, J. H. Dellinger found that two nearly identical hot-wire ammeters in series in a circuit might read alike on audio frequency current, but indicate widely differently on radio frequencies, simply because their capacities to ground were different. In effect, each of them was shunted by a condenser of a different value; and as the higher frequencies were reached, their readings became greatly divergent.

Inductances are sometimes so placed that their magnetic fields cut conductors, thus inducing eddy currents and causing losses by heating. For example, on a battleship the influence of the metal walls of the room may be to cause considerable loss. Investigators have advised in such cases placing copper shields over the steel walls where the induction takes place. It seems that in this case most of the eddy current energy is returned to the field without producing any serious loss, whereas if the iron or steel walls are left exposed, the hysteresis losses become serious.

The conclusion to be drawn from the last two paragraphs is that inductances should be kept clear of, (a) conducting masses, and (b) of substances of high dielectric constant, if high precision and low losses are desired.

In making careful inductance measurements, the influence of the leads must not be neglected, particularly at short wave lengths. Frequently the change in inductance of loose non-rigid leads will seriously interfere with repeating observations. The leads on low voltage radio frequency inductances should be kept at a definite separation. Their length should not be altered without applying a correction. The simplest way of meeting these requirements is to nail all leads in place, or, where flexibility is required, to sew the leads into the folded-over edges of a stout strip of leather. To assist the experimenter, we give a table for the inductance per meter length of various wires placed, respectively, 1 cm. and 1 inch apart. The direct current resistance (including the return wire) is also given per meter length.

Number of Wire	Inductance Per Meter (in henrys) 1 cm. Apart	Inductance Per Meter (in henrys) 1" Apart	D. C. Resistance (in ohms)
14	$83. (10)^{-8}$	$120. (10)^{-8}$	0.0164
18	$100. (10)^{-8}$	$139. (10)^{-8}$	0.0417
24	$130. (10)^{-8}$	$166. (10)^{-8}$	0.168
32	$166. (10)^{-8}$	....	1.06

We further give the capacity between such leads per meter of length (which capacity may be regarded as added across the terminals of the condenser to which the inductance is connected).

Number of Wire	Capacity Per Meter (in farads) 1 cm. Apart	Capacity Per Meter (in farads) 1" Apart
14	$153. (10)^{-12}$	$101. (10)^{-12}$
18	$124. (10)^{-12}$	$87. (10)^{-12}$
24	$94. (10)^{-12}$	$71. (10)^{-12}$
32	$71. (10)^{-12}$	....

The inductances may be wound in a variety of ways, of which some are the following: (a) For very small inductance (and easily calculable systems), in the form of large rectangles of heavy wires. (b) In spiral coils. (c) In helices (solenoids) on the surfaces of cylinders. (d) In spiral helices on the surfaces of cones. (e) In spherical variometers (Ayrton and Perry) where inductance variation is secured by means of variation of the mutual inductance of two concentric rotating coils wound on segments of the surfaces of spheres. (f) In "double-D" variometers (of the Rendahl type), inductance variation as in e). (g) In various patterns of cylindrical variometers (e. g., those of the Lorenz Company).

Section 18. Equivalent Impedance, Reactance and Inductance of Combinations of Inductance, Capacity and Resistance in Series.

We shall consider first an inductance L in series with a resistance R (shown in Fig. 1, Circuit A). The impedance, Z, is given by

$$Z = \sqrt{R^2 + \omega^2 L^2} \quad (38)$$

For an inductance L in series with a capacity C (Case B), we have for the impedance Z and the reactance X.

$$Z = X = \omega L - \frac{1}{\omega C} \quad (39)$$

And for an inductance L, a capacity C and a resistance R, all in series (Case C),

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \quad (40)$$

If inductances L_1, L_2, L_3, etc., are placed in series, their total inductances is

$$L = L_1 + L_2 + L_3 + \ldots\ldots \quad (41)$$

assuming they have ***no mutual inductance.***

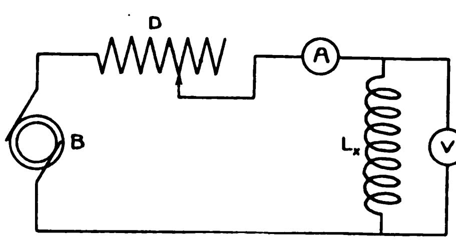


Fig. 34

If inductances L_1 and L_2 are placed in series, and if their mutual inductance is M, the total inductance will be

$$L = L_1 + L_2 + 2\,M \quad (42)$$

if their magnetic fields are assisting each other, and

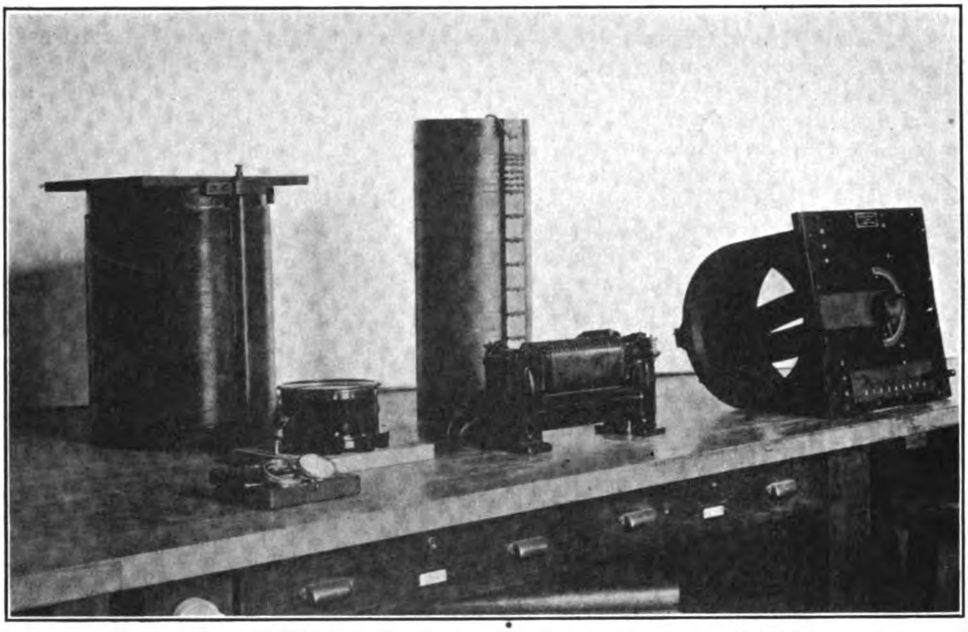


Fig. 35

$$L = L_1 + L_2 - 2M \qquad (43)$$

if their magnetic fields oppose each other. In the last three cases, the reactances are ωL, where L is the total inductance.

In all cases, if we divide the impressed electromotive force (voltage) by the impedance (or reactance, where no impedance is given), we obtain the resulting current for steady conditions.

Section 19. Equivalent Impedance, Reactance and Inductance of Combinations of Inductance, Capacity and Resistance in Parallel.

The first case considered (D, in Fig. 1) is that of an inductance L and a resistance R in parallel. The *equivalent resistance,* R_e, is

$$R_e = \frac{R\omega^2 L^2}{R^2 + \omega^2 L^2} \qquad (44)$$

The *equivalent inductance* is L_e, and is given by the equation

$$L_e = \frac{R^2 L}{R^2 + \omega^2 L^2} \qquad (45)$$

The impedance of the combination is

$$Z = \frac{R\omega L}{\sqrt{R^2 + \omega^2 L^2}} \qquad (46)$$

In case E, an inductance is placed in parallel with a capacity C.

$$L_e = \frac{L}{1 - \omega^2 LC} \qquad (47)$$

and

$$X = \frac{\omega L}{1 - \omega^2 LC} \qquad (48)$$

If an inductance L_1 and a capacity C_1 are placed in series, and the combination shunted by the inductance L_2, we have for the reactance (Case F),

$$X = \frac{\omega L_2 (1 - \omega^2 L_1 C_1)}{1 - \omega^2 C_1 (L_1 + L_2)} \qquad (49)$$

Case G shows an inductance L in series with a resistance R, both shunted by a capacity C. This approximates to the case of a telephone receiver in parallel with a condenser.

$$L_e = \frac{L(1 - \omega^2 LC) - CR^2}{(1 - \omega^2 LC)^2 + \omega^2 C^2 R^2} \qquad (50)$$

$$Z = \frac{\sqrt{R^2 + \omega^2 [L(1 - \omega^2 LC) - CR^2]^2}}{(1 - \omega^2 LC)^2 + \omega^2 C^2 R^2} \qquad (51)$$

If inductances L_1, L_2, L_3, etc. (between which there is no mutual inductance), are placed in parallel, the total inductance is given by the equation

$$\frac{1}{L} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \ldots\ldots} \qquad (52)$$

If inductances L_1 and L_2 are placed in parallel, and their mutual inductance is M (Case H), the total inductance will be given by

$$\frac{1}{L} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M} \qquad (53)$$

The attention of the reader is again called to the rules given earlier in the series, wherein it is stated that the current through any of the above combinations can be found by dividing the impressed (sinusoidal) voltage by the impedance (or reactance, in cases where the impedance is not given). Furthermore, if the voltage is divided by the effective resistance, the quotient is the component of the current which is in phase with the applied voltage, that is, the "power component." If the voltage be divided by ω times the equivalent inductance, that portion of the current which *lags* behind the voltage by 90°, that is, the "wattless component," will be obtained.

A quantity called the coefficient of inductive coupling, or, briefly, the coupling is of considerable convenience in connection with transformers and couplers. If we represent the inductance of two coils by L_1 and L_2, respectively, and their mutual inductance by M, the coupling, k, is given by

$$k = \frac{M}{\sqrt{L_1 L_2}} \qquad (54)$$

Roughly speaking, the energy transfer between the primary and the secondary is closely related to the coupling, but it by no means follows that the larger the value of the coupling, the greater the energy transfer. In particular, when dealing with circuits coupled to a primary fed by a Poulsen arc, if the coupling is too close the reaction of the secondary on the arc itself will extinguish it or cause unsteady operation. In fact, the best energy transfer under such conditions is obtained with astonishingly loose coupling.

Section 20. Measurement of Large Inductances by the Drop of Potential Method (at Audio Frequencies and Low Voltages).

(a) Theory of the Method.—Generally speaking, accurate measurements of capacity are more readily made than measurements of inductance. The reason for this is that while reasonably "pure capacities" can be easily obtained (that is, capacities almost entirely free from resistance and inductance), a "pure inductance" is practically impossible to secure. Particularly is this the case for radio frequencies, where the resistance and distributed capacity of the inductance must be carefully reckoned with. Furthermore, the resistance is markedly dependent on the frequency itself because of the "skin effect" for alternating currents of high frequency. Because of the skin effect, the distribution of the current through the cross-section of the conductors of the inductance will change as the frequency changes. For very high frequencies (radio frequencies), the current will be practically confined to the surface layer, and the resistance will therefore be much higher than for direct current or for alternating currents of audio frequencies.

A still more serious variation in inductance itself occurs when the coil contains an iron core. As is well known, the permeability of iron varies with the intensity of the magnetizing force instead of remaining constant as is the case with air, oil and most other substances. The result is that the inductance of a coil containing an iron core is a meaningless term unless both the *frequency* and the *current* passing through the coil are given at the same time. We shall see in the sample measuremen tgiven at the end of this article how serious this effect is.

In the method employed, we determine the current (I) passing through an inductance (L_x), the voltage (E) at its terminals, and the frequency (n) of this alternating current. By means of a Wheatstone Bridge, employed in the usual way, the direct current resistance (R) of the coil is measured.

Then from equation (38) above we obtain directly

$$E = I \sqrt{R^2 + L_x^2 \omega^2} \qquad (55)$$

Remembering that

$$\omega = 2 \pi n \qquad (56)$$

we obtain finally

$$L_x = \frac{1}{2\pi n} \sqrt{\left(\frac{E}{I}\right)^2 - R^2} \qquad (57)$$

We must, therefore, measure the quantities E, I, R and n.

(b) Arrangement and Description of the Apparatus. A complete wiring diagram of the alternating current portion of the apparatus is shown in Fig. 34. Here B is an alternator, D a regulable resistance (or inductance), A an ammeter calibrated for alternating current of the frequency employed, V a voltmeter similarly calibrated, and L_x the unknown inductance. It will be seen that ammeter A records the quantity I, voltmeter V the quantity E. R may be measured on the usual Wheatstone Bridge, a description of which is out of place here, inasmuch as it can be found in any elementary text book on Physics or Electricity. To obtain the quantity n, the best way is to employ a speed counter (tachometer), and find the speed of rotation of the alternator. Suppose this to be U revolutions per minute. Let V be the number of poles of the alternator. Then the frequency n is given by

$$n = \frac{U V}{120} \text{ (cycles per second)} \qquad (58)$$

The reading of the speed should be taken while the observations of the quantities E and I are in progress, because the speed may change. In case the generator is inaccessible, it becomes necessary to use a frequency meter of any of the usual types; e. g., the vibrating reed type. Or, finally, the frequency may be assumed to be that stated by the company supplying the power. Usually the frequency varies only very slightly, and hardly to a sufficient extent to be objectionable in an experiment of this order of precision.

In the actual experiment, the apparatus employed was as follows: B was a 500-cycle 220-volt alternator. It was operated by a motor with speed control through field rheostat. The generator voltage could likewise be controlled by the alternator field rheostat. D was a large resistance, variable between 252 ohms and 4.9 ohms, and capable of carrying 7 amperes. A was a Hartmann & Braun hot band ammeter, 0-5 amperes. V was a 0-250-volt voltmeter, calibrated to read correctly on 500 cycles. The unknown inductance was L_x.

In Fig. 35 is shown an assembly of apparatus of interest in this connection. In the rear are shown three air-core inductances, ranging in value from 0.003 to 0.04 henry. The inductance to the extreme right is the one employed in the measurement described below. To the left and in front is seen a special speed counter (tachometer), with registering apparatus and stopwatch. The ammeter, A, is visible behind it. To its right is placed an iron core inductance, variable in steps, which was employed in the measurement. The voltmeter used was mounted on the switchboard of the motor generator set.

(c) Procedure. It is advisable here to get a definite idea of the range of inductance which is measurable by this method. Let us assume that the lowest current which can be read accurately with the ammeter A is 1 ampere, and the lowest accurately readable voltage on the voltmeter V is 10 volts. Each of these quantities should be readable to 1 or 2 per cent. Then, using 60-cycle current, the lowest inductance which should be measured by this method is found to be about 0.03 henry. This will exclude practically all air core coils found in the usual laboratory, but will be a convenient value for most of the iron core inductances. If, however, 500-cycle current be employed, the lowest inductance to be measured by this method is found to be 0.003 henry. If a low reading voltmeter (say from 0-1 volts is available) and the coil can stand as much current as 5 amperes, it is possible to measure down to 0.0005 henry (500 μ h) on 60 cycles, and to 0.00006 henry (60 μ h) on 500 cycles. This brings the measurement well within the range of the inductances used in radio communication.

In performing the measurement, care is taken not to overheat the inductance by excessive current. The ammeter and voltmeter are read as nearly as possible simultaneously, the speed being taken at the same time.

(d) Errors of the Method; Their Elimination; and Probable Accuracy.

The voltmeter and ammeter should be calibrated for the frequency at which they are to be used. An instrument graduated at 60 cycles and then used at 500 cycles will very probably read very inaccurately, particularly if it is a so-called "soft iron" instrument. The hot wire instruments are less likely to be influenced unfavorably by change of frequency.

In measuring the resistance, R, a Wheatstone Bridge was employed. Strictly speaking, the resistance thus obtained is not the true resistance at 60 or 500 cycles, because of the increase of resistance for alternating current caused by the skin effect. However, if the resistance is small compared to the quantity (E/I), and this is usually the case, the error thus introduced will not be serious.

Two sample measurements follow:

I. Large Air Core Inductance.

$E = 38 \pm$ volts; $I = 4.0 \pm 0.05$ amperes; $R = 0.33$ ohms.

$n = 493 \pm 2$ cycles per second; $\omega = 3080 \pm 19$.

Whence $L_x = 0.00311$ henry. (Accurate to approximately 3 per cent.)

II. Closed Iron Core Inductance.

The following table shows clearly how the inductance of this coil varies with the current through it.

E	I	L_x (calculated)
50	0.60	0.028 henry
71	0.80	0.031
93	1.0	0.033
122	1.2	0.035
147	1.4	0.036
168	1.6	0.038

This is the sixth article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The seventh will appear in an early issue.

GREAT LAKES VESSEL OWNERS ADOPT WIRELESS

Captain Edward Smith, president of the Great Lakes Towing Company, has contracted with the Marconi Wireless Telegraph Company of America to install a wireless outfit on the wrecker Favorite. The towing company agreed some time ago to put wireless on the Favorite as soon as 100 lake ships signed contracts to put such equipment aboard. E. C. Newton, Great Lakes manager for the Marconi Company, has announced that at least 100 lake ships will have been equipped with wireless when navigation opens this year.

About sixty per cent. of the ships that will have wireless are passenger ships, and the rest freighters. Instruments especially designed for lake use will be built and a reduction will be made in the charges for wireless service in proportion to the number of vessels so equipped.

"Last September the manager of one of the largest boat lines on the Great Lakes said to me that if the rates for wireless were reduced and instruments designed to meet the conditions on the Great Lakes he would put wireless on his ships, and expressed the opinion others would do likewise," Mr. Newton said. "At that time the company was not inclined to consider the idea, but the storm of November 8 and 9 demonstrated the remarkable efficiency of wireless on the lakes, and it was decided to meet the demands of the lake vessel companies.

"Managers who a few months ago would not consider wireless under any circumstances are now inquiring about it, and are seriously thinking of putting it on all of their ships."

SERVICE BETWEEN ENGLAND AND SPAIN

The British Postmaster-General has consented to a license being granted to the Marconi Company's Poldhu station for the purpose of conducting a commercial telegraph service between England and Spain. Arrangements are being made to open this service to the public at an early date.

Keeping Alaska's Trees Alive

THE advantages of wireless telegraphy in conserving the forests of this country were pointed out by J. R. Irwin, of the Marconi Wireless Telegraph Company of America, in an address delivered by him to the members of the Western Forestry Association at Vancouver, B. C., on December 17 last. Mr. Irwin said at the outset that he wished to remove the idea that wireless telegraphy is still in its experimental stages in the exact sense of the words. The experimental part of any scheme necessary in placing wireless in the forest service would not be in the laboratory, but in the field in locating that portion of the district where wireless could be utilized and the telephone eliminated.

No better confirmation of the fact that wireless is efficient could be found than in the fact that it is used in war and was effectively employed in two recent conflicts—those between Italy and Turkey and Turkey and Greece. It is in general use in the armies of the United States and all European countries, and is turned to account on small torpedo boats, as well as on the largest dreadnoughts. Neither are airships without the wireless, for it is in use on flying machines as large as Zeppelin's, and on others as small as a monoplane.

Outfits Can Be Carried by Mules

The Marconi Company is in a position to supply portable outfits which can be carried upon muleback and are built for strength and efficiency. It is estimated that the average mule pack is ninety pounds on each side of the saddle. The saddle is adapted to the peculiar use to which it will be put, and is utilized after it has been offsaddled as a stand or instrument table. Upon one side of the saddle is carried a small gasolene engine somewhat similar to a motor-cycle engine, although smaller. This is directly connected to a small alternating-current generator which supplies the electrical power necessary to operate the wireless equipment.

This piece of apparatus is the heavy part of the outfit, and occupies one side of the load. Upon the other side is a half-kilowatt transformer, or smaller, the size to be determined by the use for which it is required. The half-kilowatt transformer is the heaviest piece of the actual wireless set, and weighs approximately twenty-five pounds. On the same side of the saddle are the condenser, helix, operating key and other small parts weighing comparatively but a pound or two. Here also is the receiving outfit, which weighs a trifle and can be carried in the pocket. On top of the saddle is the spool upon which is wound the antenna wire used for the aerial; this is of light, flexible aluminum wire. A portion of it is also used as ground connections.

Central Stations Advocated

Fuel is carried in tubes or tanks conveniently fitted on the saddle; also light bamboo rods fitted like a fishing pole for a mast where high trees are not available. The plan of carrying gasolene in these mast tubes, thereby saving weight and space, had been considered, but no determination reached as to its practicability. This entire outfit could be off-saddled and quickly adjusted, as it is practically set up on the saddle.

Mr. Irwin said he was given to understand that the average distance for forest communication was from fifteen to twenty-five miles. The set described would easily accomplish this and greater distances, according to the conditions, which, of course, vary; but, even given the worst which would be figured upon, these distances would be a simple matter.

He had listened to a paper describing a system of lookouts and the towers provided which, he undertsood, was in more or less general use in all States, provinces or territories where there are forests. In forming a scheme for the use of wireless in forest work, central permanent stations could be used to advantage. No better sites could be obtained than the lookout points, situated upon high peaks or hills—the patrol, with his portable set, could then report at stipulated periods to these stations, which in turn could communicate to the other stations interested. In this way a chain or network of stations that would form a system covering a huge territory would be made up. The system should provide for certain periods of time to be set aside for given stations to report or "listen in."

Say station A is to speak to station B during the first quarters of an hour on the hour every one, two or three or four hours, as the case may be. This was entirely a matter of organization., such as Marconi wireless men are confronted with daily, and their experience is always to be obtained. For the convenience of patrols and to expedite the setting up of apparatus, permanent and ground connections should be installed on the trails and at other convenient points. This would be inexpensive, as the antenna wire is not costly, and the aerial could be built very easily. It would also save the patrol time and energy, however small, in setting up his own aerial carried on the spool, the spool of wire to be carried and used only when urgency and necessity demanded.

Trees Could Be Used for Masts

High trees form excellent masts. The spreaders needed to keep the two or four wires generally used in parallel could be quickly cut in from any convenient sapling or stick. They are usually about eight or ten feet in length, according to the number of wires employed. After one season enough permanent aerials could be hung at convenient distances apart to obviate the necessity of using the antenna carried on the pack.

The apparatus used at the permanent stations would be of greater weight, and would therefore be much more powerful. Perhaps portable sets would be more suitable, inasmuch as they could be utilized in a contingency. Portable sets could, perhaps, be operated without unsaddling from the animal, providing, of course, that the mule would not be startled by the noise resulting.

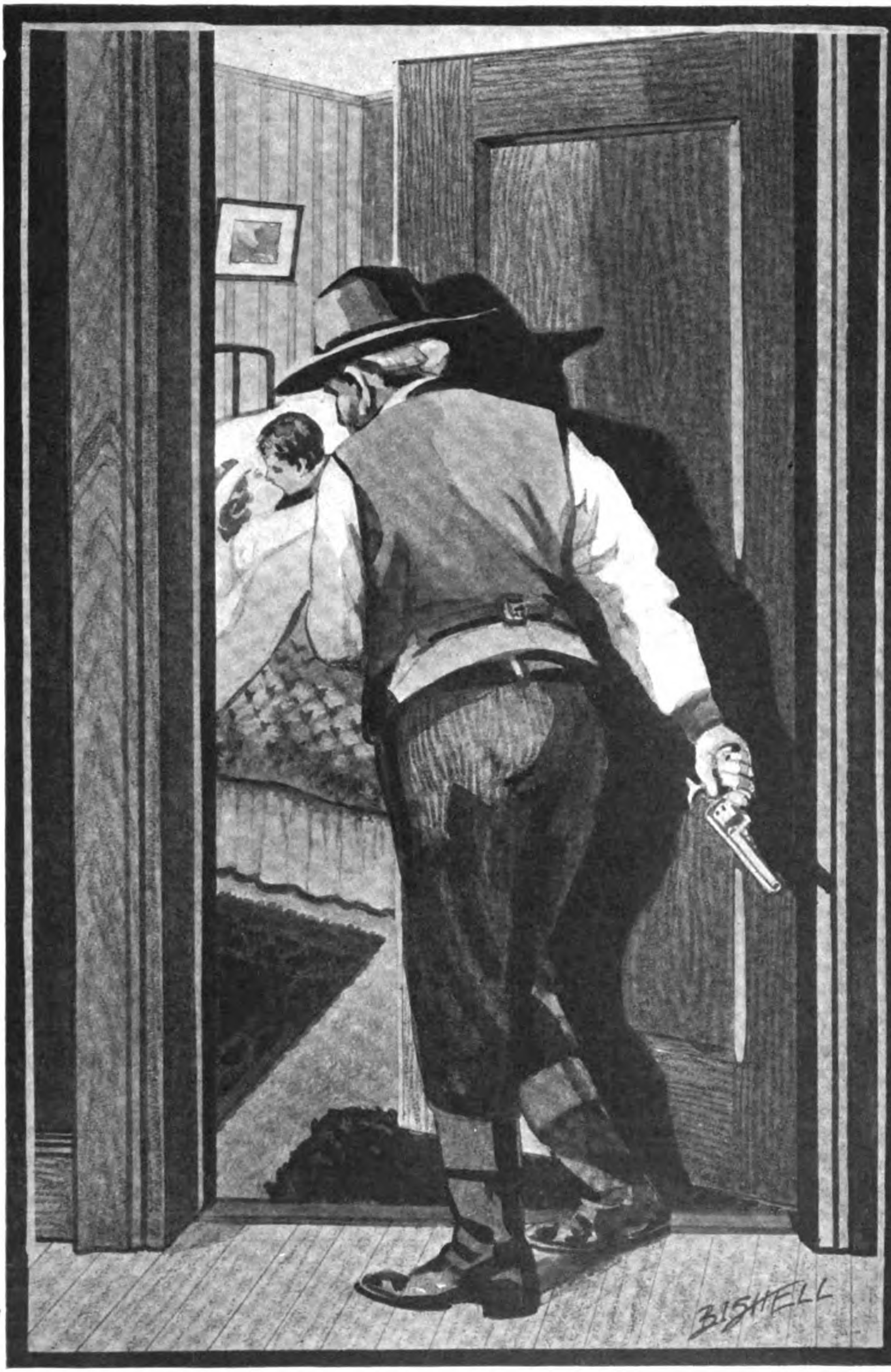
Operators at Home in the Forests

It had been pointed out that the Marconi system requires skilled operators. This was true to a certain extent, but fully fifty per cent. of the operating staff is made up of men from the villages and small towns of the interior—men familiar with forests and country life, young fellows able to jump in and turn their hand to anything. These men were for the most part of good physique, a very large number having been discharged from the army and navy after honorable service, with an excellent training; they were also thoroughly subservient to discipline. Mr. Irwin was sure that men of this class could be adapted to service in the forests. The men of the wireless telegraph would make splendid lookout men; most of them, having been to sea, were accustomed to looking out over great distances. Many of the wireless stations are located in lonesome places, where the men are forced to look out for themselves and adapt themselves to conditions of isolation. They were able through experience to be content under these circumstances—furthermore, they were able to break the monotony by the use of their wireless telegraph instruments.

The wireless would be an excellent auxiliary to the system of weather reports and forecasting fire winds. Several times daily throughout the year the large government wireless stations on every coast send out at stated intervals weather reports and forecasts for the guidance of ships at sea. The wireless stations used in the forest service could interpret reports or receive special reports for their benefit from the stations in touch with the Weather Bureau at Washington, D. C., or with the district forecaster.

STATIONS IN MOTION PICTURES

The Pathe Frere's Moving Picture Company, which puts out Pathe Frere's Weekly, is to take pictures of the Marconi high-power station, near New Brunswick, N. J., in the near future. The Marconi station at Marshalls, Cal., will also be shown in motion pictures.



Maglory paused in the open door and the harsh words that were rising to his lips remained unspoken

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Soon afterward Rance finds on the deck of the steamship a wireless message from Kennedy, superintendent of the mine, telling Sidney that the Burton-Slocum syndicate is prepared to offer Maglory $200,000 for the property. Maglory declines to credit Rance's statement. Arrived in Arizona, Maglory becomes enraged at finding one of the despised wireless stations right in his home town; it belongs to the son of one of his neighbors, who continues to operate it in an amateur way, despite Maglory's hostility. Four days after the return a representative of the Burton-Slocum Syndicate calls and makes a spot cash offer of $200,000 for the Bonanza Mine. Maglory is prevented from accepting it by the option given to Sidney. As the stranger is leaving in his motor car Bonnie's horse takes fright and the girl is seriously injured. The nearest doctor is twenty miles away, and in the emergency the amateur's wireless station sends out an appeal for aid.

CHAPTER IX

OLLIE RYCKMAN proved conclusively that his wireless outfit could be depended upon in an emergency. No operator on a sinking boat, scattering his frantic calls over the face of the treacherous deep, could have fought harder for his passengers than Ollie fought for the life of Bonanza Denbigh.

WANT DOCTOR QUICK AT RAGGED EDGE. BONANZA DENBIGH THROWN FROM HORSE AND BADLY HURT.

This is the message that darted in every direction across the deserts, the mountains and *mesas*. Intended for San Simone, it also made a bull's-eye at Poco Tiempo; and had an immediate effect in each place.

Dr. Quigley happened to be passing the San Simone wireless headquarters just as Pegleg Cartwright had finished taking the message and had stumbled wildly to the street door. In half a minute, Quigley knew what was wanted. In front of the Emporium stood an automobile. Without so much as a by-your-leave, Quigley cranked the engine, and was away. He stopped but an instant at his office to snatch up the materials he thought he would be likely to need, and then went licketty-split over the trail to Ragged Edge. Out for a record, he made such good time that he earned a sobriquet—for ever afterwards he was referred to as "Dr. Quickley."

Whether or not Bonanza's life was saved by the celerity with which the doctor had reached her side must remain an open question. She might have lived if the doctor had been slow in getting to Ragged Edge, or if he had not got there at all. But the preponderance of testimony favored Ollie and his wireless no less than the immediate enterprise and the skill employed by the doctor during the anxious hours that followed.

As Dr. Quigley was leaving the house, after pronouncing Bonanza out of danger, he stood on the running-board of the "borrowed" car and watched a cloud of dust slide towards him down the trail. It whipped aside, presently, to reveal a man on a lathered horse.

The smoking cayuse sat down in the trail and slid to a halt amid a rain of flying pebbles. The man dropped from the saddle and rushed toward the doctor.

"How is she?" he gasped.

Quigley's eyes glimmered genially behind his spectacles.

"Jeff Rance, well, well," he murmured. "Miss Denbigh is doing well, I'm happy to say, and with proper care she'll come along nicely." He put out his hand and his face softened. "Jeff," he added, "I'm glad as blazes to see you. Which I reckon is more than Uncle John will be if you go bunting into his 'dobe."

"I'm going to see Bonnie!" declared Rance, firmly. "Uncle John will have to make allowances at a time like this."

"That's you!" and Quigley nodded and chuckled. "But where were you, to get here so quick?"

"At Poco Tiempo."

"No!" said the doctor, astounded. "However did you know what had happened?"

"The wireless call that brought you was picked up at the station near the mine. The operator"—a flush dyed Rance's face—"knew I was interested, and hurried to get news to me," and the young man dashed for the house, and vanished through the front door.

At just that moment Bonnie was alone in her own little room. John Maglory was out by the horse corral, back of the house, wiping his eyes and thanking God.

"Oh, You who boss the Big Range!" he whispered, "I've been more kinds of a fool than I know how to tell! The things I ought to do I've passed up, and the things I done I ought to have side-stepped! I've landed in my declinin' years with a warped judgment and a feeble intellect, and the best I know ain't one-two-seven with the best I ought to know. You've spared the *mujercita,* and if my own miserable life can settle the bill—*only say the word!*"

As he hung over the corral fence, he stifled a sob. A brief struggle with emotion terminated as he flung back his grizzled head. For most of his life he had felt that God was too far away to bother much with him, but now he knew differently.

Abruptly he started. A voice came to him from the depths of the house—a familiar voice that knotted his brows in a hard frown and started him post haste for the kitchen door.

From a nail in the kitchen wall hung a belt with a revolver. In passing through the room he paused for a moment to jerk the weapon out of its dangling holster.

The door of Bonnie's room stood open. Maglory stepped to it, clutching the revolver fiercely, eyes a-gleam with determination. But he paused in that open door, and the hard words that were rising to his lips remained unspoken.

Jeff Rance, dusty and travel-stained, was kneeling beside the bed. One of Bonnie's arms was encircling his neck, and her head, with the white bandage around the temples, lay on his shoulder.

A pang struck at Maglory's heart. He had doubted that Bonnie loved this black sheep of the family. He could doubt no longer.

Softly, Maglory turned away. He took a chair across the room and laid the revolver on his knees. Unintentionally, he had robbed Bonnie of $150,000. Should he rob her also of the man she loved?

"Don't stay any longer, Jeff," came the tremulous voice of Bonnie through the open door. "If Uncle John should find you here, he—he might—." The voice died in a hopeless sigh.

"You're going to live, Bonnie," answered Rance, tenderly. "That's enough for me to know. . . I've got something to say to Uncle John, though, and, while I'm here, I might as well say it."

"No, no!" breathed the girl in a frightened tone. "He doesn't know you as well as I do, Jeff, and he wouldn't listen to you."

"I have a proposition to make, and he's got to hear it!"

There was determination in Rance's voice. Presently he came out of Bonnie's room; his eyes rested on the form in the chair, and he gave a start of surprise.

"Came to see Bonnie, did you," sneered Maglory, "after what I told you on the boat?"

A cry echoed from the sick room—a cry of fear. Maglory was quick to read its significance, and it seared his soul.

"Don't you be afeared, Bonnie!" he called. "I'm not going to raise a hand against Jeff. He says he has a proposition to make me. Well, let him make it!"

"If you love me, Uncle John—if you love him—"

"I'm not saying a word about *him,*" said Maglory; "but as for you, *mujercita,* there's nobody on earth I'd do more for. And just now, I don't pack the nerve to say no to you. What's that proposition?" he added, sharply, to Rance.

"You've seen Hall, of the Burton-Slocum Syndicate?" asked Rance.

"What's that to you?"

"Nothing. But if you have seen Hall, and talked with him, you know by now what the syndicate people will give for the Bonanza Mine."

Maglory twisted in his chair.

"You know, too, by now," proceeded Rance, "whether I was right or wrong in calling Bill Sidney a schemer and a thief, and trying to keep you from selling him that option. When does the option expire?"

"The twenty-fifth, at ten in the evening," was the husky response.

"Well, Bill Sidney is on the way. If he comes here with forty-five thousand dollars and asks for a deed, you'll have to give it to him!"

"Give it to him?" roared the exasperated old man. "I'll shoot him down like a dog if he dares to come here and ask for it!"

"Oh, he'll dare to come, fast enough! What's more, you'll not shoot him, and he'll get his deed. There is just one way, John Maglory, to save that mine from Bill Sidney."

Maglory started forward in his chair. "What way is that?" he demanded.

"That's my part of it," answered Rance, "and you'll have to leave it to me. Here's the proposition: If I get Bonnie out of this muddle you have got her into, and if she sells to Hall for the Burton-Slocum Syndicate for two hundred thousand, instead of to Sidney for fifty thousand, you are to give your consent to Bonnie's marrying me—and—and give us your blessing."

Rance spoke calmly. He did not bat an eye as the wrathful red dyed the old man's face, and he shot from his chair.

"Get out!" gasped Maglory, chokingly.

"Whenever you send me word that the proposition is accepted," said Rance, "I'll get busy. But don't wait too long-"

"Get out!" bellowed Maglory, "before I break you in pieces!"

Rance laughed softly as he crossed the room to the door.

CHAPTER X

On a calendar, hanging on the wall of the living room, Maglory had drawn a heavy black line around the figures "25." He divided his time between watching Bonnie slowly regain her health and counting off the days between him and the fateful 25th.

He heard that Hall, of the Burton-Slocum Syndicate, was staying in San Simone, waiting there to deal with the person who owned the Bonanza Mine after the 25th of the month. He heard, too, that Sidney had agreed to sell to Hall for $200,000 just as soon as the mine had come into his possession.

The days dragged past, however, and no Bill Sidney arrived in Ragged Edge. Maglory learned indirectly that Sidney was waiting for the $45,000 to come to him from the East. A faint hope rose in the old man's breast that the money might not come at all. He sent Derry to town to keep track of Sidney, and to report as soon as he began planning a trip to Lost Horse Cañon.

Bonnie had wrung from the old man a promise not to use violence in dealing with Sidney. If he came with the $45,000, then Maglory was to accept it, and the deed to the mine was to be executed.

Not one word did the girl say about Rance's proposition.

Bonnie's silence on this point puzzled and annoyed the old man. She was throwing the entire responsibility upon his shoulders, when she might at least, he thought, indicate a preference one way or the other.

The night of the 24th came. Maglory did not close his eyes between sundown and sunup. When he was not walking the floor he was smoking his pipe and burdening his mind with endless questions.

The situation made Maglory nervous, and his reflections made him uncomfortable. He was glad when, at the first ray of dawn, a diversion was caused by a knock on the door.

He pulled the door wide, and found old Joe Derry at the threshold. There was a look on old Joe's face that promised evil tidings.

"It's up-sticks, John," announced the visitor, stepping into the room.

"What do you mean?" demanded Maglory, grabbing him by the shoulders in his anxiety.

"This Sidney person got his spondulix at the bank jest before closin' time yesterday afternoon. It's in the shape of one o' these here certified checks. He's hired an automobile, and figgers to leave town for Ragged Edge at three-thirty to-morrow afternoon. I allow you'd better fix yourself to kiss that mine good-bye. She's sure gone!"

Maglory choked up so he could scarcely speak. After a time he managed to clear his throat, but the look of haunting remorse still remained in his dull eyes.

"What's he delaying for?" he asked. "If he got his certified check yesterday, why does he wait till this afternoon before comin' out?"

"I hear he's to see that syndicate feller in the forenoon."

"All right, Joe; all right. Go home now and put up your horses."

About the middle of the forenoon Maglory went in for a few words with Bonnie.

"Sidney'll be along this afternoon, *mujercita,* with the money," he announced.

"I expected he'd come, Uncle John," Bonnie answered, passively.

"Haven't you got a hard word to say to me?" asked the old man, plaintively; "and me cheating you out of a hundred and fifty thousand, this-a-way?"

"Come over here," she commanded, dropping her book.

He crossed the room to her, and she pulled him down, clasped her arms about his neck, drew his lips down, and kissed him.

"I hope I may die if I ever give you a hard word about anything!" she whispered.

His eyes grew misty and his throat began to tighten.

"You don't say a thing about Jeff," said he.

"I love him, Uncle John," was the quiet reply; "and I reckon you know it. What is the use of saying anything?"

Gently Maglory disengaged her arms. For a moment he stood over her, smoothing the hair from her brow. His eyes, lifting a little, rested on a photograph of Rance which Bonnie had placed on a table near by. Abruptly, Maglory turned on his heel and left the room.

What could Rance do? If he could do anything, why didn't he go ahead and do it, instead of waiting for the word from him? It was all a scheme, the old man persuaded himself, to have him go on record.

Rance was using the Bonanza Mine matter as a club to force him into consenting to a marriage of which he disapproved. It was a mean way for Rance to take advantage of him; and yet, if Bonnie really loved Rance, as she said. . . . It was a disagreeable subject, and he would not pursue it farther. His sleepless night had left him in no pleasant temper, and he tried to calm himself by a walk through the dying town.

In passing Ryckman's house, his feet slowed to a halt. Frowning and ill at ease, he leaned on the gate. Fate was working that day, for young Ollie bobbed out of the front door.

"Howdy, Mr. Maglory!" the boy called.

"See here, son," returned Maglory, in sudden desperation, "can you shoot a message into Poco Tiempo?"

"Surest thing you know," Ollie answered.

"Then send one to Jeff Rance, and send it on the jump. Just say: 'Proposition accepted.' Get that?"

"I'll begin calling right off," said the boy, starting back into the house. "How many p's in 'proposition,' Mr. Maglory?" he paused to ask, doubtfully.

"How the devil do I know?" snapped the old man, striding off down the trail.

(*To be Concluded*)

The Wireless Age, with wonders manifold,
With wonders that surpass the airy flights
Of those tale-tellers in the days of old
Who wrought the fabric of Arabian Nights.

For now man's messages go flashing on
To leap the long leagues of the trackless sea,
As swift as silver sunbeams of the dawn
They span the watery wastes at man's decree.

Or when the mighty storm-tossed ocean rolls,
Until the ships are playthings of the storm,
The wireless brings new hope to luckless souls
Whose wrecked crafts welter in the wild alarm.

The wireless robs the storm king of his right
To levy on the sails that brave the deep;
It rips away the emblems of his might
And rules the ocean in its breadth and sweep.

The Wireless Age, what wonders manifold;
What wonders that surpass the airy flights
Of those tale-tellers in the days of old
Who wrought the fabric of Arabian Nights!

BISHELL

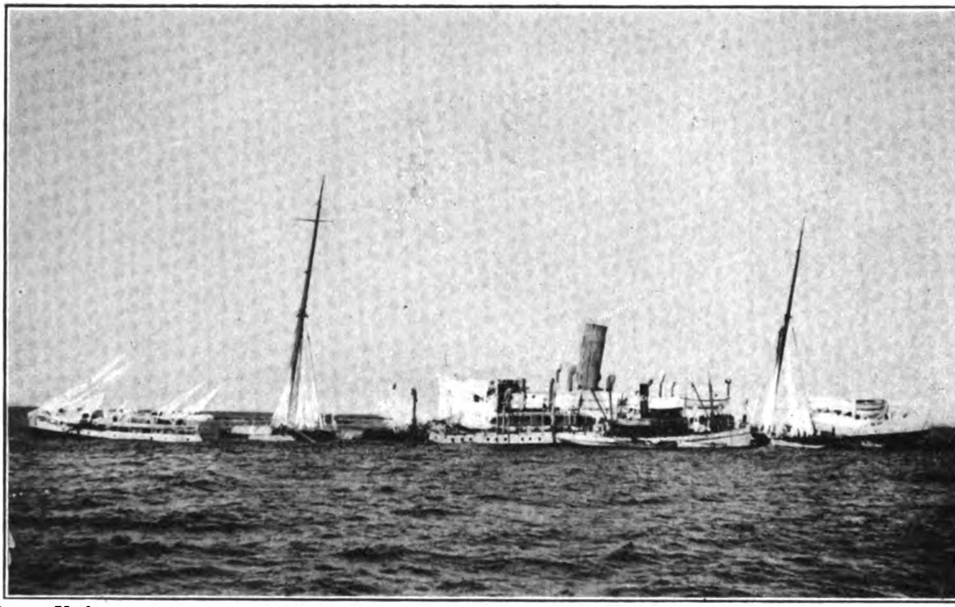


Photo., Underwood & Underwood.

Photograph showing the Cobequid covered with ice and almost submerged, and boats rescuing the passengers and recovering the mails.

Wrecked on Trinity Rock

IN the story of how wireless telegraphy brought succor to those aboard a vessel in distress—stranded on a rock and pounded by angry seas—is another striking illustration of the value of the art. For thirty-six hours the passengers and members of the ship's company awaited with all of the intense anxiety induced by their peril the outcome of the efforts to find rescuers. Uncertain as to the exact location of the stranded ship, the wireless operators were unable to give definite directions to rescuing craft, yet, notwithstanding this disadvantage, the vessels that had been searching for the grounded ship finally succeeded in reaching her.

The Royal Mail Packet Company's steamship Cobequid, which had lost her bearings in a blizzard, was stranded on Trinity Rock, in the Bay of Fundy, on the morning of January 13. Thirty-six hours after the first wireless appeals for aid had been sent out the 108 persons on board were rescued. Help came to the vessel just as the cannonading of the terrific seas was beginning to break her to pieces.

The crash came just before dawn, and a few minutes later the S O S was flashing over the waters. The Cobequid's chief operator, J. W. Hitchner, of Manchline, Scotland, was unable to give her location, for no one on board knew it definitely. Four hours later flood tide and gales had driven her still further on the rock, breaking her back and flooding the engine room. This put out the fires and interrupted the wireless apparatus. The passengers were greatly alarmed, but the courage of Captain Hawson, of the Cobequid, and his abiding faith in his vessel reassured them time and again. The steamship made water rapidly and the cargo began to tear away. Throughout the day and the night that followed the officers scanned the sea for passing craft, and the operator worked heroically to restore his wireless outfit.

The Westport, a coastal steamship, was the first vessel to reach the stranded craft. Under the supervision of Captain McKinnon, of the Westport, the rescuers from that vessel took off in three lifeboat loads seventy-two persons, including all of the passengers, the purser, several deck officers and part of the crew. Then the John L. Cann came up and aided in the work of rescue.

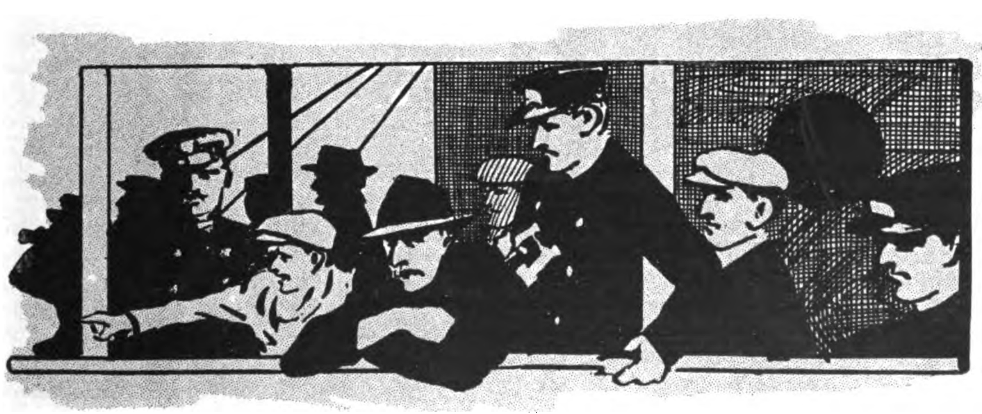
Darkness was gathering fast when the rescue began, but the boatmen from the coast steamships knew the wreck and the surrounding shoals as they did their own front yard ashore, and they went at the work before them with perfect confidence. Less than five hours later those who had faced death for two days were being warmed and fed at the hotels in Yarmouth.

Hitchner, who is an operator in the Marconi service, talked interestingly of how wireless was used to bring aid to the Cobequid. He said he started calling S O S six minutes after the vessel struck and established communication with Cape Sable. The captain reported he thought they were on Brier Island, but was not sure.

"At ten minutes after seven o'clock in the morning the dynamo gave out," said Hitchner, "and we changed over to the emergency set. Communication was established with Partridge Island and we were informed that the Lansdowne was leaving to assist us. At seventeen minutes after eight a heavy sea rolled over the boat deck and into the wireless room, smashing the lifeboats on the starboard side and carrying away the aerials. We made repairs and after a time succeeded in re-establishing communication. We heard the Kronprinzessin Cecilie calling with a message, via Cape Sable, that she could not come to our assistance owing to a shortness of coal, and saying that she had informed the steamer Belvedere of our plight.

"We were unable to acknowledge the signals from Cape Sable, owing to the great difficulty under which we were working. We called S O S continually until high tide, when we were no longer able to stay in the wireless room. At 3 o'clock the aerial again was carried away, but was repaired. We again called S O S and reported that we now thought we were on Trinity Rock, or possibly Brier Island. During the high tide the room was swamped and the receiver flooded, making it useless, but the transmitting set was working.

"We stayed in the room until the next high tide. At eleven o'clock in the morning on January 14 we again went into the wireless room and rerigged the aerials and got signals working fairly well. We worked up to fifteen minutes after eight o'clock in the morning, when we were again forced from the room by the tide. At low water we again called, and we remained in the wireless room until taken off. My assistant, E. T. Shimpton, rendered very valuable assistance and showed excellent courage under the most trying circumstances."



MARCONI'S EFFICIENCY EXPERT

The man who makes his mark in New York, as a rule, has achieved reputation in his home town—West, South or Middle West—but Elihu Cunyngham Church has demonstrated the exception by making his mark in New York City along the line of efficiency work. He has recently been engaged to apply the principles of scientific management to the Marconi Wireless Telegraph Company of America.

Mr. Church has evolved his own theories of efficiency, which he acquired in the hard school of the engineering service. After his graduation from the School of Mines in Columbia University his first efforts were applied toward the construction of a bridge on Long Island. His next activity was in railroad construction in Western Pennsylvania, an experience never to be forgotten, for it included ninety consecutive meals of fried ham.

Mr. Church obtained the first chance of developing his peculiar talents in the line of appraisal work when he was appointed cost expert of the Railroad Commission of the State of Washington, which involved a valuation of all the railroad companies of that State; this was during the trying period of the famous Spokane rate case.

At this time he was impressed with the fact that only too many railroad lawyers are insufficiently acquainted with the intrinsic necessities and requirements of the country's great transportation companies. He therefore returned East, and again entered Columbia University to pursue a law course, in order to familiarize himself with the legal end of railroad and engineering work. He taught engineering while pursuing these studies, and lectured, with the rank of adjunct professor, at Columbia, being the youngest man by six years that ever held that position.

The efficiency principles that he had acquired by close observation during his early years of engineering attracted the attention of many progressive minds in New York, and he was invited to join in the activities of the Bureau of Municipal Research, in that city, where he further developed his talents. Next he was appointed secretary of the Department of Water Supply, Gas and Electricity of New York, and Chief of the Bureau of Supplies, achieving the distinction of being the first man to organize a branch of a municipal department on a scientific basis.

The Bureau at that time was in a state of demoralization, and there was inefficiency and lack of coördination everywhere. After the reorganization effected by Mr. Church, its functional organization is a model of its kind, while its activities have been so systematized, its methods so standardized and its employees so instructed and trained that its present operation is well night automatic.

Mr. Church's principles, especially as applied to the purchasing end of a corporation, have since been widely adopted by many of the leading industrial corporations of the country, and the commercial world is watching with interest the operation of his plans for scientific management of commercial wireless telegraphy.

THE SHARE MARKET

NEW YORK, February 21.

This morning the securities market is apathetic; trading is hardly nominal, and the only changes worth noting over the preceding weeks are fractional declines. The market's rather habitual caution in "discounting" events which may, or may not, take place no doubt accounts for the recent spectacular rise in stocks. That a month has elapsed since the important change for the better in the share market, with no equally important change for the better occurring in business seems to be the reason for the slight declines in standard issues. The brokers report that Marconis are inactive, but the market for these issues remains firm.

Bid and asked prices to-day:

American, 4¾—5; Canadian, 2½—2¾; English, common, 19—22½; English, preferred, 15—17½.

TRAIN WIRELESS AGAIN PROVES ITS EFFICIENCY

Wireless telegraph messages were sent and received January 22 without a hitch by an operator on a special train on the Delaware, Lackawanna & Western Railroad, which carried 500 members of the American Society of Civil Engineeers from Hoboken, N. J., to Nicholson, Pa., and back. At Nicholson the engineers inspected a concrete railroad viaduct construction. The special train's speed was from fifty to seventy-five miles an hour in the open country.

George A. Cullen, passenger traffic manager of the Lackawanna Road, who was on the train, sent to The New York Times what was described as the first wireless dispatch from a moving train to a newspaper. Here it is:

"On board Lackawanna Civil Engineers' special, thirty-five miles east of Scranton, Pa., going sixty-four miles an hour. Greetings in the first wireless message from a moving train to a newspaper. Cullen."

This message was flashed ahead of the train to Scranton and sent from the wireless station there direct to that on the Wanamaker Building, from which it was delivered to The Times office. It was six minutes from the time the message was handed to the Marconi operator on the train until it was copied by the operator in the Wanamaker Building, and no wire transmission was used. The distance is about 125 miles.

More than thirty wireless messages were received and sent by the Marconi operator on the train during the day. Greetings were exchanged between passengers and their friends in New York, and news items from Scranton were received on the train.

When the train was thirty-two miles east of Scranton in the afternoon on the return trip, The Scranton Times sent bulletins of news to it.

Wireless stations are now being constructed at Lake Hopatcong, N. J., forty-six miles from New York, on the Lackawanna Road, and Bath, N. Y., 100 miles east of Buffalo. When they are finished the Lackawanna, with the stations at Scranton and Binghamton, will have four stations on its line with overlapping radii, so that at no time between Hoboken and Buffalo will a train equipped with wireless instruments be out of communication with a fixed station.

Both the east and west bound Lackawanna Limited trains, which run between Hoboken and Buffalo, will begin to handle commercial messages as soon as these stations are completed.

WIRELESS ON ROTTERDAM POLICE BOATS

Wireless telegraphy has been installed on two of the small boats and on the floating offices of the Rotterdam river police. The work of the police had previously been considerably impeded by the time wasted in the transmission of information and in waiting for instructions from headquarters. Now it is possible for the boats to make their way to various points, and either send information by wireless to headquarters and receive instructions; or they can be notified at any moment to take part in plans which require immediate execution. The chief difficulty to be overcome in the installation of the wireless apparatus was not so much that of distance; there was need, however, to overcome any obstructions which might happen to lie between any two of the vessels, such as buildings, large steamers and bridges.

Perhaps the intricate nature of the work will be understood when the class of vessel on which the installations were placed has been described. The two police boats are very small. One is a motor boat, provided with two hinged masts. The other craft is an electric boat having one hinged mast. The hinged masts are used in order to enable the boats to pass under low bridges, for, as is well known, Rotterdam is built on the delta of a river and consequently the harbor is divided up into sections by the diverging outlets. The floating office is much larger than the other two craft. It was decided to adopt a short-range apparatus on all three of the vessels. The work of installation was undertaken by the Société Anonyme Internationale de Télégraphie sans Fil.

Working the Set on a Stranded Ship

WIRELESS telegraphy was recently employed to advantage in summoning vessels to the assistance of the steamship Pectan after she had run aground off Adams Cove, Point Bennet, Cal. H. W. Dickow, Marconi operator on the Pectan, told the following story of the stranding in a communication sent from the vessel while she was aground:

"While en route from Taltal, Chile, and being only sixty-five miles from our destination, the forward watch reported a bell-buoy on the starboard quarter, and immediately land was sighted ahead. It was just fifteen minutes to nine o'clock in the evening, and I had finished sending a message to San Luis telling of our arrival at Port Harford at daylight. Then the vessel struck the beach, and so easily did she ground that no one knew that we were stranded.

"The weather was thick and we could not see where we were, but the captain came to the conclusion that we were at Point Bennet, and asked me if I had heard any of the Union Oil ships working that evening. I told him that the Argyll was abreast of Point Arguello and the Lansing was off Port San Luis. He ordered me to call the Argyll and tell the captain of that vessel to proceed to Adams Cove to render assistance.

"This I did, and the Argyll's captain said that he was coming to assist us entirely by soundings, as he himself had lost his course. Then the Stetson's captain asked the Argyll if he could help us, but our captain told me to thank him and say that we would not need him. Afterwards the Lansing called and asked if she could be of any help, and the captain told me to bring 'em all down to us. All night long I worked with the two ships, and they were willing to stand by with me till I gave them further orders.

"They arrived about 11 o'clock in the morning, but the weather was so bad that no ship could render assistance. We were exceedingly lucky, as there were rocks on all sides of us, and just where we landed there was soft sand. The Argyll made an attempt to enter, but in vain. Then the Lansing tried it, and came a little closer in, but a ship of that size was far too large to be of any assistance to us, situated as we were. Later we received word that the wrecker Iaqua was on her way to us, and we also ordered two tugs to come to our help, as the big oil boats were useless in the place where the Pectan was aground.

"Captain Ferris arrived on the Iaqua the following day and took charge. The Lansing was ordered to proceed to Port Harford, and the Argyll left for San Pedro for fuel, and received orders to proceed on her way.

"Many messages, ranging from ten to three hundred words, were sent, and a large number of communications was received in return. Excellent service was rendered by the operators on the Argyll and Lansing and at the San Pedro, San Luis Obispo and other navy stations. The Marconi operator at San Pedro asked if a revenue cutter was wanted. Our captain replied in the negative, but, to our astonishment, the revenue cutter Manning was dispatched to render assistance. She arrived the following morning at daylight, but she was unable to pull us off. We shall have to wait for the high tides. That is our only chance to get off."

The Iaqua, to which Dickow refers in his account of the Pectan's stranding, is a wrecking vessel owned by the Union Iron Works Company, of San Francisco. The Marconi Wireless Telegraph Company of America installed wireless apparatus on her a short time ago. The day following the completion of the equipment she was called upon to make an attempt to salvage the steamship Pomo, which turned turtle while being towed into San Francisco, and broke away from the towing vessel. The

Pomo had just weathered a severe storm. Constant communication was maintained with the Iaqua during that trip. She was unsuccessful, however, in salvaging the Pomo.

New Marconi installations have been made recently on the Cetriana and Korrigan III. The Korrigan III is a Mexican vessel, and the owners find the use of the equipment very valuable to them, as they are able to communicate from the vessel to the "States," while the steamer is cruising between ports in the Gulf of California. The Cetriana was recently chartered by the North Pacific Steamship Company for trade between San Francisco and Mexican ports.

The lumber schooner Yellowstone required aid during one of the big storms a short time ago. She does not carry a radio equipment, but she hailed a passing vessel having wireless, which placed a line aboard. The line parted and the vessel giving assistance was unable to get another one aboard.

She communicated with other vessels having wireless, however, and one of these, a lumber vessel, responding to the call for aid, stood by the Yellowstone and succeeded later in towing her to San Francisco. A tug was sent out from San Francisco to meet the vessels, but failed to locate them because it did not have wireless equipment.

A contract has been obtained calling for the installation of Marconi wireless apparatus on the new steam schooner Celilo, owned by the C. R. McCormick Company.

WARNING TO OPERATORS

The Bureau of Navigation of the United States Department of Commerce has issued the following general letter to wireless inspectors and examining officers:

"It has come to the attention of the bureau that several operators holding operators' licenses under the Act of August 13, 1912, have not taken the oath of secrecy, as required by the International Radiotelegraphic Convention and the Department of Commerce regulations.

"The attention of licensed operators should be invited to the fact that the license is not valid until the oath of secrecy has been executed. Radio inspectors may recommend the suspension of the licenses of operators in cases where oaths of secrecy have not been taken. Where practicable, radio inspectors or examining officers should not affix signatures to the licenses until the oaths have been properly executed.

"The attention of radio operators holding licenses should also be invited to the service record on the back of the form. Operators should make every effort to have the service record properly filled in by their employers, as the record will be an important factor in determining whether or not an applicant will be re-examined for a renewal of license, and in determining whether an applicant is eligible to take the examination for the 'Extra-Grade' license."

OPERATOR DISCIPLINED

The Department of Commerce, Radio Service, has suspended for a period of thirty days the license of a radio operator who had indulged in unnecessary and unauthorized wireless conversation and used profane and obscene language by radio. This is the second case where an operator's license has been suspended by the Department because of not complying with the requirements of the law.

STATION JURSIDICTION CHANGED

By an order recently issued by the Navy Department, the naval radio stations at the Puget Sound Navy Yard and Tatoosh Island have been transferred from the jurisdiction of the commandant at the Puget Sound Navy Yard to the wireless officer at Mare Island, Cal. This places every station in Alaska and on the Pacific Coast under the direct supervision of the Mare Island Navy Yard.

Another order states that every enlisted man who has served two years as a radio operator on shore duty will be sent to sea as soon as practicable, and men who have seen considerable sea service will be sent to take their places.

WIRELESS RULES ADOPTED BY LONDON CONFERENCE

The London International Conference on Safety at Sea was ended on January 20, fourteen nations, through the delegates sent by them, having signed a convention providing for regulations that will insure greater security for vessels and their passengers. Mr. Moggridge, of Great Britain, was appointed chairman of the Wireless Telegraphy Committee. A speech, delivered by Lord Mersey, chairman of the Conference, in which he moved the adoption of the convention, contains an outline of the principal provisions of the latter. That part of the speech relating to wireless telegraphy was as follows:

"The convention provides that all merchant vessels of the contracting states when engaged upon international (including colonial) voyages, whether steamers or sailing vessels, and whether they carry passengers or not, must be equipped with wireless telegraphy apparatus if they have on board fifty persons or more (except where the number is exceptionally and temporarily increased to fifty or more owing to causes beyond the masters' control). The contracting states have, however, discretion to make suitable exemptions from the requirement to carry wireless apparatus in certain cases, of which the most important is that of vessels which in the course of their voyage do not go more than 150 sea miles from the nearest land. The classification of the vessels required by the convention to be provided with wireless apparatus follows the categories contemplated by the Radiotelegraphic Convention. The precise classification is too complex to be summarized, but, broadly speaking, the fast passenger steamers are placed in the first category, other steamships, intended to carry twenty-five passengers or more, in the second category, and all other vessels required to be fitted with wireless apparatus in the third category. It need hardly be said that the owner of any vessel placed in the second or third categories can claim that his ship shall be placed in a higher category, if it complies with all the requirements.

"A continuous watch for wireless telegraphy purposes is to be kept by all vessels required to be fitted with wireless apparatus as soon as the government of the State to which the vessels belong is satisfied that such watch will be useful for the purpose of saving life at sea; and meanwhile (subject to a transitional period for fitting wireless installations and obtaining the necessary staff) the following vessels will be required to maintain a continuous watch, in addition, of course, to all vessels placed in the first category:

"(1) Vessels of more than thirteen knots, which carry 200 or more passengers, and which make voyages of more than 500 miles between two consecutive ports.

"(2) Vessels in the second category during the time they are more than 500 miles from land.

"(3) Other vessels, required to be fitted with wireless apparatus, which are engaged in the transatlantic trade, or whose voyage takes them more than 1,000 miles from land.

"Vessels placed in the second category, but not required to keep continuous watch, are nevertheless required to keep such watch for at least seven hours a day, besides the watch of ten minutes in each other hour required by the Radiotelegraphic Convention. Vessels concerned with the fishing and whaling trade are not required to keep a continuous watch. The continuous watch may be kept by certificated operators or by watchers qualified to receive and understand signals of distress, and provision is made for the possibility of the future of an automatic apparatus which will take the place of watchers. The wireless installations must have a range of at least 100 miles and an emergency apparatus, placed in the condition of the greatest safety possible, must be provided unless the main installation is placed in the highest part of the ship, and in conditions of the greatest safety possible. The convention provides that the master of a ship in distress shall have the right to call to his assistance from amongst the vessels which have answered his appeal for help the vessels which he thinks can best render assistance, and the other vessels which have received the call may then proceed on their way. A transitional period is provided to enable wireless apparatus to be fitted and operators and watchers obtained."

ARCTIC EXPLORATION

HOW WIRELESS HAS BEEN EMPLOYED

REAR ADMIRAL ROBERT E. PEARY U.S.N.

CAPTAIN ROALD AMUNDSEN

THERE was a time when members of Polar expeditions, once they had left behind the last points of civilization, were as completely cut off from the outside world as if they were buried. From the time they actually started on their journey to the frozen lands, it was a matter of conjecture whether they were alive or dead. Whatever accidents or dangers they met with did not become known till they had left the scenes of their adventures far behind, and sometimes the tragedies of the ice fields were concealed beneath the snow, perhaps never to be told.

Wireless telegraphy has done much to minimize the perils and aid the work of those venturing into the Polar regions. Now they are able to send home reports concerning their welfare, their adventures and their discoveries; they can gossip with passing vessels or other stations, and they are even publishing an Antarctic newspaper containing current news.

The most notable achievement of wireless in Polar exploration was accomplished by Dr. Mawson and the members of his expedition. The party left Hobart, New Zealand, for the Antarctic on December 2, 1911. There were fifty-two persons in the expedition; thirty-one were for service on shore and the remainder were employed to serve on board the Aurora, which carried the party to its destination. The purpose of the expedition was the exploration of the coastal region of the Antarctic continent lying south of Australia, for Dr. Mawson believes that a scientific and accurate survey of the region will probably prove the possibilities of economic development. The Aurora is a vessel which has long since made her maiden trip to Polar regions, having taken part in the search for the ill-fated Greely Expedition, thirty-six years ago. She is a whaler, heavily timbered to withstand ice pressure, and is well supplied with all things needful for her present purpose.

The Aurora reached the mainland of Australian Antarctica in due time, and Mr. Ainsworth, of the Commonwealth Meteoreological Service and a party of four were landed at Macquarie Island on December 13, 1911. One of the four was A. J. Sawyer, who at that time was a member of the Gisbourne and Wellington telegraph staffs, from which he resigned in 1908 to take up wireless telegraphy. He was afterwards commissioned to superintend and man the proposed wireless station on the island. His description of the difficulties encountered in his work is as follows:

"All stores and wireless equipment had to be landed through the surf—not a difficult proceeding, but a wet and cold one. A barrel containing a part of the wireless equipment came adrift and we thought it was lost for good. But it was cast up on shore two days later, though the contents were scarcely improved by the long immersion. Owing to the fearful gales and the bad weather, the task of erecting the wireless plant was a difficult one. We had to haul everything up a 300-foot hill and several minor accidents occurred during the work of transit, while a good many of the instruments had to be repaired before the actual work of erection could be proceeded with. Throughout, my only assistant was a Sydney wireless amateur.

"On the 6th of February everything was ready for the initial trial. Unfortunately, a violent hurricane sprung up that afternoon, carried the aerials away, and damaged the masts; but in a week's time repairs had been effected, and on the 13th communication was established with shipping and Sydney."

This station supplies meteorological data each night to Melbourne and Wellington by wireless and has proved so valuable that it has been taken over from the expedition by the Commonwealth of Australia. Several excellent results in the way of long-distance communication have been recorded; for instance, messages were transmitted to and received from the Port Moresby land station, 2,800 miles away; the Suva land station, 2,400 miles away; the Freemantle land station, 2,200 miles away, and from the steamers Manuka and Cooma, both more than 2,300 miles away.

At Macquarie Island the Aurora bumped heavily on the rocks and sustained severe damage, which necessitated almost continual work at the pumps and subsequently cost approximately $10,000 to repair.

The earliest illustrations of Arctic Exploration by Gerrit Veer, who accompanied the Dutch Expedition led by William Barentz in 1594. The text refers to the capture of walruses.

Dr. Mawson and the remainder of the party had in the meantime set out for the lesser known districts farther south. They successfully weathered the stormy conditions of the "Roaring Forties, Howling Fifties and Shrieking Sixties" and eventually discovered a magnificent harbor, afterwards named Commonwealth Bay, where it was decided to establish a base. Provisions, coal and Greenland sledge dogs for eighteen men were landed, and the ceremony of hoisting the British flag in the new territory was performed. It was called King George V. Land. Afterwards a wireless station was erected here, which has been working successfully since January, 1913.

The Aurora then proceeded westward to land the third party of eight men, but that vessel traversed 1,100 miles without being able to find a landing place. Where ice floes did not intervene they were thwarted by unscalable ice cliffs and when their supply of coal began to run short they were forced to consider the advisability of returning to Australia with their ambitions unfulfilled. But such a prospect went against the grain and the little company took their lives in their hands and chose to land on a glacier with their camp seventeen miles distant from land and with 200 fathoms of water beneath them.

This ice tongue, which is 120 miles in length, was named the Shackleton Glacier, while the adjoining land, which was afterwards explored by the party, has been christened Queen Mary Land. The members of the expedition were in considerable danger during their stay on Shackleton Glacier, for there was a possibility that the ice tongue would break away during the vernal thaw. Their work, under the direction of Frank Wild, justified the hazard, however, and when they returned to Australia they had completed the charting of a great part of the Antarctic coast and accomplished a considerable amount of research in oceanography.

It was imperative that Wild and his men should be relieved, because the season was late and a vessel penetrating the pack ice under such conditions is likely to be frozen in and jammed among the bergs in the darkness. As the efforts of the searching parties to discover the missing explorers were unsuccessful, Captain Davis decided to proceed to Wild, when a wireless message which came from Adelie Land caused him to change his plans.

Dr. Mawson, Mertz and Lieutenant Ninnis, it seems, were 300 miles from the main base when Lieutenant Ninnis, with a team of dogs and nearly all the food, was suddenly precipitated down a crevasse. He was killed, and the position of the two survivors—deprived of their supplies—became desperate. They retraced their steps and struggled on for thirty-five days without provisions. Then, on January 17, Mertz died from privation. For another three weeks Dr. Mawson continued his lonely journey, and finally reached the base on February 7.

This news was made known to Captain Davis in the wireless message he received from Adelie Land. With the information came the order for the Aurora to return at once and take off all the members of the expedition. An effort to do this, however, was frustrated by storms, and Captain Davis, exercising his own discretion, determined first to relieve the heroic little band stationed on the far-off glacier to the west.

"On February 9," his report says, "we were brought up by heavy ice, and it appeared unlikely that we should get through at all. The presence of countless bergs made navigation in the darkness almost impossible, and as daylight came we were thankful that we had passed another night without disaster. These experiences continued until February 23. The morning of that day dawned bright and clear and we calculated that we ought to be near Wild's base. So, with eyes glued to our glasses, we searched the coast and perceived a little hut on the glacier with a solitary figure outside it. Soon there were eight gesticulating black

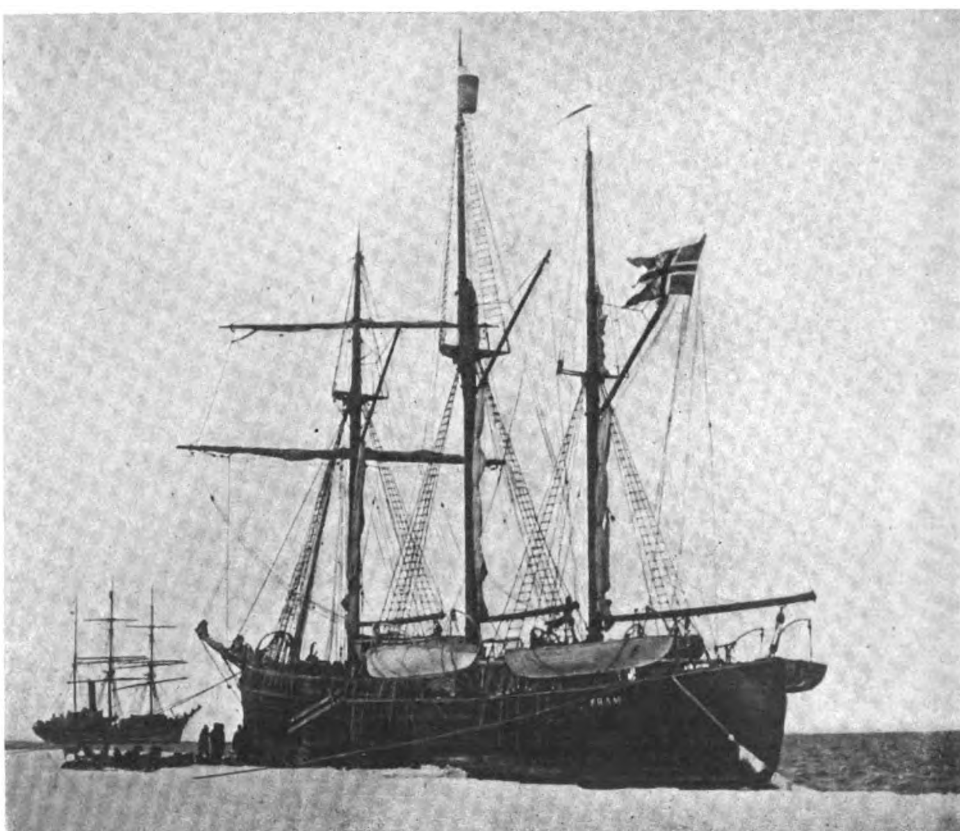
In the photograph Captain Amundsen is seen taking an observation of the sun through a sextant, while one of his assistants examines the "artificial horizon." The flag is planted at the point determined upon as the exact location of the South Pole.

figures and we knew that the whole of the party was safe and sound. Then began the work of bringing aboard the members and all their specimens and collections, and this we did in a remarkably short space of time."

With the rescued the Aurora then sailed for Hobart, arriving there in March, 1913. But Dr. Mawson and his party, which includes six of the men sent out by the Aurora to search for their leader, have been forced to spend another year in the Antarctic. They are well supplied with coal and food and there is no reason to suppose that they are running any further risks by the delay. Besides, they have the wireless to keep them in touch with the outside world.

According to reports which reach civilization from time to time, they have found the art an invaluable aid both to their work and recreation. Not only can they transmit messages, but they are able to hear communications between other stations. They pick up messages which Wellington, Melbourne and Sydney exchange with one another and sometimes they get communications between warships and other craft. Occasionally Dr. Mawson discusses, through Macquarie Island and Hobart, how Sydney shall dispose of certain scientific specimens already brought back to Australia by the Aurora. The Polar adventurers send news of the weather, of the good spirits they manage to keep up, and of the team dogs' puppies. They have also conveyed their sympathy by wireless to Lady Scott on the loss of her husband. But perhaps their most noteworthy achievment is the publication of an Antarctic newspaper with "all the latest news."

It is reasonable to suppose that had



Sisters of the Antarctic; in the foreground the Fram, which carried Amundsen in his dash to the South Pole, and in the middle distance the Terra Nova, Captain Scott's vessel. This picture was taken by Captain Amundsen while the ships were lying in the Bay of Whales.

The difficulties encountered by explorers and the absolute necessity of dependable communication are shown in this picture of the Devil's Glacier, looking down Hell Gate. Three days were required before the glaciers could be surmounted, and snow bridges like the one seen in the center had to be employed in crossing the great crevasses.

Captain Scott's expedition been equipped with the wireless apparatus the brave men who lie buried beneath Antarctic snows would have completed a triumphant journey. They were only eleven miles from One Ton Depot, where there was a store of food, and if they had been able to communicate they could have received assistance, for some of the party had quitted it to return to the ship only a few days before the disaster overtook their fellows.

Captain Scott remarked on the lack of means for communication in Polar exploration. A paragraph in the log of the Nimrod reads:

"One of the most annoying circumstances was, that until we had a solid sheet of ice about us, we could not set up our meteorological screen, nor communicate regularly with the magnetic huts, nor, in fact, properly carry out any of the routine scientific work."

Captain Amundsen apparently realizes the value of wireless as a means of communication in Polar travel, for the Fram, on which he is about to start on a trip to the North Pole, had been equipped with radio apparatus. He has also arranged for a wireless equipment to be carried on the sledges on which he will make his final dash to the pole.

NEW CANADIAN LAWS

New wireless regulations governing navigation throughout the Dominion came into effect January 1, when all provisions of the act governing Canadian Wireless passed last session became effective. Roughly speaking, the result of the new regulations is that no vessel carrying 50 or more passengers or going 200 miles or more may hereafter be without wireless apparatus. Navigation on both coasts of Canada will feel the effect of the regulations immediately, but it is understood that most vessels engaged in ocean traffic are already equipped with wireless as required. The main changes necessitated by the act will be in lake vessels, but this will not be till the resumption of navigation in the spring.

Elementary Engineering Mathematics

As Applied to Radio Telegraphy

By William H. Priess

ARTICLE IV—(Continued)

THE USE OF THE BRIGGS TABLE

SINCE

$$10^0 = 1, \quad \log_{10} 1 = 0$$
$$10^1 = 10, \quad \log_{10} 10 = 1$$
$$10^2 = 100, \log_{10} 100 = 2, \text{ etc.},$$

and

$$10^{-1} = .1, \quad \log_{10} .1 = -1$$
$$10^{-2} = .01, \quad \log_{10} .01 = -2$$
$$10^{-3} = .001, \log_{10} .001 = -3, \text{ etc.}$$

therefore the logarithms of numbers between

1 and 10 lie between 0 and 1,
10 and 100 lie between 1 and 2,
100 and 1,000 lie between 2 and 3, etc.,

and the logarithms of numbers between

1 and .1 lie between 0 and — 1,
.1 and .01 lie between — 1 and — 2,
.01 and .001 lie between — 2 and — 3, etc.

The logarithms of numbers may be expressed as a positive or negative integral number known as the *Characteristic,* which may be determined at sight, and a decimal portion called the *Mantissa,* which is found in logarithmic tables. The Characteristic—as shown above—is positive, and one less than the number of figures to the left of the decimal point if the number is greater than unity. When the number is less than unity the Characteristic is negative and equal to one unit more than the number of zeros between the decimal and the first figure in the given number. After the operations have been performed by the logarithms the anti-logarithm is found to bring the answer into the usual arithmetical form. This is done by taking the decimal portion of the logarithm and writing down the number to which it corresponds, this number being found in the tables. Then, after pointing off the proper position for the decimal point as indicated by the Characteristic, the answer is in the desired shape. (The reader may find a logarithm table in the last pages of any book on mathematics, physics or engineering hand-book. If these are not at hand he should secure a copy of a logarithmic table.)

EXAMPLE (1)

Numerical Calculation by Logarithms

In the design of an oscillating transformer for sending or receiving, or a variometer the inductance of which varies with the mutual inductance of the coils forming it, it is necessary to know the mutual inductance of the two coils forming the couple; in the first case, so that the coupling coefficient of the two circuits may be determined by means of the relation.

$$K = \frac{M}{\sqrt{L_1 L_2}} \qquad (1)$$

where K is the coupling coefficient, M is the mutual inductance between the two circuits, and L_1 and L_2 are the inductance of the first and second circuits, respectively. In the second case for the determination of the equivalent inductance of the variometer, which will have a maximum value when the fluxes from the coils L_1 and L_2 assist.

Then

$$L = L_1 + L_2 + 2\,M, \qquad (2)$$

and, as an intermediate value when $M = O$,

$$L = L_1 + L_2 \qquad (3)$$

and as a minimum value when the fluxes from the coils L_1 and L_2 oppose,

$$L = L_1 + L_2 - 2M \qquad (4)$$

We shall calculate M for two concentric, coaxial coils of the same length by means of Maxwell's Formula, which appears in Electricity and Magnetism, Vol. II, p. 678, and also in the Bureau of Standards' publication, Vol. 8, No. 1, pages 53-55. Fig. 6 represents a section through the two coils where l is the common length, A and a are the radii of the outer and inner coils, respectively, n_1 and n_2 are the number of turns per cm. on the outer and inner coils, respectively.

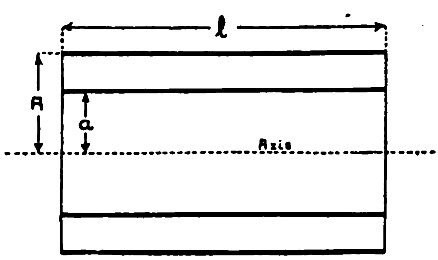


Fig. 6

$$M = 4\pi^2 a^2 n_1 n_2 [l - 2A\alpha] \qquad (1)$$

where

$$r = \sqrt{l^2 + A^2}$$

$$\alpha = \frac{A - r + l}{2A} = K_1$$

$$-\frac{a^2}{16A^2}\left(1 - \frac{A^2}{r^2}\right) = K_2$$

$$-\frac{a^4}{64A^4}\left(\frac{1}{2} + 2\frac{A^5}{r^5} - \frac{5}{2}\frac{A^7}{r^7}\right) = K_3$$

minus a series of terms the sum of which is extremely small as compared to the first term given. As a typical case, take two coils the values of which are $l = 8$ cms, $A = 6$ cms, $a = 5$ cms, $n_1 = 3$ turns per cm, $n_2 = 6$ turns per cm.

$$\text{Log. } r = \tfrac{1}{2} \text{ log. } (8^2 + 6^2)$$
$$= \tfrac{1}{2} \text{ log. } (100)$$
$$= 1$$
$$r = 10$$

$$K_1 = \frac{6 - 10 + 8}{12} = 0.3333$$

$$K_2 = \frac{5^2}{16 \times 6^2}\left(1 - \frac{6^3}{10^3}\right)$$

$$= \frac{25}{16 \times 36}\left(\frac{782}{1000}\right)$$

$$\text{Log. } K_2 = \text{log. } 25 = 1{,}39784$$
$$+ \text{log. } 782 = 2.89321$$
$$4.29115 \qquad (1)$$

$$- \left| \begin{array}{l} + \text{log. } 16 = 1.20412 \\ + \text{log. } 36 = 1.55630 \\ + \text{log. } 1000 = 3.00000 \end{array} \right.$$
$$5.76042 \qquad (2)$$

Subtracting (2) from (1) 4.29115
5.76042

$$\text{log. } K_2 = -2.53073$$

$$K_2 = 0.03394$$

$$K_3 = \frac{5^4}{64 \times 6^4}\left(\frac{1}{2} + 2\frac{6^5}{10^5} - \frac{5}{2} \cdot \frac{6^7}{10^7}\right)$$

$$\text{Log. } 2\frac{6^5}{10^5} = \text{log. } 2 = \qquad .30103 = .30103$$
$$+ 5 \text{ log. } 6 = 5 \times .77815 = 3.89075$$
$$4.19178 \quad (1)$$
$$- \text{log. } 10 = 5.00000 = 5.00000$$

Subtracting (2) from (1) $= -1.19178$ (2)

$$\text{log. } 2\frac{6^5}{10^5} = -1.19178$$

$$2\frac{6^5}{10^5} = .1553$$

$$\text{log. } \frac{5}{2}\frac{6^7}{10^7} = \text{log. } 5 = .69897 = .69897$$
$$+ 7 \text{ log. } 6 = 7 \times .77815 = 5.44705$$
$$6.14602 \qquad (1)$$

$$- \left| \begin{array}{l} + \text{log. } 2 = .30103 \\ + 7 \text{ log. } 10 = 7.00000 \end{array} \right.$$
$$7.30103 \qquad (2)$$

Subtracting (2) from (1) 6.14602
7.30103

$$\text{log. } \frac{5 \times 6^7}{2 \times 10^7} = -2.83499$$

$$\frac{5 \times 6^7}{2 \times 10^7} = .06839$$

$$\left(\frac{1}{2} + 2\,\frac{6^8}{10^8} - \frac{5}{2}\,\frac{6^7}{10^7}\right) =$$

$$(.50000 + .15530 - .06839) = 0.58691$$

$$K_3 = \frac{5^4}{64 \times 6^4} \times 0.58691$$

$$\log. K_3 = 4, \log. 5 = 4 \times .69897 = 2.79588$$
$$+ \log. 0.58691 = -\,1.76856 = -\,1.76856$$
$$2.56444 \quad (1)$$

$$-\left|\begin{array}{l} + \log. 64 = 1.80618 = 1.80618 \\ + 4 \log. 6 = 4 \times .77815 = 3.11260 \end{array}\right.$$
$$4.91878 \quad (2)$$

Subtracting (2) from (1) 2.56444 3.11260

$$\log. K_3 = -\,3.64566$$

$K_3 = .004422$

K_4 is negligible as compared with K_1

$\alpha = K_1 - K_2 - K_3$

$= 0.33333 - 0.03394 - 0.00442 = \underline{0.2949}$

Substituting in equation (1) the value of α

$2\,A\,\alpha = 12 \times .2949 = 3.54$

$[1 - 2\,A\,\alpha] = 8 - 3.54 = 4.46$

From equation (1)

$$M = 4 \times \pi^2 \times 25 \times 3 \times 6 \times 4.46$$

$$\begin{aligned} \text{Log. } M = {} & \log. 4 = 0.60206 \\ + {} & 2 \log. \pi = 0.99434 \\ + {} & \log. 25 = 1.39794 \\ + {} & \log. 3 = 0.47712 \\ + {} & \log. 6 = 0.77815 \\ + {} & \log. 4.46 = 0.64933 \\ & \qquad 4.89894 \end{aligned}$$

$M = 79{,}200$ cms.

The inductance of the outer coil—considered as a current sheet—is 60,900 cms.; that of the inner coil is 181,400 cms. Therefore, if the inductances of the outer and inner coils are, respectively, the total inductance of a primary and a secondary circuit, the coupling coefficient is—from equation (1)—equal to

$$K = \frac{79{,}200}{\sqrt{60{,}900 \times 181{,}400}} = 0.754$$

This value of coupling is much too great for the usual resonance work; i. e., transfer of energy in the form of a single wave from one circuit to another. It is decreased by the inductance of the leads and loading inductance in either, or both, circuits, and may be further reduced by varying the distance between the centers of the coils, and the angle between their axes. In practice the coupling coefficient is about 0.2.

As a variometer the maximum inductance is—from equation (2)—equal to

$$L = 60{,}900 + 181{,}400 + 2\,(79{,}200) = 400{,}700 \text{ cms.,}$$

and the minimum inductance is—from equation (4)—equal to

$$L = 60{,}900 + 181{,}400 - 2\,(79{,}200) = 83{,}900 \text{ cms.}$$

It is of importance in the design of a variometer to have the ratio of maximum to minimum inductance as large as possible, in order to obtain the greatest wave length range, of the apparatus in which it is used. This is accomplished by making the inductances of the two coils equal. In the given example the ratio is 4.77 : 1. If we increase the number of turns on the outer coil to 5 turns per cm., instead of 3 turns per cm., we increase its inductance to 169,100 cms., and the mutual inductance to 132,100 cms. The maximum inductance of the apparatus is then 614,700 cms. and its minimum inductance is 86,300 cms. The ratio is 7.13:1. On the other hand, if we decrease the number of turns per cm. on the inner coil from 6 to 3½ we decrease its inductance to 60,300 cms., and the mutual inductance to 46,200 cms. The maximum inductance of the apparatus is 213,600 cms., and its minimum inductance 28,800 cms. The ratio is 7.41:1.

EXAMPLE (2)

Change of Base

Example—Calculate the wave length of a vertical antenna 60 meters high composed of a single No. 14 copper wire. The formula for the capacity of a vertical wire of height h and radius P is

$$C = \frac{h}{2\left(\log_e \frac{h}{\rho}\right) 9 \times 10^5}\ \mu.\ \text{fs.}$$

The formula for the inductance of the same wire is

$$L = 2h\left[\log_\epsilon\left(\frac{2h}{\rho}\right) - 1\right] \text{cms.}$$

Therefore, the wave length λ is equal to

$$\lambda = 59.6\sqrt{\frac{h^2\left[\log_\epsilon\left(\frac{2h}{\rho}\right) - 1\right]}{9 \times 10^6 \log_\epsilon \frac{h}{\rho}}} \text{ meters,}$$

$$= \frac{59.6 \times h}{300}\sqrt{\frac{\log_\epsilon \frac{2h}{\rho} - 1}{10 \log_\epsilon \frac{h}{\rho}}} \text{ meters.}$$

The reader will notice that the logarithms are to the base ϵ, while the tables are to the base 10. But we have seen in the last issue that log ϵx may be put into the form of log $_{10}x$ by the following relation:

$$\log_\epsilon x = 2.3026 \log_{10} x$$

Introducing this fact, the equation of the wave length becomes

$$\lambda = \frac{59.6 \times h}{300}\sqrt{\frac{2.3026\left(\log_{10}\frac{2h}{\rho}\right) - 1}{23.026 \log_{10}\frac{h}{\rho}}} \text{ meters.}$$

Substituting for h, its value, 6,000, and ρ, its value, 0.081,

$$\lambda = \frac{59.6 \times 6000}{300}\sqrt{\frac{2.3026\left(\log_{10}\frac{12000}{.081}\right) - 1}{23.026 \log_{10}\frac{6000}{.081}}} \text{ meters.}$$

$$= \frac{59.6 \times 6000}{300}\sqrt{\frac{2.3026 \times 5.17 - 1}{23.026 \times 4.87}} = 372 \text{ met.}$$

Fleming has found that the measured wave length of an antenna of this type is about 10 per cent. above the calculated wave length. Therefore, the corrected wave length is about 409 meters.

The Slide Rule

An illustration of the application of logarithms to engineering practice is found in the slide rule. The slide rule consists of two identical rulers on which distances are laid off, proportional to the logarithms of the numbers from one to ten. The intervening spaces are subdivided decimally. For example, the distance corresponding to the number 8 is three times the distance corresponding to the number 2; for the logarithm of 8 is three times the logarithm of 2. By means of the slidng rulers we can add to or subtract from a distance on the first scale, a distance on the second scale; i. e., we can add or subtract the logarithms of numbers and read the result as an anti-logarithm. This furnishes a simple method of performing long chains of multiplications and divisions by mere mechanically setting of one slide over another and reading the result, requiring caution only in the remembering of the Characteristic or position of the decimal point.

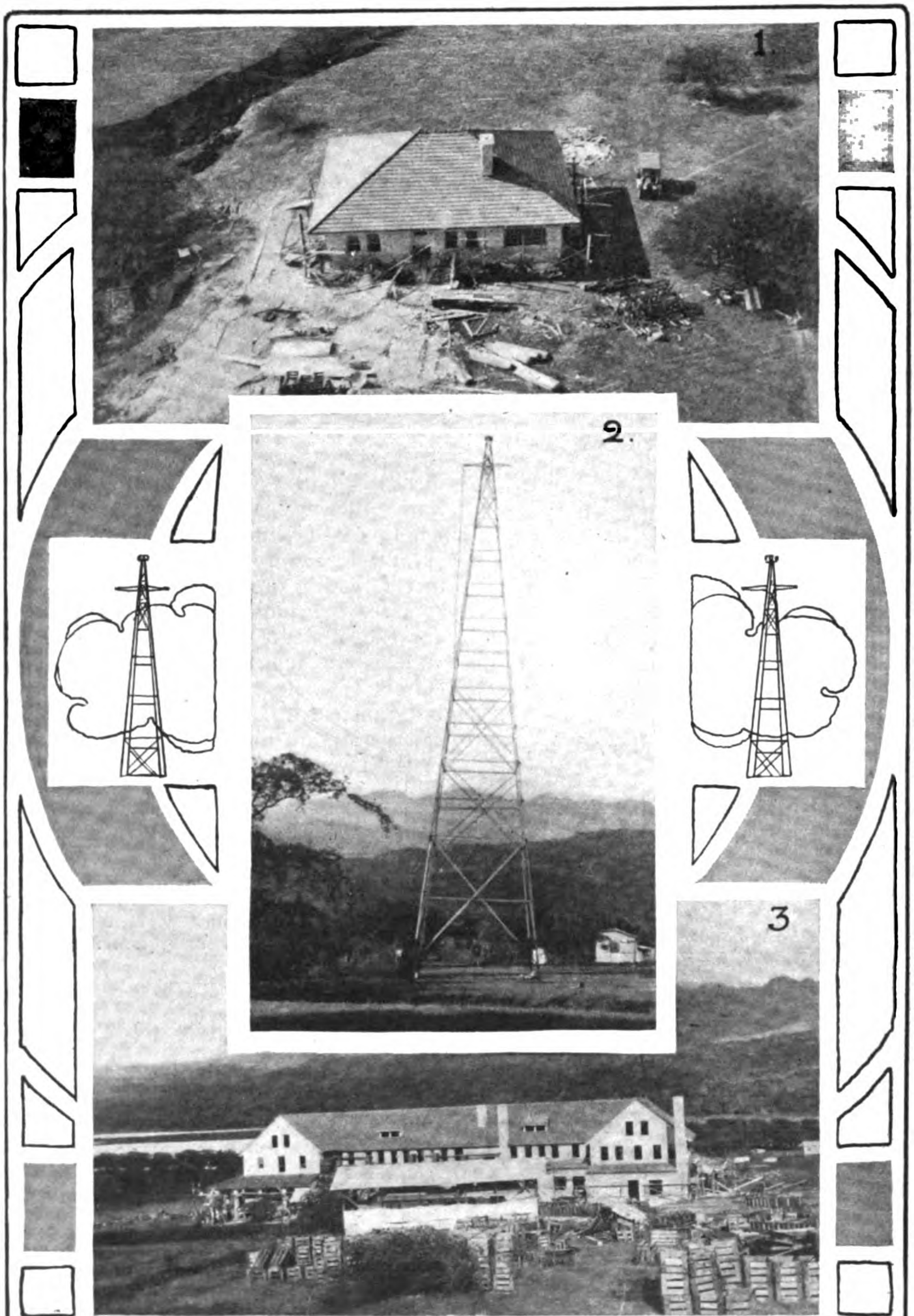
If above the first rule, and fixed to it, is placed a second rule plotted with distances half the scale of the first rule, lines drawn perpendicularly to the length of the rule cut off corresponding second-degree relationships; i. e., give direct readings of the squares and square roots of the numbers. The simplest way for the student to understand the slide rule is to make practical use of it. After a few hours' practice his skill will be sufficient to enable him to perform calculations in much less time than that necessitated by the use of logarithmic tables. At the same time errors due to addition and subtraction are avoided and the desired 0.5 per cent. accuracy is obtained.

This is the conclusion of the fourth article in a series on mathematics by Mr. Priess. The fifth will appear in an early issue.

NAVAL STATION IN TEXAS

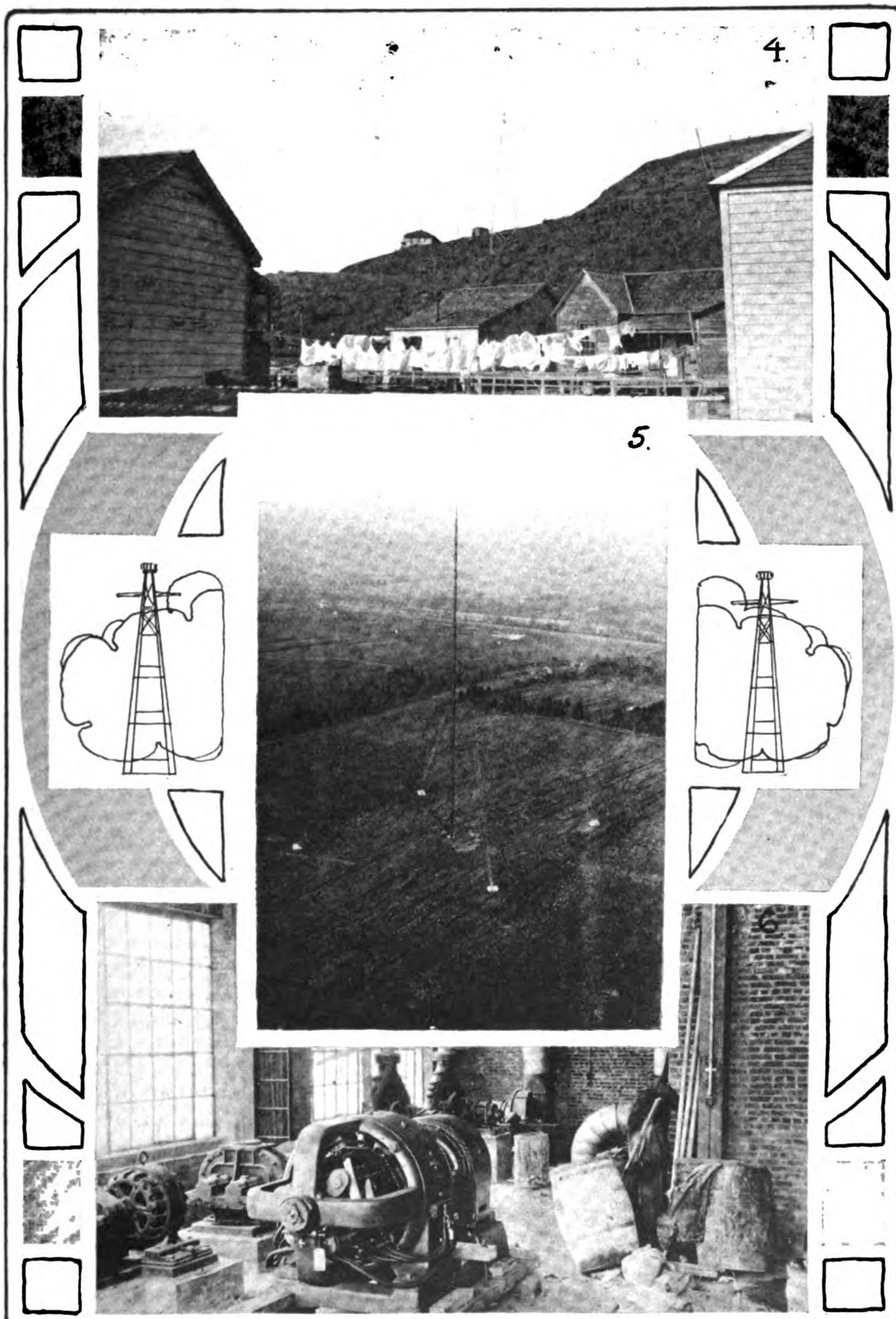
Announcement has been made that Point Isabel, a coast town twenty-two miles from Brownsville, Tex., is to have a wireless station erected by the United States Navy Department. Lieutenant-Commander A. J. Hepburn, U. S. N., has closed an option with land owners at Point Isabel, and within six months it is expected that actual work on the station will be under way. There is now an appropriation of $50,000 for this station, but Lieutenant Hepburn stated that before the contract is let it is expected that this amount will be increased to at least $70,000.

The Trans-Ocean Stations



(1) *A residence at Koko Head, Island of Oahu, Hawaii. The photograph was taken from the top of No.* 1 *balancing tower.* (2) *Balancing tower at Koko Head.* (3) *A rear view of the hotel at Koko Head, showing the quarters of the men who will operate the station.*

As They Near Completion



(4) Towers Nos. 1 and 2, operating building and fishermen's huts; also a view showing that even in wireless it is possible to have a washout on the line. (5) Mast No. 3 at Marshalls, Cal. (6) Interior view of the power house at New Brunswick, N. J.

Donald Perkins Memorial in Los Angeles

A BRONZE tablet will be hung in the lobby of the Y. M. C. A. in Los Angeles, Cal., as a mark of respect to Donald C. Perkins, wireless hero of the steamship State of California, which sank in Gambier Bay, Alaska, on August 18, 1913. Perkins, who was a graduate of the wireless school of the Y. M. C. A. in Los Angeles, sacrificed his life in order to save others.

A letter from Secretary of Commerce William C. Redfield to General Secretary Luther, of the Y. M. C. A., eulogizing young Perkins, together with the wireless operator's photograph, will be framed, by order of the directors, and hung in the Y. M. C. A. lobby. The students of the wireless school fathered the movement to place the tablet in the lobby.

Secretary Redfield's letter is as follows:

"The school of wireless telegraphy maintained by your institution is honored in having as one of its graduates Donald Campbell Perkins, first radio operator on the steamship State of California, who went calmly to his post when the vessel struck, and stood there facing certain death, sending out the distress call continuously during the few minutes that elapsed while the vessel was sinking, and went down with her and was lost.

"The evidence shows that Mr. Perkins was off duty at the time of the disaster and that he presumably could have saved his life, if that had been to him the supreme thing. He went, instead, back to his post, sent his subordinate to assist in getting out the boats and remained himself, like a faithful soldier, at his station.

"The brief story of his self-sacrifice should be high among the honored traditions of your institution. It shows that there are heroes of peace as well as of war, who, without the inspiration and excitement of battle, can face death with a quiet mind, fearlessly doing their duty to the end.

"The Department of Commerce that issued Mr. Perkins the license under which he served thinks this brief tribute to his memory due to the institution that taught him.

"Very truly yours,

"William C. Redfield,

"Secretary."

The wireless school was established in August, 1912. Lessons and recitations are carried on daily, the pupils being trained especially for the Marconi service. After the student has acquired a certain amount of knowledge, written examinations are held. Thirty-four questions are asked concerning wireless, and nine tests are made of the student's knowledge of the London Convention and the United States regulations. Unless the student averages seventy per cent. or over in his work he is expelled. The text-books used include the 1913 Navy Manual, Fleming's Elementary Manual of Radiotelegraphy and Telephony, Timbie's Essentials of Electricity, books by Pierce and works from the Bureau of Standards. The Wireless Age is included among the reference works in the radio library.

The wireless apparatus used by the scchool was leased from the Marconi Wireless Telegraph Company of America. The antenna is located on the roof of the Y. M. C. A. building, which is eleven stories in height. One aerial pole 45 feet in height is placed on an elevator housing, the top of which is twenty feet above the roof of the main building. One end of the antenna, therefore, is sixty-five feet above the top of the larger structure. The other pole is twenty-five feet in height. The antenna, which is eighty-five feet in length, consists of four 7/22 phosphor bronze wires on a 14-foot spreader. The lead-in wire is brought over the edge of the building by means of a 10-foot arm. In order not to parallel the building, the lead-in is brought into the radio room at an angle of forty-five degrees from the top of the roof. The school room and instruments are on the fifth floor. The vertex of the angle is made round by means of a seven-foot aerial strap insulator to reduce the loss of energy due to brush discharges. Although the antenna current is fifteen amperes, no trouble is experienced in the building.

During the last world's series of baseball games a direct wire was run from the office of the Los Angeles Times to the Y. M. C. A. Every half hour a summary of the innings was sent broadcast by means of the Y. M. C. A. set. At half past nine o'clock every night a summary of the day's game was dispatched by wireless for the benefit of the trans-Pacific boats and the craft running to Mexican and Central American ports. The scores were copied at a distance of 2,000 miles by the Pacific Mail steamship Persia. They were also received by the United States cruiser South Dakota while she was off the Mexican coast, 1,500 miles away. These results were obtained in spite of the fact that the Y. M. C. A. building is located in the heart of Los Angeles, fifteen miles from the ocean.

NEW RUSSIAN STATIONS

Wireless telegraphy is making rapid strides in Russia. The program for 1914 of the Russian Central Administration of Posts and Telegraphs provides for the erection of stations as follows: At Markov, on the River Anadyr, with a radius of 200 miles; at Tigila (Kamchatka), with a radius of 1,000 miles; at Sredne-Kolmynsk, with a radius of 535 miles; on the islands of Sakhalin Solovetz, each with a radius of 200 miles; at the settlement of Obdorsk, on the River Obi, with a radius of 670 miles; at Krasnovodsk, for the improvement of communication with Turkestan, with a radius of 200 miles; at Abo and Poti, for communication with vessels, each with a radius of 400 miles; and at Skobolvesk, with a radius of 400 miles.

The origin of wireless telegraphy in Russia is due to the foresight and enterprise of S. M. Wisenstein, who formed what is known as the Russian Company of Wireless Telegraphs and Telephones, and the development of the wireless telegraph network has been so well advanced by the Russian Government that a radio-telegraphic service between the Sea of Ochotsk, the Bering Sea and the Bering Strait has been established. The Russian Company has erected several stations on the northern coast of the empire for the Post and Telegraph Department. These stations are situated at Waigatz, Yugorsky Schar and Cape Maare-Saale in the Kara seas, which are open to navigation for three months of the year only.

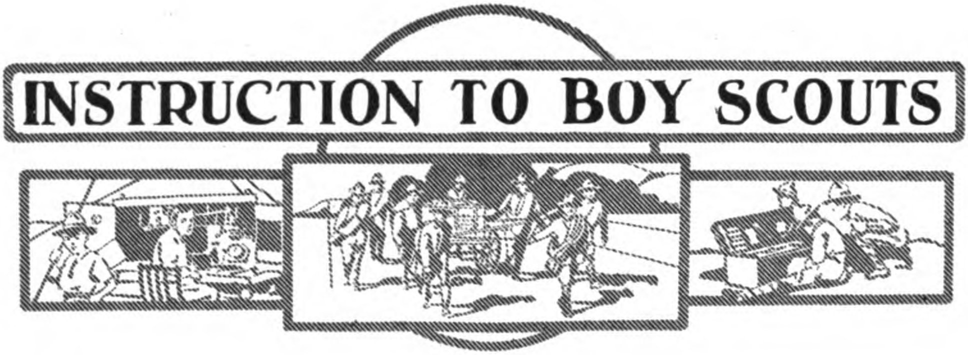
REDUCTION OF TOLLS TO FOLLOW MARCONI-WESTERN UNION AGREEMENT

A working arrangement has been effected between the Marconi Wireless Telegraph Company of America and the Western Union Telegraph Company. It is conceded to be the most important deal that has been negotiated in the history of the telegraph-telephone and cable business in the United States.

The new service will be started with a thirty-three and one-third per cent. reduction from the existing cable rates. Every Western Union office will be a Marconi wireless office, and the trans-Pacific wireless service will be operated in connection with the Western Union. The arrangement still existing between the Western Union and the Bell Telephone Company makes it possible for a person to telephone his cablegrams.

MARCONI COMPANY PURCHASES LAND

Dr. H. S. Kinmouth has sold to the Marconi Wireless Telegraph Company of America a small piece of land from his farm in "The Garden of the Gods," near the Marconi plant at the head of Shark River, Belmar, N. J. The tract is three-cornered and contains about 300 square feet. It will be used for a tower to hold a balancing line to run east and west with the Marconi plant. The company has a "balancing line," as it is called, running north and south. The lot sold by Dr. Kinmouth is at the west side of his farm, on the road leading from Corlies avenue to Glendola.



By A. B. COLE

CHAPTER IX

A Portable Receiving Set

SEVERAL different types of tuning coils and receiving transformers are in general use at the present time, but probably the ordinary type of coil with some improvements will be found most satisfactory for portable use. In the preceding chapter we explained the purpose and use of receiving transformers, showing that this device has two windings, a primary and a secondary, the former being a part of the open oscillation circuit and the latter part of the closed oscillation circuit.

The same general results may be obtained with a tuner having only one winding, by causing two different parts of the single winding to act as two distinct coils. The diagram in Fig. 47 will show that the open circuit is ACG and the closed circuit is DBC. By changing the positions of the points B and C, the wave length to which each of these circuits best respond will be altered.

Instead of using sliding contacts at B and C to connect with the various turns of wire in the winding, it has been found that a rotary switch will give better results for our purpose because sliding contacts offer more or less resistance to the flow of the small currents passing through them, and are also liable to make connection with two or three turns of the wire at one time, which results in loss of energy from the circuits where it is most needed. Moreover, sliding contacts are not so positive in action as a switch.

Two ordinary ten-point switches are employed for the purpose, and the method of connecting the contact points and levers is illustrated in Fig. 48, in which corresponding parts are lettered

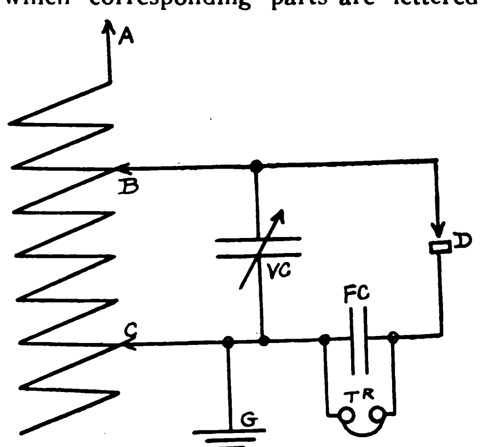


Fig. 47.—Connections for double contact tuner

the same as in Fig. 47. It will be observed that the switches accomplish the same results as sliding contacts, except that they will not permit connection with every turn of the wire. The use of an adjustable condenser, E, in connection with this arrangement, will, however, accomplish the equivalent of the effect of sliding contacts.

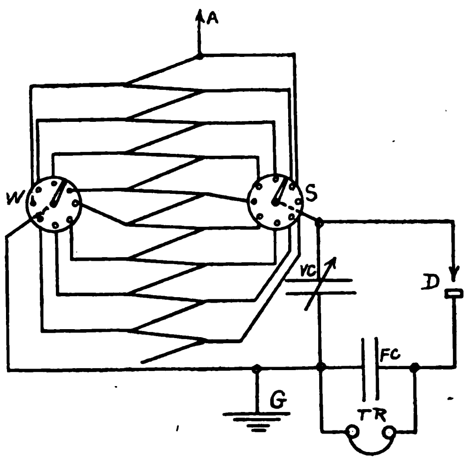


Fig. 48.—Connections for switches

The diagrams, Figs. 47 and 48, represent what is termed a double slide or double contact tuning coil. Another type is known as the three-slide or three-contact tuner, and this has certain advantages. In Fig. 49 we show a diagram of connections tor a three-slide tuner. It is superior to a two-slide tuner because the inductances of the open and closed circuits may be varied independently of each other, since no slider is common to both.

This type of coil may also be arranged with three switches instead of sliding contacts and is one of the best tuners for our purpose when so arranged.

The tuning coil for the portable set should consist of one even layer of No. 22 double-cotton covered-copper magnet wire, wound on a cardboard tube four inches in diameter and eight inches long. The tube should be immersed previously in hot paraffine wax or be painted with it to make it waterproof and to prevent its shrinking at a later time. The winding space itself is seven inches long, and the ends of the wire are passed through the tube to secure the winding in place, leaving a margin at each end of ½ inch.

As the wire is being wound on the tube, loops should be made every half inch along the length of the winding, as illustrated in Fig. 50, which shows the method of making three of the thirteen loops.

Two ten-point switches are used, and the contact points are connected as shown in Fig. 48. In place of using regular wood-base switches for this purpose, the builder should purchase the switch levers and contact points from an electrical supply house and set the switch points in the case of the outfit, as illustrated in Fig. 54.

If the loops are considered as being numbered from 1 to 14, starting from and including one end, and ending and including the other end, the contact points of switch S, Fig. 48, are to be connected in rotation to contacts 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, so that as the lever is moved over them in a clockwise manner, it makes connection successively with these loops. In the same way the contact points of switch W are to be connected to loops 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14, which is the opposite end of the winding.

By this arrangement, loops 5 to 10 are common to both switches, so that two wires can be run from each of these loops

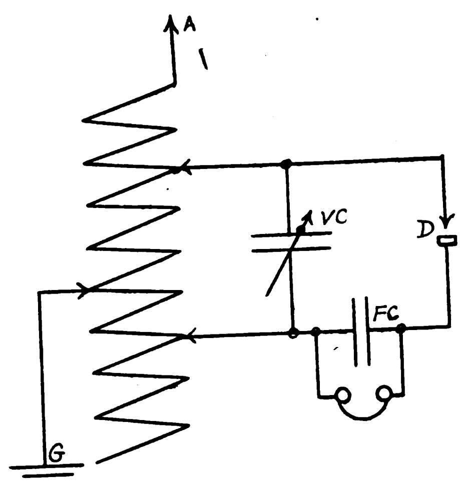


Fig. 49.—Connections for three-contact tuner

to the proper contact points of both switches.

To make connection with the loops, the insulation of the wire must, of course, be

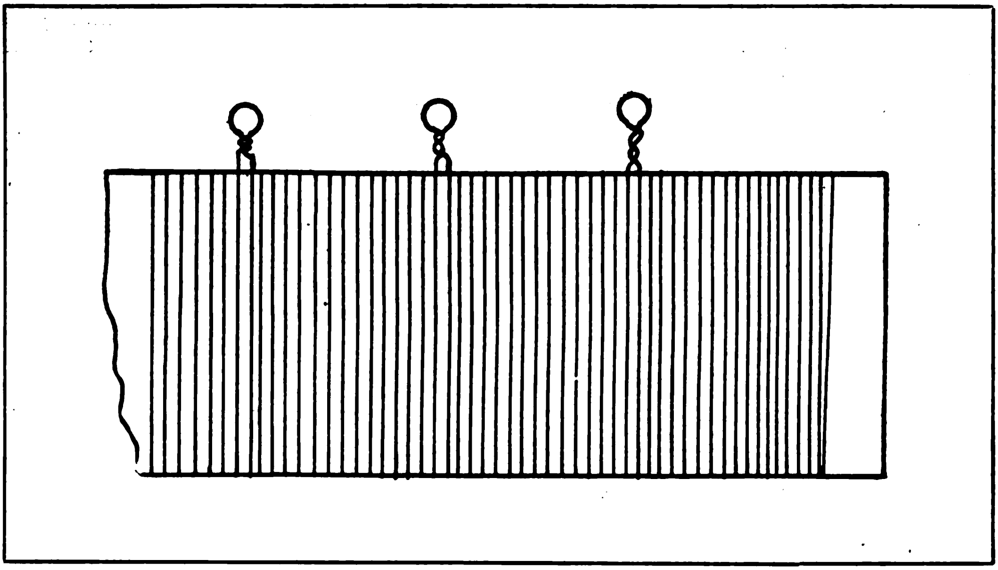


Fig. 50.—Loop connections of tuner

removed first, and after twisting this wire and the connecting wire tightly together, so that both are in good electrical and mechanical contact, the joint should be soldered and taped.

After the wire has been wound on the core it should be given a coat of shellac to make it proof against moisture and to hold it more firmly in place.

Since the tuning coil and other instruments described in this chapter are to be mounted in a carrying case, the writer will first illustrate them and then show the method of mounting them to make a complete outfit.

The Condensers

In this set a small fixed condenser and one of the adjustable type will be used, since the latter is very satisfactory, simple and inexpensive and is not likely to get out of order. The adjustable condenser consists of three sections and a switch of special type arranged to connect one, two or all three sections into circuit at the same time, thereby giving three separate capacities.

The three condenser sections, which, in fact, are three individual condensers, are made of sheets of tinfoil separated by somewhat larger sheets of a good quality of paraffined paper.

The method of building the condensers is illustrated in Fig. 51. Each consists of three strips of paper four inches wide and thirty inches long, and two strips of tinfoil three inches wide and thirty inches long. One paper strip is placed on a table and one of the foil strips is laid upon it, leaving a margin ½ inch wide on the two sides and two inches on one end (A). A second strip of paper is placed on the foil sheet so as to be directly above the first paper strip, and the second foil strip is placed on this as illustrated, but leaving the two-inch margin at the opposite end, B. The third paper strip is now placed on top of the condenser, which is then rolled up and pressed out to make it flat and compact.

The projecting end of the first foil strip will then be inside the condenser, and that of the second foil sheet will be outside. These two ends form the terminals of the condenser, and wires are to be connected to them by wrapping the foil around the wires, so as to make a good electrical contact. Care must be taken in rolling up the condenser to prevent the foil sheets from touching each other, which would render the condenser useless.

The small fixed condenser, which is employed in addition to the adjustable one, is built of three paraffined paper sheets 2½ inches wide and 20 inches

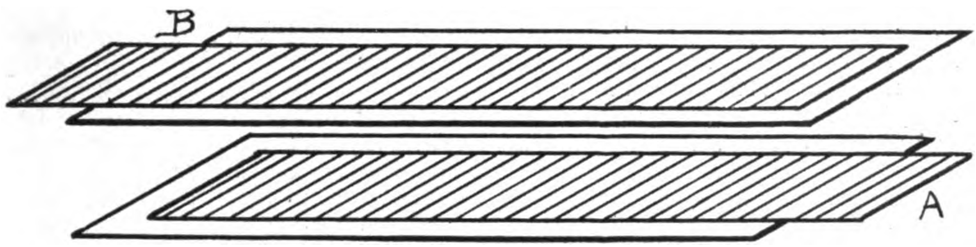


Fig. 51.—Condenser Construction

long, and two strips of tinfoil 1½ inches wide and 20 inches long, in the same manner as the three sections described above.

After the condensers have been completed, they should be dipped in hot paraffine and allowed to dry. This will cause them to hold their shapes and will prevent their unrolling. They should then be tested to determine whether the foil sheets are in contact with each other, (which would be termed a "short circuit"), by connecting them individually in series with a cell of battery and a buzzer or bell. If the buzzer indicates that the sheets are in contact the condenser will have to be taken apart and the trouble located. If a good grade of paper is employed in building these condensers, there will be no difficulty from this source.

The special type of switch to be used in connection with the adjustable condenser is illustrated in Fig. 52. It is made from a regular bell switch, which can be purchased from any electrical supply house by soldering a strip of brass or copper (A) to the lever. It is advisable to purchase the lever and contact points only, and to set the points in a circle in the case of the set, the same as with the tuning coil switches.

This is a progressive type switch, that is, it first connects with No. 1 condenser, then with Nos. 1 and 2, and finally with all three sections. Thus, three different capacities are readily available.

The condenser sections, C, have a common wire, W, connected to a terminal of each, and the other terminals are connected to contact points 1, 2 and 3, respectively, of the switch. The terminals of the complete condenser thus formed are the wires W and B, which latter is connected to the nut under the switch lever.

More condenser sections could be added by increasing the number of contact points and also the length of the arm, A, and thus would give a still greater range of capacities. In this case, the individual sections should be made of less capacity, so that the capacity range of the switch from point to point would be less, which would assist materially in close tuning.

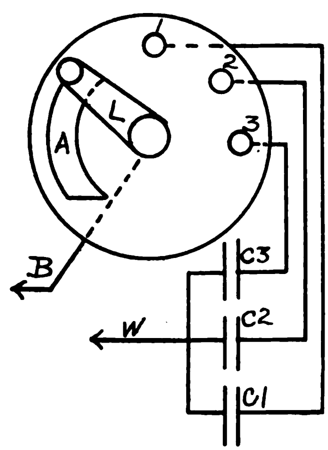


Fig. 52.—Condenser switch

The three-section condenser will, however, give a sufficiently wide range and satisfactory results in connection with the other instruments of this set.

The Detector

The detector used in this set is one of the mineral type, where galena, a lead ore, is the sensitive substance. The purpose of the detector is to change the character of the received oscillations so that they can be heard in the telephone receivers attached to the set.

The simplest and one of the most practical forms of this detector is illustrated in Fig. 53, where B is a binding post having two holes, R is a brass rod passing through the upper hole, and C is a brass cup fitted with three set screws to hold the mineral in place. Rod R is 1/8 inch in diameter and 1½ inches long, threaded at one end to take the hard rubber or fibre knob, D. The rod R is split by means of a fine hack saw for a distance of one inch of its length, and is spread apart so that it may be turned in the hole of the binding post with slight difficulty. A fine copper or phosphor bronze wire, W, of No. 30 or 32 gauge, 1¼ inches long, is soldered to rod R and makes a very light contact with the galena held in the cup, C. C is held to the base, which will be a part of the portable case, by means of a brass machine screw passing through its center. This screw is one terminal of the detector, and binding post B is the other terminal.

The galena may be purchased from any of the large chemical supply firms for about 25 cents per pound, and as no two crystals of this material are equally sensitive, it is advisable to purchase at least a pound and try out the various crystals to obtain an especially good one.

The less this mineral is handled the better, for oils and grease will decrease its sensitive qualities remarkably. The size of crystal generally used is about ¼ inch square, although this has apparently no effect on the results.

The Portable Case

The case for the apparatus may be made in two ways: to hold all the receiving instruments except the receivers, or to hold the receivers also. The use of a good double head set is recommended; for although a single receiver may be employed, the double set will give much better results. This consists of two receivers, each of preferably 500 ohms resistance, a headband and conducting cord.

Since a double head set is rather large compared to the rest of the outfit, the case would have to be made considerably larger to accommodate it, and for this reason most builders prefer to leave it outside the case. However, if so desired, the case may be made larger to include the headset.

In Fig. 54, A, we show a side view of the carrying case. This consists of two parts, a body, C, and a top, T, which are held together for carrying purposes by two clasps, E, placed at the sides. These may be obtained at a local hardware store at small cost. Two metal strips, D, are to be bent and secured to the case to hold in place a leather strap for carrying the set.

The case is 6⅝ inches wide, 7⅝ inches high and 8⅝ inches long, outside dimensions, and is made of wood 5/16 inch thick. The instrument base, F, is ½ inch thick, ¼ inch projecting above the top of the body of the case, so as to keep the top firm when clamped down.

In Fig. 54, B, we show a top view of the body of the case with the tuning coil and condenser switches in place. Fig. 55 illustrates a top view of the body of the case with the instrument base removed and the tuning coil in place. This should just fit the case and is held in position by four small wire nails at each end. There will also be room for the condensers in this part of the case. The set is to be wired, as shown in Fig. 48, and the binding posts, A and G, are the aerial and ground connections, respectively. Binding posts T and R are the connections for the telephone receivers.

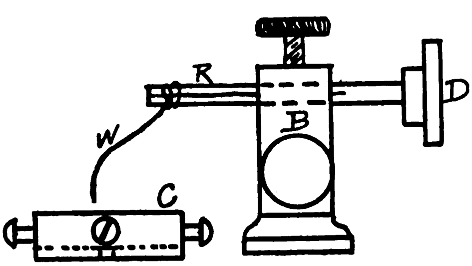


Fig. 53.—Galena detector

It is advisable to arrange a small buzzer at a convenient point in the case, connected to a vest-pocket flashlight battery and a pushbutton, to enable the operator to adjust the detector quickly to its most sensitive condition. The connections for this testing buzzer are shown in Fig. 56, and it will be seen that only one wire from

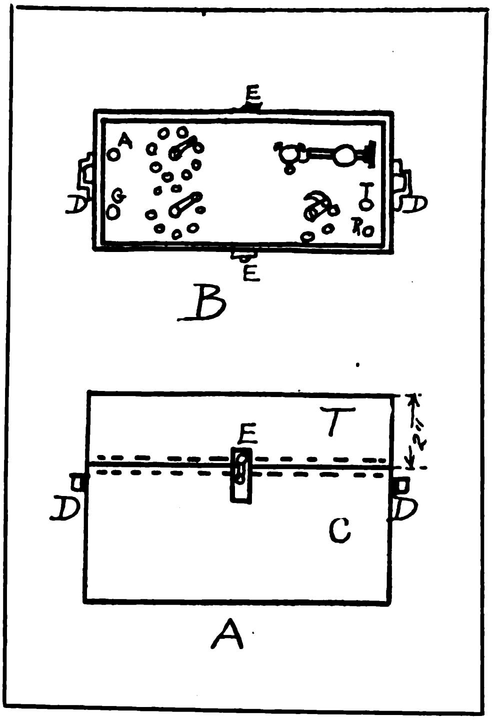
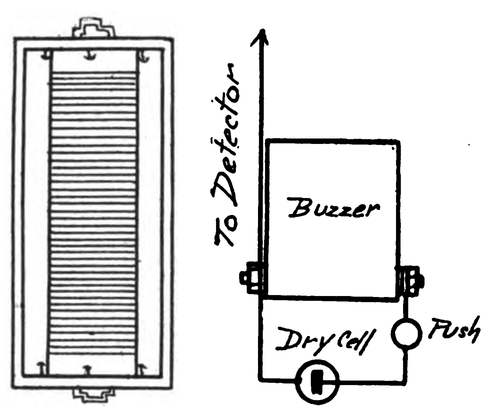


Fig. 54.—Carrying case

it is connected to the detector. When the buzzer is set in operation, it generates electromagnetic waves, due to the small spark which occurs at the contact points, and these will affect the detector, so that it may be readily adjusted at will.

The operation of this set is a very simple matter. The aerial and ground are connected to binding posts A and G, and the detector is adjusted by the aid of the testing buzzer until loudest sounds are heard in the receivers connected to posts T and R. Then the lever of switch S is revolved to a point where it is connected to a loop near the aerial end of the tuning coil, and that of switch W is moved to connect with one of the loops near the other end of the coil. If the capacity of the adjustable condenser is now varied by means of its switch, the set should be in condition to receive messages. As soon as a station is heard, adjustment is made for signals of loudest intensity by means of the two switches of the tuning coil and that of the condenser. These switches are used also to eliminate the signals of any stations which might interfere, and the result is accomplished by combinations of the positions of these three switch levers. This adjustment may cause a little difficulty at first, but as soon as the operator becomes sufficiently familiar with his set he will be able to make all necessary adjustments without delay.

In the operation of portable sets, the greatest source of trouble is that occasioned by a poor ground connection, so that the operator should always bear in mind the necessity for securing the best possible contact with the earth when setting up his station. In many cases a good



Figs. 55 and 56.—Top view of case and connections for buzzer

ground can be obtained by driving an iron pipe four or five feet into the earth at some moist spot.

This is the sixth installment of Instruction to Boy Scouts. The seventh lesson by Mr. Cole will appear in an early issue.

SIGNALS ON A SCREEN

The remarkable feat of recording a distant wireless message by magnified images of the signals thrown on a screen was the crowning surprise in a unique meeting held recently in London, England, to mark the start of the newly formed Wireless Society of London. The signals came from the top of the Eiffel Tower, Paris.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE TEN DOLLARS

A Musical Spark for Amateurs

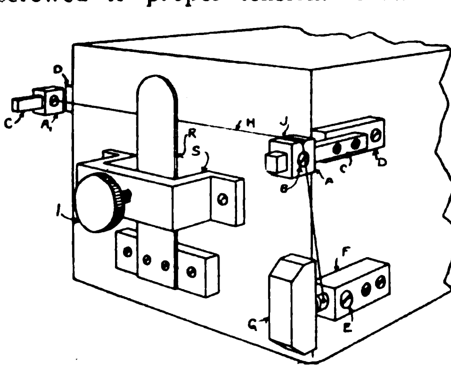
Efforts are invariably made by amateurs to attain a high spark note from an induction coil or transformer. A 500-cycle motor generator set is out of the question with most amateurs on account of the high price. The use of a commutator break has been tried, but at 500 breaks per second the arc formed soon burns away the segments or chars the insulation so as to make it conductive. The vibrators of induction coils, when properly adjusted, sometimes give a high note, but are never steady in action because of the arc at the contacts.

My attention was first called to the solving of this problem by the weird, unearthly and otherwise obnoxious sounds that were to be heard at receiving stations anywhere in the vicinity of New York, from amateurs trying to produce a high-pitch spark. It appeared more like a case for S. P. C. A. than for a radio experimenter. However, the following seems to solve the problem:

The break which I am about to explain is for induction coils only drawing less than 5 amperes. A slightly different apparatus is used for closed-core transformers.

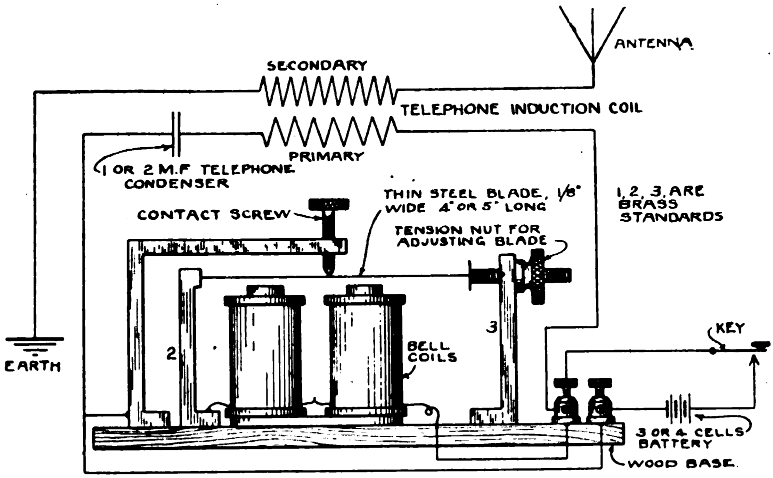
An ordinary vibrator on the end of a spark coil, providing it be of the high-speed type, will do for the break. On the sides of the coil two brass plates, d, d, as shown in the accompanying diagram, are screwed (all dimensions depend upon the size, shape, etc., of the coil and vibrator). To each of these plates is screwed a square brass rod, c, c, which protrudes from the end of the coil. On these rods are put two sliders, a and a_1, one (a) of them having a groove J. The slider a_1 has a hole 1/64 inch in diameter bored through it either above or below the hollow. Each slider has a set screw, which will keep it in any desired place. Through the hole in slider a_1 pull an A string of either a violin or mandolin; knot the end so it doesn't slip through. Pull the string over the grove J and through the hole in the key (G). Now turn the key until the string has the required tension; then lock it with set screw (e).

Adjust the sliders so that the string just touches the vibrator when it is screwed to proper tension. Now that



we have the apparatus made and set up, let us proceed and get the high-pitched note.

Connect up the primary of the coil in usual manner, but do not use more than 5 amperes. Adjust the contact I. As you slowly turn it the frequency of the spark increases; suddenly the frequency



Diagram, Second Prize Article

will give a jump, say, from about 100 to 300 cycles. This is caused by the vibrator K coming in contact with the string. By adjusting the sliders a and a_1 the key (G) and the contact (I) you will soon acquire the desired frequency.

A brief explanation of the cause for this action is as follows: When you tighten up an ordinary vibrator it will not vibrate steadily because, owing to the brief time that the magnet is attracting the vibrator, it sometimes sticks and an arc will then form. However, it is quite different if we use the vibrating string. Let us consider that we have adjusted the instrument and are getting a pure, clear, musical spark (which will be the case when adjusted). The A string, which normally vibrates at 440, is tightened to vibrate at 1,000. The vibrator is adjusted to vibrate at 500. Now, when the current is turned on, the vibrator is drawn toward the magnet and hits the string just as the circuit is broken. The vibrator springs back to make contact while the string starts to vibrate at the rate of 1,000 per second. Now, at every other vibration of the string it meets the vibrator (K) and is kept in motion by it and in turn assists (K) in making contact. In short, (K) causes the string to vibrate and the string keeps (K) vibrating at regular intervals, the magnetism being the force giving the impetus to the vibrator K.

By using this apparatus the amateur will find himself able to increase the range of his experiments remarkably, and will be more than repaid for his work by the surprising distance he will be able to transmit, even though restricted by the Government.

CHARLES WILLIAM TAUSSIG,
New York.

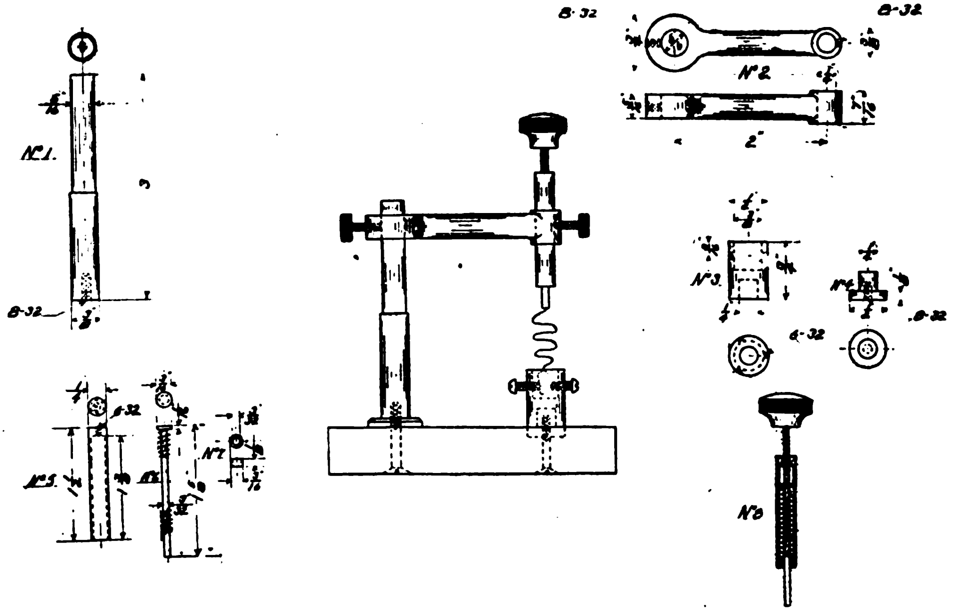
SECOND PRIZE FIVE DOLLARS

An Amateur Transmitting Set for Short-Distance Work

A very good sending set that is not beyond the limit of the average amateur's pocketbook can easily be constructed out of an old battery bell, a telephone condenser and telephone induction coil.

Take a file and file a groove on the base of the coils as near the supporting frame as possible. Then take a pair of pliers and carefully bend the base of the coils back and forth a few times, and they will break loose along the groove made by the file. Now take a wooden or fiber base that is of sufficient size to mount the coils, binding posts and standards: then mount the coils in the center of the base.

Make two standards out of brass, as shown in the accompanying diagram. They should be ½ inch higher than the bell coils. Take a thin steel blade ⅛ inch in width, 4 or 5 inches in length, and solder to standard No. 2, as shown, and fasten to the base. Then solder the other end of the steel blade to the head of an old battery bolt. Standard No. 3



Diagram, Third Prize Article

has a hole large enough for the battery bolt to easily pass through the hole drilled near the top. Now mount this on the base, and place the battery bolt (soldered to the steel blade) through the hole previously drilled. If correctly spaced and mounted, the blade can easily be adjusted by tightening or loosening the tension nut, thus changing the tone of the vibrator.

Now make a standard for supporting the contact screw, and mount as shown at No. 1. The threads for the contact screw may be made by soldering a nut off an old battery bolt onto the standard. An old battery bolt will serve for the contact screw by filing a blunt point on the end and providing a lock-nut. Wire the coil as shown, and by adjusting the vibrator and contact screw you will be able to produce a faithful high-frequency sound. Now wire the induction coil and condenser across the vibrator as shown. Then connect the aerial and ground to the secondary leads. The condenser may be a 1 or 2 M. F. telephone condenser.

If carefully made and adjusted it will give surprising results for short-distance work. The tone is very pleasing, as it gives a singing, musical note.

Delbert Myers, Indiana.

Note.—No doubt this device will transmit over short distance, but we wonder what the wave length would be with the apparatus described. Resonance between the antennæ and the buzzer circuit (with condenser) is only probable; but the arrangement is productive of highly damped forced oscillations, which may carry a few hundred feet or even half a mile.—*Contest Editor.*

THIRD PRIZE THREE DOLLARS

A Neat-Appearing Detector Capable of Very Fine Adjustments

This is a description of a neat-appearing detector which is capable of very fine adjustments.

The parts of the detector can be made at any machine shop at a very small expense, or at home. The accompanying drawings, Nos. 1 and 2, are simple enough not to require explanation. No. 3 is the mineral cup; there is a ¼-inch hole at the bottom of the cup which fits onto a stud (No. 4) so that the cup can be turned, enabling one to find the sensitive spots on the mineral. Nos. 5, 6 and 7 when assembled will look like No. 8.

Directions for assembling these parts are as follows: Place No. 6 with an open coiled spring wound over it into No. 5 so that the shoulder on No. 6 is nearest to the taped hole in No. 5. Now take the brass washer No. 7 and slip it over No. 6 so that it comes flush with No. 5; take a chisel and chip the edges on No. 5 very lightly so that the washer cannot come out. Secure a six thirty-two screw and screw it in as shown. It will push No. 6 out of No. 5; then turn the screw the other way, and the open, coiled springs will push No. 6 back.

The knob and the 6/32 and 8/32 screws can be bought of any wireless dealer. The base is made of marble.

If all parts are carefully made according to the drawing a first-class detector for minerals requiring light contact can be obtained.

RALPH HOAGLAND, Massachusetts.

FOURTH PRIZE SUBSCRIPTION TO THE WIRELESS AGE

A Novel Type of Tuner

The tuner shown in the accompanying drawings is, I believe, of entirely new design. While experimenting with various types of loading coils I found that I had a tuner which brought in signals considerably louder than the ordinary "loose-coupler."

This instrument is especially adaptable to very long wave lengths. Although it is not very selective, it is just the thing for tuning in the far-distant, faint station. This tuner has two windings—a primary and secondary—both wound with the same size wire; the secondary has ten per cent. more turns than the primary.

The cores for these coils are of the shape and dimensions shown in Fig. 1. The diameter of the winding, marked X in the figure, is shown in the table at the end of this article. The cores can be constructed of hard rubber, black fibre or wood. The groove, ¼ inch deep, should be turned out in a lathe. However, if the use of a lathe can not be secured, a piece of wood can be sawed into circular shape by a jig or coping saw, and two heavy pieces of cardboard glued on each. Make sure these are glued on securely, for otherwise trouble will be encountered.

Two cores of the same size are required. The wire of both is wound in the grooves in the *same direction.* Taps are taken off at every seventh turn in both primary and secondary. I have found this number to give sufficiently fine tuning. If possible, these taps should be spliced and soldered, avoiding "loops" to the switches. Shellac each layer as soon as wound, and then cover with a strip of oiled or paraffined paper. This makes it much easier to wind the several layers.

After the windings have been finished the cores should be held together by a *brass* machine screw placed about an inch from the windings (Fig. 1B). This allows the coils to be moved back and forth, thus varying the coupling between them. The closest coupling is found when the two windings completely overlap each other.

The instrument may be mounted in a case and the switches placed on the outside. If this is done a rod should project from the case so that the upper core can be moved. If desired, no case need be used. The switches may then be mounted directly on the cores. In connecting the switches care should be taken that the taps are connected in consecutive order to the points of the switches. Connections to the set are the same as those used with the ordinary loose-coupler.

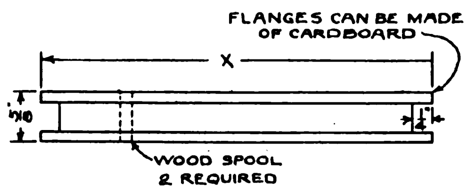
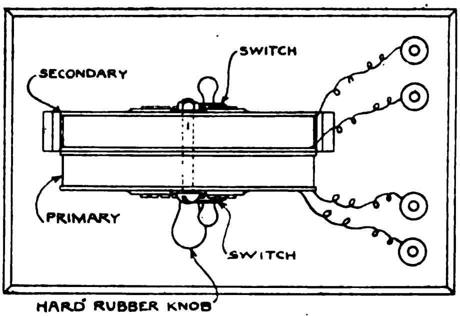


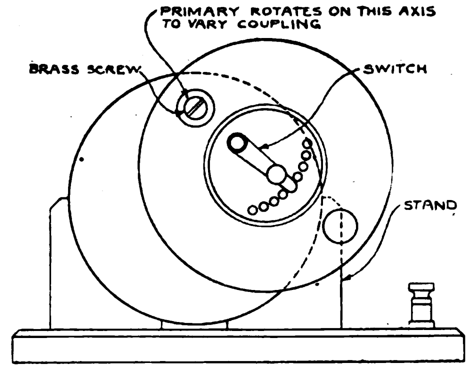
Fig. 1.—Fourth Prize Article

The compactness of the tuner makes it suitable for portable or cabinet sets, but the greatest advantage is in the efficiency obtained. I made a tuner of this type for a young man who now uses it altogether for tuning in stations using long wave lengths in preference to an excellent loose-coupler which he owns.

I have experimented with these tuners on several different antennæ in order to find the most efficient windings. As my own antenna has a natural wave length of 760 meters, which is greater than



1A



1B

Figs. 1-A and 1-B.—Fourth Prize Article

that of the average amateur station, I have prepared the following tables showing the dimensions for tuning in certain wave lengths for 200-meter aerials. These results were obtained by a series of experiments on an aerial of this size. The tuner, whose dimensions are shown under A, is suitable for portable sets and for use with large antennæ when short waves are to be received.

	Size (B. & S.) & kind wire	No. Pri. turns.	No. Sec. turns.	X (see Fig. 1)
2,500 meter wave-length (Time-NAA)	28 DCC	80	88	5½"
4,000 meter (NAA regular)	30 DCC	120	132	5¼'
Short waves Boats and Amateur	24 DCC	50	55	4'
FOR USE ON LARGE ANTENNAE.				
2,500 meter	26 DCC	80	88	4'
4,000 meter	28 DCC	120	132	4'
Short waves	22 DCC	60	66	3'
TYPE A	20 DCC	60	66	3'

Paul H. Geiger, Michigan.

HONORABLE MENTION

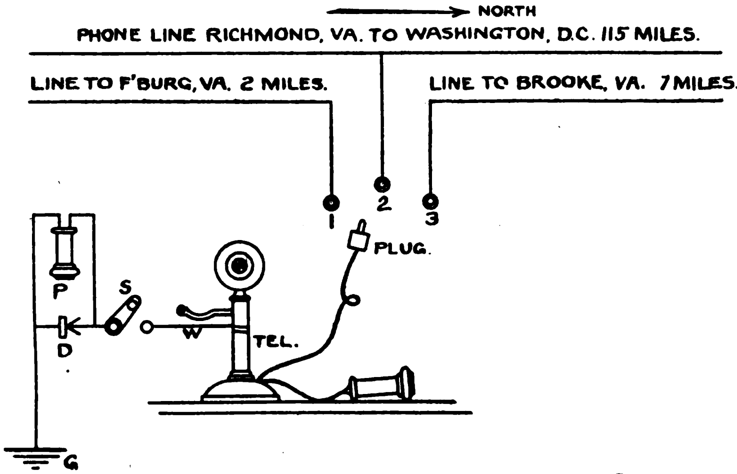
A Diagram of Connections Used to Get Base Ball Scores

This describes and shows a diagram of connections for a wireless receiving set that I worked out, principally to get base ball scores from Arlington to my home, a distance of about 50 miles. This connection in no way interferes with the telephone except when much pressure is applied to the detector a very slight hissing sound that would not be noticed unless it was known that the detector was connected to it, can be heard. This arrangement gives remarkable results.

In the accompanying diagram G represents the ground wire, D a silicon detector, P a telephone receiver, W a wire that connects the detector to telephone instrument, and S a switch that makes or breaks connection of the wire and telephone. The telephone's receiver should be left off the hook for best results.

1, 2 and 3 are telephone lines, as described. The telephone which I used is so arranged that one instrument is employed to work all three lines by placing the plug in either one of the holes 1, 2 or 3 as desired. When the plug is inserted in hole 2 I get Arlington best when they are working on 3,500 meters. When inserted in hole 3 I get them best when they are working on 2,500 meters, and also when working on 1,000 meters with small set I hear their signals best in hole 2. I receive these signals about as well in the day time as I do at night.

When Arlington is working on the small set on 1,000 meters their signals are not so strong, but very easily read; but when they are using the large set on 2,500 and 3,500 meters the signals are surprisingly strong. I can easily copy them direct on a typewriter, and the signals can be clearly heard 10 or more feet away from the receiver. I can sometimes hear boats on the Potomac River, especially the U. S. S. Mayflower (NJV), which I have heard very clear on several occasions.



Diagram, Honorable Mention Article. A. L. Groves

What is most surprising of all is that since early in November, by placing the plug in hole 1, I can copy press from Sayville (WSL) practically every night. The signals are very weak, but somehow they are very distinct and easy to copy. The distance to Sayville is over 225 miles. I have on numerous occasions when Arlington and Sayville were working at the same time (Arlington's signals being very weak when plug is in hole 1) made a different adjustment on the detector, and, while this would in no way interfere with the signals from WSL (Sayville), it would cut out the signals from NAA (Arlington) entirely.

What causes this, or, in fact, how the signals get here at all, is a mystery to me. If anyone can explain the phenomenon, I shall be glad to hear from them.

I have tried many other experiments with this set, one of which is unscrewing the hard rubber mouth piece from the telephone and placing the wireless receiver against the transmitter of the telephone and letting all the operators between Richmond and Washington hear the time signals at 10 P. M. By placing the telephone's receiver to my ear I can also hear the time signals, too. The operators along the line and the train dispatcher in Richmond say the signals are quite loud, and some say the signals can be heard two or three feet away when everything is quiet.

A. L. Groves, Virginia.

Note.—Exposed telephone and telegraph lines very often act quite efficiently as aerials. There is no reason why this should not be the case, for the effect of the oscillations on the telephone wire is to cause nodes and loops of potential at various points along the line. If the detector happens to be connected to a point on the line where the potential (due to the incoming oscillations) is high, the crystal should respond even without an earth connection, although better results are obtained by establishing connection with the earth.—*Contest Editor.*

A RECEIVING HOOK-UP

Which Will Respond to a Wide Range of Wave Lengths

For really satisfactory and efficient service, a receiving set should be able to respond to a wide range of wave lengths, should have a quick and effective control of the different circuits, and should consist of as few parts as possible. Such a set is shown in Fig. 1. It consists of a loose-coupler, two variable condensers, one fixed condenser, a detector, a pair of phones and two DP, DT controlling switches.

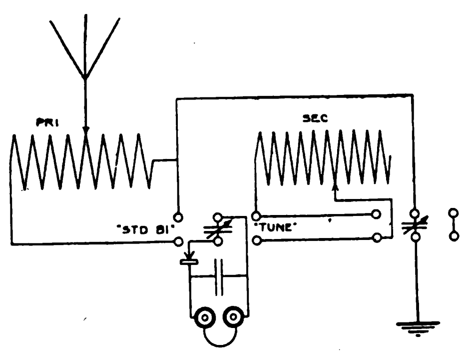


Fig. 1.—A Receiving Hook-Up

One variable condenser and the detector circuit are connected to the blades of one switch, and the remaining variable condenser and the earth wire are connected to the blades of the other switch, as shown in the diagram.

Throwing the detector circuit switch to the left gives the "stand-by" circuit shown in Fig. 2. Any station that is working can then be picked up by moving one slider.

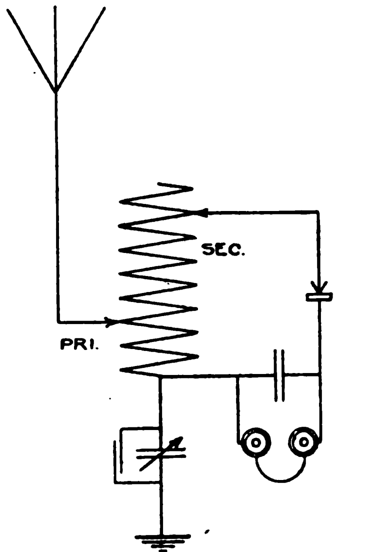


Fig. 2.—A Receiving Hook-Up

The detector circuit is connected directly to the ends of the primary winding unless this puts too much inductance in the detector circuit for it to respond to the shorter wave lengths, in which event a two or three-point switch should be used for varying the inductance in the detector circuit, as shown in the

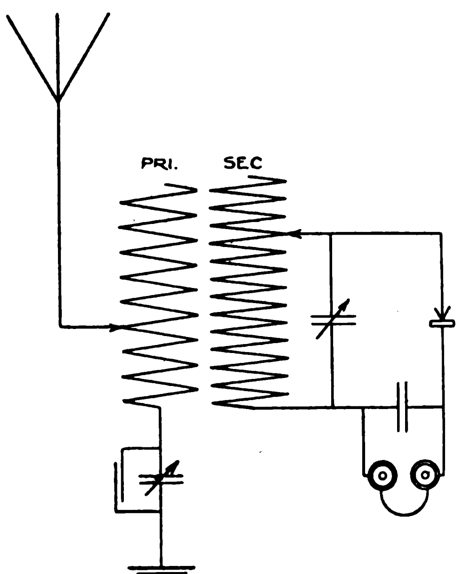


Fig. 3.—A Receiving Hook-Up

diagram. Throwing the detector circuit switch up disconnects the detector circuit while transmitting, and throwing it to the left gives the "tune" circuit for working through interference. This circuit is shown in Fig. 3.

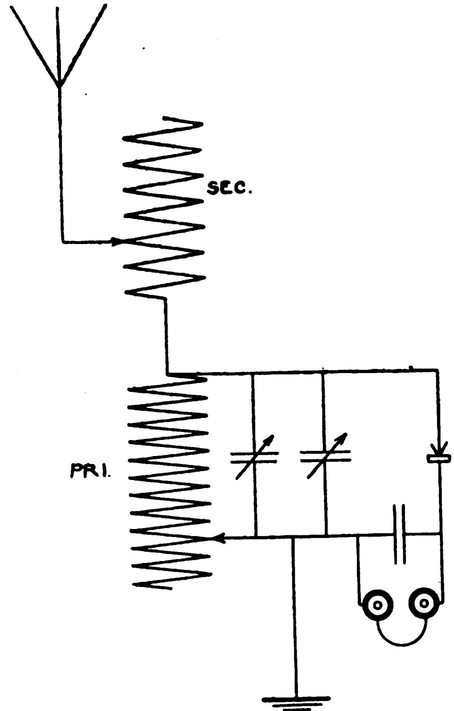


Fig. 4.—A Receiving Hook-Up

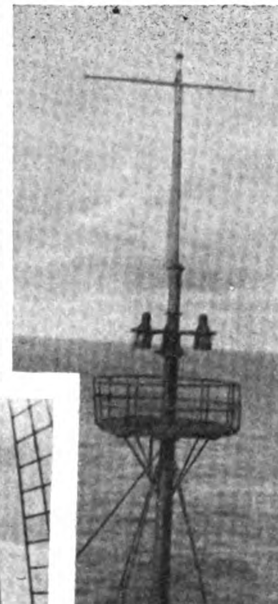
Throwing the earth circuit switch to the left gives the "long-wave" circuit, as shown in Fig. 4 The primary winding is now used as a loading inductance and both variable condensers are in parallel. Throwing the earth-circuit switch up leaves the variable condenser in series with the earth wire, and throwing it to the right short circuits the variable condenser.

The two variable condensers are not absolutely necessary for good results, but if the loose-coupler has switches for varying the inductance the use of at least one variable condenser is urged.

This hook-up is being used with a loose-coupler which has a moderate amount of inductance in each winding and is giving most excellent results. Any station, from amateur stations to those employing longer wave lengths, such as Arlngton, Va., can be readily picked up.

Charles D. Heinlen, Ohio.

The Sea Sentinel at Lurcher Shoals



OF the many craft recently fitted with wireless by the Canadian Marconi Company, Lurcher Lightship No. 14, owned by the Dominion Government, is an object of interest, if only because of the fact that it is the first vessel of its description in Canada to be provided with a radio equipment.

The Lurcher Lightship is anchored in sixty fathoms of water, two miles from the shoals of the same name, a place of great danger to navigation, and located about sixteen miles off the southwest coast of Nova Scotia. The main shoal, which is known as the Southwest Breaker, is bar shaped, three-quarters of a mile long and 100 feet wide; the depth of water on the shoal at low tide is only one and one-half fathoms. The shoal is composed of rock and stone, and, although there is a gap in the middle, it fails to break the force of the rough seas.

Heavy gales and strong tides generally prevail about the lightship, and the members of its crew frequently relate to visitors a story illustrating the might of the ocean and the peril of their calling. The yarn is to the effect that on a stormy night the Lurcher broke away from her moorings and drifted over the shoal. Every moment those aboard expected her to crash on the rocks. Good luck was with the vessel and her crew that night, however, for she passed over the gap and found safety in the open waters.

The lightship not only serves to warn mariners of the proximity of the shoals, but is also a guide to seafaring men navigating the Bay of Fundy, marking the turning point in the paths of vessels bound to ports north of the reef.

Built of steel, the ship is fitted with electric lights throughout, and can be navigated under her own steam. She has two masts, each carrying a gallery sixty feet above the water line; to these galleries are attached the ship's lanterns, equipped with 100-candle-power lamps.

The lanterns show a light for eight seconds, with intervals of four seconds, visible for a distance of thirteen miles. During foggy weather a diaphone, operated by compressed air, is used, which emits three four-second blasts at intervals of three seconds. The vessel also possesses a submarine bell which strikes the ship's number, "14," every twenty-three seconds, and can be heard for about ten miles.

The wireless station that has been installed on the craft adds considerably to its efficiency as a safeguard for mariners. The station is of the Marconi standard ½ K. W. type, with an emergency set. The installation gives a range of 255 kilometres, with wave lengths of 300, 450 and 600 metres.

MR. MARCONI LECTURES TO A DISTINGUISHED AUDIENCE

Word has come from Rome, Italy, to the effect that a lecture delivered recently in that city by Guglielmo Marconi in the Circus of Augustus on the progress of wireless telegraphy, his first in Rome since he spoke on the subject at the capitol in 1903, attracted a great and very distinguished audience. The enthusiasm reached its height when King Victor Emmanuel shook hands with Mr. Marconi and congratulated him.

Lantern slides showed the stations at Glace Bay, Clifden and Poldhu, also that at Coltano, near Pisa, which Mr. Marconi succeeded in having built in less than two months so as to have it available during the Italian-Turkish war. The reproduction of the sounds at these stations when wireless messages arrive from 1,000 miles away produced a great effect on the audience, which cried "Viva Marconi!"

Mr. Marconi, in predicting the early success of radio-telephony, said the human voice could be sent across the Atlantic more quickly by this method than the cable could send a message.

In an interview in London a short time ago, Mr. Marconi talked concerning wireless and its use on ships.

"I have been trying to make an approximate return of the percentage of British ships fitted with wireless apparatus," he said. "If you take steamers of 100 tons and upwards on Lloyd's Register you find that less than 7 per cent. have wireless installation. Roughly, there are about 10,000 vessels of more than 100 tons and fewer than 700 of these have wireless.

"Twelve per cent. of Germany's ships have wireless equipment, and about 8 per cent. of those of France.

"Wireless seems to be even more necessary to-day than it was years ago, owing to the increase in the number of ships and in speed. Certainly, accidents appear more frequent than they used to be. Even to-day a ship may fail to report herself, may disappear and not be heard of again. In fact, there is a greater publicity when a ship is saved than when one goes to the bottom."

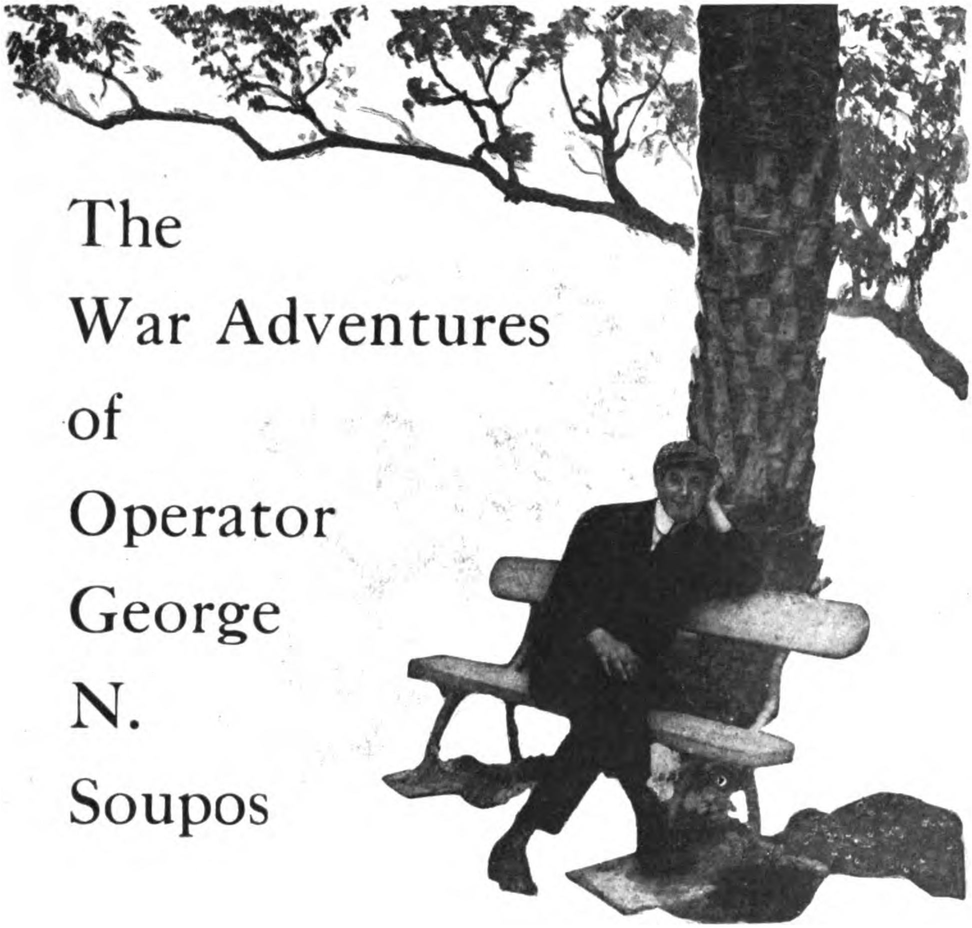
Mr. Marconi said he had never computed how many lives had been saved at sea by wireless, but he thought the number was between 3,000 and 4,000—certainly more than 3,000.

MADRID SCHOOL FOR WIRELESS OPERATORS

In the presence of leading officers of the Telegraph Corps, a school for the training of wireless telegraph operators was recently inaugurated in Berlin. The ceremony was attended by the director-general of Posts and Telegraphs, Mr. Arminan, who also represented the Minister of the Interior. The latter was prevented from attending by indisposition. Speeches were delivered by Lopez Cruz and Mr. Arminan. Afterwards the various classes were visited and demonstrations of wireless telegraphy were witnessed. The school is located at 23 Calle Echegaray, in the old Moctezuma Palace.

Dr. Filipi, with his exploring party for the Western Himalayas, is near Skardo, according to recent reports. He is erecting a wireless installation with which to obtain communication with the wireless station at Lahore.

The War Adventures of Operator George N. Soupos



THERE are jobs and jobs nowadays for American youths. A fellow may elect to drive a grocer's wagon or an aeroplane. Again, instead of jumping over the back fence in the old-fashioned way of running off to sea, he may, after certain set preliminaries, become a pounder of the brass, ride the high seas, talk the world around, and thus meet adventures more wonderful to the stay-at-homes than this world's wonder of wireless.

Such was the case of George N. Soupos. One year he was eighteen years old and merely an aspiring wireless amateur with his little station in a New York City back yard. The next year he was returning home with ten years' war experience crowded into a few brief months of fighting in the Ægean Sea for the liberty of Greece. He had tucked away in his valise a comfortable supply of gold coin and a tattered uniform jacket with two diagonal stripes struck across the right sleeve to show that the wearer was a lieutenant in the Greek Navy.

Once he had been in irons, awaiting execution. He had taken part in the countless minor brushes and one big naval engagement. He had transmitted important war messages. He had refused Turkish bribes to reveal the import of these messages. He had, by wireless skill, saved his own vessel. He had helped to save women and children from assault and death at the hands of Turkish bandits.

Here is Soupos' account of what he saw and did in the war-ridden Ægean:

It was through my love for wireless that I got the opportunity to show its value in war.

"Hey, Soupos! The chief wants you!" a fellow called to me one day as I was sitting at a bench in the operator's room of the Marconi Company, at 29 Cliff Street, New York, wondering when I was to be given a ship. "He's going to give you a chance, I guess." I got up and went over to the desk of Chief Operator Edwards.

"You speak Greek, don't you?" asked the Chief.

"Yes, sir," I answered.

"Got your license yet?"

"Yes, sir; I passed at the Brooklyn Navy Yard last week, just after I finished at the Marconi school."

"Well, how'd you like to take a Greek ship to the Mediterranean?"

"Fine!" I told him, and it was the truth. I was so anxious to get a ship would have gone on a trip to the North Pole.

"All right; we'll try you out," replied Mr. Edwards. "The Themistocles is her name. She's over at Pier 30, Brooklyn. Here's a note to her captain. She sails day after to-morrow; so you'd better go home right now, pack up and get aboard. Overhaul your set first thing."

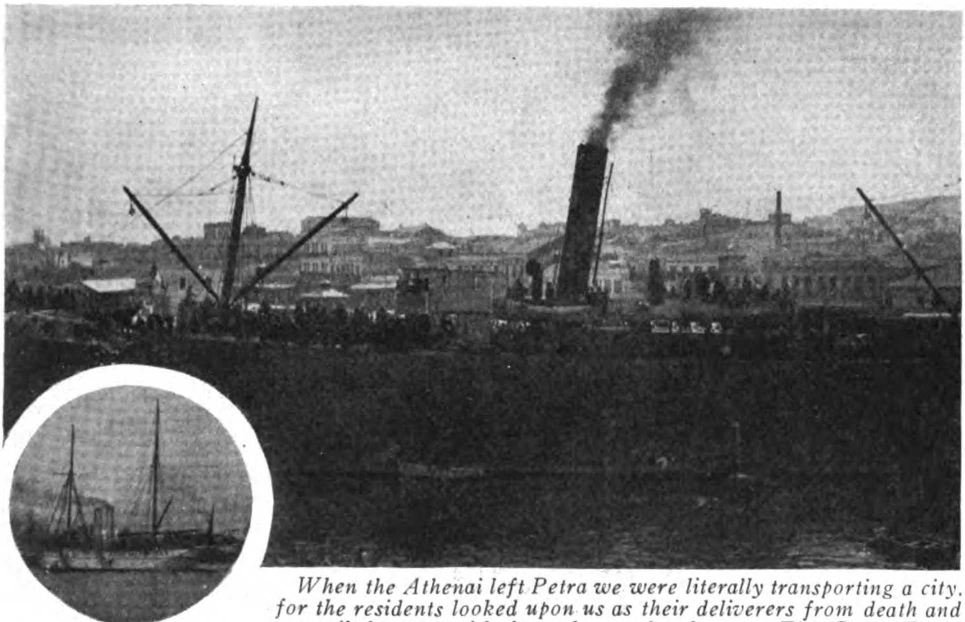
And that was how I got my first ship. For two years I had operated an amateur station at home, and had often listened as the ship operators talked with one another and to the land stations. Sometimes I had caught messages as far south as Key West. During the Titanic disaster I sat up for three days and nights "listening in." Now I was going to be a real operator myself. But I did not dream how far and how deep into wireless my first ship would take me.

George N. Soupos, an aspiring wireless amateur, forsook his little station in a New York back yard to become a commercial operator. The first ship he was assigned to carried him to the Balkan war. When he returned a few months later he had seen many stirring adventures, narrowly escaped death by execution, and had won the rank of lieutenant in the Greek Navy.

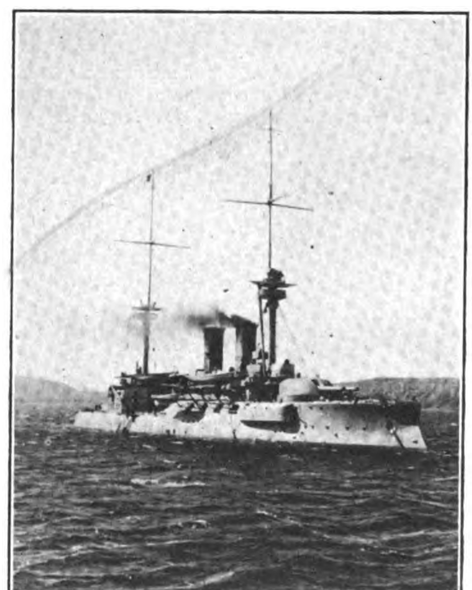
When the Themistocles, laden with arms, provisions and two thousand Americanized Greeks got to sea the talk was of nothing but war. The men, who were going home to volunteer for the war, talked about the trouble even when they were sea sick. Some of them had made sacrifices of considerable consequence in order to aid the Greek cause.

One fellow, Piperopoulopoulos by name, a fruit dealer, had taken $4,000 from his savings to give to the Greek government when we should arrive at Piræus, the seaport of Athens.

I had no wireless practice while the Themistocles was in the Atlantic, although I picked up not a little of the English Channel ship slang, which was difficult for me to make out. The passengers on the vessel, however, worried me constantly with requests to obtain war news for them. The first information of this description that I received was from a friendly operator on the Island of Malta, in the Mediterranean, who said a Lieutenant Votsis had blown up the Turkish battleship Fatihpoulent with a torpedo. I thought the passengers would go wild with joy when I told them this news. They hugged and kissed me, Greek fashion; the captain



When the Athenai left Petra we were literally transporting a city, for the residents looked upon us as their deliverers from death and we sailed away with four thousand refugees.. The Greek Royal yacht aboard which I enjoyed a rest of a week or more is seen in ***the small circle.***



A Turkish battleship bottled up in the passage of the Dardanelles; when one of these vessels broke through the blockade unknown to Soupos an order for his execution was issued.

blew the giant fog whistle, and that night a celebration dinner was given aboard the vessel.

At Piræus the volunteers left us. Then several Greek naval officers came aboard the Themistocles and told Captain Nicholas Goulandris that arrangements had been made with her owners to take the vessel as a transport for the Greek naval service.

The captain and his officers were asked to remain with the ship, and they agreed to do so. One of the naval officers asked me if I would like to remain. He said the navy needed wireless men very badly, and that my services would be appreciated. I consulted the captain, who told me that I would be returned to my home if I cared to go.

"I don't like to advise you," he said; "as we will run great risk of being captured or sunk. I myself should like to have you with me, but then, war is not a boy's game."

Well, I took a whole day to think the matter over. It wasn't that I was afraid, but I had promised my mother that I'd be careful, and going to war isn't exactly being careful. Still, I didn't like that remark of the captain—"War is not a boy's game." While I was turning the question over in my mind the vessel was moved into dry-dock to be overhauled and to have steel

The twenty-five thousand Turkish soldiers holding Saloniki were hardened and seasoned fighting men, with equipment of the highest standard. But for their Arabian turbans they might easily have passed for Anglo-Egyptian or German colonial soldiers.

plates bent about the bridge. It was also planned to mount four-inch guns on her decks.

The naval officer who had asked me to join the Greek forces came aboard again late in the afternoon.

"Well, what are you going to do?" he asked.

As he spoke there came to me the thought of how proud my mother would feel if I actually engaged in warfare and reached home safely.

The officer was beginning to look impatient.

"Why, I'm going along, of course," I said hastily.

"Very well," he said. "But be careful. A great deal may depend on some of the messages you send; even the fate of an army. We are surrounded by traitors and Turkish spies, and if you are suspected you will be shot."

This was earning glory at a great risk indeed. But, having made my decision, I stood by it. In fact, I was already burning to get into a fight; to be under fire.

Events followed thick and fast from there on. Three thousand troops were hustled on board for us to transport to Eleftherohore, a port to the west of Saloniki. A general movement of Greek forces was planned against Saloniki, which had been coveted by the Greeks for a long time. The city was held by twenty-five thousand Turkish soldiers, and a supposedly impregnable fort—Karampounou—at the entrance to the Bay of Saloniki.

The first day out from Piræus I found that my work would permit me little leisure. I was kept on the alert, with the head phones glued to my ears, practically every minute of the day. My duties consisted not only of intercepting stray messages from the Turkish warships and determining how far away the enemy's craft were; part of my time was spent in transmitting messages from Saloniki and relaying from other points to the central station at Athens. These messages were sent by inexperienced operators in a secret code with which I was none too familiar. The messages were dispatched at the average rate of about six words a minute, and it was necessary for me to have them repeated two or three times, in order to insure accuracy. What with sending without cessation, the fumes in my cabin became so thick that my eyes began to pain me. I had no mate to help me, and was awakened at all times of night to "listen in" or to take and send messages.

The night that the Themistocles neared her destination I was very near exhaustion. The ship was creeping along, with the captain trying to find the harbor, when, half dozing, I caught in my head phones the peculiar spark used by the Turks. It seemed very close. Believing it might indicate the proximity of a warship, I ran out to report my discovery to the captain.

"Great Cæsar's ghost! Know where it's coming from?" he said. "We're on the wrong shore side. We're near that fort, and they'll blow us out of the water!"

He ordered all the ship's lights extinguished at once. Then he put the vessel about and worked off shore. After we had proceeded about a mile, the searchlights from the fort began to play over that part of the Gulf of Saloniki which we were steaming away from. They made all of us apprehensive, because we knew that the fort's battery of twelve-inch armored guns might be trained on us at any moment; then, too, we readily recognized that by pressing an electric button in the stronghold one of the many mines with which the harbor and outer bay waters were filled could be set off.

The captain was in doubt as to the proper course to take, in order to reach Eleftherohore, and I got into communication with the Greek battleship Averoff, which was anchored off that port. She gave us the exact course to follow. Needless to say, perhaps, we increased the distance between the Themistocles

The ease with which the Greek forces captured Saloniki impressed me as one of the most remarkable features of the war; the fighting lasted hardly a day. In this picture is seen part of a division commanded by Constantine, Crown Prince of Greece, as the bugler sounds the call to charge.

and the fort just as rapidly as steam could propel us. All on board the vessel were greatly relieved when the flashing lights of the stronghold looked like fireflies in the distance.

I was considerably gratified the next day when the captain of the Themistocles sent a wireless message to the Navy Department at Athens saying that his vessel might have been destroyed or captured but for my aid. A reply came back by wireless to the commander of the Averoff. It said that I had been made a lieutenant.

For the next month we were kept busy bringing in more troops and carrying away the sick and wounded. Battle after battle was fought on land, and I constantly handled messages to and from Athens and the army heads on shore. On various occasions when we were off Saloniki I picked up weak, short-distance messages sent out by apparatus operated under the direction of the Turks. The messages, which asked to speak with the Themistocles, were in continental code. I answered one call, and the operator asked if I wanted to earn some money. I questioned him concerning his inquiry, and, after sending several communications intended to deceive the operators on the French and German ships, he said if I would promise to relay my important messages in continental code, immediately after sending in the Greek code, a man would meet me in a day or two and hand me a handsome sum of money.

"I'm English, and you're American," he said; "and let's get what we can. It isn't our business if these fellows want to cut each other's throats."

I answered NIL, shut off, and told the captain about the conversation. I did this to protect myself. For I knew I should be shot if I were caught playing double.

"String him along," ordered the captain. "Some other fellow may fall for his money, and we ought to find it out."

I called him up, and told him I would think over what he had said. After that I kept track of stray messages and "listened in" frequently. I noticed that a Belgian operator on one of the Greek ships gossiped whenever he found an opportunity to do so.

When the Greeks were ready to march on Saloniki I detected the Belgian sending in continental the news of our plans. I was sure he was in communication with the operator working for the

A view of the landing dock at Saloniki, long coveted by the Greeks and finally taken through the capture of its supposedly impregnable fort, Karampounou, at the entrance to the bay.

Turks, because I knew that a Turkish buzzer and spark were being used. I reported my discovery to the captain of the Themistocles, and, after a brief inquiry, the Belgian was put on a train and started for home.

The ease with which the Greek forces captured Fort Karampounou and Saloniki impressed me as one of the remarkable features of the war. The fighting hardly lasted a day, and at the end of that time the Turks ran up white flags and sent wireless messages saying that they would surrender.

I am unable to explain how we won our victory. During the bombardment I was on the cruiser Sfacteria, and I am sure that the fort could not have been taken by the Greeks. It may have been that the Turkish commanders were unable to induce their soldiers to fight; then, too, it is possible that the enemy lacked food supplies.

Greek patriarch (priest) and Servians on board the cruiser Athenai, the captain of which interceded successfully when Soupos' execution was demanded.

When we took possession of the fort all of the Greek ships anchored in the bay off Saloniki. I was transferred to Queen Olga's yacht, the Amphitrite, and enjoyed a rest of a week or more. The Queen was interested in wireless, and asked me one day if there was anything I would like to have.

"If you please, I'd like to have some mashed potatoes with plenty of cream," I said.

She laughed. Then she inquired why I wanted them.

"It's the dish I like best at home. Mother always makes a lot for me," I explained, "and I haven't had any for weeks."

The Queen then summoned a steward and told him to see that the cook gave me all the creamed potatoes I wanted. Thereafter, on the Amphitrite, it was frequently necessary to cook a considerable quantity of potatoes *a la Soupos* —so called by me.

This incident seems trivial enough, but it well illustrates the craving one has while in distant lands for the things he is accustomed to at home. Particularly among the prisoners and the wounded men I met ashore did I find this intense longing for small aids to temporary happiness. Some wanted tobacco, and some liquor. Plain water represented happiness for many.

One day I saw an army of men march in from the hills and mountains where they had been compelled to live for months with only a limited supply of water at hand. They swarmed aboard the ships at the docks and went on their knees to beg for fresh water. The members of one company found a boat loaded with four barrels of fresh water alongside the dock, and they drank every drop of it.

When I resumed active duty it was on the Athenai, commissioned to succor harassed cities on the coast of Asia and to patrol and blockade work. I had a new captain, but I was recommended to him by my old one. The new captain took a fancy to me, and called me "Mascot," instead of plain George. It was fortunate for me that I had impressed him favorably, as later events proved.

We had been out of port only two days when the monotony of life aboard ship gave way to exciting incidents. I was "listening in" early in the morning,

Soupos, in civilian habiliments, is the central figure in this group of officers. This picture was taken shortly after his release from confinement on the ground that, being an officer, he could not be shot without court martial.

having turned out of my bunk at daybreak. Suddenly I caught a Turkish spark EX, which in the code of our foes meant the enemy. The spark was strong, and I concluded that the set which emitted it was not far away.

Awakening the captain, I told him of my discovery, and, with the aid of his glasses, he began searching the horizon. A cloud of smoke in the distance caused him uneasiness. He ordered the engineer to make ready for a fast run. In the meantime I sent out by wireless a call for aid, which I hoped would be picked up by the Greek cruiser Psara, dispatched to capture the fast Turkish warship Homidieh. The latter had broken through the blockade at the Dardanelles, where the Greek vessels had bottled up the Turkish craft.

We were almost certain after an hour had passed, that we were being chased, but we were at a loss to determine which way to turn in order to escape. After a long period of anxiety, the Psara, which was about forty miles east of the Athenai, answered my call. Our captain immediately decided to seek the protection of the Greek cruiser, and the engineer was ordered to send the vessel full speed ahead.

With the propellers of the Athenai revolving so rapidly that the vessel fairly quivered, we started toward the Psara. The Turkish vessel was not far behind us, and gaining rapidly. For a time the outcome of the race was in doubt. Then, just as the Homidieh began to train her guns on us and drop a few shots in our wake, we came in sight of the Psara.

Our safety was then assured, for the Homidieh put about and steamed away as the Psara came within hailing distance of us.

The first words uttered by the captain of the Psara foretold trouble for me. He asked the captain of the Athenai why he had given the Homidieh a chance to capture us. The commander of the Athenai replied that he had no information to show that the Turkish vessel was so close to him. The matter did not end with this explanation, however, for that night both vessels put into Kerkera, and the captain of the Psara summoned me before him. With two marines as an escort, I was taken to the commander.

"What do you mean by not reporting to your captain the presence of the Homidieh?" he demanded.

"I had no message that she was in these waters," I answered.

"You lie!" he said, curtly. "I'm going to execute you!"

Then, at his order, the marines placed handcuffs on my wrists and locked me up in the brig.

After a while I managed to get word to the wireless operator aboard the Psara. In response to my request he came to the brig, and I asked him to tell the captain of the Athenai of my predicament. The wireless man returned in half an hour to report that the captain of the Psara and the commander of the Athenai were quarreling concerning the disposition of my case.

He went away leaving me to the companionship of thoughts far from consoling. I spent the rest of the night in speculating as to my fate. I had been so much behind the scenes of the war, figuratively speaking, that the idea of death in the abstract did not fill me with terror. But I did not want to die—in disgrace. Having volunteered to aid the Greek cause, and served my country faithfully, the prospect of being shot as a traitor was harrowing. That night will remain always in my memory. I never once closed my eyes. The next morning at eight o'clock my guards ordered me to accompany them to the captain of the Psara. I came before him with a calmness of bearing that belied my anxiety. He scarcely looked up at me.

"Your captain has interceded for you, so I am going to let you go," he said, and walked away.

Whew!

When I was again aboard the Athenai, the captain told me he had explained to the commander of the Psara that, as an officer, I could not be shot without court-martial. He added that if I was executed without a trial he would ask for an investigation. He was very angry, and did not hesitate to accuse the other captain of being afraid to fight the Homidieh.

After this, we cruised for a time in the waters from Corfu to San Guiani to protect steamers carrying soldiers; then we returned to Piræus for coal and supplies, and made a call at Prevasa. Here the operator of the cruiser Mykalli, whose skill was on a par with most of the men I met, asked me to repair his apparatus. He said it had not been working for a week. I discovered that the set needed only a new detector, and a few pieces of galena crystal borrowed from an operator on a French man-of-war fixed him up. The crystal made such a good detector that I used it myself, and was frequently able to pick up night calls as far as Poldhu station.

Knowing how much our safety depended on the wireless apparatus, I made it a rule to overhaul my 2-kilowatt set at frequent intervals. As a matter of fact, there was little news in those waters that I did not pick up, either from Athens, our ships, or the wireless men on the United States warships. It did me lots of good, too, to talk with the operators on home ships, for in this way I found out the names of the ships trying to break the blockade and get arms and supplies to the Turks. We captured two ships of the Hadgi Daout line trying to slip through by flying the American flag. The Regina, a fast Austrian ship in the contraband business, showed fight when she found she could not run away, but a

Greek soldiers in camp outside Jannina

couple of shells fired over her bridge made her surrender.

To our captain I repeated news, picked up by wireless, of the horrible massacres of Greeks at Petra, on the island of Mitylene. Following this information, he asked for and received orders to carry the entire population of the little city to the island of Tenedos, located outside the Dardanelles. When we reached Petra the women had pitiful stories to tell. The majority of the men had left their homes to fight for the Greek cause, and bandits from the mountains had been preying on the city. It was customary for these outlaws to cut large crosses on the breasts of the women with their knives. Some of the soldiers and sailors were so incensed over the outrages that a party, of which I was a member, was organized to wipe out the bandits. We found a number of the outlaws, and took considerable satisfaction in putting bullets into them.

When we left the place the ship was simply packed with people.

The residents of Retra looked upon us as their deliverers from death or worse, and when the Athenai sailed away with about four thousand refugees she left behind her what was practically a deserted city. I gave up my cabin every night to a family of three, a mother and two beautiful daughters.

Soon after we put the refugees ashore at Tenedos we took part in the naval engagement off Lemnos. Here the Turkish craft were securely bottled up. They were compelled, because of their position, to come out of the geographical pocket one by one. The Greek fleet battled with one Turkish warship at a time, which, of course, resulted in overwhelming victories for our forces.

After eight months of battle-smoke and innumerable narrow escapes, I began to long for more peaceful pursuits. I found myself dwelling frequently on thoughts of home and its comforts. One night I had a wireless conversation concerning America and Americans with the operator aboard the U. S. S. Virginia. It brought such a flood of memories that I was seized with an acute attack of homesickness.

It did not pass, and soon afterward I asked for and received my discharge as a member of the Greek forces. Two days before I reached New York I sent my mother a wireless message, telling her that I was on my way to the United States. It was supper time when I entered my home and was greeted by mother. She was proud, very proud, of her son. She had thought a lot about me, too. For what do you think she had cooked for me?

A bowl of potatoes mashed in cream!

(*The End*)

An Amateur's Wavemeter

By H. P. Nielson, M. D.

THE cost of constructing a wavemeter of sufficient capacity, efficiency and simplicity has in the past, so it seems, deferred the wireless experimenter from adding this important and essential instrument to his equipment. A description of an instrument of this type, as constructed by the writer, follows. It has met all requirements and will doubtless satisfy the needs of the average amateur. All of the parts and materials may be purchased from dealers in wireless telegraph supplies at prices within the reach of most experimenters.

A wavemeter consists of a known inductance or capacity, adjustable to a certain value, with indicating components, such as a telephone and detector, or a vacuum tube whereby resonance may be obtained between this known circuit and an unknown circuit. The set I have constructed is not complicated. The amateur duplicating my design will attain the same degree of satisfaction as from the more expensive sets at a cost within the limits of his financial resources.

The Condenser

The condenser as used by the writer and shown in the sketch published herewith is made up of thirty-one plates of aluminum, fifteen movable and sixteen stationary; the former are 2½ inches in diameter and the latter 3 inches in diameter. These may be purchased as a set, finished in every detail and ready for assembly (except that the edges should be carefully dressed with emery cloth or an emery stone, and care should be taken to see that the plates are not bent in smoothing the edges) at a cost of seventy cents. The rods, separating washers, nuts, bolts, rubber handle, pointer and bearings may be purchased for $1.75. If desired, a metal case rubber top and scales may be purchased for $1.75, or the complete condenser, ready for assembly, for $3.75. The top and case may be dispensed with and a glass case used that will cost about fifty cents.

The capacity of the condenser using air as dielectric is .0008 mf. If castor oil is used the capacity will be .004 mf. Capacity of the order of .0008 microfarad will meet all requirements and additional advantage is secured when air is used as the dielectric. From an engineers' and plumbing supply house a No. 6 oil glass, outside diameter 3½ by 4 inches in height, can be purchased. The glass is more suitable than any other enclosing material and considerably improves the appearance of the set. It should be cut off 1½ inches from the end. At the same time obtain two cork washers to fit the glass. These two items will cost about fifty cents. A scale in brass or nickel used by draftsmen may be purchased at a cost of from fifteen to twenty cents. When the parts for the condensers have been assembled, two pieces of hard rubber should be secured, one for the top having dimensions 5½ by 5½ by ¼ inches; the second for the base, 5½ inches wide, 8 inches long and ⅜ of an inch thick. Lay out the position of the condenser and have two grooves for the cork washers burned in a lath. The depth of the groove need not be more than 1/32 of an inch.

By reference to Fig. 1 it will be observed that four hard rubber posts as uprights between the cover and base are required. These may be cut from a single hard rubber rod ½ inch outside diameter and 12 inches in length. The rod should have a ¼-inch hole. Each upright should be 2 5/16 inches in length. Four 14-20 brass bolts, 3 inches in length, will also be required. These will allow the top to be pulled down tightly and with the assistance of the cork washers will make an air or oiltight joint. The top and base should be drilled as per the sketch and then assembled. The detector may be made as shown in the sketch or some other "time tried" favorite giving equal satisfaction may be employed, the principal requirement being that whatever the type used it will perform its function without the assistance of a local battery. It will be of further advantage if the detector stand is of such construction that a number of crystals may be brought into use quickly if needed. It should also have provision for altering the pressure upon the crystals by an insulated knob or handle. The detector stand should be constructed of copper where metal is used. When completed the detector stand need not be nickelplated. Nickel will not materially improve its appearance and it will increase the resistance of the parts to the flow of high frequency currents which travel on the skin or outside of the conductors over which they are required to pass. It will improve a set in no small degree to have all parts finished in a polished or buffed surface and oxidation will be prevented if a coat of good brass lacquer is given. A neatly polished and lacquered instrument in brass is better both in appearance and in use than the best nickel instruments ever made.

At any electrical supply house obtain fifty-five feet of fine pigtail made up of 24 No. 36 B & S copper wires. This is rolled flat to 3/64 of an inch. Cut off such lengths as needed for connecting up the instruments, twist a strip of friction tape around the braid and when soldered in give the tape-covered connectors a coat of orange shellac. The pigtail is to be used for the windings of the inductance coils of the wavemeter.

Inductance Coils

Purchase a paper pulp tube that is 7 inches outside diameter by 3/16 inches wall and cut off a piece 1½ inches in length. On the outside of this tube, or rather ring, wind thirty turns of the same pigtail braid, as mentioned, placing between each turn of wire a strip of thin Empire cloth ½ inch in width. When wound give the flaps of Empire cloth a coat of orange shellac and seal them down flat. This forms a good insulating medium between the turns of the braid, as the braid is, so far as the writer knows, made only in the bare metal. Next make a form 6 7/16 inches in diameter and wind upon it fifteen turns of the same braid in the same manner as the thirty turns on the outside of the 7-inch

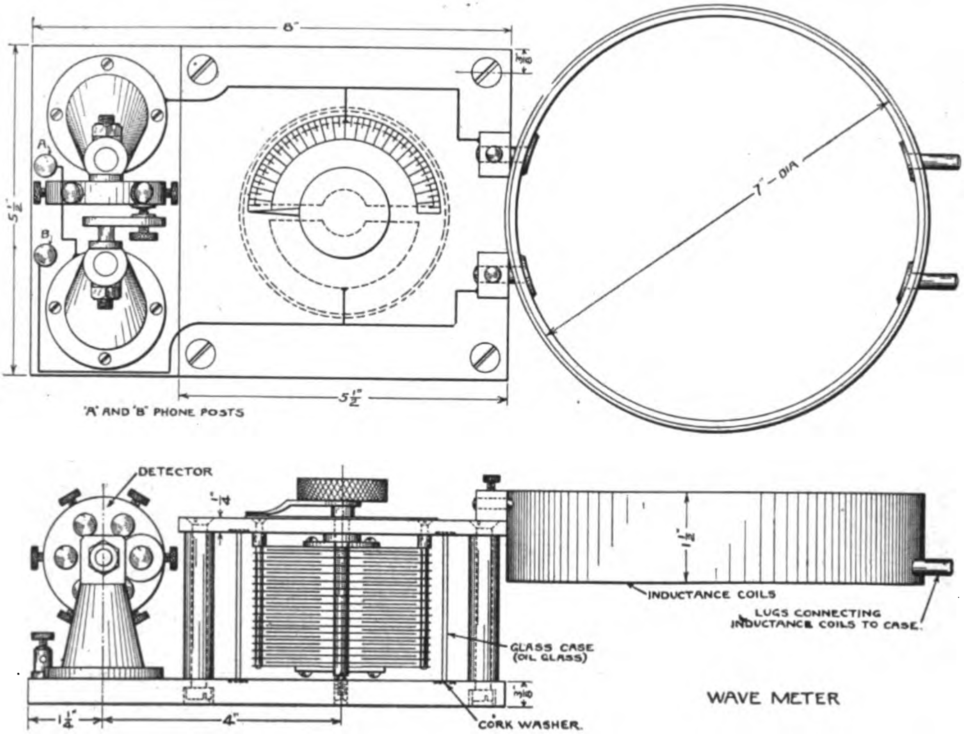


Fig. 1

ring, but do not shellac. Remove the fifteen turns from the form and place the same on the inside of the 7-inch ring, then shellac and solder the ends of both the thirty and the fifteen turn coils to lugs, as shown in the sketch. The coils should then be covered with friction tape, and to give a neat finish the coils may be covered with a piece of paper tape made up in the form of pebbled leather, which may be obtained from a book bindery. When so covered and thoroughly dried out, the pair of coils will look neat and will be so light in weight that they may be suspended from the lugs on the top of the condenser case without additional support. The fifteen-turn coil is for low wave lengths up to approximately 300 meters and the larger coil gives range above 300 meters.

Phones

Any good head set or a single phone may be used, but best results will be obtained if they are of 2,000 ohms resistance per set of two. The writer favors a set of 3,000 ohms. The amateur may use the headphones employed with his regular receiving set.

Calibration

The set is now ready for calibration. This is best accomplished by comparison with a standard wavemeter, but the writer recommends that the entire set be carefully packed and forwarded to the Bureau of Standards, Washington, D. C., where the work will be quickly and accurately done at a very nominal cost. It is well to have a curve sheet made up with a ten-point determination for each inductance coil, in which the wave length is found for ten places on the condenser scale and laid out (as shown in Fig. 2) in a curve for each coil. The scale may have the figures marked directly upon the same if desired, the figures to be in different colors for the two coils. To obtain the wave length for any particular capacity reading note that the figures at the left of the sheet are as per the scale on the condenser and those at the base of the sheet correspond to wave lengths in meters.

To illustrate a 200-meter wave reading: Suppose the reading of the condenser is, say, 48 degrees (if a degree scale is used). To the right run a dotted line until it intersects the curve line; from

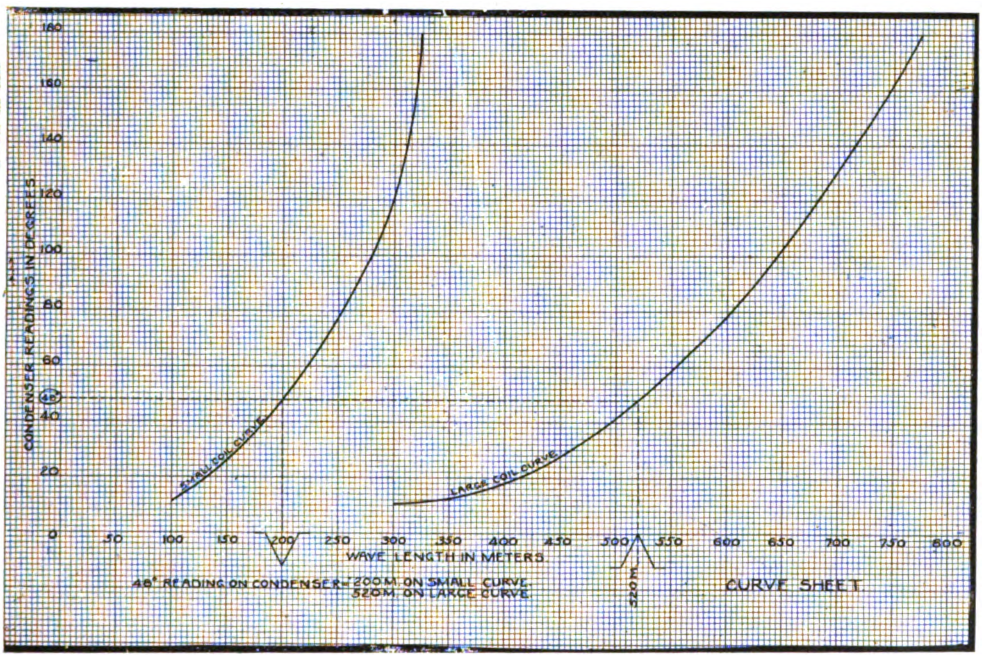


Fig. 2

this point drop a line to the base at right angles to the first line; this should correspond to the 200-meter point, as per the dotted line in the sketch.

The Wavemeter in Use

To tune a transmitting set, place the wavemeter a few feet away from the primary of your oscillation transformer. (Do not get too close or results will not be satisfactory, it being better to be far enough away to just clearly hear the signals.) First, the closed circuit is measured, i. e., with the secondary, aerial and ground cut out. Make a note of the reading. Then a reading of the secondary circuit is taken with the primary of the oscillation transformer and the condenser cut out. Make a note of this reading. By varying the turns in the oscillation transformer the circuit can be tuned to any desired wave length. When the two circuits have been tuned to resonance it will be noted that it requires a certain ratio of turns between the primary and the secondary for a definite wave length—say three turns of primary to nine of the secondary. Mark these points on the oscillation transformer and it is then only necessary to place clips at these points to connect up for the desired wave length.

To determine the wave length of a station from which signals are being received, place the coils on the wave meter near the receiving inductance or loose-coupler primary, so that both are parallel, in a manner forming another loosely-coupled detector circuit. Tune the receiving set to resonance and then tune the meter to resonance with the receiving set, using it in the same manner as with the transmitting set. In this way one may take the wave length of all stations within range.

VANDERBILT YACHT PASSENGERS RESCUED

Wireless telegraphy was employed to bring rescuers to the yacht Warrior, owned by Frederick W. Vanderbilt, which ran aground near Savanilla, on the coast of Colombia, on the morning of January 26 last. Aboard the yacht, besides Mr. Vanderbilt, were Mrs. Vanderbilt, the Duke and Duchess of Manchester and Lord Arthur George Keith-Falconer, son and heir of the Earl of Kintore. The Warrior is equipped with Marconi apparatus.

Eight lifeboats were lost, one after the other, in the first rescue attempt. The small craft were crushed like egg shells or overturned in the churning seas.

These boats were from the United Fruit Company's steamship, the Frutera. Captain Henschaen, of the Frutera, spurred his men to heroic efforts, but all were futile. While the men worked, the party aboard the Warrior looked on anxiously.

As they looked over the rail the Warrior's wireless operator told them the Frutera was making distress signals. She had begun to call for the Almirante, which responded quickly and finally effected the rescue.

Soon after the Warrior struck, the Frutera picked up her wireless appeals for aid and steamed toward the scene of the wreck. Although the waves were running high, Captain Henschaen lowered boats. One of them was capsized and the others were crushed.

The Almirante, which was at Santa Marta, about forty miles distant, then was called and succeeded in taking off all the Warrior's passengers, although the undertaking was attended with great peril.

WIRELESS ON FISHING VESSELS

An agreement has been signed between the Marconi Company and the principal owner of a large fishing fleet at Lowestoft, England, in which it is provided, among other things, that the company shall install wireless apparatus on board the principal vessel of the fleet, to be worked by an efficient operator. By means of this wireless installation the vessel in question will keep in touch with the other vessels of the same fleet during the whole of each fishing expedition off the East Coast. In the course of time all the fishing fleets off the coast of Great Britain will no doubt be provided with wireless, and this, obviously, must eventually lead to its general introduction among those of foreign nations.

This, it is believed, will mean a revolution, all over the European fishing grounds.

Comment and Criticism

IN regard to experiments with undamped oscillations, amateurs on the Atlantic Coast are less fortunate than their fellow-workers dwelling in the shadows of the Sierra Madres, for, on account of the activities of the Federal Telegraph Company in that vicinity, a rare opportunity is afforded for obtaining data with continuous waves.

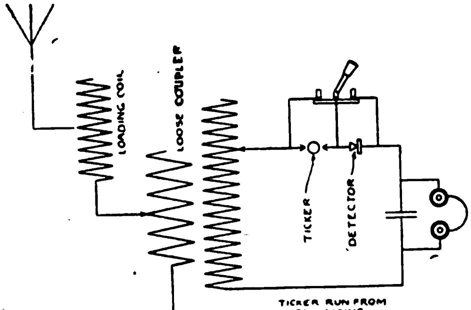
Readers of this class have, without doubt, noted the communication appearing in the Queries and Answers Department of the January number of THE WIRELESS AGE from H. V. R., of Los Angeles, Cal., in which he states that he is able to read undamped oscillations on the ordinary rectifying detector. The details given in that communication were insufficient to allow accurate diagnosis of the matter, but in reply the supposition was put forth of the possibility of a "heterodyne" effect on his aerial, due to the radiation of two Poulsen transmitters located in his vicinity.

It was further mentioned in the reply that the Poulsen transmitter may exhibit damped characteristics, making the signals audible. We have received more complete and detailed information from H. V. R., and are now satisfied that the latter explanation is correct.

The communication in question included a circuit diagram of the apparatus (published herewith) in use, and was accompanied by an interesting report of phenomena noted. It will clear up the matter somewhat if the operation of the Poulsen tikker, as used in connection with undamped oscillations, is understood.

Our correspondent's circuit diagram indicates no variable condenser in shunt to the inductance coil of the closed circuit of the receiving tuner, but at the wave length at which his set operates there is no doubt that the effective distributed capacity of the coil is of itself of sufficient value to act as a storage for the energy. During the intervals that the tikker is open, energy accumulates in the inductance coil which, upon the closing of the circuit by the tikker, is discharged into the condenser connected in shunt to the head telephones. It is very probable that the condenser and the head telephone (connected in shunt to each other) constitute another circuit of relatively high damping, and therefore a practically aperiodic discharge takes place through the receivers. It will then be readily understood that the note produced in the head telephones will be due to the number of interruptions produced by the tikker per second.

To explain the reception of undamped waves with the ordinary detector: It is a well-known fact that in the local circuit of an arc-transmitting set the frequency of a circuit is not always that due to the square root of the inductance times of capacity, but is to some extent affected by irregularities at the arc gap itself. Slight inequalities of frequency are thus produced, resulting in corresponding slight changes of the emitted wave length. This, in effect, will cause a slight variation of the amplitude of the rectified oscillations passing through the head telephones. The variation seems to occur just often enough to cause pulses in the head telephones within the limits of audition.



An excerpt from H. V. R.'s communication follows:

The receiving circuit used for these tests is similar to the standard loose-coupler receiving circuit employing a crystal detector (as shown in Fig. 1). In the detector circuit the "tikker" (the interrupter which opens and closes the circuit at a rapid rate) is placed in series with the detector. A double-throw single-pole switch is wired up so that either the tikker or detector may be shorted at will. In all tests the tikker was operated from the 50-cycle lighting circuit, and at this frequency the tikker points open the circuit 100 times per second. The results obtained were noted on long wave lengths, as all Poulsen stations send on wave lengths over 2,000 meters.

He continues:

With the tikker shorted the signals from the Poulsen stations in Los Angeles (about 4 miles away) could be read within a radius of 20 miles. The tone in the receiver was very low, somewhat resembling the tone of air under slight pressure in a valve. With this hook-up no other stations could be heard. Of course, the signals from sending stations using a spark could be read, as this circuit is the regular loose-coupler receiver hook-up as used when receiving signals from spark stations.

The fact, as he explains, that the signals from the Los Angeles stations were inaudible on the crystal hook-up beyond a distance of twenty miles verifies our explanation that the phenomenon is due to slight changes of wave length. Theoretically, undamped waves should have no decrement, but when produced by the arc the statement is not strictly true.

To give a clearer idea it should be stated that, when rectifying crystal is connected to a receiving tuner which is being energized by undamped waves, the telephone windings are traversed by a practically continuous current, and hence no sound is produced except at the "start" and the "stop" of current flow. If, however, there are slight changes of wave length in the transmitter producing these waves, it will have the effect of causing the continuous current already flowing through the telephones to fluctuate (due to increase and decrease of resonance), and hence audible sounds are produced on the receiver diaphragm.

Certain results were then noted with the detector short-circuited using the tikker alone. H. V. R. states:

With the detector short-circuited, using a tikker alone, the signals from the Los Angeles Poulsen stations were very loud, and all Poulsen stations within the radius of 1,000 miles could be read. The tone in the receivers was rather low, as in the preceding hook-up. Spark stations using 500 cycles could be read in spite of the fact that there was no detector in the circuit. Signals from 500-cycle spark stations were about as loud on the tikker as on the detector, but the tone was not so pleasant, as it was very low. When using the tikker the signals from the 500-cycle spark stations were not so easily read as the signals from the Poulsen stations, for the reason that the signals from the spark stations were somewhat broken up. When nearby low-frequency spark stations were sending, their signals could not be read, as nothing but clicks were heard in the receivers.

This phenomenon is interesting, but has been known of for some time. It should be first observed that our correspondent's tikker operates at a very slow rate of interruption, and, taking into account the fact that the note produced depends upon the number of breaks made by the tikker per second, it will readily be seen that naught but a low note could be expected under the conditions. (When receiving undamped oscillations.)

It is also plainly evident that at this rate of interruption the tikker does not discharge the condenser at equal points during the cycle; hence a variation of energy is supplied to the head telephones, causing an irregular note. There is no reason why spark stations giving damped oscillations should not be read upon the tikker, as the effect of the tikker is simply to periodically charge the condenser in shunt to the head telephones.

Furthermore, it is immaterial whether the telephone condenser is charged by damped or undamped oscillations, with the exception that when damped oscillations are being received a mixed note is produced, partly due to the interruptions of the tikker and partly to the spark frequency of the transmitting station. It will then be understood that if the rate of interruption of the tikker is of the same order as the spark frequency of a distant transmitting station, practically no signals need be expected, the effect produced being, as our correspondent says, nothing more than a succession of clicks; for at certain periods the condenser of the receiving tuner will be connected to the head telephone circuit at times when there is no energy to be supplied.

A higher note and better signals *should be* expected from the 500-cycle stations, for, on account of the increase in group frequency, the duration of contact of the tikker is sufficient to allow the telephone condenser to be charged from 3 to 5 times by the condenser of the receiving tuner.

Results were then noted with a detector and tikker, both in the circuit connected in series. With this arrangement H. V. R. says:

The signals from the Poulsen station at Los Angeles could be read and the note in the receivers was of high pitch. Using this arrangement the signals from the Los Angeles Poulsen station could only be read within a radius of 20 miles, and no other Poulsen station could be heard. The signals from 500-cycle spark stations could be read, and are about as loud as though the tikker was not in the circuit. There is only one Poulsen station in Los Angeles, and there is none other of like character within a radius of 100 miles. The phenomenon noted was constantly observed.

We are inclined to believe that this arrangement *will* respond to undamped oscillations and that the effect of the crystal simply amounts to the introduction of a resistance in series with a circuit to the telephone condenser, and therefore causes a reduction in the amount of energy that might accumulate. It also prevents surgings from the condenser (in this case an imaginary condenser connected across the closed circuit in the tuner), allowing only one-half of the oscillation to pass to the telephone condenser. Therefore, the total energy would be less than if the circuit were operated without the detector.

We have ample evidence that our correspondent is intent on going into the matter thoroughly, for he asks a series of questions in a second communication, which deserves notice. He says:

In receiving undamped waves by means of a tikker, is it not a fact that the diaphragm of the telephone receiver is actuated only by the energy of the first iscillation in each group?

This is not the case, for the sound in the head telephones is, without doubt, produced by the energy stored in the condenser in shunt with the head telephone. The amount of energy accumulating depends in a certain degree upon the duration of the contact when the circuit is made by the tikker. The assumption is therefore wrong.

He then asks:

If only the energy contained in the first oscillation of a group actuated the receiver diaphragm, then why is it necessary to use a detector when receiving damped wave trains which are already divided into groups?

Our correspondent should understand that, even though the oscillations from a spark transmitter arrive at his aerial in disconnected groups, yet the frequency of the oscillations composing each group is of such high order that the diaphragm of the telephone receivers could not possibly respond. Therefore, as far as the telephone is concerned, it is immaterial whether the energy arrives in continuous or discontinuous form. The first part of this query has been previously answered. He further inquires:

When receiving damped oscillations by means of a detector, does the pitch of the sound produced in its receiver correspond to the group frequency or half the group frequency of the sending station?

The pitch of the sound produced corresponds to the group frequency: For example, suppose the transmitter to be a 120-cycle truly synchronous spark set giving 240 sparks per second; then 240 disconnected groups of oscillations will be produced in the receiving tuner at the distance receiving station. While only half of the energy of the oscillations in each group will be productive of sound, there will be 240 groups of decaying direct-current pulses passing through the head telephones, each group causing a vibration of the diaphragm.

Still, H. V. R. is not wholly satisfied, and is at loss to explain another phenomenon. He inquires:

Please explain why it is possible to tune in a station emitting a pure sharp wave with different values of primary inductance, secondary inductance and coupling at the receiving station?

An exhaustive reply would require too much space, but we may enumerate a few facts:

This effect has often been observed, and in many cases is largely due to the nearness of the transmitting station, for, owing to the strength of the oscillations being radiated, forced oscillations will be produced, even though the wave length of the receiving aerial and its associated tuner are quite different from that of the transmitter. This, however, is not the condition of circuits for the best signals, as it is invariably found that the maximum strength of signals is obtained when the receiving circuits are in resonance with the distant transmitting station.

Again, the phenomenon may be accounted for in the following manner:

Let us suppose that the transmitting station is some distance off, and that its signals can be read at a receiving station with a fairly loose degree of coupling. Suppose, then, that the signals can again be heard with a complete change of primary and secondary inductance and coupling. It may be that the coupling has been "tightened" to such an extent that the tuner is responsive to two wave lengths, one of which may be in complete resonance with the transmitting station, yet the adjustments of the receiving tuner are wholly unlike that used with the "looser" coupling.

The "broadness" of adjustment may further be due to a poorly designed receiving tuner, the circuits of which have considerable resistance, and are therefore highly damped. If so, for a given wave length (provided the transmitting station is not too far off) the signals may be heard with a variety of adjustments.

Very close coupling between the primary and secondary of the receiving tuner is productive of increased damping, due to the rapid rate at which energy is extracted from the circuits. This, also, has the effect of "broadening out" the adjustments of the circuit.

Proper design of the receiving tuner, particularly for use with long wave lengths, is a factor often overlooked, but when taken into account the increase in efficiency is very marked.

* * *

Apparently there are amateurs in New York City and points nearby who hold ideas at variance with the winner of the second prize in the prize contest series in the January issue of THE WIRELESS AGE. In that communication, it will be remembered, the statement was made that a single long aerial wire was preferable for amateur long-distance work to an equivalent length of wire divided into four parallel lengths.

Of course, the article in question was quite general and did not give any specific data, for a complete verification of the case would require information as to the wave lengths employed both at the sending and receiving stations and surrounding conditions.

We believe, however, that some of the points were well taken, but that is not the opinion of the writers of the following communication:

In the January issue of THE WIRELESS AGE there appeared a letter by Carl Dreher on the use of single-wire aerials for receiving. We believe that Mr. Dreher has an erroneous opinion concerning aerials. In the first place he states that with a four-wire aerial, 100 feet long, the amateur will hear only local stations, which is radically wrong.

The writers have in use a 4-strand, 75-foot aerial of aluminum wire which has seen five years' service. With this aerial weather reports can be head every night from N. A. R. (Key West), and several times in a week it has been possible to hear N. A. W. (Guantanamo, Cuba). We do not dispute the fact that a long single wire will not give better results at times, as we are also using an aerial 500 feet long.

Where the amateur is located in the center of a great many other stations using high power, a long aerial produces forced oscillations, making it impossible to copy distant stations through the interference; whereas, with the smaller aerial it is possible to tune out unwanted stations.

If Mr. Dreher would do a little more experimenting with a long and short aerial he would, no doubt, change his opinion.

We have also experimented with a hundred-foot aerial, 6 strands, T connected, 7-22 copper, natural period, 186 meters, which was designed for transmitting. With this aerial, stations have been heard north as far as Buffalo, south to Key West, and most commercial stations intervening. These results have been achieved with the use of galena detector, receiving transformer and variable condenser. We have found with the use of the small aerial we can tune up to 3,000 meters without excessive loss by the use of variables. We do not advise the use of loading coils when using a properly designed receiving transformer that can be balanced by the condensers. Considering the trouble the city amateur has to contend with in getting permission to erect long aerials, it is not worth the effort.

If the average amateur will use a little patience, content himself with the smaller aerial and adjust his instruments, he will hear long-distance stations; but in most instances his time is occupied in trying to get local stations loud enough to burn out the receivers.

F. L. M.
W. W.
New York.

There is a possibility that Mr. Dreher has been misunderstood, for we are of the opinion that if the available amount of aerial wire is limited the longer single wire antenna is apt to give better results while receiving the longer wave lengths, such as employed at the naval station at Key West, Fla.

It is true, however, as our critics state, that the longer aerial wire in the vicinity of high-power transmitting stations is more productive of forced oscillations than if it were shorter; but they should also understand that when using the short aerial, better tuning at all wave lengths is not entirely due to the fact that the antenna is actually shorter, but may be better accounted for by the fact that with the short aerial a considerable amount of inductance is required to be added in the receiving circuit to arrive at a certain wave length. This additional inductance (if its resistance is not too high) has the effect of "stiffening" the circuit; i. e., it decreases the decrement, and hence the sharper tuning.

To repeat, when employing the short aerial for receiving, it is necessary to add a considerable amount of inductance to arrive at a definite wave length, and therefore such a circuit will tune more sharply than if the same wave lengths were obtained by the use of a longer aerial and less inductance.

We are handling the case generally, and our statements must be taken with limitations, for we assume in the argument that the wave length of the receiving aerial is considerably less than that of the sending aerial.

There is a statement made by our critics upon which we would like more detailed information, viz.: the reference to the desirability of using condensers for tuning in preference to loading coils. Before commenting, we should like to know just where and how these condensers were connected. An ill-designed loading coil is without doubt productive of energy losses, but just how they propose to eliminate the tuning inductance by the substitution of a condenser is somewhat of a mystery.

The Talo Wireless Club has discussed the matter, and on behalf of the members its president has sent the following communication:

Referring to Mr. Dreher's article in the January issue about giving the average amateur 400 feet of wire, and how it should be strung to get the best results, I, as the president of the Talo Wireless Club, have been requested by the members who have read the paper, to give some of the results discussed at one of the meetings as to the proper size of aerial for receiving. Let me state before going further that when oscillations are set up in a receiving aerial, another wave is sent out by that aerial. This being the case, the more efficient the construction of the aerial for sending the poorer it is for receiving, and *vice versa.*

The argument tends to point to a long aerial for the best work, which works out fine for long distance if there is no local interference. When it comes to tuning out interference with a large aerial the results are far from being perfect.

Mr. Dreher speaks of hearing W S L (Sayville) 5 feet from the telephones. Good work, but he should be able to hear it 10 to 15 feet off with a 400-foot aerial.

The members were surprised that he did not get W S L (Sayville) further away that 5 feet, as with their own aerials ranging from mine, which is 40 feet long, to others which are 100 feet long, we get W S L as well as Mr. Dreher, and even better. Getting back to the working properties of an aerial, ask any commercial operator who has plenty of real work to do whether he likes signals to "pound in" and have interference through forced oscillations, or have a station come in loud enough to read well and not be bothered trying to tune out forced oscillations. He will invariably prefer the latter condition in locations having interference such as is encountered in New York City. This whole article boiles down to the fact that for practical use and to get the best operating results from an aerial, that aerial need not be over 100 feet long, composed of 4 or 6 wires.

Personally, I have found that my 40-foot aerial will do fine work, having picked up N A R very often, and, incidentally, few surpass my records as to distance. Of course, with a small aerial the apparatus has to be first-class, and much depends upon the operator. For those who wish to experiment, let them put up large and small antennæ and try them out. If the outfit is sensitive and correctly designed, ninety-nine out of a hundred amateurs will permanently use small aerials, at least in this location where interference is constantly received from wave lengths other than those to which they have their outfit tuned.

Some of the readers of this paper may like to have other "bugs" come to their houses and astonish them with the way things "pound in"; all well and good, but the minute you try and copy W C C (Cape Cod) there is intereference from W S L (Sayville) and a few navy yards, so that from the viewpoint of getting the best

working results the small aerial for receiving beats every time.

It is interesting to note that the ideas held by the members of this club are in accord in many respects with the arguments of our two critics.

Undoubtedly, when energy is received by an antenna a portion of the energy is re-radiated into space. We therefore do not see how, as our critic states, that "the argument tends to point toward a long aerial to get the best work." We believe that if it is desired to prevent the receiving aerial from re-radiating its energy it would be an advantage to erect an aerial of a loop type; i. e., a closed-circuit oscillator. Then the energy picked by the antenna would be conserved, because it is a well-known fact that the closed circuit oscillator is a poor radiator of energy.

It should not be forgotten that the matter of location is an important one, and it is known that certain antennæ located in New York City, while properly erected and of large size, are hopelessly inefficient because of adverse local conditions.

For the general elimination of interference we agree with all parties concerned that the shorter aerial is productive of sharper tuning, although we must also keep in mind the fact that for long-distance work it is of value to have natural wave length of the receiving antenna somewhere near the wave length of the transmitting station.

HONORS FOR CAPTAIN INCH

Captain Francis Inch, commander of the steamship Volturno, which was burned in mid Atlantic on October 11. 1913, with a loss of many lives, was the recipient on February 4 of the freedom of the city of London, England, in a silver casket, and also of a gold medal, a gold watch and chain, a purse of gold and Lloyds' silver medal. The Lord Mayor and Mr. Marconi delivered eulogistic speeches, in reply to which Captain Inch modestly disclaimed having done anything but his duty.

JACK BINNS TO WED

Jack R. Binns, the wireless operator of the steamship Republic, who remained at the key and brought the aid that saved the lives of the passengers of that vessel when it was sinking off Nantucket, January 23, 1909, is to be married in June to Miss Alice A. McNiff, of Beverly Road and East Eighteenth street, Brooklyn. Mr. Binns and Miss McNiff met at the home of Mr. and Mrs. T. S. Tenney, in River Edge, N. J. At that time Binns was wireless operator on the steamship Adriatic.

Heretofore the sea had held a great fascination for him. Then, too, he was intensely interested in wireless telegraphy, and, like the majority of radio operators, his work was a part of his life.

All this was changed following his meeting with Miss McNiff. The voyages become somewhat irksome, and he looked forward constantly to reaching New York. That was why he left the wireless telegraph service and became a reporter on the New York American. He became a member of the staff of that newspaper the day before the Titanic wreck.

Miss McNiff is a daughter of the late Lothian McNiff. She and Mr. Binns will take a honeymoon trip to the Mediterranean.

FIRST SOS CALL FROM THE ARCTIC

The first wireless call for help ever received from the Arctic Circle is told about in an English publication:

"Bergen is working 'S O S' Wait and listen," was the message which, it is stated, went the round of Europe's wireless stations at 1 o'clock Tuesday morning, December 23 last. All did as requested, and the fact was then established that the Norwegian steamship Sagnivald Jarl had gone ashore on the Lofoden Islands, 600 miles north of Bergen, Norway. This is double the working distance of the ship, and to enable Bergen to communicate, all stations were asked to close down so that the faint signals might be read.

Loosely Coupled Definitions

THE INTERRUPTER

WORKING HIS TRICK

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

B. S., Newark, N. J., writes:

Ques. (1) I am constructing a receiving cabinet and have available space to the amount of 3½ by 6 by 18 inches in which to place a loading inductance capable of tuning to 6,000 meters. My Blitzen tuner and aerial respond to 1,000 meters. Will you please tell me the size of the tube, size and kind of wire and the number of taps necessary for this inductance? Is a loading coil of this size practical? If not, what is the maximum pactical size?

Ans. (1) Apparently you intend receiving wave lengths of 6,000 meters on a receiving tuner whose present maximum range of adjustment is but 1,000 meters. While it is possible to add sufficient turns in the antennæ circuit to reach a wave length adjustment of 6,000 meters, unless a corresponding change is made in the detector circuit no signals will be received. You apparently have made no provision for "boosting" the wave length of the local circuit. Keep in mind the desirability of resonance between the two circuits. For a 6,000-meter loading coil wind a drum 5½ inches in diameter, 18 inches in length, with No. 20 bell wire, bringing taps out at intervals. You will find that this coil will possess considerable high frequency resistance.

* * *

A. N., Cambridge, Mass.:

Loud speaking telephones may be obtained from the Western Electric Company, New York City.

* * *

L. L. C., Sumas, Wash., writes:

Ques. (1) Is there any way by which I can determine the secondary voltage of my transformer, which is home-made, and the voltage is therefore not rated. If so, please state same?

Ans. (1) You may measure the potential of your transformer with a fair degree of accuracy by mounting a pair of brass spark balls ½ inch in diameter, so that the distance between them may be accurately gauged and measured. They are then connected to the secondary terminals of the transformer and widened out to the maximum possible distance for discharge. The voltage will then correspond to the following scale:

Gap in inches.	Break down voltage.	Gap in inches.	Break down voltage.
1/16	5,000	9/16	22,300
1/8	9,000	5/8	23,500
3/16	12,000	11/16	24,500
1/4	14,000	3/4	25,700
5/16	16,000	13/16	27,000
3/8	18,000	7/8	28,000
7/16	19,500	15/16	29,000
1/2	21,000	1.0	30,000

Ques. (3) Please name a number of firms that handle books on electricity and wireless telegraphy and also mention several good, thorough books on these subjects.

Ans. (2) In the article appearing under the heading, How to Conduct a Radio Club, in the December issue of The Wireless Age, several books are tabulated which may be of value. Books may be purchased from D. Van Nostrand Company, 25 Park Place, New York, or the book department of the Wireless Age.

Ques. (3) Please give me a good hook up for the following instruments: Loose coupler, variable condenser, Ferron detector and pair of receivers.

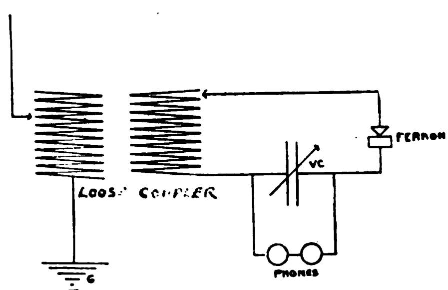


Fig. 1

Ans. (3) Proper connections for these instruments are indicated in Fig. 1.

* * *

A. R. M., Minot, N. Dak.:

Ques. (1) Which of the following is the best aerial wire, and why: 7-strand No. 20, phosphor bronze; 7-strand No. 22, copper; 7-strand No. 18, silicon bronze?

Ans. (1) Silicon bronze is supposed to have the greatest tensile strength. The greatest conductivity may be expected with the copper. However, all three, practically speaking, will give equal results.

Ques. (2) Where can I purchase this wire?

Ans. (2) From any amateur supply house.

C. K., St. Louis, says:

I should like to know what I require to receive the time signals from Arlington. At present I am unable to hear them. My set consists of an aerial 78 feet high, 85 feet long, composed of four 7-strand No. 20 P. B. wire; lead in 80 feet long, 50 feet of which is 7-strand No. 18 copper rubber-covered wire. Ground lead, 7-strand No. 18 copper rubber-covered wire to the water mains. My receiving set consists of a Blitzen receiving transformer, Blitzen variable condenser across the secondary windings, Audion detector, one pair of Hotlzer Cabot 3,000-ohm phones and fixed condenser. I am using a loading coil wound in grooves—130 turns; taps are taken off every 14 turns. Is this correct for 2,500 meters, or what would you recommend me to use to receive time signals from Arlington.

Ans. (1) We have taken note of the diagram enclosed with the query and find it is quite correct, with the exception that the fixed condenser is connected in shunt to the headphones and not in series; for if it were connected in series the local battery current could not flow through the telephones. We are not familiar with the wave lengths obtainable in the secondary circuit of the Blitzen tuner. Probably there is not sufficient wire to reach a wave length adjustment of 2,500 meters. If so, the addition of a loading coil in the antennæ circuit will be of little value, as the two circuits are not in resonance. In the January issue of THE WIRELESS AGE, in the article, How to Conduct a Radio Club, data is given for a tuner suitable for receiving signals from Arlington at a wave length of 2,500 meters.

* * *

J. P. E., Jersey City, N. J.:

Your request for a complete description for the construction and operation of a Decremeter requires too much space in this department. You will find an interesting description of the Decremeter and its operation in a book entitled Wave Meters in Wireless Telegrapthy, by Lieutenant Mauborgne, U. S. A.

* * *

H. P., East Orange, N. J.:

Ques. (1) Will you please tell me what the age limits are for admittance to the Marconi School and if a technical knowledge of wireless is needed before going in; also about what length of time it takes and are there any night classes?

Ans. (1) Applicants are not received at the Marconi School at an age of less than 18 years. No technical knowledge is required, but applicants must be able to receive in the Continental code at a speed of from 10 to 15 words per minute. The technical course requires three months of instruction. The length of time necessary to qualify in respect to the Continental code depends entirely upon the student.

Ques. (2) Would a knowledge of German or Spanish help one in getting in?

Ans. (2) Such knowledge is not necessary, but is a desirable asset.

C. A. B., Ocean Grove, N. J., asks:

Ques. (1) What is the difference between a sharp wave and a pure wave?

Ans. (1) According to the United States regulations, a pure wave is of such character that if the energy is radiated in two wave lengths the energy in the lesser wave shall not exceed in value by 10 per cent of that in the greatest. By the same regulations a sharp wave is one where the logarithmic decrement per complete oscillation is less than 0.2.

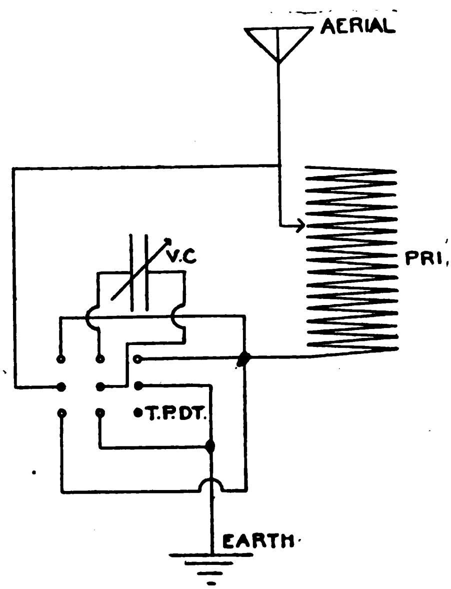


Fig. 2

Ques. (2) When by the wavemeter it is found that two waves are being radiated instead of making the coupling looser, why not vary the inductance, or capacity, or both, until but one wave is radiated?

Ans. (2) By a variation of the inductance or capacity the circuits will be put out of resonance and the radiation seriously crippled. It is possible to leave the primary and secondary of the oscillation transformer alone as regards position, and then, if the condenser capacity of the closed circuit is increased and the inductance of the closed circuit decreased, the mutual inductance will diminish in value on account of the decrease of the self-inductance of the closed circuit. Hence we may expect a decrease in coupling. But if distance is to be expected, resonance betwen the two circuits must be maintained.

* * *

C. I., B. & O. R. R., asks:

Ques. (1) Please give a drawing of a switch to cut the aerial, primary of loose coupler, variable condenser and ground in series, which, when thrown over in opposite position, will connect aerial and primary to ground, with the variable across the primary terminals, thus enabling one to tune for long or short wave lengths.

Ans. (1) The result may be obtained by the use of a triple pole, double through switch, as per the diagram, Fig. 2.

Ques. (2) What capacity of fixed condenser would be necessary to give good results in this case?

Ans. (2) This question cannot be answered, as you have not stated in what part of the circuit you desire to use it.

Ques. (3) Would a variable condenser (rotary) built up of 16 stator and 15 rotor plates 2½ inches in diameter give enough capacity to use for tuning?

Ans. (3) We suppose you refer to the small condenser, which may be purchased in the open market. If so, it will be sufficient for wave lengths from 200 to 1,000 meters.

Ques. (4) In the rotary receiving transformer, such as the Blitzen, does this give as good results where the wire is wound in two grooves, one layer upon the other, than in the ordinary transformers where there is only one layer?

Ans. (4) Practically speaking, yes.

* * *

J. A. M., Milford, Utah, asks:

Ques. (1) What results could be expected by using an abandoned copper transmission line two miles long, consisting of two No. 8 copper wires 2 feet apart, on 25-foot poles, as an antenna?

Ans. (1) You should be able to obtain results from stations sending on longer wave lengths, but, of course, the transmission line is out of resonance with the emitted wave from any station in the universe. It is a curious phenomenon that it is possible to receive signals from 600 meters' stations on such aerials with a fair degree of efficiency, provided a variable condenser is connected in series with the earth and close coupling is employed at the receiving oscillation transformer.

Ques. (2) What results could be expected at this point, surrounded by deserts and mountains, with an aerial 80 feet high of 4 wires, 400 feet long, in connection with a triple audion set, described in your January issue, in getting signals from Kansas City, Colon and the Pacific Coast?

Ans. (2) You should be able to hear signals 2,500 miles at night time during the winter months. The day range is rather difficult to estimate.

Ques. (3) What will the Marconi Company assemble and wire a cabinet triple audion set complete, except head phones, for?

Ans. (3) These sets are not made by the Marconi Company. Communicate with the Radio Telegraph and Telephone Company, 309 Broadway, New York City.

Ques. (4) What are the names and addresses of other wireless publications besides those of the Marconi Company?

Ans. (4) The Wireless World-Marconi Press Agency, Marconi House, Strand, London, E. C., England. The proceedings of the Institute of Radio Engineers are published periodically, and copies may be secured by addressing the secretary, 8 New street, New York City.

* * *

D. O., Tieton, Wash., writes:

Please inform me where I can obtain the books named in How to Conduct a Radio Club on page 217 of the December issue of The Wireless Age.

Ans.—D. Van Nostrand & Co., 25 Park Place, New York City; the book department of The Wireless Age.

* * *

L. W. E., Columbus, O., asks:

I have constructed a wavemeter loose-coupled receiving tuner, the windings of which are made on a wood fiber coil 7 inches in diameter, for primary circuit, and 5¾ inches in diameter for secondary circuit.

The primary windings have a tap for every two turns and secondary windings have a tap for every ten turns.

With this tuner I receive signals from all the long wave length stations much louder than I did with a 2-slide tuner wound on a drum; but all stations on wave lengths below 600 meters do not come in as loud as on the 2-slide tuner; some stations that I heard before, I cannot hear at all now.

Can you explain the trouble?

Ans.—At sight it appears that possibly the switches on your inductance coils are so arranged that when the minimum number of turns are in use the inductance is of such value as not to allow wave length adjustments below 600 meters.

Again, it may be that the natural wave length of your aerial is above that of the stations from which you desire to receive, and, owing to the "loose" degree of coupling afforded by the variometer, the antenna cannot set up forced oscillations in the local detector circuit.

With the 2-slide tuner, however, owing to the closeness of coupling between the two circuits and the corresponding increase of damping, the tuner is responsive at one adjustment to a wide range of wave lengths (due to forced oscillations). This does not indicate that the 2-slide tuner is the more efficient of the two, for, if the inductively-coupled tuner were properly designed and the aerial proportioned to the wave length it is desired to receive, equal results could be expected with both tuners as far as the signals are concerned. Advantage is derived with the inductively-coupled tuner on account of the ease with which any degree of coupling desired may be obtained.

When receiving wave lengths below 600 meters, try connecting a variable condenser in series with the antennæ, thereby reducing its wave length.

* * *

L. C. G .,Mattituck, N. Y., writes:

On January 13, while listening in at my wireless outfit, I disconnected the ground wire and noticed a small spark as the wire left the binding post. Thinking in some way that it might have come from the battery of the test buzzer, I disconnected that, and still noticed the spark as I touched the wire to the "ground" slider of the tuner. I then wet my fingers and touched one finger to the ground wire and the other one to the ground slider, and received a light shock. This seems very strange to me, as there is only one battery on the place, and that is on the buzzer test, and was not in any way connected. There are no high-tension lines anywhere near my outfit. I told a wireless friend about what I had done and he tried it on his outfit and received a fairly good shock. This was at 12:05 P. M. and I have never noticed it since. The weather was overcast and very cold, with occasional loud bursts of static. Can you tell me what this was?

Ans.—The phenomenon indicates nothing unusual. It is simply an accumulation of static electricity on the aerial wires, which, when touched with the earth connection, discharge this current to the earth, causing a spark. Frequently at some of the larger stations having good-sized aerials sparks 6 inches in length can be drawn in from the aerial, particularly in mountainous countries. Static charges are especially prevalent previous to the arrival of a new snowstorm.

* * *

J. M. H., New York City, inquires:

Kindly let me know where I can buy an auto-transformer with a resistance of 9,000 ohms?

Ans.—We suppose you refer to the auto-transformer to be used in connection with the audion amplifier described in a previous issue of THE WIRELESS AGE. You will find it difficult to purchase such a device. Why not make it yourself? It simply consists of a single coil of wire wound about a soft iron core composed of a bundle of fine iron wires.

Please observe that it is not the amount of resistance which determines the efficiency of the coil, but the value of the inductance obtained.

As a substitute, you may use the secondary winding of a transmitting transformer, or the secondary winding of an induction coil.

* * *

O. B., Natick, Mass., writes:

Ques. (1) I have a transformer that cuts 110 volts alternating current down to 3 voltages—6, 10 and 16. I also have a 1-inch spark coil, but when used in connection with this transformer it gives only ¼-inch spark on the 6-volt tap, much less on the 10-volt tap and none at all on the 16-volt tap. How can I increase the size of the spark? Would a rectifier be of any use; where could I buy one?

Ans. (1) Induction coils are not intended to be used on alternating current. The proportionments of the primary and secondary windings and the constants of each circuit are not designed for alternating current. We are under the impression that the coil will give better results with a rectifier, which may be obtained from any amateur electrical supply house.

Ques. (2) Is the auto-transformer, shown in Fig. 2 of the article on How to Conduct a Radio Club, in the January issue of THE WIRELESS AGE, wound on an iron wire core, as indicated in the diagram, or on an air core?

And. (2) On an iron core composed of a bundle of fine iron wires.

Ques. (3) According to the dimensions given, the primaries of the receiving transformers slide inside the secondaries. Will this form be as efficient as the usual one?

Ans. (3) Certainly.

Ques. (4) Would the set shown in accompanying diagram work, and if so, would it give the same results as the one in Fig. 2, provided the crystal rectifier shown is as sensitive as the perikon? Fixed condenser FC and the local battery circuit have been dropped; otherwise the two are the same. The mineral used is, of course, one that does not require a local battery.

Ans. (4) The arrangements of circuits as shown in your diagram would make the equipment absolutely inoperative for long distance signals.

* * *

E. C., Fort Wayne, Ind., asks:

Is it possible to use iron wire instead of aluminum wire for an antenna, and what would be the difference?

Ans.—You will be able to hear signals on an aerial composed of iron wires, but iron has an enormous value of high-frequency resistance, which is productive of considerable energy losses. Aluminum is the better conductor of the two, but trouble is apt to be encountered at the joints, owing to the coating of oxide, which forms when the wire is exposed to the weather. There are special solders made for aluminum wire joints, which may be obtained from any large hardware concern.

* * *

L. H., Bennington, Kan., asks:

Ques. (1) Without antenna or "ground" connected to my receiving set, consisting of loose-coupled tuner, condensers, detector and telephone receivers, I easily get signals from a friend's wireless station 2 miles distant, the transmitting apparatus consisting merely of a small ignition spark coil, giving a ¼-inch spark, a D. P. D. T. switch and the spark gap shunted across leads from secondary of spark coil to the switch; no condenser or helix is used. I hear this station remarkably loud when having either antenna or ground alone connected, and when both ground and antenna are connected I find the incoming wave so "broad" that it covers entire gamut of tuner. Now, have we stumbled onto something worth while, or are such results common?

Ans. (1) It is very likely that the signals from your friend's transmitting station are getting to your receiving station over the telephone and power wires in the vicinity of his sending aerial. The signals are caused more by electrostatic induction than by wireless telegraph radiation.

Had you given more detailed information as to the disposition of the aerial, its relation in wave length to the transmitting station, etc., perhaps we might have answered the query more satisfactorily. The broadness of tuning, as noted on your receiving tuner, is probably due to the fact that the spark gap is connected in series with the aerial, thereby producing a highly damped wave, possessing practically no tuning characteristics.

Broadness of tuning is also often due to a poorly designed receiving tuner. You have stumbled on nothing new. The effect has often been noted. You will probably find that intervening wires are assisting the transmission.

Ques. (2) All other conditions being equal, is there any difference in the transmitting range of a ¼ K. W. and a 1 K. W. transmitting wireless set using a wave of 200 meters?

Ans. (2) With the limitations of wave length imposed, in order to use 1 K. W. at the transformer, even with a frequency of 500 cycles, it would be necessary to increase the secondary voltage of the transformer. At a frequency of 60 cycles the potentials would need to be so high as to become destructive to insulation. Such conditions of voltage would require a spark gap of abnormal length, resulting in increased damping.

By the above statements we mean that "all other conditions cannot be equal" at a wave length of 200 meters, with an increase of energy from ¼ K. W. to 1 K. W. Increased power with proper design of apparatus should be productive of increased distance. The statement, however, must be accepted with limitations.

Ques. (3) Why does the law require a rotary gap when using an oscillation transformer?

Ans. (3) We are not aware of any United States law requiring the use of the rotary gap.

Ques. (4) What is the advantage of an oscillation transformer over a sending helix?

Ans. (4) We suppose you refer to the advantages of an inductively coupled oscillation transformer over the directly connected helix. If so, the principal advantage lies in the ease with which any degree of coupling desired can be obtained. The degree of coupling is varied in the case of the inductive coupled arrangement by simply drawing the helices apart, whereas with a directly coupled set to obtain the same adjustments it is necessary to shift four connections to the helix.

Ques. (5) With two sections of condenser and three turns of wire on helix in the primary circuit and eighteen turns in secondary circuit of my transmitting set I get the same amperage in the antenna circuit as when using three sections of condenser: one turn of wire in the primary and nine turns in the secondary circuit, although the spark "crashes" more in the latter case. Which coupling gives the longest wave and which is to be recommended?

Ans. (5) Having no data at hand as to the capacity of the condenser or the inductance value of the helix, we cannot answer specifically, but the condition of the circuits having 18 turns in series with the aerial will give the longer wave length, both on account of the closeness of the coupling and the increased number of turns in the antenna circuit. The second condition, however, will probably give the better results, for on account of the "loose" degree of coupling obtained the energy radiated is more nearly confined to one wave length. The spark gives a greater "crash" with this arrangement on account of the increased condenser capacity and decreased inductance in series.

* * *

L. E. R., East Moriches, N. Y.:

Your first query is answered in the reply to another query in this department.

Ques. (2) Describe more fully the construction of the auto-transformer, as used in connection with the audion amplifier, as to the method of winding, composition of the core, etc. What is the function of the same in the circuit?

Ans. (2) The method of winding is described in another query in this department. The function of the winding is to act as a temporary storage for the energy from the high-voltage battery of the first audion, then to transfer it to the second audion.

Ques. (3) Referring to Fig. 2 in the article, How to Conduct a Radio Club, in the January issue of The Wireless Age, would the diagram be identical for a mineral detector employing no local battery?

Ans. (3) Yes, the diagram would be identical with the exception that the potentiometer and its associated battery would be completely removed from the circuits. Better results, however, will be obtained when employing a battery and a potentiometer.

Ques. (4) Is it to be understood that in a receiving circuit using the audion detector additional inductance should be included in preference to capacity in tuning to a longer wave length?

Ans. (4) Yes, additional inductance is preferable to capacity for adjustments to longer wave lengths, provided the resistance of the inductance is not too high.

* * *

E. E. H., Wilkinsburg, Pa., writes:

Ques. (1) I intend to install a receiving set in my room so that I can listen in on any wireless news which happens to be in the ether. The whole apparatus goes in a third-floor room, 10 by 11 feet. What kind of aerial (size, number of wires, etc.) could I arrange to place near the ceiling?

Ans. (2) Whom do you intend to receive from? You are rather badly situated, particularly to receive signals from the stations on the Atlantic Coast. Furthermore, an aerial strung in a room of this size, using the average amateur receiving apparatus, will not allow the reception of signals more than about 5 miles. If the house has an attic, string 4 wires the entire length of the roof.

Ques. (2) Would the gas pipe of the chandelier do for the "ground" connection?

Ans. (2) No, not in all cities. In some localities, particularly where a combination gas and electric light fixtures are used, the gas pipes are insulated from the earth by a fibre bushing, which is usually located near to the meter.

Ques. (3) Should an indoor aerial of the kind described be grounded while not in use?

Ans. (3) Not a bad idea.

Ques. (4) Is the audion the most sensitive detector?

Ans. (4) Yes.

Ques. (5) What would you suggest as an inexpensive but efficient receiving circuit containing the necessary apparatus?

Ans. (5) Two slide-tuning coils, 1 fixed condenser, a silicon or galena detector, 1 pair of 1,000-ohm headphones.

* * *

L. E., Lanesboro, Minn., inquires:

Ques. (1) Do you think that I could receive the time signals from the Arlington station with the following apparatus: 3-wire T-type aerial 100 feet long, 65 feet high, wires spaced 3 feet apart, ground connected to water pipe. Receiving instruments are Clapp-Eastham loose coupler, Clapp-Eastham Duplex loading coil, audion detector with all regulating switches and rheostat, filament and high voltage batteries, and a pair of Brandes 2,000-ohm Superior receivers. Connections made like Fig. 1, on page 275 of the January WIRELESS AGE. The Arlington station is about 900 miles from me.

Ans. (1) We are not familiar with the constants of the Clapp-Eastham tuners and associated apparatus, but if it has a range of wave length up to 2,500 meters you should be able to hear Arlington's time signals at night.

Ques. (2) Where can I obtain the audion bulbs described in the January issue of THE WIRELESS AGE? Have the owners of the audion patents obtained an injunction against the manufacture or sale of audion detectors, unless those persons have a license from the owners of the patents?

Ans. (2) Communicate with the Radio Telegraph and Telephone Company, 309 Broadway, New York. They cannot be manufactured or sold except under license from that company.

Ques. (3) Does it make any difference in the reception or transmission of signals whether the aerial lead in is taken from the ends, center or between the center and one end of a horizontal aerial?

Ans. (3) No great difference.

* * *

H. W., Atlantic City, N. J., inquires:

Ques. (1) Where can the audions described in the audion article in the January issue be obtained at the price of $3.50 mentioned?

Ans. (1) Answered under another query in this issue.

Ques. (2) Were the $3.50 audions the ones actually used by the author of the article referred to in his circuit, Fig. 3, where he copied distances up to 2,800 miles.

Ans. (2) The bulbs that were formerly priced at $3.50 were used. With the triple amplifier using bulbs of this type, the author has since copied signals at a distance of 3,700 miles.

Ques. (3) What is the maximum number of amperes that should be shown by a hot wire meter placed in the aerial circuit of a 2 K. W. transmitting set working on from 400 to 500 meter wave length?

Ans. (3) Using a set operated on 60 cycles, 7 amperes may be expected in the antenna circuit.

Ques. (4) Is there any rule for calculating the number of amperes that should flow in an antenna by a given amount of power on a stated wave length?

Ans. (4) You will find the following formula of use:

$$I = \frac{4.45\ W}{V}\sqrt{\frac{P \times 7}{N\,\delta\,\lambda}}$$

Where

I = Current (RMS value) at base of aerial.
W = Watts in closed circuit.
V = Voltage at spark gap.
P = Percentage of energy transferred from condenser circuit to aerial.
δ = Total antenna decrement.
λ = Wave length aerial circuit.
N = Number of spark discharges per second.

Ques. (5) Why is it that, although a battery consisting of an aluminum and lead plate immersed in sulphuric acid will change an ordinary 110 V. A. C. to a direct or pulsating current, it does not rectify or transform high frequency A. C. wireless waves so that they can be detected by such a battery in connection with a pair of headphones, notwithstanding that just such a rectification forms the explanation of the perikon detector?

Ans. (5) To date no satisfactory explanation has been offered. It is interesting to note, however, that electrolytic or other rectifying detectors possess current-voltage characteristics at variance with Ohm's law, i. e., if the voltage through them is steadily increased, the amperes flowing in the circuit will not correspond with the value to be expected from Ohm's law. If a curve of the results is plotted, it will not be a straight line.

We have no data at hand as to the volt-amperage characteristic of the aluminum rectifier. When used in connection with alternating currents of low frequency (60 cycles), the current will pass from the lead through the liquid to the aluminum, but a current in the reverse direction forms a film of oxide of aluminum which effectually prevents the flow of current.

It is a noticeable fact that when either the electrolytic or crystal rectifiers are used to rectify high frequency electrical oscillations, such as flow in radio telegraph circuits, the action of these oscillations must be confined to small area of contact, particularly so in the case of the electrolytic, where one of the electrodes is not more than a 1/10,000 of an inch in diameter.

THE WIRELESS AGE

APRIL, 1914

THE RADIO REVIEW

AMONG the many fine tributes paid to the memory of Ferdinand Kuehn of the ill-fated Monroe, this editorial in the Hartford Times is well worthy of reproduction:

"A Brave and Courteous Gentleman"

When the Republic sank, Jack Binns, her wireless operator, who went, immediately after the collision, to his key, and therewith expressed the fervent hope that somebody from somewhere would come hastily to the assistance of his companions and himself, became by virtue of this appeal a hero. There were the usual accompaniments of newspaper encomium, moving pictures and vaudeville offers.

The wireless operator of the Titanic, who cried out for help until he went to the bottom with the 1,500, was also a hero. So was the surviving operator who worked hard aboard the Carpathia.

Young Kuehn of the Monroe sent his spark shrieking for aid until the rising waters stilled his instrument. Then he stepped outside and took the life preserver from his body to give it to a woman passenger.

"I can get another," he said.

The terrified woman was not to have the added distress of knowing she had deprived a fellow human of his chance, although when he gave her that cork jacket Kuehn gave her also his life.

So if young Kuehn was not the kind of a hero we have been making in the newspapers these latter days he was at least a brave and courteous gentleman; as now, humble subordinate seafarer that he was,

Greater than Drake or Frobisher,
Than all their peers together,
He is a brave discoverer
And far beyond the tether
Of them that seek the frozen pole.

May his great voyage of discovery be the more glorious because of the knightly gallantry that signalized its start.

AFTER examining the junior Marconi wireless operator of the ill-fated steamer Monroe the Board of Steamboat Inspectors at Philadelphia reported that wireless telegraphy has yet to prove that it can prevent collisions of ships within a short distance of each other in a fog. The Inspectors did not know of the tests recently made on the steamer Northland, on the United States revenue cutter Seneca, and in the laboratories of the United States Navy of a direction finder, or "radio compass"—its technical name is

Eliminating the Dangers of Fog

radiogoniometer—which shows accurately the direction from which signals come.

This Marconi apparatus is independent of the regular wireless outfits on shipboard, and it requires no power for operation. It requires a separate installation of aerial wires, presenting two triangles that bisect each other at right angles. Its range is from forty to fifty miles, according to the size of wires employed. It can be manipulated very simply either by the wireless operator or by the navigating officer.

The direction finder should ultimately be relied upon quite as much as the foghorn, although the sounding apparatus can never be dispensed with until all vessels, big and little, have complete wireless equipments. But wireless has already been of great service in locating vessels in a fog. Messages exchanged between ships and shore stations have served to keep sailing masters informed about vessels near them, and experienced operators can gauge the proximity of another vessel by the increasing strength of received signals as the distance diminishes. The direction finder has not yet been adopted for general use on shipboard, but the installation is well begun.

Marconi's Patents Upheld

AFTER an admirably comprehensive study of wireless signaling from its almost historic beginning, in beacon fires on hilltops, down to the utilization of Hertzian waves, Justice Veeder of the United States Circuit Court has decided that Marconi was the first man to make of wireless telegraphy a practical means of communication and that the patents for which he applied in 1886 and secured in 1897, 1898, and 1904 are valid. As such litigation goes in matters of such financial importance, this is quick work, but that the decision just rendered should end the controversy—that it should put an end to any use of Mr. Marconi's devices unauthorized by him—would be expected only by those who have given no attention to the workings of our wonderful patent law.

Litigation over wireless telegraphy will doubtless continue, in one form or another, for years to come, but Justice Veeder's decision, confirming, as it does, others to like effect rendered in England and France, gives Mr. Marconi a strong position from which to conduct his battle. It is in harmony, too, with public sentiment everywhere, for there has never been any question in the general mind as to the originator of wireless telegraphy, or to whom fame and gratitude should be accorded for the almost inestimable benefits which the world has derived and will derive from this remarkable invention.

That in addition to fame and gratitude the inventor should have exclusive control of a means of communication so important, and should monopolize its profits, was vehemently denied by the counsel of his rivals, but the various Governments of the world are quite competent to protect themselves against abusive exploitation of the rights they grant.

BUT a few weeks ago foreign dispatches noted that Mr. Marconi had gone to Sicily to make some experimental tests of his wireless telephone scheme; and now reports are received that these tests conducted between vessels of the Greek navy, under the official supervision of the Duke of the Abruzzi, have proved entirely successful.

Successful Wireless Telephony

Marconi has repeatedly expressed his belief that he would be able to prove that telephoning without the intervention of wires is altogether as feasible as telegraphing without wires. Very recently wireless telegraphy was a chimera in the public mind; now everybody understands it is a certainty and apparently an indispensable necessity. The telegraph itself was once in the same position of doubt and so was electric lighting. So indeed was the propulsion of vessels by steam, and it is a fact that it is less than 100 years since the first successful ocean steamer went into the water.

What a period in the world's history the past 100 years has been! Sum up the achievements of that time and they seem to include almost everything greatly useful but the arts of printing and weaving. They include antiseptic surgery, the development of the cooking stove, heating by hot water and steam systems, photography, the extraction of the aluminium from clay, the Bessemer system of making steel, the development of the railway, discovery of the office of nitrogen bacteria and of the X-ray, anesthesia, the germ agency in disease—almost everything which gives people of the present day large control over the material world around them.

With successful wireless telephony added to the list no man can foresee what will yet be accomplished in the mystery of the universe of which we have only learned the rudiments.

Since Mr. Marconi is quoted as saying the problem of the wireless telephone has been "practically solved" it can, of course, be taken for granted that the quiet experiments in progress for several years have at last had the hoped-for success.

PERHAPS the solution of the "safety first" matter is going to come through the wireless agency on land as well as on sea.

During a recent blizzard, when the wires were down and railroad telegraphy was out of condition, the trains on the Lackawanna road were operated wholly by Marconi wireless and without mishap.

Anent the Railroad Slogan — Safety First

It is likely that the time will come when a wireless equipment will be a part of the outfit of every train and at least supplement the present more complicated outfit of poles, wires, block signals, etc., in the control of traffic whether in sunshine or in storm.

The Editor.

Marconi Wins Sweeping Victory in Patent Suits

AN opinion handed down on March 17 by Judge Van Vechten Veeder, of the United States District Court, Eastern District of New York, contains a sweeping decision upholding the validity and priority of the patents of Guglielmo Marconi. The opinion is a comprehensive and exhaustive compilation, reviewing the early history of wireless telegraphy from the speculative period down to the method in use by Mr. Marconi in 1904.

The decision was the outcome of two suits instituted by the Marconi Wireless Telegraph Company of America against the National Electric Signaling Company. One action was instituted on May 3, 1912. In this suit the plaintiff alleged that the defendant infringed the claims of Mr. Marconi's patent, No. 11,913, and the patent of Sir Oliver Lodge, No. 609,154 issued in 1898. In a second suit instituted by the Marconi Company on May 23 of the same year it was charged that the National Electric Signaling Company infringed the claims of Mr. Marconi's patent, No. 763,772 issued in 1904 for circuit tuning. The latter patent is a counterpart of the patents of Mr. Marconi which were sustained in Great Britain and France by the courts of these countries.

Particular stress was laid by the defendant upon publications and prognostications by various scientists previous to the discoveries by Marconi. It is emphatically held in the opinion that not one of these earlier publications disclosed a complete wireless telegraph system.

Marconi First in the Field.

After a chronological review of the events of the period prior to the taking out of Marconi's first patent in 1896 or in the words of the court, "To sum up the results of this period of speculation and experiment," the conclusion is reached that

No one had described and demonstrated the system of wireless telegraph apparatus adapted for the transmission and reception of definite intelligible signals by such means. This was the state of scientific knowledge and practice when in 1896 Marconi applied for his first patent.

The original Marconi patent dated July 13, 1897, and reissued June 4, 1901, is treated from every possible standpoint and in an interesting manner. Reference is made to the early tests conducted by Marconi and to statements made by representatives of various governments who had personally witnessed such tests.

The Bristol Channel Tests.

A particularly interesting quotation is cited. This was published in Berlin in November, 1897, and in it the noted savant and electrical scientist, Professor Adolphus Slaby, who had witnessed the wireless tests conducted by Marconi across the Bristol Channel on March 18, 1907, unconditionally expressed himself as to the novelty of Marconi's invention, giving the inventor the full honor for the discovery of a complete wireless telegraph system.

He says:

> What I saw was something new; Marconi had made a discovery; he worked with means the full importance of which had not been recognized, and which alone explained the secret of his success. I ought to have said this at the commencement of my subject, as at a later date, especially in the English technical press, the novelty of Marconi's process was denied. The production of Hertz waves, their radiation through space, the sensitiveness of the electric eyes—all are known. Very good; but with these means 50 meters were attained, but no more. In the first instance Marconi has devised for the process an ingenious apparatus which, with the simplest means of assistance, attains a sure technical effect. He has thus first shown how by connecting the appa-

ratus with the earth on one side, and by using long extended vertical wires on the other side, a telegraphy was possible. These wires form the main feature of his invention.

Particular stress is laid upon the value of Mr. Marconi's discovery of the vertical aerial wire and the connection to earth or water and the advantage he gained in adopting such methods. The opinion gives Marconi the full credit for the disclosure of the adaptability of such means. It says:

I think that the described characteristics of the grounded vertical conductor plainly indicate its utility for a long distance transmission, as does also the statement that "the larger the plates of the receiver and transmitter and the higher from earth the plates are carried the greater is the distance at which it is possible to communicate."

After a review of some of the earlier publications mentioned by the defendant in which it is claimed that disclosures as to the value of the aerial wire and ground connection had been made prior to Marconi's discovery, it is stated in reply in one case:

The defendant's contention is untenable.

In another case it is said:

The fact that Lodge made no reference to ground connections in his subsequent lecture on the work of Hertz shows that his earlier statement is nothing more than an incidental reference to an abandoned experiment.

Evidence Supports Inventor's Claim.

The opinion adds:

Accordingly I find that **the evidence establishes Marconi's claim that he was the first to discover and use any practical means for effective telegraphic transmission and intelligent reception of signals produced by artificially-formed Hertz oscillations.**

The Lodge patent dated August 18, 1898, is discussed in detail, and he is given the credit for the first realization of the advantage to be derived in the matter of sharpness of tuning by the use of feebly damped or more persistent oscillations. However, it should not be forgotten that in Marconi's original patent he specified that his elevated capacity areas or plates are "preferably electrically tuned with each other," that is, of similar electrical dimensions. It cannot be denied that Marconi thoroughly understood at the date of issue of his first patent the necessity of tuning the open circuit of his transmitter to the open circuit of his receiver.

Comparing the early work of Hertz in his experimental investigations in respect to tuning with that of Marconi at the time of his discovery of the complete wireless system the opinion states:

While Hertz effected whatever tuning was possible in his structure by adjusting the capacity and inductance in the closed receiving circuit, Marconi adjusted the capacity of his open transmitting and receiving circuits.

The Discovery of Lodge.

Mention is then made of the fact of the inability of an open oscillatory circuit, not having a self-induction coil in its path, to accumulate sufficient energy to emit feebly damped waves. While it was true that the use of self-induction coils in connection with closed oscillatory circuits was old, their value had not been sufficiently demonstrated prior to the work of Lodge.

The opinion continues:

Lodge solved the problem by a compromise between the radiatory and oscillatory qualities of his transmitter on one hand, and between the absorbing and accumulating qualities of his receiver on the other hand. He was the first to realize that if he could get a long train of waves he could afford to diminish the amplitude of the first few of them, the desired result being secured by cumulative effect. The principle disclosed by him was that, although a radiator with several swings is less violent at its first impulse than a momentary emitter, the lessened emitting power of a radiator may be largely compensated by a correspondingly prolonged duration of vibration on the part of the receiver or absorber, thus rendering the radiator susceptible of tuning to a special similarly tuned receiver. The tuned receiver then responds, not to the first impulse of the radiator, but to a succession of properly tuned impulses, so that after an accumulation of the first few swings the electrostatic charges in the terminal plates become sufficient to overflow and spit off into the coherer, thereby effecting its stimulation and giving the signal.

While Lodge undoubtedly understood the sharp resonance effects to be had in the use of feebly damped oscillations his apparatus left much to be desired in obtaining long distance communications. Even while recognizing the value of his system, he stated in one of his publications: "For the most distant signaling the single pulse or whip crack is the best." Thus for covering distances, according to his own statements, it would be necessary to revert to the apparatus of Marconi.

These difficulties were later solved by Mr. Marconi himself and the method was completely disclosed in the Marconi patent of June 28, 1904. A lengthy discussion is devoted to this patent. This is the famous "four circuit" tuning patent which covers the basic principles upon which all wireless telegraph systems in the universe depend.

The opinion states that although Lodge in his 1898 patent had come forward with a new idea he recognized the impossibility of having a circuit which should be at once a good radiator or absorber and a persistent oscillator. He therefore proposed a compromise.

Difficulties Overcome by a Compromise.

To quote the opinion:

> He increased the persistence of vibration of his radiating circuit at the expense of its radiating qualities, and increased the accumulative power of his receiving circuit at the expense of its absorbing qualities. Effecting this compromise by means of the introduction of an inductance coil in an open circuit, he obtained a train of waves of approximately equal amplitude and thus rendered effective syntony possible. But the syntony thus obtained was utilized for selectivity alone. It was attained at the expense of the radiating and absorbing qualities of the circuit; and Lodge still supposed that for distant signaling the single pulse or whip crack was best.

Improvements Made by Marconi.

Marconi's improvement, in his second patent, upon his own prior apparatus, and his solution of the difficulty involved in Lodge's compromise consists in the substitution for a single circuit in both transmitter and receiver of a pair of circuits, one of which is so constructed as to radiate or absorb readily, and the other to oscillate persistently and be a good conserver of energy. By using two linked circuits in his transmitter, in which the circuit of the primary contains a condenser of any desired capacity, with the usual provision for its discharge through the spark gap, and in the circuit of the secondary the vertical wire, any required energy may be imparted to the radiator, since the closed circuit of the primary is a good conserver or reservoir of energy for the radiating open circuit of the secondary. This arrangement would be futile, however, without means whereby the stored energy of the reservoir circuit could be transmitted to the elevated conductor at the rate at which that conductor could effectively radiate it. The mode of getting the energy from the reservoir circuit into the radiating circuit, in like measure as it is radiated, is the tuning of the persistently oscillating circuit to the radiating circuit. In this way the principle of resonance is fully utilized between the two circuits. Similarly, the two circuits of the receiver are linked through a transformer so that electrical oscillations in an open and absorbing primary build up similar oscillations in a closed and conserving secondary until the coherer breaks down. Finally, the four circuits must be tuned together.

That this apparatus overcame the difficulties emphasized by Lodge is not disputed. Where Lodge compromised, Marconi reconciled.

The opinion distinctly states that with Marconi's apparatus he was not only able to obtain the persistency of oscillation of the apparatus of Lodge, but also obtained such effects without any sacrifice of radiating qualities, and furthermore allowed an increase in the available amount of energy drawn from the local circuits of the transmitter.

The opinion continues:

With this definite control over radiation effective selectivity was maintained. . . . In combination with the increased available energy in the transmitter the distance over which messages could be sent was enormously increased.

With this apparatus Marconi communicated across the Atlantic in 1901, and the claims in issue constitute the essential features of apparatus which has since made possible communication over a distance of 6,000 miles. It is used in more than 1,000 installations by Marconi, and is admittedly an essential feature of the wireless art as at present known and practiced.

In connection with the claims of the defendants that various inventors had disclosed previously to Marconi his method of "four circuit" tuning, the opinion in each instance disproves and casts aside the allegation. There is no proof or mention whatsoever in the publications or lectures of Fessenden that he recognized the necessity of "four circuit" tuning in a complete wireless telegraph system.

Tesla's Conception Remote from Marconi's.

In reference to the patents of Tesla which now and then are brought to the front as being prior disclosures of the inventions of Mr. Marconi in respect to "four circuit" tuning, the opinion clearly states the impossibility of obtaining wireless telegraph communication with apparatus such as Tesla describes, for by calculation it is shown that the local oscillatory circuits of the Tesla transmitter were vibrating at a wave length of 1,200 meters while the elevated wire, which he suggested should be somewhere in the vicinity of from six to seven miles in height, would have a wave length of from 28,000 to 56,000 meters. The coupling up of these two circuits would in no sense bring about a condition of resonance and Tesla's conception was entirely remote from the subject matter of Marconi's patent.

In reply to the argument of the defendant that Dr. Pupin had been instrumental in the discovery of "four circuit" tuning, ample evidence was introduced to disprove such statements, closing the matter once and for all.

Summing up certain statements made by Dr. Pupin in 1899 the opinion states:

It is absolutely incompatible with the supposition that Pupin himself or anyone else so far as he knew had solved this problem.

Mr. Nally Talks of the Decision.

Edward J. Nally, Vice-President and General Manager of the Marconi Wireless Telegraph Company, commenting on the decision of Judge Veeder, said:

The Marconi Company is much gratified because the Court sustains the validity of all three patents and holds that the Lodge patent and the Marconi patent, having the longest term to run, are infringed. The eulogistic remarks in the opinion as to both Mr. Marconi and Sir Oliver Lodge as inventors are also exceedingly gratifying to the company.

Mr. Nally believes that the ruling will be upheld in the higher court if an appeal should be taken, and that this decision will have a far-reaching effect on competing wireless companies and also upon steamship companies proposing to acquire wireless telegraph apparatus from competitors of the Marconi Company. He spoke further concerning the decision as follows:

Practically all other companies use the basic principles involved in these patents. In some of them there is a slightly different form, but they all use the Lodge patent in some way or other, and they also use Mr. Marconi's four-circuit tuning principles. These patents cover devices which tend to make commercial wireless telegraphy a practical thing and a financial success. By this decision, Marconi is now for the second time officially recognized in this country as the inventor who made commercial wireless telegraphy a possibility, and without Marconi and Lodge there would be no practical wireless telegraphy; to them belongs not only the credit for the invention, but the returns.

Setting the Clocks of the World by Wireless Telegraphy

M. Darboux, who presided at the International Time Conference

WHETHER in the wastes of the Sahara Desert, or on populous Broadway, New York City, you can to-day, through wireless telegraphy and the efforts of the International Time Conference, set your watch to the exact moment of the zone you may be in. The mariner, lost on the seas, can obtain the time from the air and steer his vessel accordingly; the explorer, wandering aimlessly over the ice fields of the far North or through the wilds of Africa, can ascertain his position by means of the radio signals sent from remote points.

Time, as is well known, is regulated by the travels of the sun. Therefore if watches indicated the true hour they could not be correct in two places east and west of each other. The difference in time is quite perceptible even in places close together. At noon in City Hall in New York it is 12h. 00m. 21s. at the Brooklyn Navy Yard, and 11h. 59m. 39s. at Newark. The sun rises at New Haven, Conn., 4 minutes, 11½ seconds before it creeps over the horizon in New York. Between the time at New York and Sandy Hook there is a difference of seven seconds.

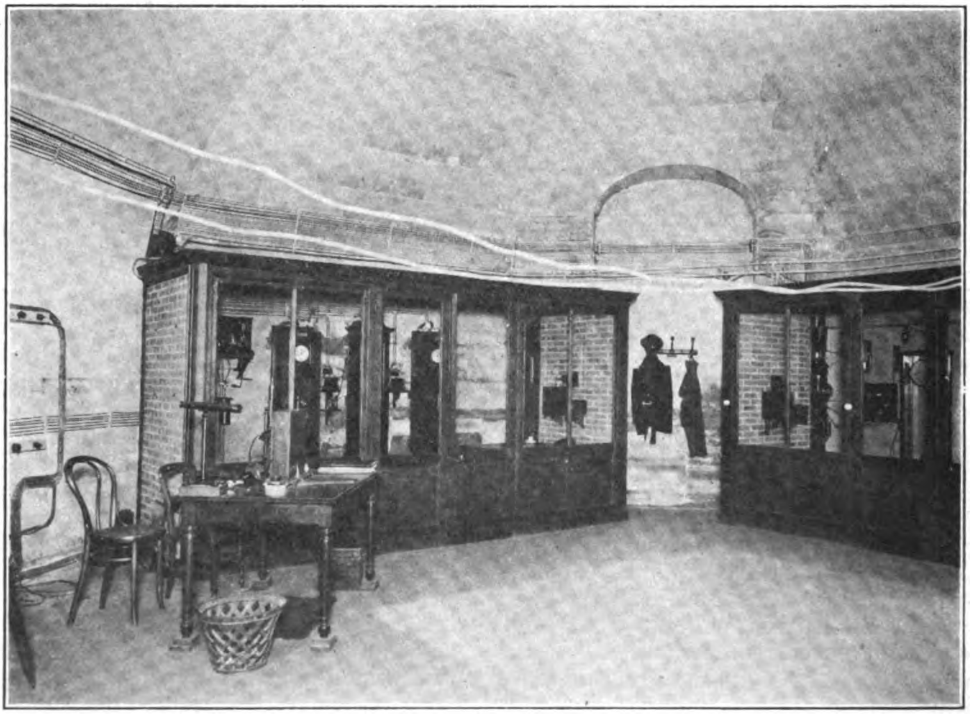
With the appearance of the first watches came the difficulties of attempting to keep correct time. It was obviously necessary to establish a uniformity of time and consequently various cities adopted a certain standard by which to set their clocks. Afterward the countries of the world adopted a standard of time. The standard of time in the capital or most important city in each country was selected. The clocks in England were set to conform with Greenwich time, those in France to that of Paris and those of Ireland to that of Dublin.

Difficulties were met with when this plan was applied to America and other nations similar to it geographically because of the vast extent of territory. This is illustrated by the fact that the difference in actual time between the Eastern and Western states in this country is so great that when it is noon in Maine it is only about eight o'clock in the morning in Oregon. The difference in time in Canada is even greater.

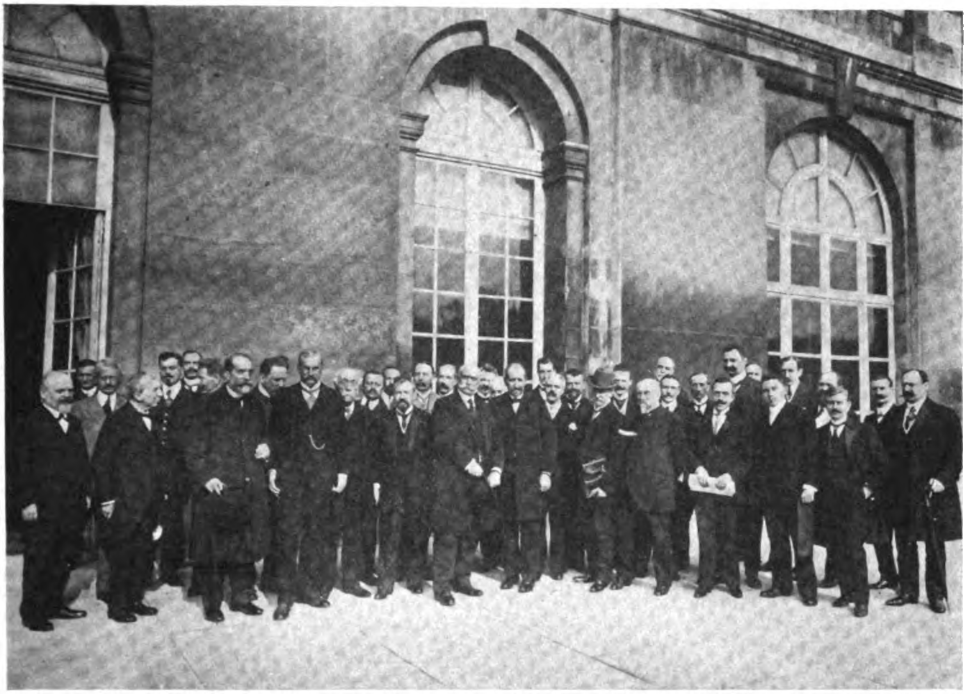
Sir Sandford Fleming, a Canadian statesman, evolved the idea of time zones. Canada first put into practice his suggestion and the United States afterward adopted it. The entire continent under this plan is divided into zones running north and south, in each of which the time used is that of its central meridian. These zones are fifteen degrees in width; in each the time is one hour in advance of that in the next zone to the west of it and one hour behind that in the zone adjoining it on the east.

Professor Charles Nordmann, astronomer of the Paris Observatory, has likened the earth to a melon with twenty-four sections. It has been agreed, as the sun apparently makes a circuit of the earth in twenty-four hours, to divide the earth into twenty-four zones each of fifteen degrees, running from pole to pole. All over each zone the time is that of its central meridian.

The reckoning begins in the zone which is bisected by the meridian of Greenwich, from which longitude is counted east and west. Each country, until a few years ago, reckoned longitude east and west of an arbitrary meridian of its own. International commerce and wireless telegraphy, however, are bringing the various points of the world closer together, and it was therefore necessary to determine upon a common meridian. France, by setting her clocks to Greenwich time, decided the question; to-day Greenwich time is the basis upon which all but a few of the countries set their clocks. Russia still has a time system of its own and Holland remains loyal to Amsterdam time; Ireland sets its watches by Dublin time. Greece and one or two other countries remain independent of the common meridian. The international time union, however, in-



This photograph shows the Hall of Time Clocks in the Paris Observatory. Paris is called the time capital of the world, and the Central Time Bureau is at the Observatory in that city. From the Observatory run wires to the antennæ on the Eiffel Tower



Group of members of the International Time Conference. These men arranged a time table for the world and adopted the laws governing it. Central points all over the globe were chosen to send the time broadcast twice a day by means of wireless telegraphy

cludes both North and South America; all Africa, all Europe with the exception of the countries mentioned; China, India and Australia.

The International Time Conference governs the time of the nations and Paris is the official time capital of the world. The Conference has arranged a time table for the world and adopted the laws governing it. Central points all over the globe were chosen by the Conference to send the precise time broadcast twice a day by means of wireless telegraphy.

The places from which the time is announced are as follows:

San Fernando (Brazil), Arlington, Va., Manila, Mogdishu (Magadoxo), on the coast of Italian Somaliland; Timbuctoo, Norddeich (Germany); Massowah (Eritrea) and San Francisco. It is planned to add Melbourne, Australia, and Tananarivo, Madagascar, to this list of wireless time stations. In order to prevent confusion the time is signaled in a code that is independent of language and can be understood by all nations. Greenwich time is sent from each center. Three minutes are required to send each signal, which is divided so that the recipient has abundance of time to regulate his chronometer by it.

The Eiffel Tower in Paris begins sending signals at 9h. 57m.

From some stations these signals are sent twice a day and from others once, but at different hours. Paris sends signals at oh. (midnight) and at ten o'clock. San Fernando sends at 2 and 16; Arlington at 3 and 17; Manila at 4; Mogdishu at 4; Timbuctoo at 6; Norddeich at 12 and 22; Massowah at 18 and San Francisco at 20.

It has been necessary in the past for explorers, geographers and surveyors to rely upon the accuracy of the chronometers they took with them in order to calculate their longitude. Wireless time signals were used in surveying the frontier between French and Spanish Morocco. A similar method will be used to survey the Congo-Cameroons frontier and that of French Guinea and Liberia. The Belgians have used the same method to survey their Congo possessions.

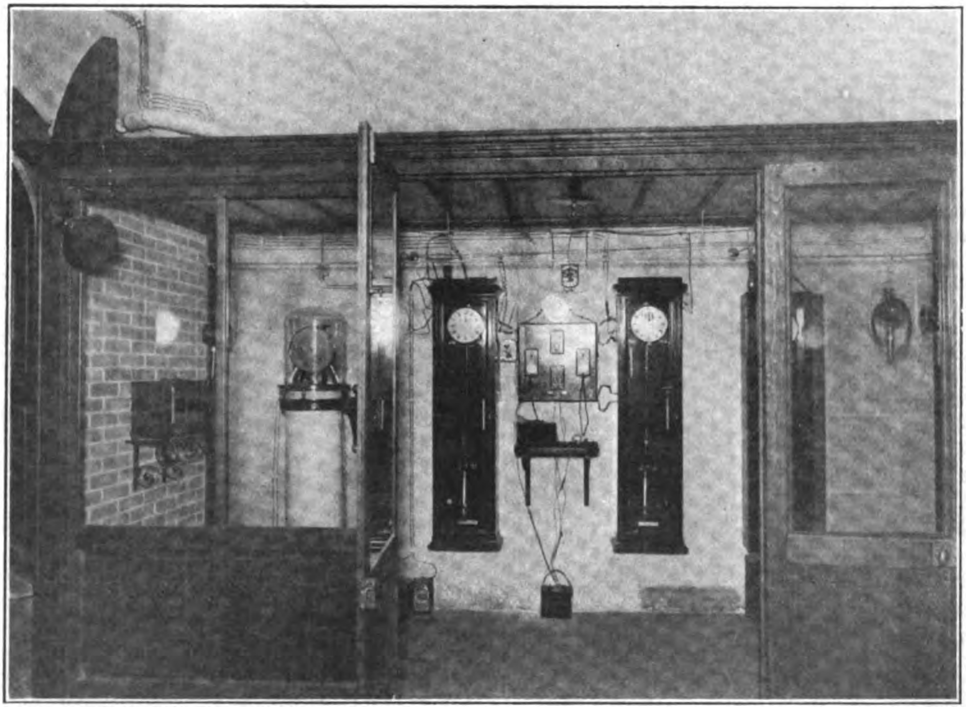
Commandant G. Ferrie, of the French

Navy, has interesting views concerning the use of wireless time signals. He says that the principal disseminating agents of the time had been the railways and the telegraph, for which the knowledge of the precise time is particularly necessary. The principal centers of administration received the time directly from the neighboring observatories, by telegraph or telephone, and retransmitted it in like manner to the important stations or telegraph offices. These sent it again to other secondary points where special agents or watchmakers received it and transmitted it to widely scattered places by means of watches which served to regulate public clocks, from which, finally, individuals took their time.

The number of retransmissions necessary before the time from an observatory reached any particular clock was often very considerable, and the precision obtained was slight because of the accumulation of errors of the intermediaries. For the needs of individuals this defect in exactitude generally had no serious inconvenience; but it was not so with public services—the railroads for instance, where a relatively small error in time at a station might cause an accident. Navigators required still greater precision; for geodists, seismologists and explorers the precision necessary was still greater.

The use of wireless telegraphy avoids all the difficulties and solves all the problems by suppressing totally, when necessary, all the intermediaries between an observatory and any particular clock. All that is necessary is to connect the observatory with a wireless station equipped to send time signals. These signals, sent out in all directions with the speed of light, can be perceived on land or sea at considerable distances by any number of operators having timepieces to regulate.

M. Darboux is president of the International Time Conference. He has remarked very aptly that "the same sun shines successively all over the world, determining in his course this universal time of which we aspire to be not the masters but the servants."



Receiving time at the Paris Observatory. The use of wireless telegraphy eliminates difficulties by suppressing totally, when necessary, the intermediaries between an observatory and any particular clock. The stations keep so closely in touch with one another that they can compare notes without difficulty

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE III

WIRELESS apparatus of the nature described in the preceding article should be constructed under the personal supervision of the president of the Radio Club.

The possession of an ultra-sensitive receiving apparatus of this type, the direct result of the members' labor, will bring a sense of satisfaction, amply repaying the effort expended. The president of the club should at all times require accurate workmanship, counseling the members in this respect from time to time, for once the method of doing things well is acquired it easily becomes a habit.

Very often the careless amateur will be inclined to the belief that definite principles need not be followed in order to obtain certain results, an assumption based on the generally accepted opinion that anybody can make wireless apparatus. Nothing could be further from the truth, for experience has proven that success comes only to the experimenter working with scientific accuracy.

Delicate apparatus should be placed in the hands of the senior members known to be skilled in the wireless art. A committee should be appointed to determine those qualified to operate such apparatus and all others should be excluded until they have acquired a certain degree of knowledge of amateur wireless telegraphy.

Since the appearance of the January issue of THE WIRELESS AGE a number of inquiries has been received from wireless organizations on the relative merits of Fleming valve and Audion detectors. These communications invariably request information as to whether the Fleming valve is available as an amplifier.

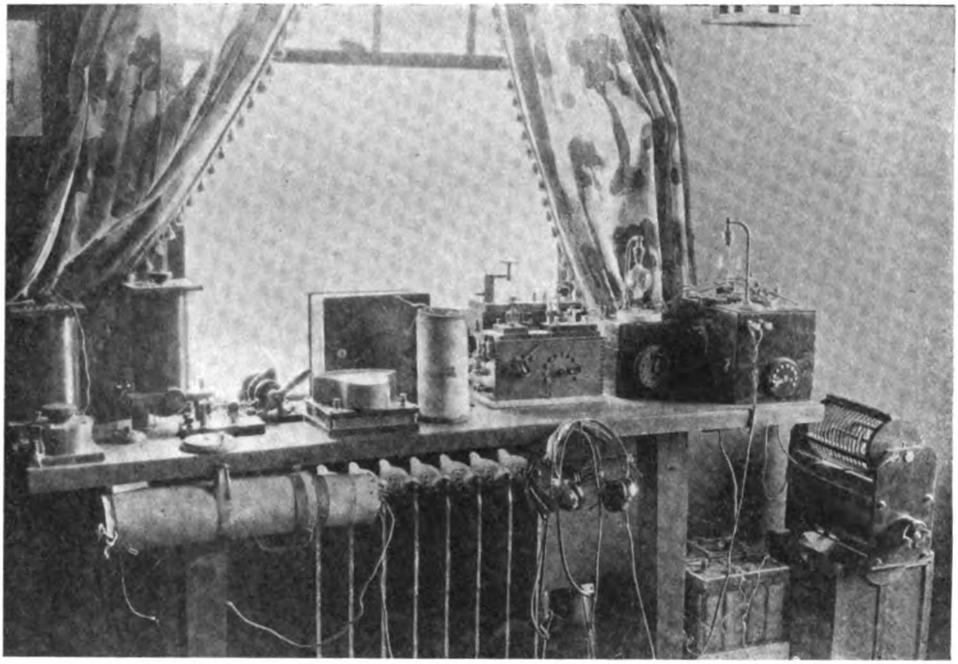
This, the writer's reply, must not be considered as the final analysis of the situation, but an unbiased opinion based on several years of experiment: While the Fleming valve is not quite so sensitive as the Audion—that is to say, will not give the same intensity of signals produced by the Audion under similar conditions—yet it is not so difficult to adjust, and apparently has longer life. Consequently, from the standpoint of commercial practice, the Fleming valve is the more desirable of the two.

Commercial equipments should not be encumbered with "laboratory" devices. The apparatus should be capable of easy handling, quick adjustment and protected against loss of sensitiveness. The amplifier, in the writer's opinion, is more or less a "laboratory" device of considerable scientific interest.

Regarding the "hook-up" for the valve as an amplifier: Apparently, the Audion and the valve work on a different principle and to date the Audion is the more successful as an amplifier. Some promising experiments with the valve as an amplifier are now in progress, but details of this "hook-up" are not available for publication.

Among the inquirers, "T. B. Jr." seems to have had more experience with the Audion than the average amateur. He says in part: "I note that the Audion decreases in sensitiveness and the adjustment of the voltage for best results is not the same from day to day. Is the same true when the Audions are used as an amplifier? Is there any method by which this gradual decrease can be corrected?"

The inquirer has already found out that when the sensitiveness of this de-



The daylight range of this club receiving apparatus is 1,400 miles; the night range, 2,800 miles

tector is on the verge of decline variation of the voltage of the filament battery and a corresponding correction in the high voltage battery will maintain normal working conditions to a marked degree. This is not a difficult adjustment, but an understanding of the method can only be attained through practical experience.

A New Method for Retaining the Sensitiveness of the Audion

The writer has made a number of experiments with Audion bulbs under rather unusual conditions and has found that when any particular bulb has become critically weakened it may be restored to a considerable degree of sensitiveness in the following manner: A cardboard or other insulating tube 3½" in diameter by 9½" in length, is wound closely with No. 30 S. C. C. magnet wire in the same manner as the coils of a receiving tuner. This winding is then connected to an 8 or 10 volt dry-cell battery in series with which is connected a 10 or 15 ohm battery rheostat. A tubular magnetic field is produced, the intensity of which may be regulated by means of the rheostat. The circuit for this arrangement is shown in Fig. 1.

If the tube is then placed directly above the Audion bulb in such a manner as to cause the magnetic flux to act directly upon the vacuous space a considerable increase in the strength of radio signals may be expected. Although it has not been proven, the explanation offered is that the magnetic field so produced materially assists the passage of the ions from the filament, hence the increased sensitiveness.

The polarity of the magnetic flux issuing from the tube is important and must not be overlooked. Of course, it may be reversed by changing the direction of the flow of the battery current. The strength of the magnetic flux is not necessarily regulated by the rheostat; the same effect may be obtained by simply raising or lowering the tube as indicated in Fig. 1. The tube should be so mounted that it may be gradually raised and lowered. During more recent experiments it was found that for best results with a certain Audion, the tube should be placed 12 inches above it. The test also indicated the necessity of very careful regulation of the magnetic field. It was further observed that with some Audion bulbs the tube did not give increased strength of signals, but a decided decrease. When a triple amplifier is used the magnetic tube seems to be of no assistance to the first Audion, but if applied to the second or third bulb an increase of signals to five times the original strength is obtained.

One of the decided peculiarities noted was the fact that when the magnetic field from the tube was abnormal in strength the Audion suddenly became inoperative; in some cases it required a wait of a minute or two (without any changes of voltage adjustment) to restore normal conditions, and then it seemed to have been accomplished automatically.

In another experiment the electrical conditions inside the Audion bulb were completely changed through simply exciting the secondary of the receiving tuner (while connected to the bulb) with a magnetic field produced by a 60-cycle alternating current. It necessitated a complete change of the filament voltage and the local circuit voltage to obtain best results. The effect, however, was to increase the sensitiveness. From these preliminary experiments it is at once evident that the progressive amateur has before him a field of research having unlimited possibilities.

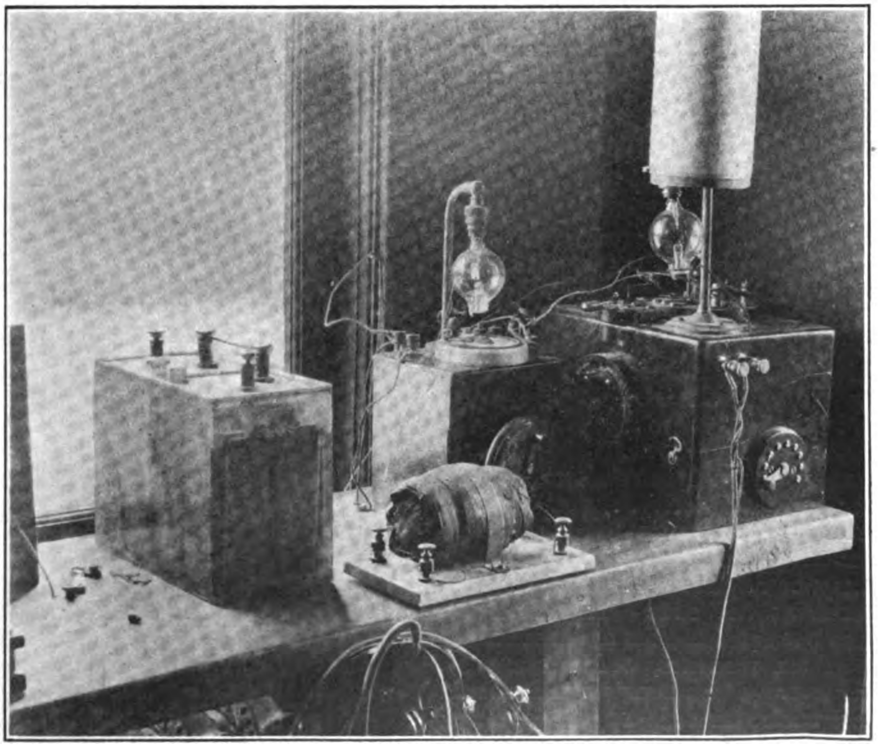
Members of radio clubs should construct this device and give it a thorough test.

Telegraph Codes

It is a matter of no small importance that members of wireless organizations become good telegraphists.

The necessity for such knowledge arises primarily from two sources: first, because the United States laws require the wireless telegraph amateur to be capable of receiving a certain number of words per minute before he is allowed a license, and none but licensed telegraphists are allowed to manipulate the equipment at a radio club.

Second, experimental tests cannot be



If the magnetic tube is placed directly above the Audion bulb a considerable increase in the strength of signals may be expected

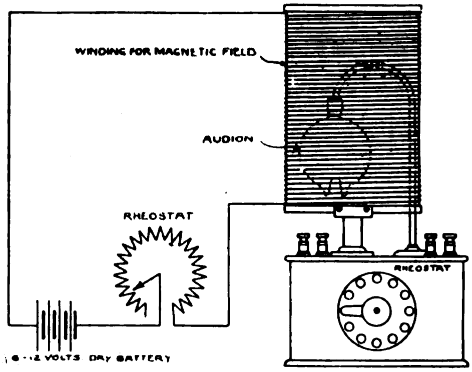


Fig. 1.—Details of the circuit for increasing sensitiveness of the Audion

conducted skillfully unless the one in charge is a capable operator. Knowledge of the code removes all doubt as to what station is doing the sending, and observation of the uniform regulation of commercial message traffic gives one a general idea of the wireless practice not otherwise obtainable.

The radio engineer lacking the ability to manipulate the telegraph key is seriously handicapped. It should be the aim of every club to assist members toward early skill in key manipulation.

Code Practice

Generally speaking, proficiency in the telegraph codes cannot be acquired quickly. From six to twelve months of steady practice are ordinarily required to attain a speed of twenty words per minute. Therefore it is almost essential that the club should be equipped with a buzzer, telegraph keys and head phones, making an artificial wireless telegraph system for the members and students of the club to practice upon.

A plan for an arrangement of the table, together with a circuit diagram of the connections to be used, is given in Fig. 2. The actual dimensions are shown, but these may be adjusted to suit the available room at the club. The arrangement has been planned for the accommodation of ten students, which is ample for the average amateur organization. Another table, known as the master table, is placed crosswise to the practice table. The apparatus for the production of artificial signals is mounted on the master table, where it is under the direct charge of the instructor in the code.

After the officers of the club have decided as to the arrangements suitable for their needs they should make a thorough study of the circuit diagram as shown in Fig. 2, an explanation of which follows:

An ordinary buzzer, A, energized by either dry or storage cells, B (4 to 6 volts is sufficient), is used to operate the lead phones, P, P^1, P^2. The circuit to the buzzer is so arranged that it may be closed by the master key, K, or any of the keys, K^1, K^2, K^3. The head phones, P^1, P^2, P^3, etc., are connected in series with the condenser, C, which preferably has capacity of the order of two microfarads. The later circuit is then shunted around the contacts of the interrupter of the buzzer, A.

The operation of the device is simple. The counter-electromotive force produced by the rapid make and break of the cur-

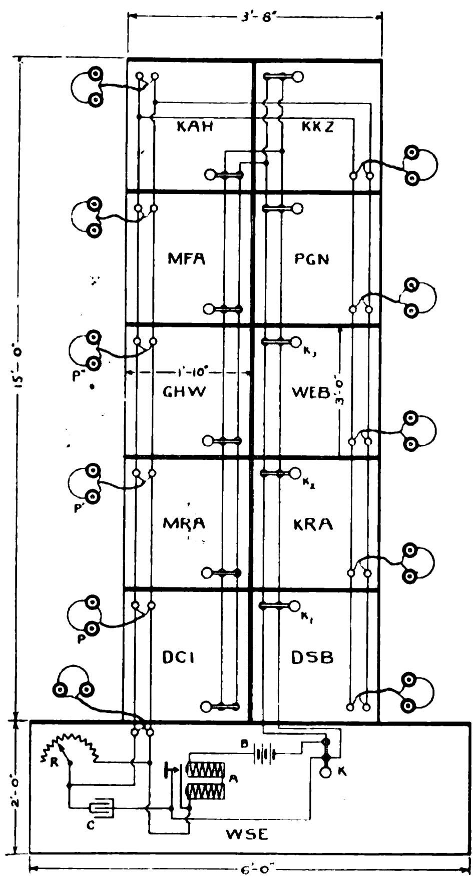


Fig. 2.—The buzzer practice system

rent passing through the coils of the buzzer charges the condenser, C, which in turn discharges through the head telephones, causing sounds, the volume of which will depend entirely upon the rapidity of the breaks made by the interrupter.

This arrangement gives an exact reproduction of the note of a wireless telegraph set and may be adjusted to imitate the 500-cycle quenched spark transmitter or the "grumble" of the induction coil with a magnetic interrupter. If properly employed these buzzers work with great regularity, remaining in adjustment for weeks at a time.

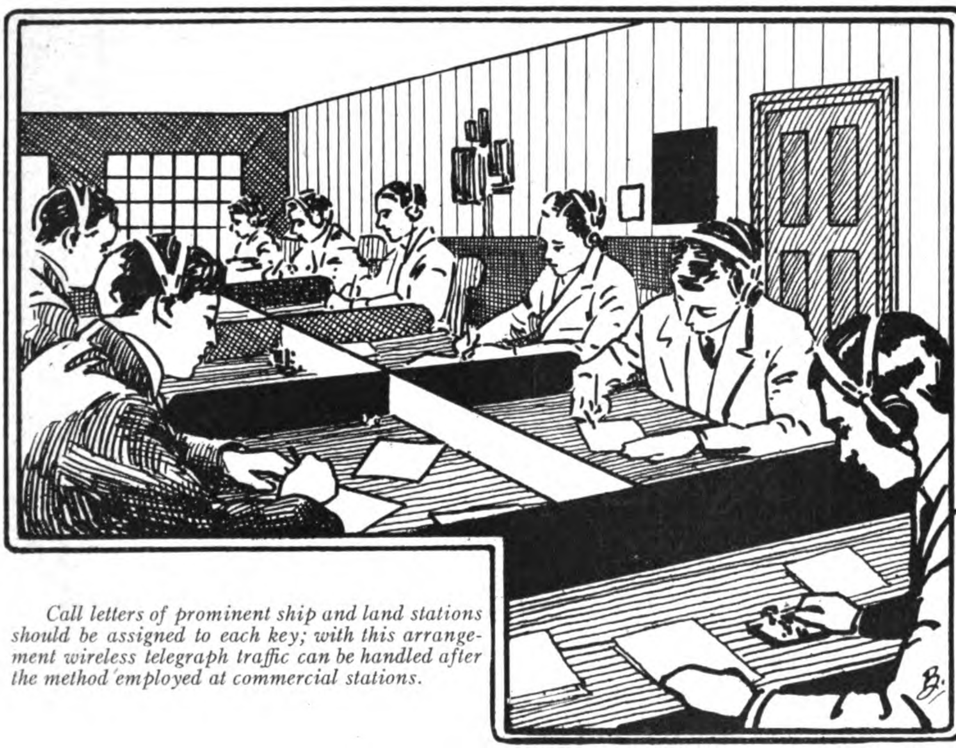
The note produced by each key on the practice table can be made to differ from the others if a small 10 ohm rheostat is included in series with each individual key. Each key may then have a different value of resistance in series with the buzzer, which causes a corresponding variation in the current flow through the buzzer, thereby changing the note. Thus the effect of several stations communicating with one another is created.

How to Make the Buzzer Squeal.

It is sometimes considered desirable to adjust the buzzer to a very high note. This is usually done to imitate the quenched spark transmitter. It may be accomplished in the following manner:

The soft iron armature of the average buzzer has the platinum contact mounted on a phosphor bronze spring. This spring should be removed and the platinum point fastened directly to the soft iron armature. When this is done the buzzer can be adjusted to a very high note and the operation made practically noiseless. It should be added that for a time it may seem desirable to produce the high tones, but after a while the pitch becomes disagreeable and trying to the ears. Commercial operators, when asked their opinion on this matter, invariably state that they prefer the lower pitch of the non-synchronous discharger.

By reference to the diagram (Fig. 4) it will be noted that a rheostat, R, is shunted across the head phone circuit at the master table. The rheostat is used



Call letters of prominent ship and land stations should be assigned to each key; with this arrangement wireless telegraph traffic can be handled after the method employed at commercial stations.

to regulate the strength of sounds produced in the head phones. Ordinarily the sounds will be of unbearable intensity unless a shunt of less than a fraction of an ohm is used.

When the code practice tables are ready for use call letters of prominent ship and land stations should be assigned to each telegraph key. For the convenience of amateur organizations the call letters have been included in the diagram Fig. 2.

A Small High-Frequency Generator.

Should the Radio Club desire a more positive method for producing imitation wireless signals, the apparatus shown in Fig. 3 will be found an easily constructed instruction device, demonstrating the principle of electric magnetic induction. Referring to the diagram: A fan motor, A, has mounted on its shaft a soft iron spider, B, made from a casting having eight radial arms.

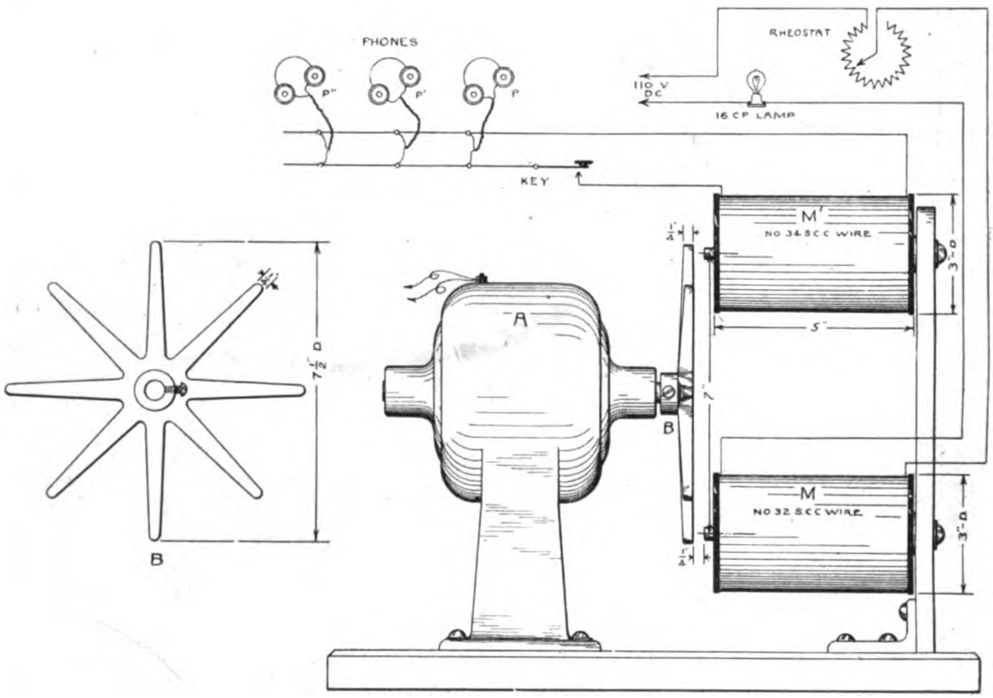


Fig. 3.—Apparatus for producing high-frequency wireless telegraph signals

With this arrangement wireless telegraph traffic can be handled after the method employed at commercial stations. The student so trained is better fitted to carry on experiments, for the knowledge thus obtained will enable him to avoid needless interference and to use better judgment when working the club's station.

As the circuit diagram indicates, but one student at a time can communicate with the land station (the master table). This is not a disadvantage as it duplicates the conditions in commercial practice.

The spider, B, revolves in front of the magnets, M and M^1, in such a manner that when two arms of the spider bridge the air gap between M and M^1 the magnetic circuit is closed, causing the lines of force to cut through the coil M^1, and to induce a current in it. This current, in turn, operates the head phones, P, P^1, P^2. The motor should not rotate less than 2,400 R.P.M. and preferably at a higher speed.

When the magnetic circuit is completed by the arms two distinct pulses are produced in the head phones, one by the establishment of the magnetic circuit and the second by the breaking of the circuit, which gives the stronger signal. What might be termed a mixed note is produced, usually somewhat higher than the rotation speed of the arm may indicate.

The greater the speed of the arm the higher will be the note's pitch. The speed of the motor is best controlled by a variable resistance in series with the field coils of the motor.

The intensity of signals in the head phones may be adjusted either by shunting the head phone circuit with a small battery rheostat, or a variable resistance may be placed in the series with the magnet, M, thereby regulating the magmetic flux and consequently the intensity of signals in the head phone circuit.

While a laminated iron core for the magnets is preferable, a solid soft iron core will serve the purpose.

The spider, N, is cast from a wooden pattern, which the members of the club can easily construct.

The dimensions of the magnets, M and M^1, are clearly shown in the drawing. Magnet M^1 is wound full with No. 34 wire; magnet M, with one-quarter pound No. 32 wire, is connected to the electric light circuit in series with one or two incandescent lamps in addition to the rheostat. The device is in reality a miniature dynamo serving to illustrate the generation of alternating currents.

If a still more elaborate device is desired the shaft of the motor can be extended and two or three sets of magnets mounted, each with its own set of "spiders."

Thus a variable tone transmitter is produced and variations of the note may be employed as desired. Constructed in this manner, it may be used as an automatic "interfering" or jamming device. Signals of two or three tones may be supplied to the line, imitating the interference encountered at a commercial wireless station.

This is the third article in a series especially prepared for radio clubs. The fourth, which will appear in an early issue, will give complete details of a novel type of transmitting and receiving apparatus suitable for the use of amateurs.

THE KING OF ITALY ENTERTAINS MR. MARCONI

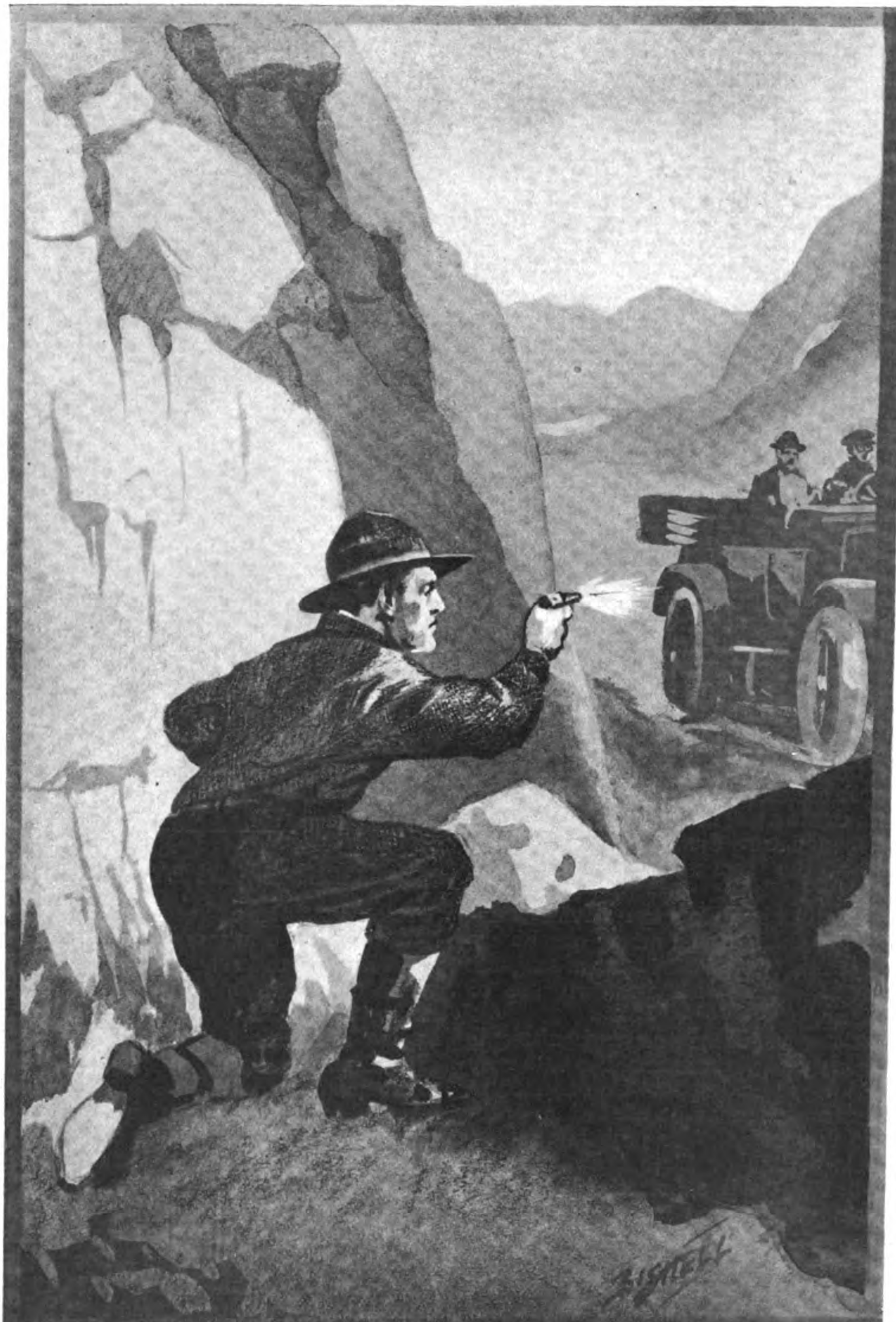
A message from Rome, Italy, says that the King, who has a special regard for Guglielmo Marconi, entertained him at dinner privately before the inventor departed for Syracuse to join the Duke of the Abruzzi on board the flagship Regina Elena.

The king said that he wished to have the great inventor of wireless telegraphy en famille, to be able to talk with him freely, and so only the queen and a lady and gentleman in waiting were present.

The queen inquired cordially for Mrs. Marconi, who has had the special distinction among foreign women of being appointed a lady in waiting to her Majesty. The queen also took an interest in the health of Mrs. Marconi's sister, regretting that her condition obliged her to return to England. When Mr. Marconi took his leave the king expressed the hope that the series of experiments he was going to make throughout the Mediterranean from the Regina Elena might reserve to the Italian warship the honor of being the first to communicate by radio-telephony at a great distance. A crowd of notabilities, including Mayor Nathan, gathered at the railway station and wished him success in the experiments.

MEDICAL ADVICE BY WIRELESS

Another instance of employing wireless telegraphy to bring medical aid for the alleviation of suffering occurred recently. While the British steamship Pectan was on her way from Chile, South America, to San Francisco J. Dempsey, an oiler, slipped on the engine room grating and received severe injuries. His condition became critical and Captain McKenzie ordered a wireless message sent to the German cruiser Nurenberg, stationed off Mazatlan, Mexico, asking the physician aboard that vessel for advice. The message was sent by H. W. Dickow, Marconi operator on the Pectan. The reply, which was in German, came two hours afterward and was translated by a member of the Pectan's crew. The treatment prescribed for the injured man brought about a marked improvement in his condition.



The automatic barked and the explosion merged into another of greater volume

Little Bonanza

A Serial Fiction Story

By WILLIAM WALLACE COOK

Begun in November—On the steamship Ostentacia, bound westward across the Atlantic, is John Maglory, of Ragged Edge, Ariz., his adopted daughter, Bonanza Denbigh, and his nephew, Jefferson Rance. Maglory is developing for Bonanza a gold mine, which has shown so little promise of yielding good returns that his attempt to sell it in London has met with no success. On the steamship he meets William Sidney, who buys an option on the sale of the mine. Rance, who has received a wireless message telling of a rich vein that has been uncovered in the mine, warns Maglory against Sidney. Maglory, however, is skeptical regarding the efficiency of wireless and pays no heed to Rance's statement that Sidney knows more than he appears to about the value of the property. Soon afterward Rance finds on the deck of the steamship a wireless message from Kennedy, superintendent of the mine, telling Sidney that the Burton-Slocum syndicate is prepared to offer Maglory $200,000 for the property. Maglory declines to credit Rance's statement. Arrived in Arizona, Maglory becomes enraged at finding one of the despised wireless stations right in his home town; it belongs to the son of one of his neighbors, who continues to operate it in an amateur way, despite Maglory's hostility. Four days after Maglory's return a representative of the Burton-Slocum Syndicate calls and makes a spot cash offer of $200,000 for the Bonanza Mine. Maglory is prevented from accepting it by the option given to Sidney. As the stranger is leaving in his motor car Bonnie's horse takes fright and the girl is seriously injured. The nearest doctor is twenty miles away, and in the emergency the amateur's wireless station sends out an appeal for aid. The message reaches a physician passing San Simone and sends him hurrying to the bedside of the injured girl. It is also picked up by the wireless operator near the mine and communicated to Rance. The latter hastens to Bonnie and meets Maglory. Rance asks that his uncle give his consent to marrying Bonnie in the event that Jefferson succeeds in defeating Sidney's plans, enabling the girl to accept the offer of the Syndicate. Maglory orders Rance from the house without giving him a satisfactory answer.

CHAPTER XI

JEFFERSON RANCE had not been idling away his time over at Poco Tiempo; neither had he been waiting for John Maglory to accept his proposition. Rance was extremely anxious to be *persona grata* with his uncle—on Bonnie's account. He did not intend, however, to hinge his plans altogether upon the old man's change of heart.

Rance had had a crisp, but satisfactory, interview with Lafe Kennedy; he had rounded up Chet Sidney, the watery-eyed wreck, and for $5 had secured from him a certain affidavit; he had borrowed $5,000 from Dalzell, of Globe, after agreeing to pay a bonus and the highest legal rate of interest; and, last but not least, he had gone frankly to Hall, of the Syndicate, and secured his coöperation.

On the evening of the 24th a trusted messenger had brought this note to Rance:

J. Rance, Poco Tiempo.

Will hold William Sidney in San Simone until 2 o'clock in the afternoon of the 25th. On the morning of the 26th I will close either with him or with John Maglory, acting for Miss Denbigh. Personally, I am on your side and wish you success, but there is no sentiment in business, and I am directed to take over the Bonanza Mine from any one who is able to give title.

Hall.

At 12 o'clock, noon, of the 25th, no word had come to Poco Tiempo from Uncle John. Rance was bitterly disappointed, but he did not allow the disappointment to interfere in any way with his plans.

Kennedy rode over from the Bonanza on horseback, with a saddled and bridled cayuse in tow. Rance mounted the led horse and rode with Kennedy across country to a point on the San Simone-Ragged Edge trail.

"Now you can leave," said Rance crustily, after dismounting. "Mind you have the old shack in proper condition to receive us."

"I don't know what right you've got to force me into your cussedness," Kennedy grumbled.

"You don't?" Rance's voice was like velvet, but it cut like steel. "You've proved yourself a two-faced coyote, Lafe, but for the sake of the man I once believed you to be I'm letting you help undo a great wrong. If you fail me, or if you open your head about this to any one, I'll camp on your trail till I get you. That will be about all."

Rance turned away, and Kennedy rode off with the led horse. Came then for Rance a period of waiting, snugged among the rocks that bordered the trail.

At that time of the day there was little traffic between San Simone and Ragged Edge. Since the Edge had waned almost to the vanishing point, travelers had waned with it, and what few there were shunned the heat of the day. Rance had no fears, therefore, that his undertaking would be interfered with.

It was half-past two when the growing hum of a motor-car was heard in the distance. Rance drew an automatic revolver from his pocket and straightened himself out beside a boulder; his elbows were bent and his weapon was leveled in front of his eyes. A trickster was to be beaten at his own game, and the Bonanza Mine saved to Bonnie for the sale to Hall.

The rushing car drew nearer and nearer. Suddenly it flashed into Rance's view and the point of the automatic settled finely to a bead. Rance had a glimpse of a touring car, and of two passengers in front. They were the only ones in the machine, and there was no doubt that the man beside the driver was William Sidney.

There was time for impressions only, and none for extended thought. The automatic barked, and the explosion merged into another of greater volume. A rear tire was punctured, and the driver hastily applied his brakes.

"What was that?" asked the startled Sidney.

"A tire let go," the driver answered. "It's one of these demountable tires and I'll have another on in a jiffy."

"I—I thought I heard the report of a firearm."

"You did, Mr. Sidney," called Rance from the trailside, looking at the schemer along the barrel of the automatic. "Your driver will proceed to fix the blow-out. If he can do it in a jiffy, so much the better."

The suddenness with which Rance appeared was astounding. Sidney was taken all aback. While he was recovering his wits, Rance drew near enough to mount the running-board of the car.

"Is—is this a hold-up?" gasped Sidney, his eyes wide and his face a ghastly gray.

"Not exactly," answered Rance. "You're merely getting your come-up-with. No foolish moves now," he added sharply, as Sidney's hand went to his hip. "If there's a gun in that back pocket, drop it into the tonneau."

"This is an outrage," cried the other, losing his calmness as his guilty mind dealt with reprisals.

"I don't care what you call it," said Rance, "but you drop that gun into the tonneau or I'll bore you. Think I won't? Why, Sidney, I'd scotch you as quick as I'd set my heel on the head of a rattler."

A small, nickel-plated six-shooter rattled upon the bottom of the tonneau.

"Go on and fix the tire," continued Rance to the driver. "I have no grudge against you, and I shall be as kind as circumstances will permit. You'll take orders from me, for the present."

"I can't stand for any high-handed work," returned the driver, making a feeble stand for what he believed to be his duty.

"Then you're with me," went on Rance, "for if there's a greater villain unhung than this man Sidney, I have yet to find him. You were taking him out to Ragged Edge to commit a big robbery, and—"

"It's a lie," burst hotly from Sidney.

"We're not on the deck of a trans-Atlantic steamer now, Sidney. Here in the desert a man can grapple his problems with two hands and wrestle them to a fall without being interfered with. Put on a new tire," Rance finished to the driver, "and be quick about it."

The driver had to climb over Sidney's

knees in order to leave the car. While he was doing it, Sidney found occasion to whisper:

"I'll give you a thousand dollars, Dugan, if you get me to Maglory's by six o'clock."

From the ground, Dugan returned a significant glance. A little later he opened his tool-box, and from his quick repair kit he took an open knife with a stiletto-like point. This he smuggled into the breast of his dust-coat.

In ten minutes the car was speeding onward again with Rance on the back seat holding a drawn revolver and giving directions to the driver.

CHAPTER XII

For the present, at least, Rance held the whip hand. Under his orders the machine was turned into a blind trail and driven for six miles into the heart of the hills. Here, abandoned for years and almost a ruin, stood an adobe house.

Into the old structure Rance conducted his prisoners. Two cots and two chairs were in the main room and against one wall stood a table upon which was a large hamper. Canteens containing water lay beside the hamper, and flanking these were a candlestick and a supply of candles.

"You will be here over night, gentlemen," remarked Rance, closing and locking the door, "so make yourselves comfortable."

"What's your scheme?" cried Sidney, drawing his own deductions from what he saw.

"Your option expires to-night. If you don't close the deal for the Bonanza Mine within a few hours, the option won't be worth the paper it's written on; that's what I'm here for." There was savage determination in Rance's voice.

Sidney was on the point of giving way to a wild outburst of rage. He checked his anger, however, before it exploded.

"You reckless fool," he exclaimed. "Where will this piece of work land you, do you think? Even in the West, people have something to answer for when they do what you've done. And I swear to you, I'll leave no stone unturned to make you pay the full penalty."

Rance laughed. He was giving his entire attention to Sidney; he did not notice that Dugan was edging around the wall to a place in his rear.

"I'd be twice a fool, Sidney," said he, "if I went into this without covering that point. When you leave here, to-morrow forenoon, you'll sneak quietly out of the country and say not a word about me. You—"

"I'll have you sent up for this."

"No," proceeded Rance. "I have here," and he took a paper from his coat with his left hand, "an affidavit from your brother, Chet. It tells how you were 'wildcatting,' three years ago, and how you salted the Eureka Workings, cleaned up thirty thousand dollars from the widows and clerks of Phoenix, and then got out of the country between two days."

"It's a lie," yelled Sidney.

"I tell you," flung back Rance, "that I have your brother Chet's affidavit. You can't get around *that*."

"A man named Overton pulled off that deal."

"Overton is the name you were sailing under, at the time. Chet tells all about it in this very interesting paper, to which he has sworn and subscribed. And listen, Sidney. Say a word about how I have made you lose all rights under your option, and I'll publish this affidavit of Chet."

"Will you let me look at that paper?"

It was Dugan who spoke. He stood at Rance's elbow, his face white and drawn. Rance looked at the driver sharply, stepped a little to one side and held the affidavit under his eyes.

"I'll keep it in my own hands," said Rance, "but you may look at it."

Dugan's staring eyes fixed themselves on the paper, following the words slowly downward, line by line. Suddenly a crash sounded through the room, and Rance looked around just in time to catch a glimpse of Sidney, vanishing through a window opening.

Rance ran to the opening in the wall. As he did so, a second crash echoed through the room. Rance whirled quickly about; Dugan had beaten down the door and darted away.

For a moment it seemed as if Rance's plans were destined to fail; then came a surprising development in the train of events. Dugan, overhauling Sidney at the running-board of the automobile, threw him to the ground and held him pinned under one knee. He wound up his bewildering tactics by shouting:

"Here he is, Rance. I've got the whelp."

"Bring him back to the house," Rance called.

Then he watched the driver hoist Sidney to his feet and half drag and half carry him back to the adobe. As soon as they were inside the house, Dugan flung Sidney into a chair.

"For two cents," said Dugan grimly, "I'd strangle you."

"So there are two of you against me, eh?" gasped Sidney. "You're in Rance's pay—and have been, from the start. I thought matters were going pretty easy for him."

"Easy with that," stormed Dugan, his face red with anger. "I am not in Rance's pay, but if Rance is calling the turn on any of your dirty work, I'm here to help him. My father was ruined in that Eureka Mine deal—and you're the 'Overton' who did it. So help me, as sure as my name is Dugan it's all I can do to keep my hands off of you!" The driver turned to Rance. "If you don't mind," said he, "I'd like you to tell me what he was going to steal at Maglory's."

Rance told him.

"You can see what sort of a snake-in-the-grass he's been, Dugan," he finished. "I hired Kennedy to keep me advised, and *he* put up good money to buy Kennedy away from me and learn of developments a few hours before they came into my hands."

"The two-faced skunk," breathed Dugan.

"You're mighty free with your talk of underhand thieving," sneered Sidney. "I have a certified check for forty-five thousand in my pocket. By your work, Rance, I am unable to turn it over, make good on that option and secure the Bonanza Mine. What about the five thousand I gave your uncle on the boat? By keeping me here, you are filching that from my coat just as much as any 'dip' who goes after a 'leather.' You needn't be so high and mighty in your virtuous talk."

Rance brought out and displayed a thick roll of bills.

"Here's the five thousand," said he. "I've paid usury to get it, and the money must be returned as soon as Miss Denbigh makes the sale to Hall. I believe, Sidney, in giving even the devil his due, and when we part, to-morrow morning, I'll give you this bunch of *dinero* and we'll call the thing square."

"You're too generous," grumbled Dugan. "You ought to keep that, Rance, to remember him by."

"Two wrongs don't make a right, Dugan," answered Rance.

"Nor do they always land a man in the big stone *yamen*," commented the driver, "which is where Sidney should be, after that Eureka Mine clean-up and this crooked attempt to rob Miss Denbigh blind. But you know best."

CHAPTER XIII

All afternoon of the 25th, John Maglory paced up and down in front of his house, watching the trail in the direction of San Simone. According to information brought by Derry, Sidney was to leave for Ragged Edge at half-past three.

"There's nary a thing Jeff can do," mourned the old man, hopelessly, "and to-day's when that sneaking, underhanded crimp trims Bonnie out of a hundred and a half in thousands. I wish I had the nerve to kill him."

He had the nerve, and he had the inclination, but means were lacking. Bonnie had hidden his guns, and was watching him from the porch.

"Don't worry, Uncle John," the girl cried, as Maglory climbed to the top of the fence and peered down the road; "everything is going to be all right."

"If that tinhorn left Simone at half-past three," the other returned, "and if he was coming in one of them devil-wagons, it's nigh time he hove in sight."

"He'll not come," declared Bonnie, with confidence.

"Why not?"

"Because you accepted Jeff's proposition," was the serene rejoinder, "and Jeff is working for me. Which," she added with a furious blush, "you can take in two ways, Uncle John."

"If you're so plumb sure Sidney won't get here," demanded Maglory, "why are you holding out them guns on me?"

Bonnie's confusion passed in a gay laugh, but she did not explain. After a time, she went out to the road, put her arms about Maglory and walked up and down with him. The sun sank and the evening shadows began to thicken, but there was no sign of William Sidney.

"Let's go in and have supper, Uncle John," suggested Bonnie.

"Go you," was the answer, "although I don't feel a heap like eating. If Jeff pulls these chestnuts out of the fire for you, Bonnie, it'll be the biggest trick he ever turned in all his life. If he pots Sidney with a forty-four from the trail-side, I'll move heaven and earth to get the boy clear of the law—I will so!"

"He'll not do anything like that, Uncle John," averred the girl.

"What makes you so pesky sure?" asked the old man curiously.

"Why, this: Jeff knows what I expect of him."

Maglory whistled softly as he walked into the house with the girl. They ate their supper, and then they sat on the porch until the evening was far spent and Maglory was nodding in his chair.

Hope was rising in the old man's breast. Legally the thirty days had expired and Sidney could have no claims under the option; but the dawning of another day would put every doubt past debate.

It was nine o'clock the next morning when a motor drummed in Maglory's front yard and faded into silence. He went out on the porch, imagining that Sidney had arrived a trifle late. But it was Hall he found, and not Sidney. A lawyer from San Simone accompanied the representative of the Syndicate.

"Have you sold to Sidney?" asked Hall.

"Haven't seen Sidney," returned Maglory, "and his option expired last night."

Hall laughed.

"Then Rance has made good," said he, "and he has snatched the Bonanza Mine away from the smoothest schemer in the country. You ought to be proud of that nephew of yours, Maglory."

The old man looked uncomfortable. Bonnie sidled up to him and laid an arm across his shoulders.

"You are, Uncle John, aren't you?" she asked.

"I reckon," was the feeble response.

For half an hour the lawyer was busy. At the end of that time papers had changed hands, and Bonnie found herself possessed of a draft for $200,000—a fortune handed on to her from one who, years ago, had departed into the Valley of the Shadow.

"You can thank Rance for that," smiled Hall, as he turned away.

"And you can do it now," laughed the lawyer, "for here he is."

Kennedy had brought Rance's horse to the old adobe that morning and, in due time, Bonnie's sweetheart had taken to saddle and started for Ragged Edge.

"Boy," called Maglory, stepping forward, "if you've killed that two-faced cimiroon—"

"But I haven't," said Rance. "I simply met him on the trail yesterday afternoon, and conducted him to an old adobe in the hills. We spent the night there."

"Oh, ho!" chuckled the old man. "Count on me, Jeff, to stand between you and any trouble he tries to stir up."

"He'll not stir up any, Uncle John. I have the goods on him. Read that."

Rance passed over the affidavit from Chet Sidney, and it was read with interest.

"Say," cried Maglory admiringly, "it ure took headwork to copper Sidney's back-fire in that fashion! On top of that affidavit," he gloated, "Sidney's out a cool five thousand! That'll teach him to think twice, by thunder, before he tries to hornswiggle anyone else out of a mine."

"He's out nothing, Uncle John," said Rance. "I borrowed the money and paid it back to him."

"You—bor—" Maglory stared at his nephew. "I reckon you couldn't do a really brilliant thing, Jeff," he mumbled, "without playing the fool somehow or other. If I was Bonnie, blamed if I wouldn't let you pay back that five thousand out of your own pocket!"

"He'll not pay it out of his own pocket!" cried Bonnie, ranging herself alongside Rance. "What he has done is just what I would have him do."

"Oh, you!" grinned Uncle John. "Why, you're a prejudiced party. You got busy right after I accepted that proposition of yours, eh, Jeff?" he asked, drily.

Rance gave a jump.

"Did you accept it?" he asked.

"Didn't you *know* I'd accepted it?" roared Maglory.

"No. It must have been pretty late in the day. I didn't leave Poco Tiempo until noon, yesterday, and I hadn't heard from you up to that time."

"It was later than noon. I sent a wireless message." Maglory showed considerable curiosity. "And you played this through," he went on, "without ever knowing whether I'd let you have Bonnie or not?"

"I intended to keep Bonnie from being swindled by Sidney," said Rance, "whether you agreed to let me have her or not. So—"

Ollie Ryckman came into the house at that moment, waving a couple of pieces of paper.

"Two messages for Jeff Rance," he called. "Is he here?"

"I allow he is, Ollie," answered Uncle John, "big as life!" He grabbed the marconigrams. "'Congratulations,'" he read; "that's from Poco, and is signed 'Everybody.' Well, well! And the other's from—Blamed if it ain't signed 'William Sidney.'"

"What does it say?" asked Rance.

"'Don't spring the affidavit and we'll call it square,'" read Maglory.

"He's worried," laughed Rance, "but he needn't be. I told him what I'd do if he'd be peaceable."

"If congratulations are in order," spoke up Hall, "I'd like to tender mine."

"They're in order, all right," beamed John Maglory, "and Bonnie is really going to marry into the family. Eh, girl?"

For answer, Bonnie threw herself into Rance's arms.

"Mines," went on Maglory, taking Hall and the lawyer each by an arm and leading them out on the porch, "ain't the only things in life that develop a pay-streak. There are pay-streaks in human nature, le'me tell you, and Bonanza Denbigh is pure gold, through and through. And Jeff Rance is panning out a lot more color than I reckoned. Friends, I'm one happy man this day!"

And he looked it.

THE END.

The readers of The Wireless Age are invited to tell whether or not they liked "Little Bonanza"; they are also asked to express their choice of serial or short fiction; love stories or stories of adventure; stories of action or stories of mystery.

RESEARCH WORK AT COLUMBIA

Twelve men of the American Navy are at present at Columbia University for research work in wireless telegraphy. Extensive experiments and observations are being made by experts under the direction of Professor Pupin and Professor Morecraft. Last September the Government sent two Annapolis lieutenants to Columbia to study wireless telegraphy, and the results have been so satisfactory that the class was increased by ten more experts from the Navy.

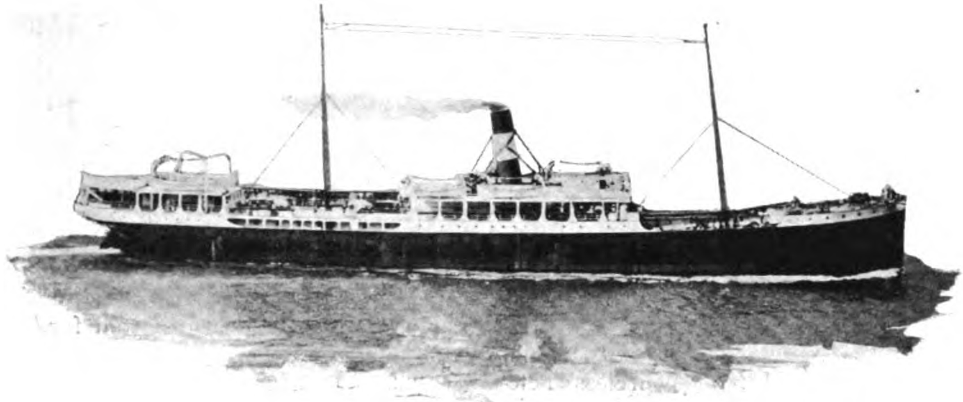
The equipment of Columbia's wireless is of the Marconi type. The sending radius has been estimated as varying from 500 miles in the day time to 1,400 miles at night. At times the operator has been in touch with the University of Michigan, and frequently with the Clifden station in Ireland, some 3,000 miles distant. The instrument is also capable of picking up messages from Berlin. The transmitting set can be used with either a synchronous rotating spark or quenched spark cap. For the generation of continuous waves a 200,000-cycle Alexanderson alternator is used. This set was installed to facilitate work in connection with experiments in wireless telephony. The antennæ, suspended between the Schermerhorn and Havemeyer buildings, are 130 feet above ground and 500 feet long.

PLAN A WIRELESS RESEARCH LABORATORY

The House Committee on Appropriations had before it recently an appeal from Secretary Redfield, in which other members of the Cabinet joined, for an appropriation of $50,000 for the establishment in Washington of a wireless research laboratory in connection with the Bureau of Standards.

Secretaries Daniels, Garrison, and McAdoo wrote expressing interest in wireless improvements and pointing out the desirability of the project. Acting Secretary Galloway of the Department of Agriculture, wrote that any advancement in the science of wireless communication would be of great assistance to the Weather Bureau.

The committee is expected to act favorably upon the request.



The Steamship City of Sydney

The Rescue of the Sydney's Passengers and Crew

WHILE the seas were threatening to demolish the Red Cross liner City of Sydney, which ran on the Sambro Rocks twenty-five miles east of Halifax, N. S., on March 17, wireless messages brought the tug Rosemary and other vessels to the rescue of those on the stranded craft. Altogether fifty-three persons were taken from the ship and landed at Halifax. Of these thirteen were passengers and forty members of the crew. The vessel, which carries a cargo valued at $300,000, will be a total loss.

Albert Blunheim of New York, one of the passengers, said he was asleep when the liner struck the rocks. The shock awoke him.

"When I went on deck," he said, "the steamship was rolling in a heavy sea. A heavy fog prevailed. Some of the passengers were not informed of the situation, and did not come up on deck for some time.

"The boat finally began to settle aft, and all of the passengers went to the forward decks. Four hours after we struck the tugboat Rosemary appeared, and the work of rescue was begun."

Blunheim said it took the crew twenty minutes to launch the first lifeboat which put out to the Rosemary.

The City of Sydney has been running regularly all winter between New York and St. John's, N. F. The vessel left New York on March 14, and, while the weather was thick though not boisterous all the way up the coast, the steamship made fair progress.

The fog was still dense, and Captain McDonald, believing that he was wide of Sambro Head, apparently steered for the entrance to a harbor.

The Sydney, according to reports, fetched up on Stag Rock, one of the outer ledges in the Sambro group, about 4 o'clock in the morning and at once began pounding, as the deep ground swell from the Atlantic was crashing onto the rocks. Within a short time the rocks had punctured the steamer's bottom in several places, and the sea sweeping in put out the fires.

The vessel was equipped with a Marconi wireless set. This continued in commission, and help was summoned from the life saving station at Sambro and from Halifax. The fog, however, was dense, and the life savers and tugs had great difficulty in locating the stranded steamer.

The Rosemary landed eleven passengers and thirty of the crew, and then other tugs reached the Sydney and began the work of taking off the remainder of the crew. The transfer was made with some difficulty as the sea had become rough. It was practically decided to abandon the vessel, temporarily at least.

Some Recent Marconi Sets*

By ROY A. WEAGANT

Designing Engineer of the American Marconi Company

THE purpose of this paper is to describe some recent radio sets designed for the Marconi Wireless Telegraph Company of America to meet the new specifications of the United States Navy, and to consider further certain interesting points in the design and operation of such sets.

The manufacturing plant and laboratories of this company are located at Aldene, N. J., where a force of approximately 200 men are engaged exclusively in the construction and testing of radio apparatus. For testing the sets under conditions of commercial operation, in addition to an artificial antenna, an outdoor aerial is provided. (Fig. 1.) This aerial is supported by two 200 feet (65 meter) steel towers, 450 feet (148 meters) apart.

For the sake of clearness, we shall consider the apparatus beginning with the point of entry of the direct current power, namely the switchboard, and pass successively through the automatic starter, the D. C. motor, the alternating current generator, the power transformer, the closed circuit of the transmitter, the open circuit of the transmitter and the relay key and receiver.

The switchboard (shown in front view of Fig. 2 and in rear view of Fig. 3) consists of a slate panel approximately 6 feet by 2.5 feet, and carries the following instruments: D. C. voltmeter, D. C. ammeter, A. C. voltmeter, A. C. ammeter, A. C. wattmeter, frequency meter, motor field rheostat, generator field rheostat, main A. C. switch, main D. C. switch, D. C. circuit breaker, solenoid switch for opening the A. C. field circuit and one side of the A. C. armature circuit (this solenoid switch is ordinarily remotely controlled by the aerial switch, but may be controlled by) a double pole switch on the panel board; a push button for controlling the automatic starter, and a spare switch.

Fig. 4 shows the marine type of automatic starter supplied by the Cutler-Hammer Company, which is mounted on a slate panel, together with seven-pole double-throw switch, the purpose of which is to connect the automatic starter to either of two motor generators. The entire assembly is enclosed in a metal case.

The motor generator provided with these sets, the armatures of which are shown in Fig. 5, is supplied by the Crocker-Wheeler Company. The machine is of the two-bearing type, semi-enclosed. It consists of a two-pole, 120-volt, 2,000 R. P. M., D. C. shunt wound motor and a 220-volt, 500-cycle, single-phase generator. The generator is of the rotating armature type, the complete rotor being shown in Fig. 6. This generator has special electrical characteristics which particularly fit it for use with quenched spark sets.

The protective devices employed consist essentially of condensers, spark gaps and resistance rods connected between each side of the line and ground. Fuses capable of carrying the total current of the circuit to which the device is connected are provided and so arranged that the short circuiting of any of the protective condensers or spark gaps blows the corresponding fuse. It is thus impossible to operate the set with a defective protective device in any of its circuits. The various units composing the device are mounted on a slab of insulating material and enclosed in a cast iron case. The points at which these devices are inserted are as follows: Motor armature and field circuits, generator armature and field circuits, primary of power

* Abstracted from the Proceedings of the Institute of Radio Engineers, Vol. 1, No. 4.

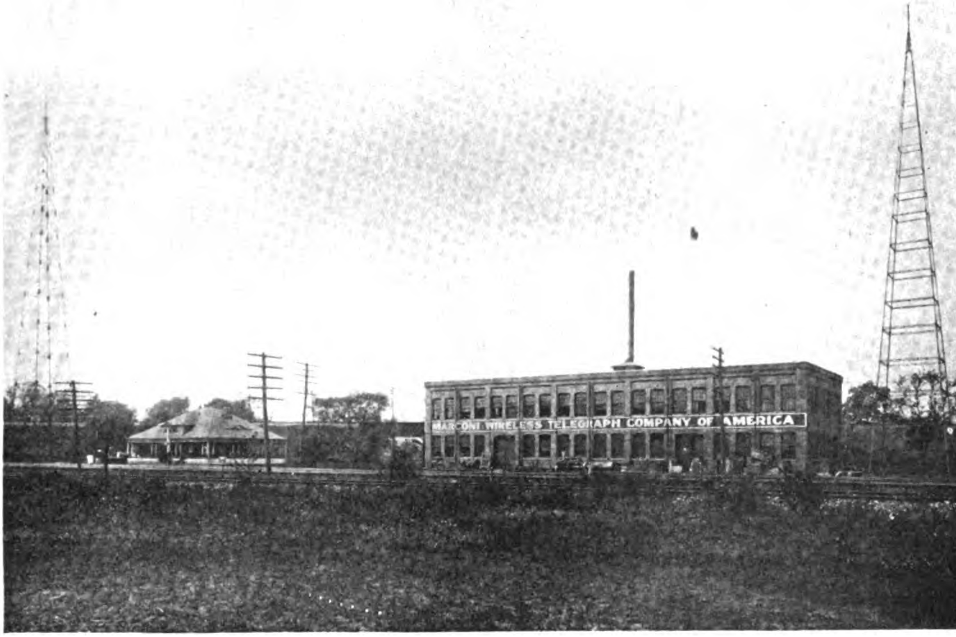


Fig. 1

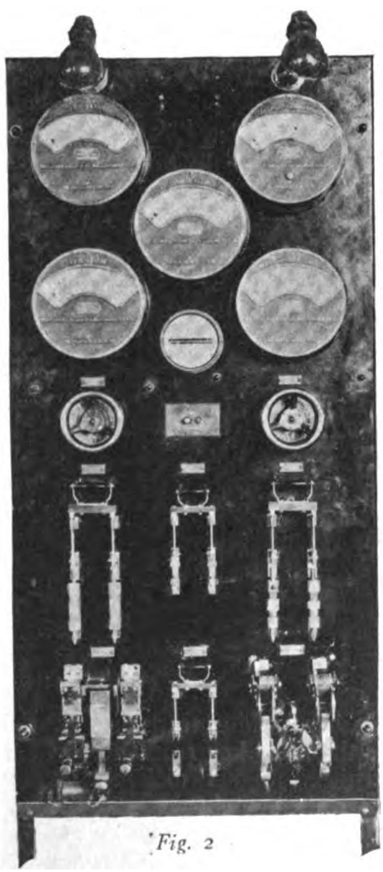


Fig. 2

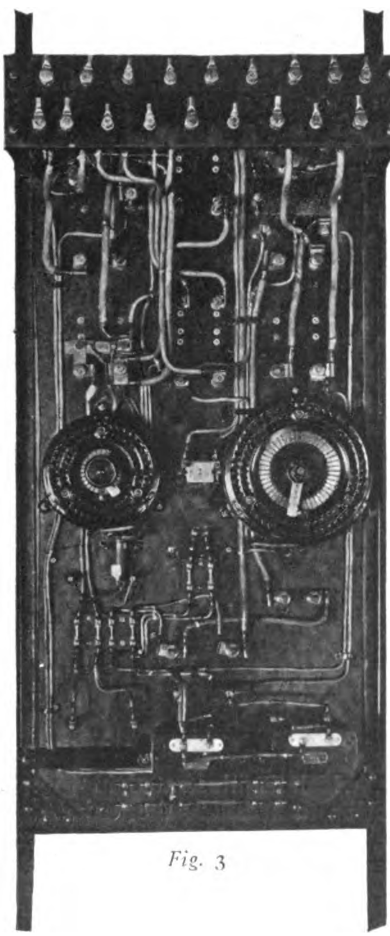


Fig. 3

transformer, blower and rotary gap motors (one protective device common to both field and armature).

The operator's key controls the relay tenna is opened, the detector is short-circuited and the telephone circuit is opened. The arrangement adopted makes it possible to receive between dots

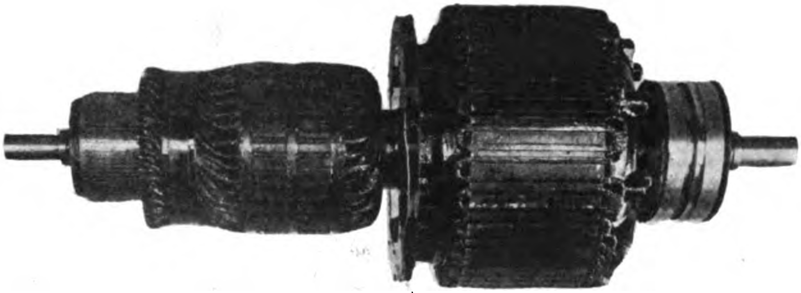


Fig. 5

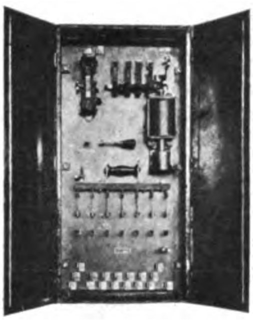


Fig. 4

Fig. 7

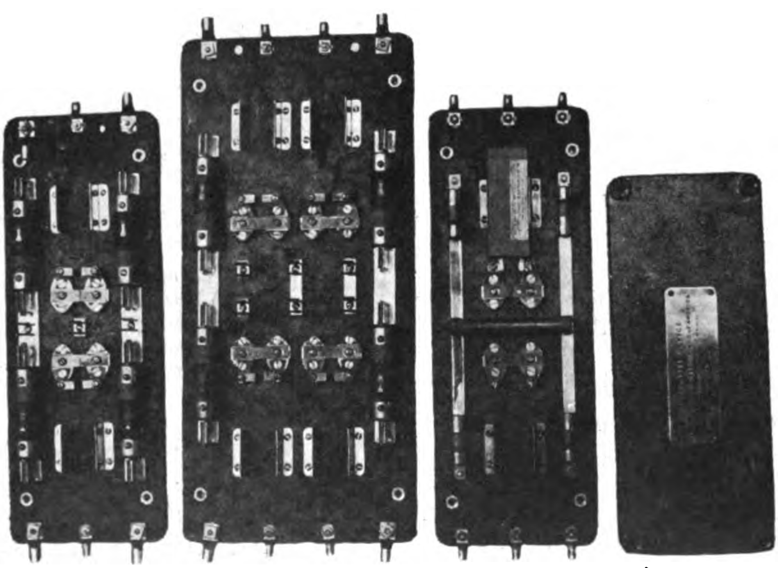


Fig. 6

key, which is illustrated in Fig. 7. In addition to breaking the main A. C. circuit, the relay key operates contacts whereby the ground circuit of the an- and dashes, while transmitting. Fig. 8 shows the relay key reactance, which can be adjusted to six different values by means of the switches mounted on its top.

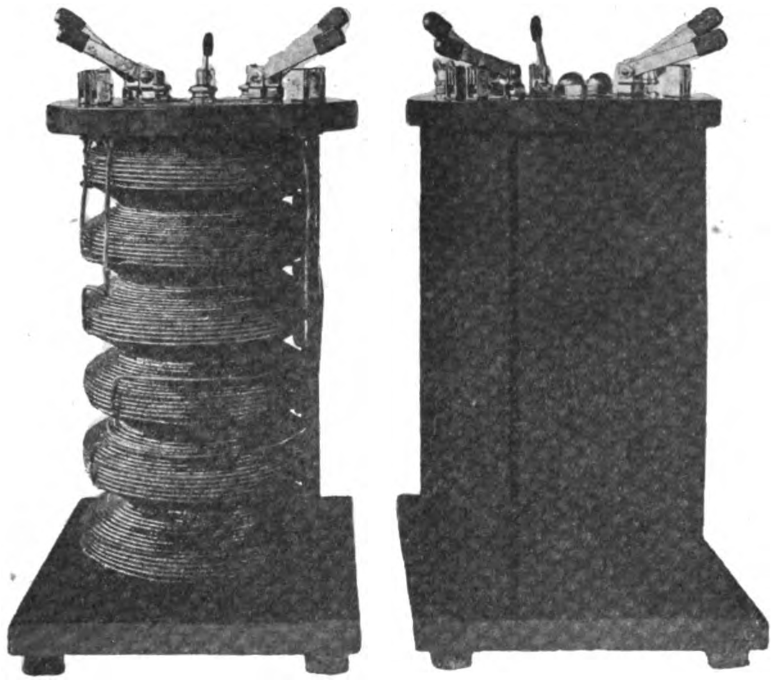


Fig. 8

This reactance is used to reduce arcing at the main A. C. contacts of the relay.

Photographs of the exterior and interior of the transformer are given in Figs. 9 and 10. The transformer is open core, air cooled. A perforated cover encloses and protects the secondary, while permitting a free circulation of air for cooling purposes. Two insulators on the top of the case carry the secondary terminals, and a third insulator carries a metallic ball connected to ground. The metal terminals at the tops of these insulators act as protective spark gaps and limit the potential strains between the secondary terminals or between the secondary winding and ground. The danger of puncturing the insulation between the primary and secondary winding through resonance phenomena (and consequent enormous rises of potential) in the transformer secondary capacity circuit, when the connections to the spark gap are accidentally opened, is thus obviated by the connection to ground on the third protective gap terminal.

The transmitter construction will next be considered in detail. The complete 5 K. W. transmitter is shown in front, side and rear views in Figs. 11, 12 and 13. The transmitter consists of a number of parts conveniently and compactly arranged and supported on a slate panel. The units are as follows: A quenched spark gap with blower (A), leyden jar

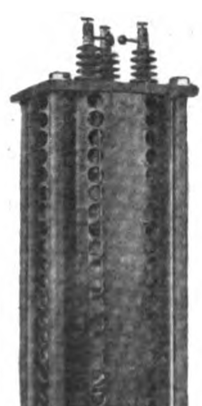


Fig. 9

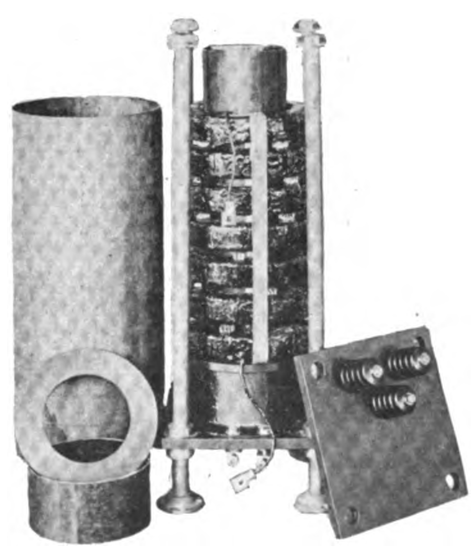


Fig. 10

condenser and rack (B), an oscillation transformer (inductive coupler) (C), the aerial inductance (D), a switch for changing wave lengths (E), and an aerial ammeter (F).

The transmitter here shown is designed so that eight definite and predetermined wave lengths lying between 600 and 2,000 meters may be instantly obtained by the setting of a single rotary switch, E, which makes connections in C, until the primary circuit shows the desired wave length as indicated on a wave meter. The antenna is then tuned by rotating the handle of the aerial inductance, D, until the aerial ammeter, F, gives the maximum indication. During this process, the coupling between the primary and the antenna circuits must be varied, which can be readily accomplished by pushing the handle of the oscillation transformer, C, in or out. It

Fig. 11

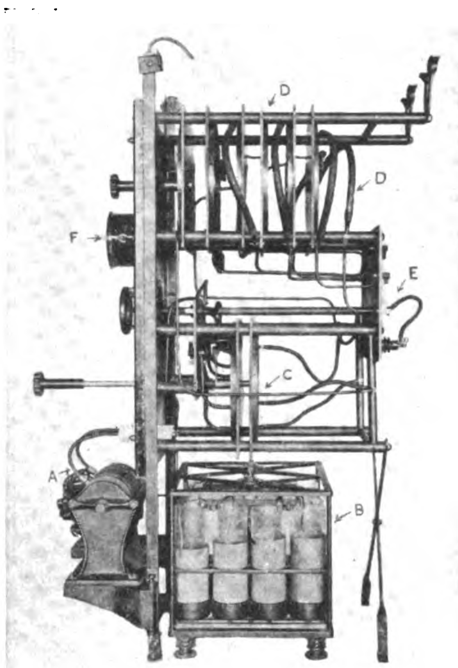


Fig. 12

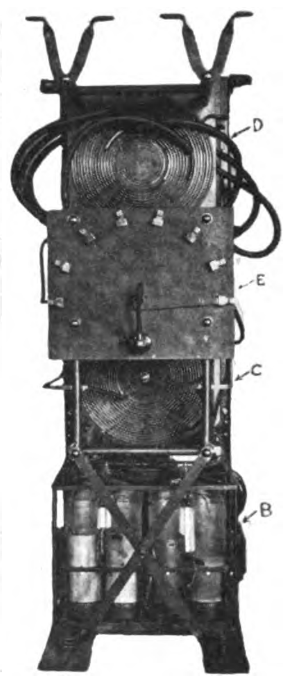


Fig. 13

both open and closed circuits. A preliminary adjustment to suit the particular antenna used is necessary. The connections (which are particularly well shown in Figs. 12 and 13) from the switch in the aerial circuit to the aerial inductance are made through very heavily insulated flexible cables. The calibration of the primary circuit is accomplished at the factory. The fixed wave lengths used in these sets are 625, 750, 875, 1,000, 1,300, 1,575, 1,800 and 2,000 meters.

It is also possible to obtain any intermediate wave length between the designated limits by setting the fixed wave length switch to the wave length lying immediately below that desired, and rotating the handle of the inductive coupler, will be seen by reference to the illustrations that the wave length changing switch E consists of two blades mounted on a micarta tube at a separation of about 24 inches (60 cm.), these blades being arranged to rotate with the switch handle. Supporting the jaws of the switch, which are connected to the appropriate taps on the inductances, are two micarta plates through which the micarta tube supporting the blades passes. The support of the primary switch is the one nearer the panel, and the support of the secondary switch is at the extreme rear of the unit.

The oscillation transformer consists of two spirals, the primary one being fixed and the secondary being movable in

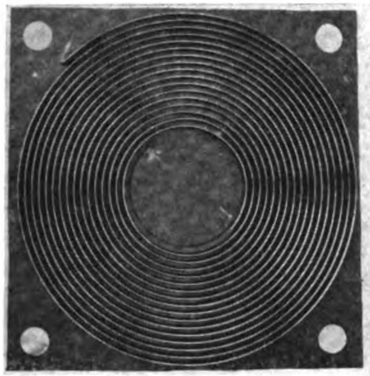


Fig. 14

such a way as always to remain parallel to the primary. These coils, which are shown in Fig. 14, consist of copper ribbon wound in a spiral groove cut in an insulating plate support. The plate supports are placed facing each other. Eight taps are taken from the primary to the wave length switch and a sliding contact is arranged so that rotation of the handle of the oscillation transformer produces a continuous variation of inductance sufficient to cover the range between any two fixed wave lengths.

Attached to the secondary are three flexible leads. The first of these is connected to the continuously variable portion of the antenna tuning inductance and thence to the ground. The second tap is connected to the first jaw of the wave length switch. The third tap is connected to the end of the antenna tuning inductance, which is variable in steps. It will thus be seen that the aerial tuning inductance consists of two portions: a continuously variable portion which is nearer the ground than the secondary of the inductive coupler, and a portion which is variable in steps, consisting of a number of coils placed nearer the antenna than the secondary of the inductive coupler. The basis of this arrangement is the necessity of using less than the entire secondary coil of the inductive coupler for tuning the antenna at short wave lengths and the further necessity of using the entire secondary coil of the coupler to obtain ***sufficient coupling*** at *longer* wave lengths. The advantage of placing the continuously variable portion of the antenna tuning inductance in the ground side of the inductive coupler is that it is then in circuit regardless of the position of the wave length switch. The portion of the aerial tuning inductance which is variable in steps consists of five spirals, identical in construction with those of the inductive coupler. From these, seven are brought to the remaining

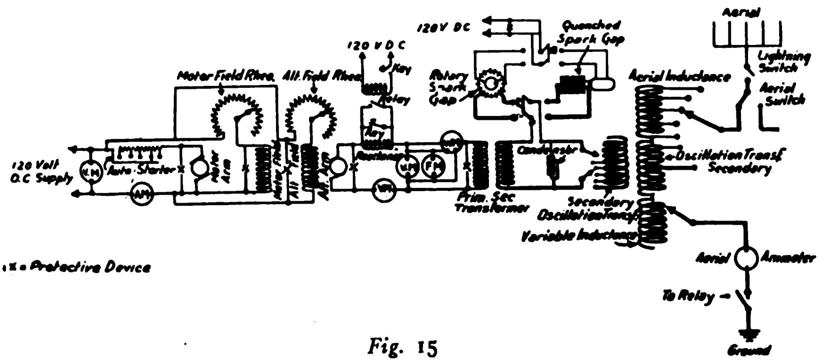


Fig. 15

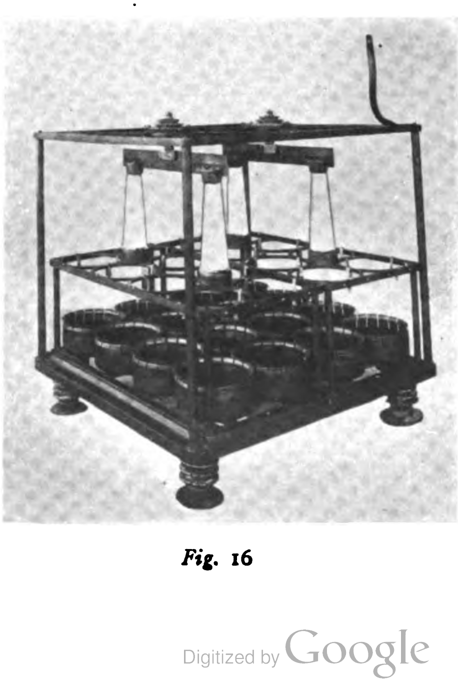


Fig. 16

jaws on the secondary portion of the wave length switch.

The primary condenser consists of sixteen leyden jars, each having a capacity of 0.002 μf. The entire number is connected in parallel. The jars are of the usual silver and copper-plated type. Each group of eight jars is mounted on a tray which can be drawn out of the rack through the front of the panel without disturbing any connections. This is accomplished after swinging the spark gap at the front of the panel on either of its hinges, so that it will no longer obstruct the passage of the tray. Broken or defective jars are thus easily replaced. The rack and the sliding trays are shown in Figs. 16 and 17.

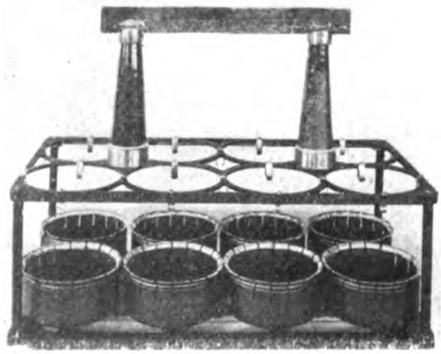


Fig. 17

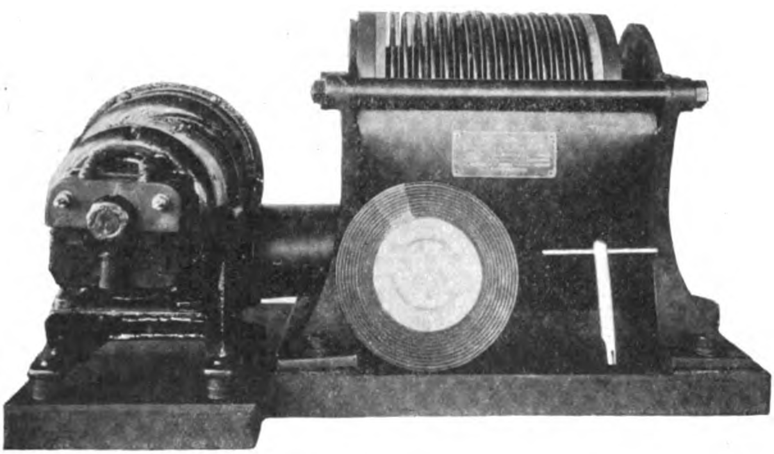


Fig. 18

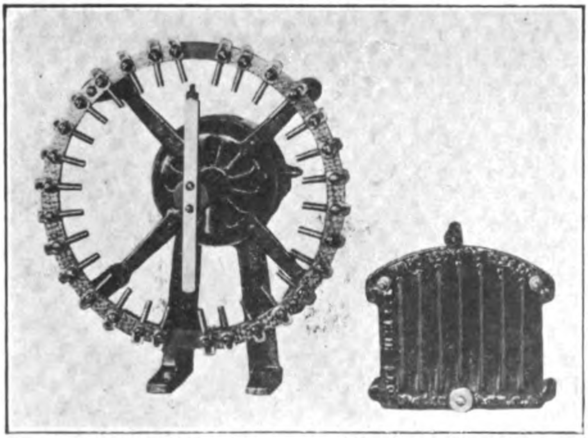


Fig. 19

The construction of the spark gap is clearly visible in Fig. 18. It consists of fifteen plates with fourteen insulating gaskets between them. These plates and gaskets rest on a tube of insulating material, and later displacement is prevented by two more tubes at the sides. Through these tubes run steel tie rods which hold the two vertical end castings rigidly in place. A set screw at one end per-

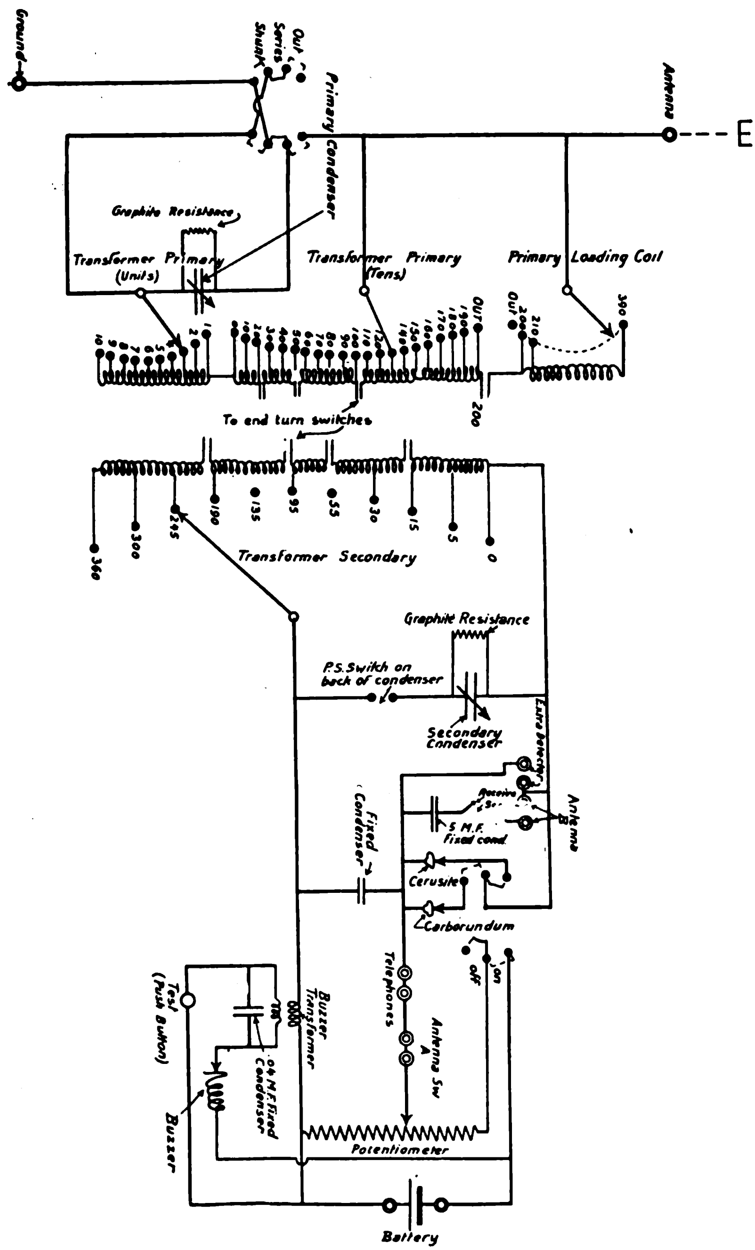

Ground
Out
Series
Shunt
Primary Condenser
Antenna
E
Graphite Resistance
Transformer Primary (Units)
Transformer Primary (Tens)
Primary Loading Coil
To end turn switches
Transformer Secondary
Graphite Resistance
P.S. Switch on back of condenser
Secondary Condenser
Antenna B
S.M.F. Fixed cond.
Fixed Condenser
Cerusite
Carborundum
on
off
Telephones
Antenna Sw A
Buzzer Transformer
Test (Push Button)
.04 M.F. Fixed Condenser
Buzzer
Potentiometer
Battery

Fig. 20

mits clamping the plates and gaskets very tightly against each other. Between the two end plates of the gap and the end castings are heavy discs of insulating material. The gap plates consist of copper castings. The sparking surfaces are raised above the gasket bearing surfaces to such an extent that the separation of the sparking surfaces when the gap is either side. In these sets an auxiliary rotary spark gap of the non-synchronous type is provided. It is intended for special naval service in times of war.

A six-pole double-throw-switch provides means for shifting from the manually-operated antenna switch to the relay key.

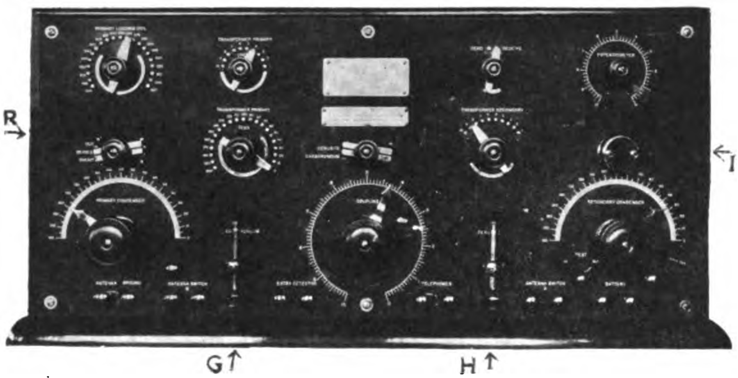


Fig. 21

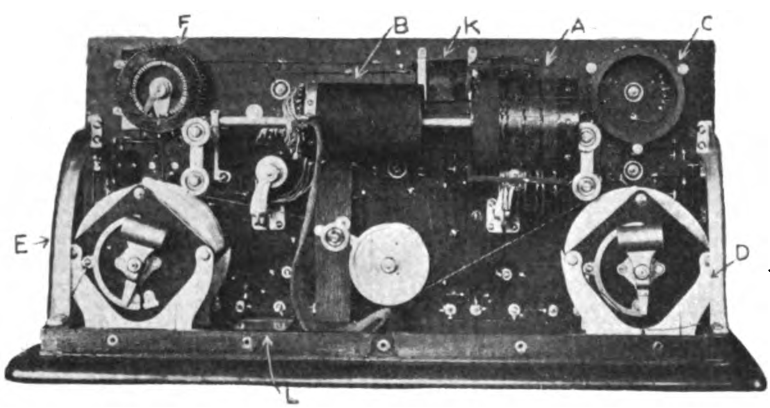


Fig. 22

assembled is approximately one-third the thickness of the gasket itself.

Attached to the gap is a motor-driven blower, which forces air up between the flanges of the plates and prevents overheating. The construction of the side of the gap is such that the cooling air must pass between the flanges before escaping. The rotation of the gap and blower motor about either of two hinges is necessitated by the limited space available in many ship installations and the difficulty of reaching the back of the panel from

The receiver, the wiring diagram of which is given in Fig. 20, is of the two-circuit, inductively coupled type. It contains the following parts: Primary of the inductive coupler (A), secondary of the inductive coupler (B), antenna tuning inductance in the primary circuit (C), primary variable air condenser (D), secondary variable air condenser (E), potentiometer (F), carborundum detector (G), cerusite detector (H), test buzzer (I), coupling controller (J), detector protective condenser (K), detector stopping condenser (L), coupling primary switch (M), (dividing the transformer primary into steps of ten turns), coupler primary switch (N) (for variation by single turns), aerial tuning inductance

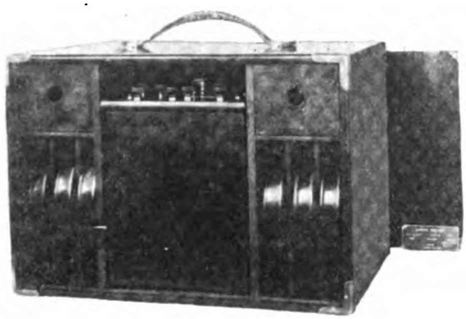


Fig. 24

switch (O), transformer secondary switch (P), test buzzer switch (Q), primary condenser switch for connecting condenser in series to or in parallel with the total primary inductance or for disconnecting it entirely (R).

The inductive coupler consists of a fixed primary, and a movable secondary mounted on a rod and controlled in its motion by a flexible metal band passing over a number of pulleys. The coupling is thus varied through a wide range by a single rotary motion of a knob. Both primary and secondary coils are divided into four sections connected to the controlling switches in such a way that dead ends are avoided. Sufficient inductance is provided in both circuits to work up to wave lengths of 7,000 meters in the case of the "long range" tuner, and up to 4,000 meters in the case of the "short range" tuner. Compactness of the coils (in combination with the unusual range of wave lengths) demands special coil construction in order that high efficiency may be obtained. The variable air condensers are of the conventional type, counterbalanced so as to rest in equilib-

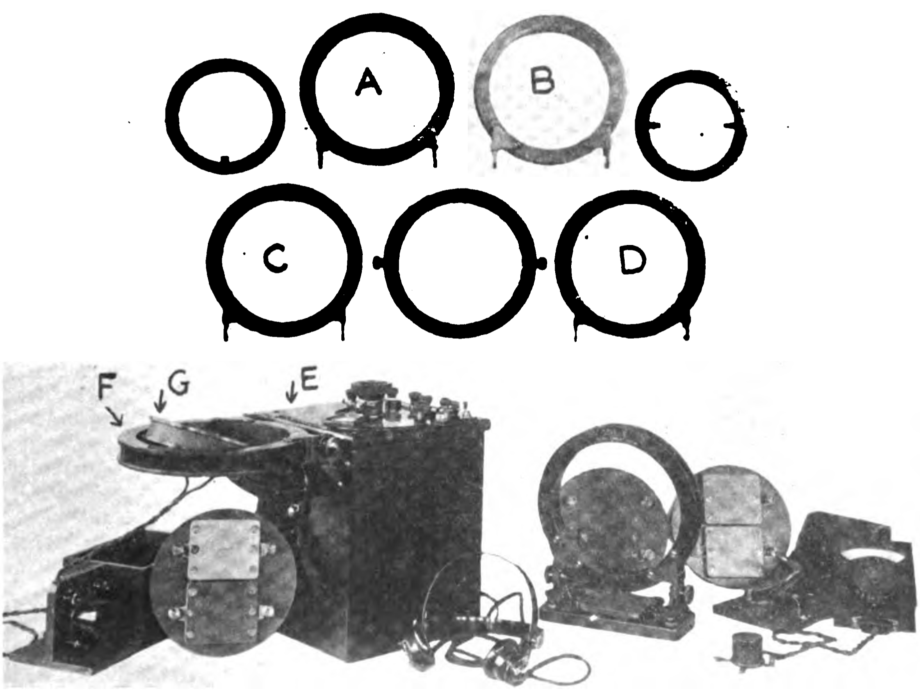


Fig. 25

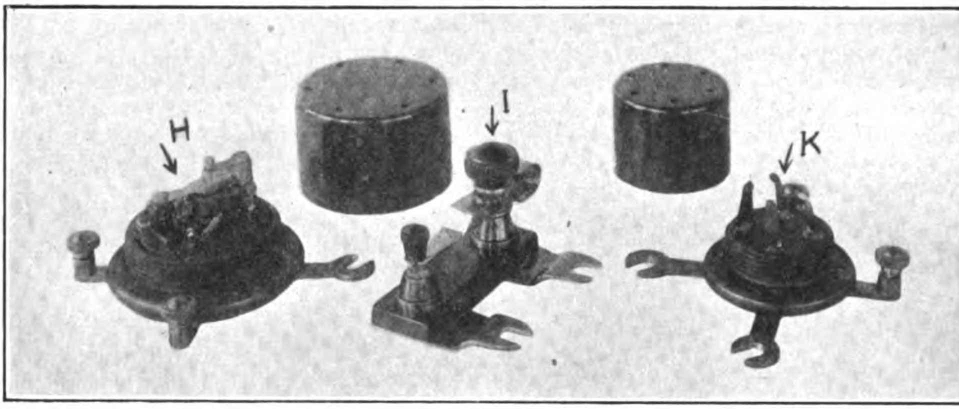


Fig. 26

rium in any position. The potentiometer, which provides for fine adjustment of the voltage across the detector, is of a rotary type.

Two detectors, of different operating characteristics, are provided. The carborundum detector is of moderate sensitiveness and great stability. The cerusite detector is of extreme sensitiveness. A switch is provided for using either of these at will. Separate binding posts are provided in order that any other detector can be connected in place of those furnished.

During transmission, a large condenser (K) is connected across the detector to protect it against being thrown out of adjustment. The entire receiving apparatus is so mounted that the exterior case can be removed without interfering in any way with the connections, all parts being mounted on the heavy front panel, which is supported by right angle brackets attached to the base.

The Marconi wavemeter, from the designs of Mr. Harry Shoemaker, is shown in Fig. 24 through 28. Fig. 24 shows the instrument in its case. Fig. 25 shows the various elements of the instrument, A, B, C and D being the coils used to cover the various ranges of wave lengths. E is the condenser case, with attached brackets for holding the inductances F

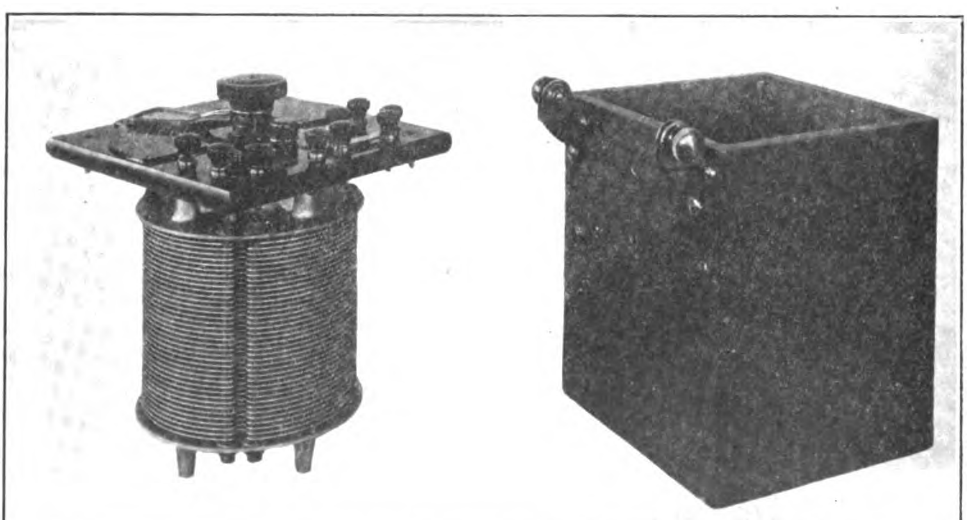


Fig. 27

and G. The buzzer, H, the detector, I, and the thermo element, K (of Fig. 26) are also mounted on this case. The variable air condenser is shown in Fig. 27, while Fig. 28 shows the complete instrument with the galvanometer, L, and the "pickup" coils, L and M.

This instrument covers a range of wave lengths from 100 to 5,000 meters, and is arranged for measurements of inductance, capacity and decrement as well as for wave length. A plug containing a known resistance may be inserted in the oscillatory circuit, and the decrement of the instrument itself at any wave length determined. In addition, coils are provided for measuring the wave length of incoming signals, in which case the instrument is employed in much the same way as an ordinary receiver.

We shall now discuss briefly certain matters of design and construction. The alternating current instruments on the power switchboards must be so constructed as to read correctly on wave forms differing widely from the pure sinusoidal type. The alternating current circuits need not be provided with any special protective devices against excess current, inasmuch as the characteristics of the generator are such that it is not possible to draw more than the load current. Nevertheless, these circuits have been provided with fuses. Fuses are used because it has been found impossible to construct suitable 500-cycle circuit breakers.

The motor of the motor generator set must be provided with closer speed regulation than is common with the usual commercial set, namely, from 3 to 5 per cent. The generator is purposely designed to have very poor regulation, so that the voltage drops markedly as the load is applied.

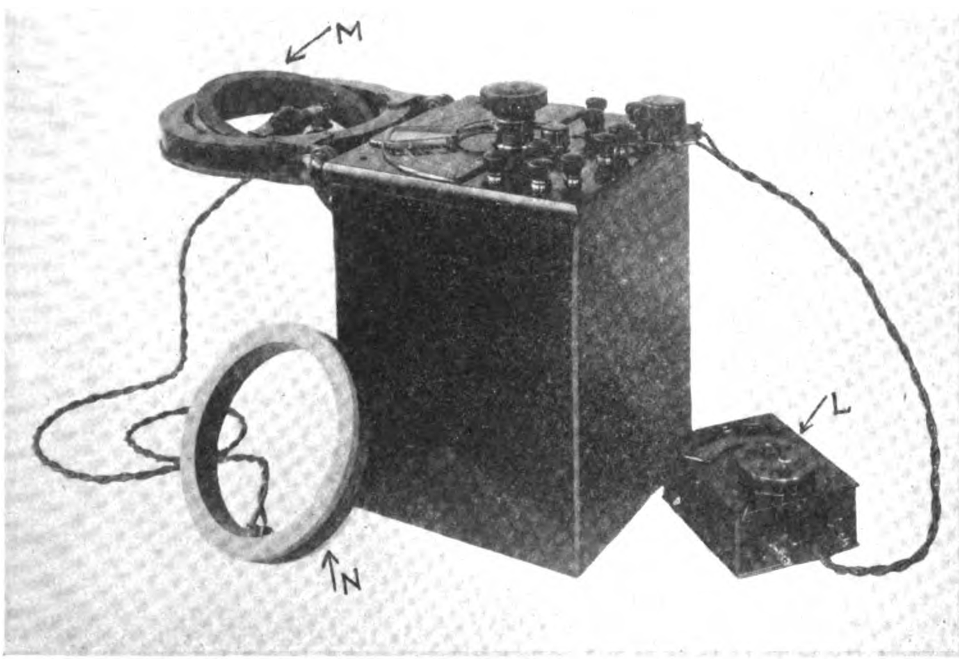


Fig. 28

A complete theory of the action of the transformer, with particular consideration to the transient phenomena involved, is beyond the scope of this paper.

The quenched gap exerts a frequently neglected influence on the coupling required for satisfactory operation of the transmitter. The greater the number of sections and the shorter each section, the closer the coupling which must be used. It is possible therefore to work within a desired range of coupling by properly choosing the number of gap sections.

In the type of receiving set previously described, it has been necessary to cover in one apparatus an extreme range of wave lengths. However, experience shows that such receivers are preferably subdivided into those intended for wave lengths below 1,500 meters, and those designed for wave lengths greater than 1,500 meters. Radically different types of construction are required in the two cases to obtain maximum efficiency. It may also be noted that the efficiency of the modern receiver is far less than that of the transmitter, and that there is room for much improvement in this regard. It appears further, as the result of considerable experiment, that with a given aerial, the receiver must be specially designed for it if maximum efficiency is to be obtained.

The foregoing general remarks concerning quenched spark transmitter design are to be taken as merely indicative of the directions in which future research may be profitably carried on, rather than any complete solution of the problems involved.

THE NAVY CHANGES ITS PLANS

Rear Admiral Robert S. Griffin, chief of the Bureau of Construction, Washington, D. C., has announced that the Navy Department has changed its proposals of establishing a chain of wireless stations to complete wireless communication between the national capital and Manila. Wireless stations at Guam and Samoa are to be eliminated and high-power stations will be erected at San Diego, Panama, Honolulu and Manila. The station on the Isthmus, which will be located at Darien, will be completed about January 1, 1915, according to present plans.

DR. MAWSON WEDS

A dispatch from Melbourne, Australia, says that Dr. Douglas Mawson, the Antarctic explorer, was recently married to Miss Delprat, daughter of a mine owner. Dr. Mawson has just returned from a trip in which he faced many perils. Miss Delprat and Dr. Mawson became engaged before the explorer started on his last expedition. At that time she was nineteen years old.

MEMORIAL SERVICE FOR FERDINAND J. KUEHN

Although Ferdinand J. Kuehn, wireless operator on the sunken steamship Monroe, found a grave near that of the wrecked craft, the fame of his heroism still lives. Kuehn remained at his post with danger imminent and went to his death in order to save a woman from a similar fate. The Auditorium of the East Side branch of the Y. M. C. A., 153 East Eighty-sixth street, New York, was crowded to the doors when the memorial service was held for him on March 1. Wireless operators from the majority of large vessels in port at that city and several from Philadelphia, Baltimore and Boston were in attendance. Among those who expressed their appreciation of Kuehn's valor was John Bottomley, vice president of the Marconi Wireless Telegraph Company of America.

Mr. Bottomley praised Kuehn as one of the great number of wireless operators who performed their duties without faltering. He declared that Kuehn was one of the highest minded young men in the Marconi service, his name standing at the head of the long list of heroes whose deeds were coupled with wireless telegraph exploits in marine disasters. Kuehn's example, he said, was an inspiration to others.

L. E. Russell, quartermaster of the Monroe, told how he had seen Kuehn take off his own life preserver and give it to a woman. Joseph K. Van Demberg, principal of Public School No. 40, where Kuehn was a pupil for eight years, and Edward Freeman, a schoolmate and erstwhile shipmate of the wireless operator on board the Ancon, of the Panama Steamship line, also spoke. The marine band on the battleship North Dakota furnished music for the occasion.

Kuehn's name has been added to the roll of honor of Public School No. 40, which is at 320 East Twentieth street, New York. He installed a wireless set on the roof of the school building while he was a pupil in the institution.

The Monroe, which was owned by the Old Dominion line, and the Nantucket, of the Merchants and Miners Transportation Company, came into collision off Hog Island, sixty miles from Cape Charles, on January 30 last.

MARCONI SET AT REPORTERS' DINNER

A Marconi wireless telegraph set was used to add to the gayety of the annual dinner of the City Hall Reporters' Association of New York held on February 21 at the Hotel Astor. The apparatus was set up in the banquet hall and was seen in actual operation in charge of two Marconi operators. The dinner had hardly started when the "messages" began to be received. The first "marconigram" was as follows:

"You have my unconditional pardon in advance. You need not waive immunity. Go the limit.

"Woodrow Wilson."

to Chief Justice Edward F. O'Dwyer, of the City Court, read:

"Sit down. You're rocking the boat."

Several "messages" came to Mayor Mitchell. One was as follows:

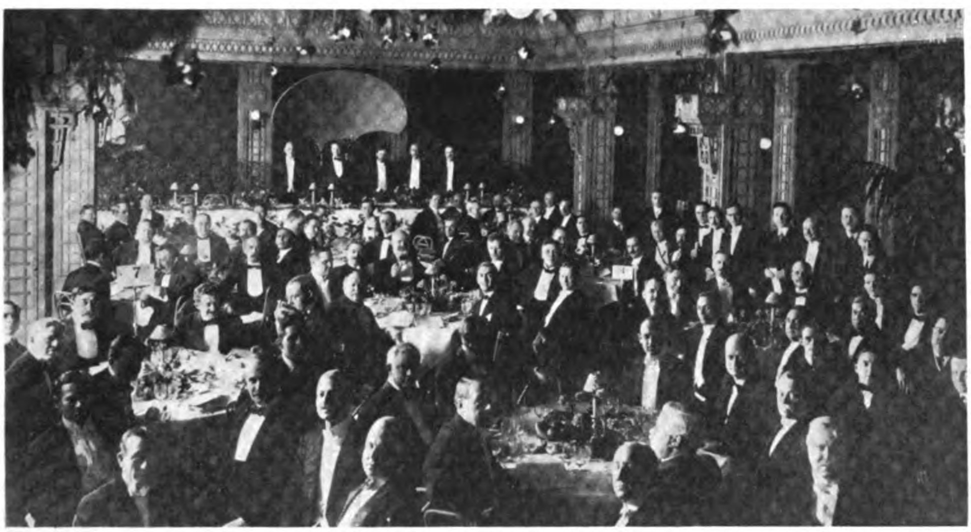
"You made me what I am to-day. I hope you're satisfied.

"Rhinelander Waldo."

A "message" to the City of New York from the City of San Francisco read:

"Shake!"

The reporters had prepared an issue of The Wrecker, an annual publication, which is a burlesque on the City Record. The Wrecker contained articles about various municipal matters.



Annual dinner of the City Hall Reporters' Association of New York at the Hotel Astor

South America was next heard from. This was the "message":

"What does Mitchell want with six secretaries? I found one, Loeb, sufficient. "Theodore Roosevelt."

Street Cleaning Commissioner Featherson was among those at the dinner. He was much surprised when the following "marconigram" was read:

"Have just read your monumental claims of success in snow removal. You've got me skinned to death.

"Doc. Cook."

Charles F. Murphy evidently used the wireless, too. His "marconigram," sent

OPERATOR VIOLATES THE LAW

Commercial wireless operators holding licenses issued by the Department of Commerce should be very careful to have the service record on the back of these licenses properly filled in and signed by the captain or official under whom they are employed.

Recently a commercial operator, either through ignorance or intent, forged the signatures of two captains under whom he had served to the license record. The Secretary of Commerce has referred the papers in the case to the United States Attorney in order that prosecution for forgery may be instituted.

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, The College of the City of New York

ARTICLE VII

The measurement of inductance at low voltages and audio frequencies, using the Wheatstone Bridge, is fully discussed. Various types of standard inductances, of transmitting and receiving inductances, and of inductive couplers are described. A convenient form of bridge is then considered. The application of inductance measurements to the determination of mutual inductance and coupling coefficient is explained.

Section 21.—MEASUREMENT OF INDUCTANCE AT AUDIO FREQUENCIES AND LOW VOLTAGE BY THE BRIDGE METHOD. It is frequently necessary to measure the inductance of coils at low (audio) frequencies and low voltages. For example, in determining the distributed capacity of a coil, its inductance was assumed to be calculated or measured. In such a case, the inductance, if measured, should be determined at low frequencies, else the result obtained will be markedly influenced by the frequency employed, and this last is precisely what is to be avoided. In other words, in such cases the true inductance or what might be called the inductance at an infinitely low frequency, is the quantity which is desired. For ordinary air core coils, particularly of single layer types, the method here described practically meets the requirements outlined above. Furthermore, it illustrates admirably the complication introduced in the measurement of inductance by the inevitable accompanying resistance, and one of the ways in which this influence of the resistance of an inductive coil may be eliminated in measurement.

(a) THEORY. Consider the arrangement of circuits of the Wheatstone Bridge shown in Fig. 36. As will be seen, the current which is supplied by the generator, II (which we shall take to be an alternator for the present), divides at the point A. A portion will pass through the path AXB and a portion through the path AYB, assuming that the bridge is "balanced," and that no current passes through the indicator, I. The condition that no current shall pass through the indicator I is that the potentials at X and Y shall be equal. In order that the potentials at X and Y shall be equal, the following relation must hold:

(Impedance of Path AX)/(Impedance of Path AXB) = (Impedance of Path AY)/(Impedance of Path AYB).

(Since, for alternating current circuits, the drop of potential along any current-carrying element is proportional to its impedance). However, by Formula (38) of Article VI of this series,

Impedance of Path AX $= \sqrt{R_1^2 + \omega^2 L_1^2}$ and

Impedance of Path AXB $= \sqrt{(R_1+R_2)^2 + \omega^2 (L_1+L_2)^2}$

The impedance of paths AY and AYB are merely their resistances. Consequently,

$$\frac{\sqrt{R_1^2 + \omega^2 L_1^2}}{\sqrt{(R_1+R_2)^2 + \omega^2 (L_1+L_2)^2}} = \frac{R_3}{R_4}$$

It is obvious that the relation just given is satisfied if

$$\frac{R_1}{R_2} = \frac{R_3}{R_4} \text{ and } \frac{L_1}{L_2} = \frac{R_3}{R_4}. \qquad (60)$$

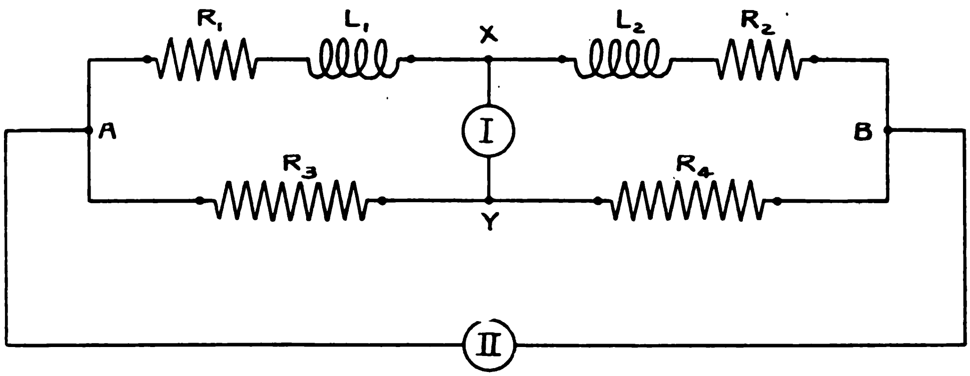


Fig. 36

The first relation given is also that holding for the bridge when balanced for direct current only, while both together express the balance conditions for alternating current as well.

From a consideration of Formulas (60), we reach the conclusion that one of the simplest ways of satisfying the two equations is first to balance the bridge for resistance, using direct current; and then to balance it for inductance with alternating current, using an alternating current indicator, such as a telephone receiver, instead of a galvanometer as before.

It will be noted that we have assumed that the inductance to be measured and the standard are both free from capacity. Strictly, this is never true, since distributed capacity is always present. Its effect could be allowed for, but since it will be very small at the frequencies employed, we shall not further consider it. In addition, we have separated the resistance and inductance of each of the coils as if they were physically distinct elements connected in series instead of being embodied in one and the same coil. No error is thus introduced under the conditions of this experiment.

It can be shown by a mathematical discussion too lengthy to be given here, that the maximum sensitiveness and accuracy can be obtained in such a Wheatstone Bridge when the impedances of the four branches are equal. Suppose that we are comparing inductances of the order of magnitude of 0.001 henry at a frequency of 500 cycles, and that the resistance of each of these coils is about 1 ohm. The impedance of each will be found to be about 3.3 ohms. Consequently, if a slide wire bridge were used, an appropriate value of the resistance of the bridge wire would be about 6.6 ohms. In practice, it is usually convenient to use a somewhat higher resistance, because the form of alternating current generator used (namely a buzzer) is incapable of supplying very large currents. Success in the measurement, since a low resistance bridge is used, will be found to be dependent on obtaining large currents through the bridge, and a step-down transformer may be used for that purpose as indicated in the description below.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. A wiring diagram of the apparatus, as set up, is shown in Fig. 37. At the top of the diagram is shown a typical slide-wire Wheatstone Bridge. It will be noticed that where the known and unknown resistances are usually inserted, we have placed instead the known and unknown inductances L_1 and L_n. In addition, supplementary, finely variable, external resistances, R_1 and R_n are provided. At least one of these is generally needed. The points X and Y of the bridge, which are usually connected to a sensitive galvanometer indicator, are in this case connected to the double pole, double throw switch F. This enables points X and Y to be connected readily either to the direct current galvanometer G or to the sensitive telephone receiver T, which latter is employed as the indicator for alternating currents. The ends of the slide wire, A and B, are also connected to a double pole, double throw switch. They may be connected either to the battery, E, or to the low voltage, high current side of the step-down transformer, J. One terminal of the high voltage side of the transformer J is connected directly to the buzzer pivot point S, on one side of break of the buzzer. The other terminal of the high voltage side of transformer J is connected through the large condenser K to the remaining terminal of the buzzer break, namely Q. The buzzer itself is kept in vibration by the battery N, the buzzer current being regulated by the resistance P. Every time the buzzer contact is opened, the condenser K is charged to a fairly high potential because of the effect of the inductance of the buzzer electro-magnet M. When the contact is next closed, the condenser K discharges through the high voltage side of transformer J, and a strong pulse of current is delivered at the switch H, whence it may be carried to points A and B of the bridge. It is to be noticed that the transformer *must* be so connected that the low voltage side feeds the bridge. Otherwise the sensitiveness will be very small, and no accuracy of measurement can be secured. The reason for this, as pointed out above, is the low resistance of the bridge arms, which therefore require fairly high currents to produce appreciable drops of potential across them.

A photograph of the various forms of standard inductance which may be used for this experiment is given in Fig. 38. To the left are two wooden core, single layer helices, which may be used as standards up to moderately high frequencies. Standard multi-layer inductances wound on marble, for use on low frequencies, are seen in the center. They range in value from 0.0001 to 0.1 henry. To the right are several air core inductances which are frequently used as secondary standards at radio frequencies. In Fig. 39, various types of unknown inductances are shown. They give a good idea of common methods of building transmitting inductances. To the left, in the rear row, is seen a transmitting inductance for Poulsen arc circuits. It is divided into sections which can be readily tapped. The winding itself is made of a number of heavy, solid copper, cotton insulated wires in parallel, the whole being wound on a press-board core. To the right of it is a helix of flat copper band wound edgewise, beside which stands a helix of round copper tubing. In each of these latter coils the windings are supported by notches in vertical rubber guides. In the front row, starting from the left, is shown a single, heavy copper conductor, low voltage inductance, divided into sections; a multi-layer low voltage inductance, with so-called staggered winding to diminish distributed capacity; a "litzendraht" or multiply-stranded wire helix for long wave length work on arc circuits, and a flat band coil, the band being wound into a sort of hexagonal spiral. A number of more complex types which are sometimes used in the laboratory are not shown, their consideration being unnecessary.

The most essential parts of the apparatus are shown set up in Fig. 40. In the background, the resistances R_1 and R_n, the inductances L_1 and L_n, and the buzzer exciter in its sound-proof box, are visible. In front of them stands a precision Wheatstone Bridge. The telephone receiver and galvanometer are in the foreground. In the measurement itself, a supplementary, nearly non-inductive, low resistance was sometimes used instead of the plug resistance boxes

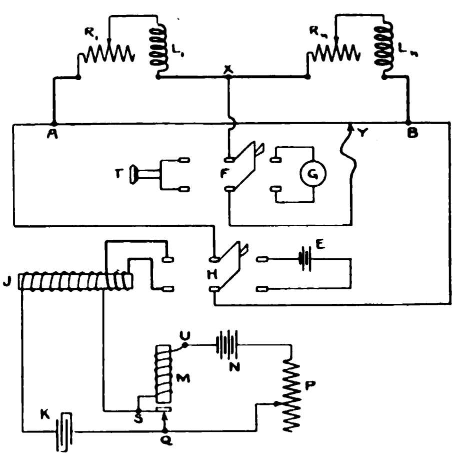


Fig. 37

shown. This supplementary resistance consisted of about 45 cm. (18 inches) of 0.02 inch diameter "Therlo" wire, having a total resistance of 1.05 ohms. A

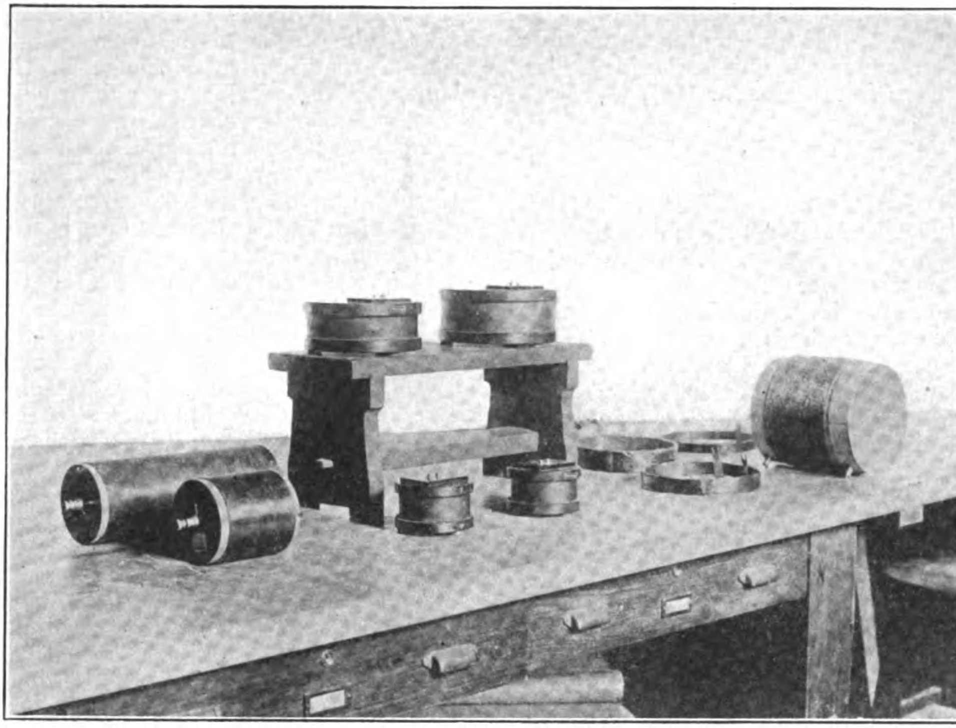


Fig. 38

slider made contact at any point of it, thus securing continuous variation. The galvanometer had a resistance of 381 ohms, and 1 division deflection represented 8.73 micro-amperes. The telephone receiver had a resistance of 2,000 ohms. Both galvanometer and receiver could be replaced by instruments of lower resistance to advantage. The buzzer used was the usual high pitch "Eco" buzzer. The condenser, K, was a 2 microfarad No. 21-D Western Electric condenser. The transformer, J, was a No. 5 Western Electric "induction coil," the resistance of the high voltage secondary being 149.2 ohms, and of the primary 0.39 ohm.

(c) PROCEDURE. The buzzer is set into operation, as high and clear a note as possible being obtained in the telephones T. R_1 and R_n are both set to zero resistance, and the slider Y is moved along the wire until a ***minimum*** of sound is heard. Both switches, F and H, are thrown to the left. Absolute silence in the receivers will not be obtained; the best that can be obtained at first is a comparatively weak sound at some point of the wire. When this has been secured, vary ***one*** of the resistances R_1 or R_n (which, as explained above, are preferably continuously variable) until the sound has become as feeble as it can be made by varying these resistances. When this is done, move the slider Y back and forth again until a new and more sharp minimum is secured. Then return to a second adjustment of the resistance R_1 or R_n. This process of adjusting alternately the resistance R_1 or R_n, and moving the slider Y till a minimum of sound is secured must be continued until the sharpest possible minimum is secured. Practically always it will be possible to localize the silence point within a millimeter or two on the scale of the slider Y. With the apparatus properly set up, and some knowledge of the resistances of the known and standard inductances, a little practice suffices to ensure a rapid and accurate measurement. Once the bridge is balanced the lengths of the arms are read off the slide wire. Thus, if the slider stands at 68.2 cm. from the left hand end of the wire, the arms are 68.2 cm. and 31.8 cm., the total length of the wire being 100.0 cm. In general, if these lengths are m and n (and assuming a uniform bridge wire), we have from Formula (60),

$$L_1 = \frac{m}{n} L_n \qquad (61)$$

(d) ERRORS OF THE METHOD, THEIR ELIMINATION; AND PROBABLE ACCURACY. It is obvious that, if the resistance of the unknown coil is quite large in comparison with its reactance (which is sometimes the unconsciously achieved state of affairs in coils used for radio-receiving apparatus), it will be more difficult to balance the bridge properly for inductance alone than when the resistances of the coils are small. In such cases, their resistance may "swamp" the inductance, and the measurement becomes less accurate. The distributed capacity of the coils is also a source of error in this measurement, though at the frequencies used and for inductances of less than about 0.1 henry, its effect will not be serious. The bridge wire, AB, has been assumed to be of uniform resistance per unit of length. This is usually not the case, particularly if very thin wire is used. For such thin wire, a small absolute change in the diameter of the wire at any point causes a larger percentage change in the cross-sectional area (and therefore, the resistance also) than for larger wire. In such cases it may be necessary to employ, instead of m and n in Formula (61), the corresponding true resistances, as measured in a Wheatstone Bridge, of the portions AY and YB of the bridge wire. The inductances L_1 and L_n, and the buzzer M and the transformer J should all be placed at considerable distances from each other to avoid inductive effects between them which would seriously influence the accuracy of the measurement. As examples of actual measurements, the following are given:

1. Standard Inductance $= L_n = 0.001$ henry. Resistance of $L_n = R_n = 1.0$ ohm. To secure balance, it was necessary to add a resistance of approximately 0.5 ohm to R_n. Balance point secured at

$$m = 73.5 \pm 0.1 \text{ cm.}$$
$$n = 26.5 \pm 0.1 \text{ cm.}$$

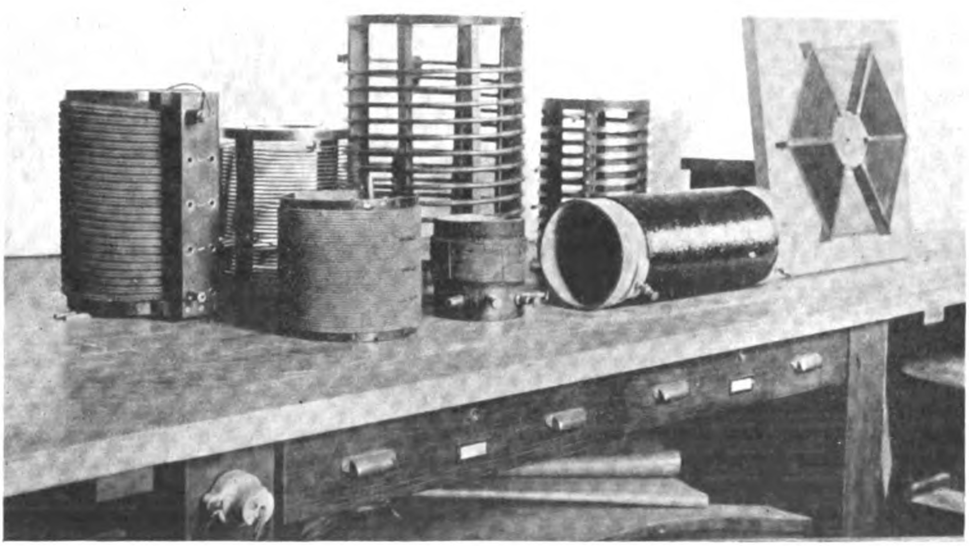


Fig. 39

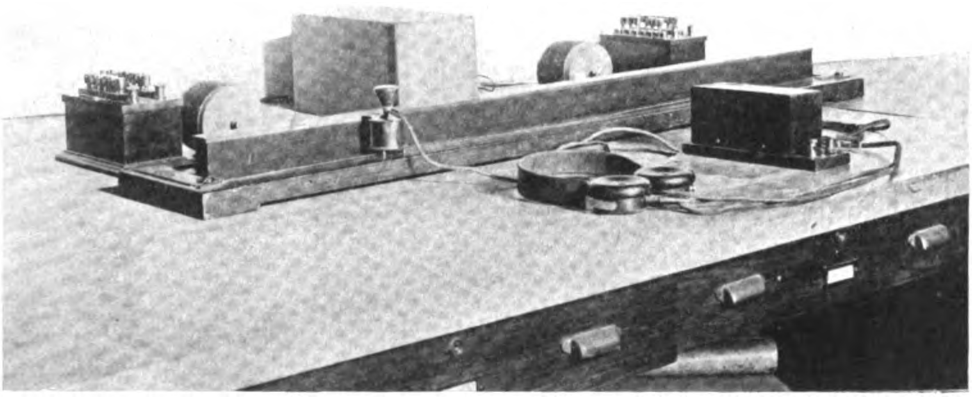


Fig. 40

Therefore $L_x = 0.000360$ hy. (Accurate to about 0.5%).

R_x = approximately 0.53 ohm.

2. Standard Inductance = L_n = 0.0001 henry.

Resistance of $L_n = R_n = 0.23$ ohm. To secure balance, it was necessary to a resistance of approximately 0.3 ohm to R_x. Balance point secured at

$$m = 21.6 \pm 0.2 \text{ cm.}$$
$$n = 78.4 \pm 0.2 \text{ cm.}$$

Therefore $L_x = 0.000363$ hy. (Accurate to about 1%.)

It is to be noted that as the value of the inductances are decreased, the measurement has a diminished accuracy.

To verify these results further, the resistance R_x was measured on a precision Wheatstone Bridge. It was found that $R_x = 0.50$ ohm.

The inductance L_x was then measured directly on a Seibt inductance apparatus (see Article VIII of this series), at about 100,000 cycles, and it was found that $L_x = 0.000362$ hy. (Accurate to about 1%.) It will be seen that the results agree well among themselves, and that the inductance of the coil under measurement does not change appreciably between 500 and 100,000 cycles. The coil was a single layer "litzendraht" helix. Under the next measurement, further measurements on this coil will be given for comparison.

Section 22. MEASUREMENT OF INDUCTANCE AND COUPLING COEFFICIENT (MUTUAL INDUCTANCE) BY WHEATSTONE BRIDGE (Modified Form, of Siemens & Halske).

(a) THEORY. Referring to Formulas (42) and (43) of Article VI of this series, we are immediately led to a simple method of measuring mutual inductance. The two coils of inductance L_1 and L_2, the mutual inductance between which is to be measured, are connected in series. If their fields add, the total inductance, as measured on an inductance Wheatstone Bridge, will be

$$L_x = L_1 + L_2 + 2\,M.$$

If their fields do not assist (which state of affairs can be secured by reversing the connection to one of the coils), their apparent total inductance will be

$$L_y = L_1 + L_2 - 2\ M.$$

From these two equations we find

$$M = (L_x - L_y)/4. \qquad (62)$$

If we know the individual inductances, namely L_1 and L_2, we can calculate their coefficient of coupling from Formula (54) of Article VI of this series, namely:

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

The Siemens & Halske Inductance Bridge differs not at all in theory from that previously described in this article. However, by the addition of an ingenious form of variable standard inductance, no direct current and galvanometer readings need be taken, the telephone receiver used with alternating current constituting the only indicator needed. The variable standard inductance consists of a small coil into the center of which can be slid an iron core of suitable shape. The inductance is thereby gradually and continuously increased. However, if solid iron were used for the core, the hysteresis and eddy current losses would be considerable, and (because of the nature of hysteresis effects) it would hardly be possible to secure sharp silence points when balancing the bridge. Therefore the iron used is in finely divided condition, and is imbedded in paraffin wax. The resulting mass has a moderate permeability, and very small alternating field losses.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. In Fig. 41 are shown the two ways in which inductances L_1 and L_2 can be connected so as to cause their fields either to assist or to oppose each other. Lines 1 and 2 of that figure correspond to cases of the determination of L_x and L_y. It may be mentioned that, if the coils are then connected in parallel, Formula (53) of Article VI of this series affords a good check of the accuracy of measurement of M. In Fig. 42 a number of different types of coupling are shown. In the rear, to the right, is seen a transmitting coupler, wound with flat copper band, one of its coils being helical and the other spiral. To the left, in the rear, is a double cylinder transmitting coupler wound with round copper tubing. In the front, to the right, is a low voltage coupler for use on Poulsen arc transmitting circuits. An ordinary receiving coupler is visible in the center of the front, and to its left an efficient type of receiving coupler, the inner coil of which is wound on a spherical surface.

In Fig. 43 is given a wiring diagram of the Siemens & Halske inductance bridge. Between the points U and V a source of alternating current is applied; for example, such a buzzer and transformer as are shown in Fig. 37 (J and M, etc.). The bridge wire is short, so as to have small inductance. The unknown inductance is inserted at L_x. R_x is a small additional resistance with a delicately adjustable slider contact, forming a permanent part of the bridge. R_n is a set of resistances, which can be inserted by removing their short-circuiting plugs in the usual method, as adopted for plug resistance boxes. The resistances at

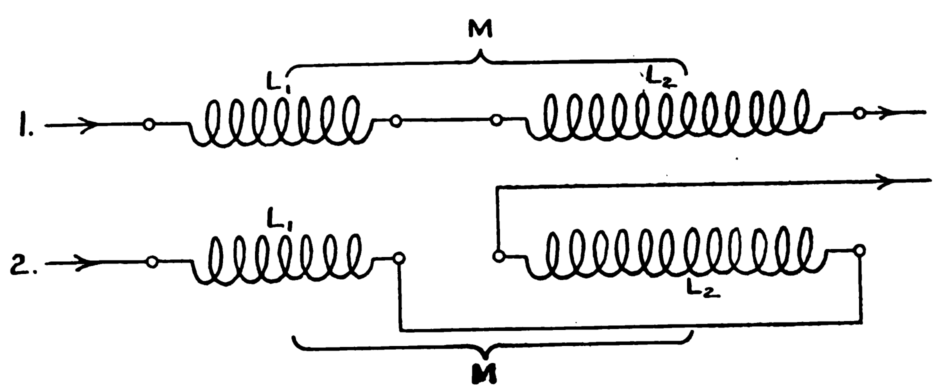


Fig. 41

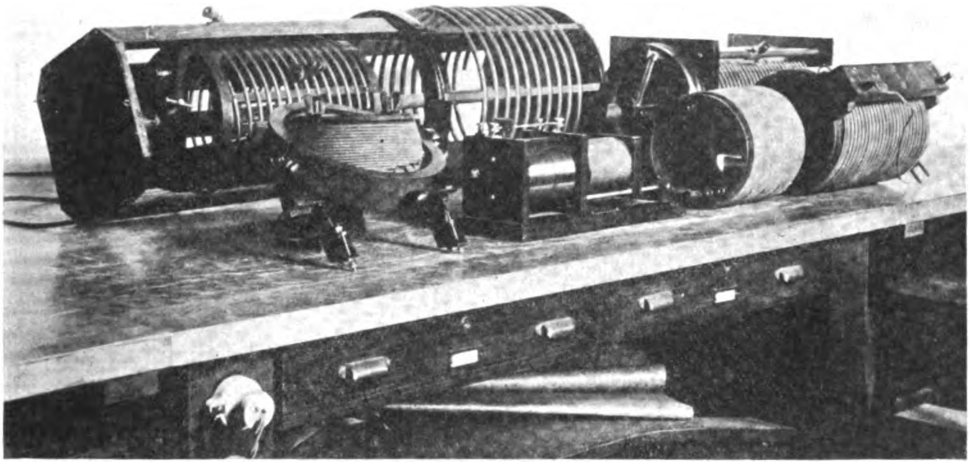


Fig. 42

R_n are 0.1, 0.2, 0.2, and 0.5 ohm. Two extra slide wires for R_x are also provided in mounted form, and are readily inserted if the one which is in place proves not to be adapted to the particular unknown inductance which is under measurement. L_n is the standard inductance, with the finely divided iron movable core. The inductance of L_n for every position of C (which moves over a graduated scale) is given in a chart which is supplied with the apparatus. The telephone receiver, T, is of low resistance. The apparatus itself is shown in Fig. 44. As will be seen, to the left of the bridge baseboard is the slider which moves over the resistance R_x. In the front and middle of this board is the small plug rheostat, R_n. The standard inductance with its movable core, C, is to the right of R_n. At the right of the photograph is the special telephone receiver, T, lying in front of the containing box for the entire apparatus. The calibration curves, covered with glass, are in the background.

(c) PROCEDURE. The procedure is precisely as in the previous measurement of this article, except that it is unnecessary to use anything but alternating current and the telephone indicator. Slider Y is first adjusted to as nearly a minimum sound as possible. Then slider X is adjusted to approach the silence point further. Alternate adjustment of

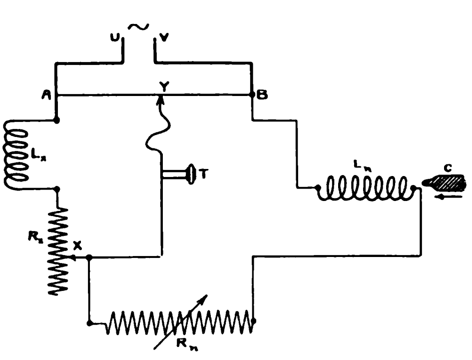


Fig. 43

X, Y, and of the position of core C will, if R_x and R_n have been properly chosen, soon lead to a sharply determined balance point.

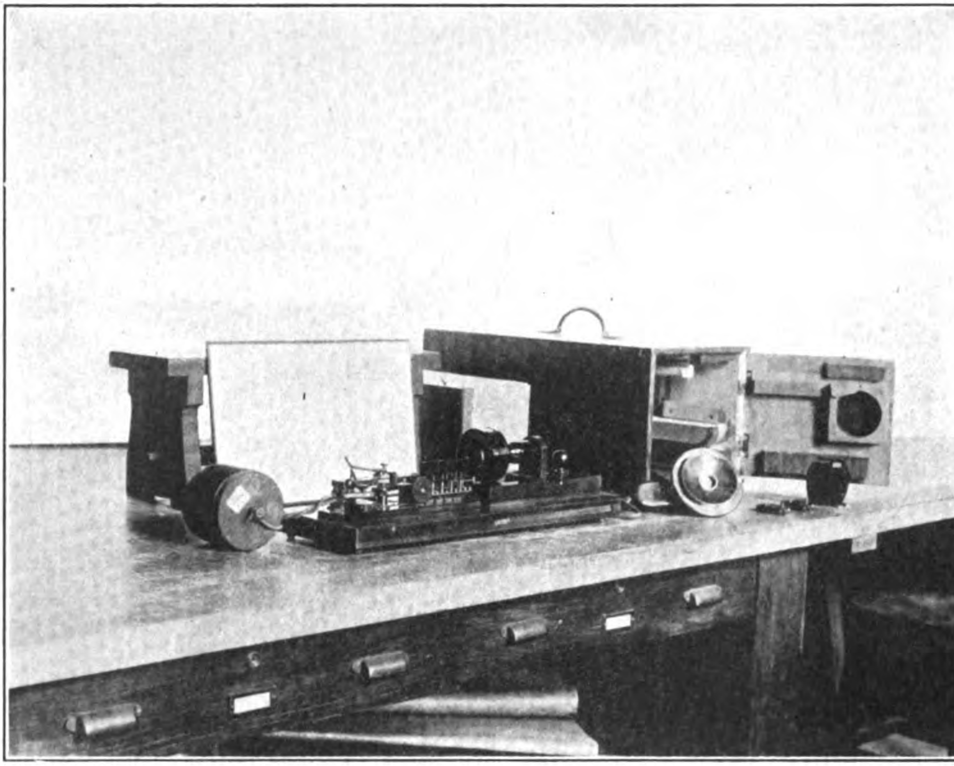


Fig. 44

(d) ERRORS OF THE METHOD, THEIR ELIMINATION; AND PROBABLE ACCURACY. The errors to which attention was called in the previous measurement of this article are all likely to be present in this method as well. In addition a new error due to the iron core C may be introduced. The inductance of L_n will depend on the current passing through it, inasmuch as the permeability of the iron core is not constant, but varies with the field strength, that is, with the current which produces the magnetic field. However, for the small currents used, this error is not serious.

The same unknown inductance which was used in the first measurement of this article was then measured on the Siemens & Halske bridge. Two trials gave the results:

$L_x = 0.000361$ hy. and $L_x = 0.000358$ hy.

The probable error was, therefore, about 0.5%.

To test the accuracy of the calibration curve furnished for the standard inductance, L_n, at two positions of the core C, very accurately known inductances were inserted at L_x and the bridge balanced. Using a known inductance of 0.0001 henry as L_x, the values of L_n found were

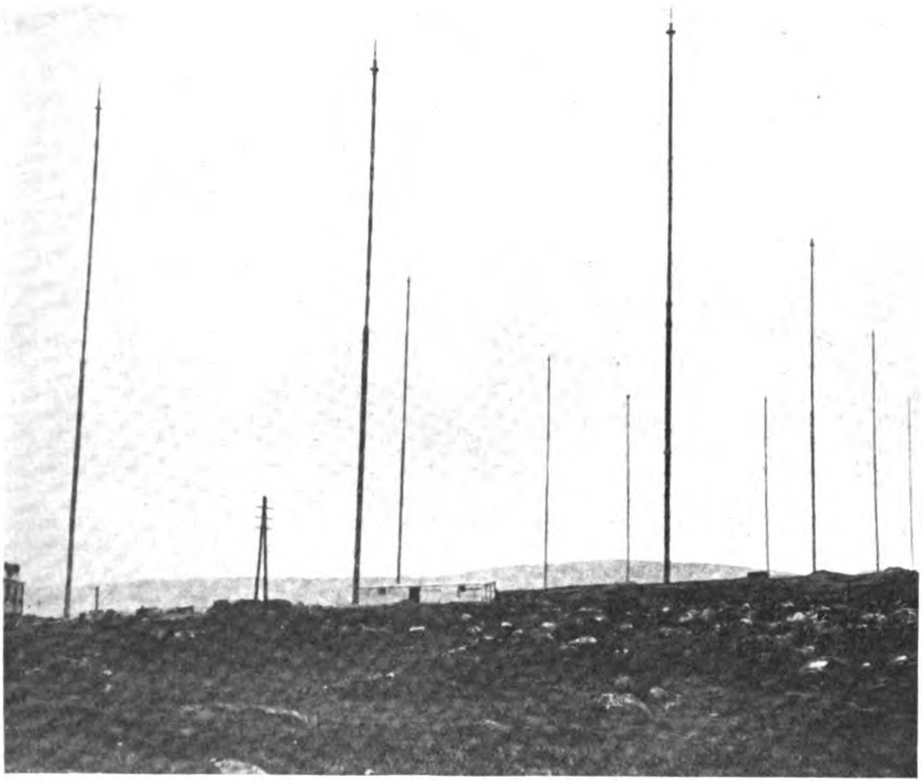
Position of core = 44.0, $L_n = 0.000233$ henry.
Position of core = 60.0, $L_n = 0.000272$ henry.

A known inductance of 0.001 henry was then used as L_x, and it was found that with

Position of core = 44.0, $L_n = 0.000233$ henry.
Position of core = 60.0, $L_n = 0.000270$ henry.

These values of L_n agreed closely with those given by the calibration curve, and, as will be seen, the probable error was again less than 0.5%.

This is the seventh article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The eighth will appear in an early issue.



The Carnarvon Station, located on the side of the Cefndu Mountain, Wales

The Wales Link in the Marconi Chain

ADDED interest has been given to the picturesque old city of Carnarvon, Wales, due to the fact that one of the Marconi high power trans-Atlantic stations is being built at Cefndu which is nearby. The station is located on the side of the Cefndu Mountain, and merely from a wireless point of view the site is admirable. The ground begins to rise as soon as the Geunant road, which stretches along the lower edge of the Marconi Company's property, has been passed, until at a point on the extreme eastern side of the site it reaches an altitude of some 800 feet. The station itself is built at a height of 750 feet and the last row of masts is estimated to stand about 1,400 feet above the sea level. It will communicate directly with the station in course of construction in New Jersey.

This is a description of the locality as it would strike a wireless expert, but from the point of view of the observer of natural beauty much more might be added. Looking toward the north from the mountain side the land lies spread out below till it reaches the water's edge. Beyond stretches the glitter of the sea, its attractiveness emphasized by the proximity of Anglesea.

Further than this the eye on a fine day can penetrate the blue haze and catch a glimpse of the white shore of Ireland far out in the distance. It is a splendid spot for those who will be in charge of the station, and though in the winter months it is cold and swept by strong winds, a quick walk down to the valley below will bring them into another climate, for in all the lower lying districts and along the coast, it is warm and mild.

The transmitting aerial of the Carnarvon station consists of thirty-two wires of silicon bronze, and is supported on ten tubular steel masts, each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two extremely wide circles of plates sunk in the ground with the main building as a center. Extensions to this system are buried underground immediately beneath the aerial, and they extend as far as the eastern extremity of the site.

The main building is divided into two sections — the permanent transmitting section and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 horse power and the main switch boards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. The experimental section adjoins the main machinery hall on the west side and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves.

FORTY STATIONS IN THE PHILIPPINES

A dispatch from Manila says that the Legislative Assembly has given a franchise to the Marconi Company to build forty wireless stations in the Philippines. The bill as originally proposed provided that in the event of war the American Government might take over the wireless system. The bill was amended, however, so as to accord this right to the Philippine Government instead of the American Government. The amendment was proposed by Philippine Commissioner Vicente Ilustre.

THE SHARE MARKET

New York, March 26.

A day of even lighter trading than the days which immediately preceded it closed this afternoon with only a slight net change in the general level of prices. On the Exchange and outside markets some of the standard industrials were under early pressure, but recovered the slight declines before the close of the day. Canadian Marconi remains about the same as last month, but both common and preferred English Marconis show slight declines. The brokers attribute this to the greatly exaggerated reports of the disturbances in Ulster, where considerable stock is held by individuals. It is generally accepted that the present unimportant disturbances amount to nothing, and rapid recovery is confidently looked for. American Marconi shows a slight advance following the favorable opinion handed down by Judge Veeder in the infringement suit against the National Signaling Co. and, as one broker expresses it, the advance demonstrates the confidence of the 20,000 shareholders in their company.

Bid and asked prices today:

American, 4⅞–5⅛; Canadian, 2⅜–2⅝; English, common, 17¼–18½; English, preferred, 14–16.

YACHTSMEN TO LEARN S O S

Chicago yachtsmen must learn the continental code for sending and receiving wireless calls. This was the decision reached by the yacht and motor club heads in that city following the demonstration of wireless for small boats at the recent motor boat show. Not that the skippers must learn the entire code, but before they can be known as regular skippers they must know the S O S call and the number of their boat.

The possibility that the United States government would take up the matter was expressed by Commodore William Hale Thompson. "If the yachts are all equipped with wireless it will be necessary for the life-saving stations to take the matter up," he said. "This wireless apparatus will be much more valuable than the Coston signals which we now use, for it has a much longer radius than the blue fire."

Is the Game Worth While?

A Review of the Commercial Wireless Operator's Career and a Few Comments from an Operator of Experience

By FREDERICK A. KLINGENSCHMITT

SOMETIMES it is a passenger on board ship; a boy, his father, his mother, uncle, aunt or cousin; again it has been an amateur rubbering about the Cliff Street office, or the next door neighbor's young hopeful—every so often I can expect to be asked: Is the commercial operating game worth while?

People of all shapes, sizes and ages have put the question to me; I have heard it in three languages, expressed in at least thirty distinct styles of phraseology.

Naturally, my answers have varied in construction and amplitude with the individual temperaments; the sum and substance of all, however, may be confined to two words: It is!

Now I believe that this unvarying reply has carried conviction to inquirers where we have come into personal contact; for I have seen physical reflections of my own enthusiasm awakened in hearers, and, what is perhaps more to the point, there are men in the service today whose preliminary inquiries were addressed to me.

When I speak of genuine enthusiasm where I am concerned, I really mean it. I have enjoyed my operating career; I still enjoy it and expect to be enjoying it just as much when the Powers-that-be in the home office call me to a more responsible task—a remote possibility mayhap, but one that adds a certain zest to things. Meanwhile, I am seeing the world, learning something of all kinds and classes of humanity, imbibing the basic principles of salesmanship, acquiring a fair knowledge of electrical phenomena, appreciating the respective merits of systematic effort and discipline, storing up a tremendous reserve of good health for the coming years and earning a lot more money than my erstwhile classmates who turned to more sedentary occupations.

Yet there are kickers in the wireless service—lots of them. There are kickers in every business, for that matter, with always the same grievance. Working hours too long, wages too low, promotion too slow, is the burden of their lamentations. Analyze their qualifications and you find: energy sporadic, initiative unknown, ambition negligible — and there's the answer.

In nine out of ten cases they are living on a higher scale than they ever dreamed of, have more actual spending money than they have ever known, and voice their alleged discontent only because some older operator has patronizingly referred to their humble situation in comparison with his exalted (personally exalted, usually) position in the service.

Matter of fact, wireless operators, collectively and individually, are to be envied. Most of them have not yet reached their majority, yet they earn from thirty to sixty dollars a month, with bonuses on message traffic and sales of the steamship daily newspaper that run an extra ten dollars a month or more with very little effort. And look at the opportunity to save! No board and lodging to pay and all the ship entertainments at their disposal. At sea or ashore the wireless operator is furnished with comfortable quarters and attendance. His food is the same supplied to officers of the ship and in most cases he is permitted to dine and sleep aboard even when the vessel is in port. The saving man, and by saving I do not mean stingy, can confine his personal expenditures to the sum earned by bonuses, leaving his salary intact at the end of the month.

Think of what that means. He can live well, far better than other self-supporting men of his own age, lead a more varied and interesting life, and still set aside every cent of his earnings. Some operators are the sole support of dear ones at home; that, of course, should be different, at least so far as the saving part is concerned; yet, paradoxically, these young men can usually show a far larger bank balance than the loud complainers of what we term the static room.

We get around to places that the tourist stopping at a hotel would never see, and we become familiar with the people and the customs in an intimate way

Lest there be some speculation as to just why I am jotting down these remarks it may be well to state here that my motives are purely altruistic. I am not on the defensive. I firmly believe that commercial wireless operating opens up a great future for young men and I hope that the views of an insider may influence the right kind of fellows to join the service.

Since wireless telegraphy needs men, good men, and offers rewards that should call out the best material, it occurred to me that it was time for some one who really knew something about an operator's life to show it in its proper light.

About all the layman hears of are the shipwrecks and attendant heroism. Other adventures form a large part of the literature on the subject. So the first time a young man addresses a commercial operator he is usually amazed to find that that particular individual has met with none of those amazing experiences that presumably are part of the daily work. Very often the operator will explode this theory in a supercilious dissertation on the deadly monotony of the whole business.

You hear a lot about this deadly monotony thing. Personally, I can't see where it exists. In my years of service I have never encountered what could legitimately be termed an adventure, yet my career has been anything but monotonous.

This is typical of my experience in what are termed the "long, dreary waits."

Nine A. M. on board one of the fast mail steamers bound for Havana, Cuba. Having wrapped yourself around a hearty breakfast and relieved the junior operator you are tipped back comfortably in the operating chair, head phones adjusted and feet crossed on the adjacent table. Business is slack and you are leisurely scanning the pages of a current periodical or contentedly reflecting on the beauty of the scene, the beauty back home, or the one that tripped down the companionway shortly before nine last night. Just about then your reverie is disturbed by something like this:

"Good morning, Wireless, any news this morning?"

A figure of generous proportions stands in the doorway and the genial countenance of its elderly owner beams on you cheerily.

"Morning," you reply. "News?—you betcher; couldn't have seen a copy of this morning's Ocean Wireless News! Deck steward's been around with them twice."

"Must have missed him; matter of fact, I've just turned out."

With an eye to business, you feel around a bit, remarking: "Let's see now, seems to me there are a few copies left. Oh, yes, here we are! You're lucky; here is the last one."

There is always a last one when a customer is in sight, and you turn it over, pocketing the coin it calls for and reflecting that this adds another little tinkle to the coffers being steadily piled up with commissions for you and your junior on the sale of the daily wireless newspaper.

Meanwhile the visitor has been scanning the news and market reports, and beginning with a few brief comments, he soon launches forth on a discussion of current topics, during which you learn that he is no other than the great John Affluent, with heavy interests in Cuban sugar plantations and bound there on a combined business and pleasure trip. Absorbing carefully his terse and thoughtful comments on vital issues of the day you are amazed at the breadth of his knowledge and his simplicity of expression. Later on—it may be months or years later—something arises in conversation where the few facts gleaned from that brief discourse prove of inestimable value to you. A surprising amount of useful information is acquired this way, for on board ship you encounter all classes of people and a good memory is alone necessary to provide you with a fair working knowledge on almost any subject. On foreign-owned vessels this great boon is missing; their rules do not

All the points I have visited have distinct appeals, and none more so than Curacao, a Dutch possession, commonly called Spotless Town

The Wireless Man is ever a popular figure with the feminine sex.

Scene during Neptune Service Dr. Pill making speech through megaphone as ship crosses Equator.

Tea-time on Deck is always a cheerful period.

permit an operator to mingle with the passengers and whatever association he may have with them in the line of business must be marked by deportment which upholds the dignity and responsibility of his position. On American ships a more democratic condition exists and the line between the passengers and the man who presides over the wireless room is not so closely drawn. In both services, however, the operator who attends to his duties faithfully and conducts himself in conformity with the rules of the ship is treated with every consideration.

But to return to the ship acquaintance. By this time the conversation has drifted to where the weather and the high-cost-of-living bugbear have been gracefully set aside in favor of a more interesting ocular demonstration of one of the worth-while considerations; in this case, none other than a radiant vision of feminine loveliness, whose identity is disclosed by the visitor's cheery call: "Oh, daughter—Helen, dear—come over here and see the wireless!"

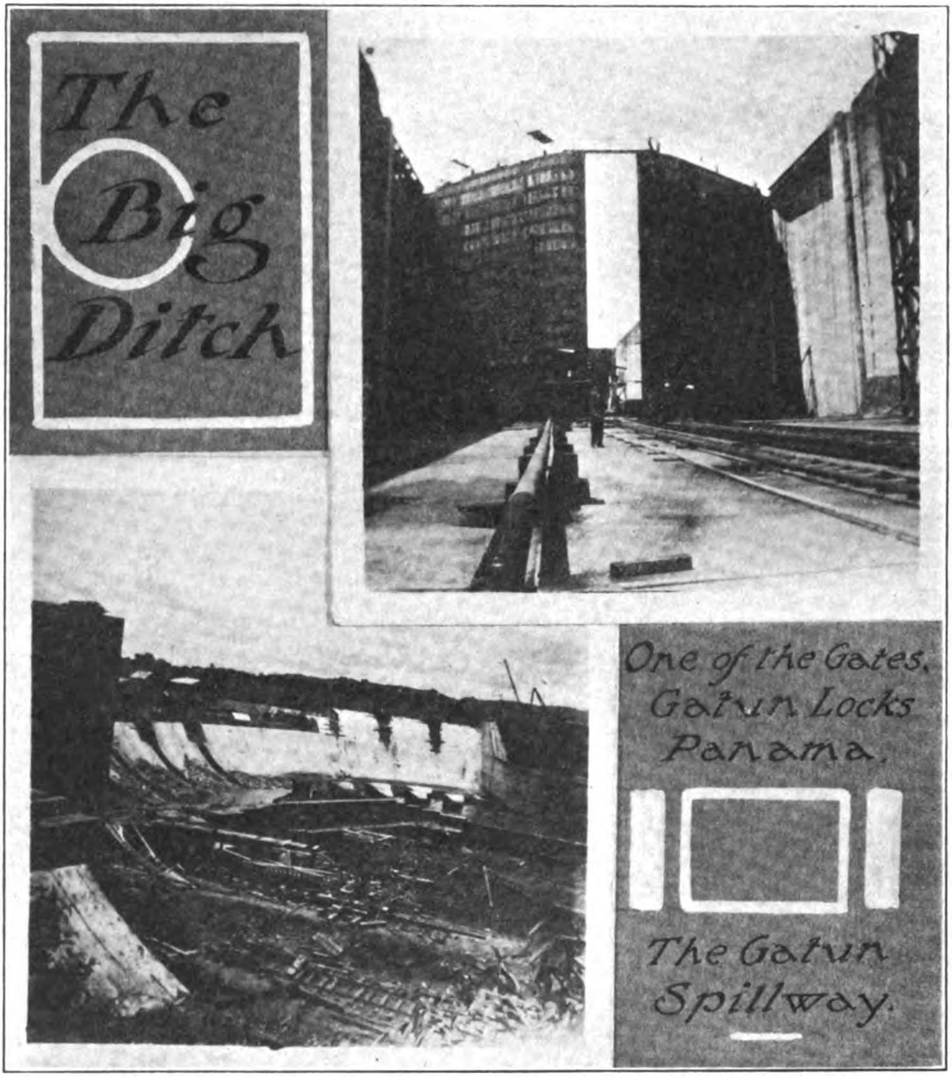
Whereupon you surreptitiously fix your tie and guardedly polish the brass buttons on your sleeve. Papa makes the necessary introductions while you mentally note the charms of a Miss about 'steen years old and decide that this voyage is to be a most enjoyable one.

Having ascertained that this is the little lady's first sea trip you reply to her immediate interrogation by giving a knowing squint at the sky, shaking your head ponderously, and telling her that this is not the open season for storms and that you have arranged with the captain that nothing of that nature will interfere with the serenity of this particular trip. An answering twinkle in fond Papa's eye is just discernible as he ambles away down the deck, leaving the field clear for a nice little tête-à-tête. Grasping the opportunity you proceed to unravel the wonders of the wireless. One by one, from the anchor gap to the drip pan of the motor generator, you explain the relation of things and give the function of each particular device. Then you unwrap the mighty intellect and parade your erudition handsomely in a little lecture on the theory of transmission. It is remarkable what an impression can be created by simply going over the same old gag about throwing pebbles in a pond of water, how the waves go out in all directions, rocking the conveniently floating chip and expending their energy when they strike the shore. If time permits and it looks as if you are making a dent, you go back to the old coherer days when youthful inventors used a tin can for an antenna and wirelessed one hundred feet across their fathers' flower gardens. This is only resorted to when you are keen on making a lifelong impression. The regular conclusion of the lecture is reached when you impressively adjust the tuner, pick up some ship about one hundred miles away and invite the audience of one to listen in. Assure her, him, or it that it's San Francisco working with Honolulu and you have become the feature attraction of the ship. Start up the motor, then, make a few sparks fly and you accomplish two things: You probably jam one of the boys who is trying to get rid of a batch of paid business, and have put yourself in line for a two-dollar message.

All needed is a timely suggestion that in the bustle of departure something or somebody has been neglected at home. Why, to be sure, recalls the visitor, Grandma, or Fifi, or somebody, has been overlooked, and you take down a message reminding someone at home to give that dear little pomeranian its olive oil bath every morning—or a similar message of equal importance. Punctuated with many gasps of amazement from the bystander, the message is rattled off and you have added another clink to your message bonus money box.

Now old John Affluent's daughter, aside from her physical attractions, is well worth cultivating. You watch a glorious sunset or two with her by your side, and perhaps the moon rising over the southern sea. She is very popular with those aboard and you are made acquainted with all the young people in short order. You draw their attention to the Ocean Wireless News and organize an editorial staff among them, appointing sporting, society and dramatic editors, who are to obtain all possible local news aboard the ship and help prepare it for publication in the following morning's issue. The concert reviews are patterned after the genuine article, and the personal items are written in a jocular vein. This local news makes a tremendous hit with the passengers and those whose names get into print may be counted upon to take half a dozen copies as souvenirs. On the page assigned to these local items appear the names of the editors and their temporary titles, friendly rivalry being created by changing the personnel of the staff each day of the trip.

Net result: An increase in sales of about 100 copies per diem and a couple of dollars extra added to your commission fund.



Deadly monotony—pooh! This wireless operating business is about the most interesting game I know of. And it's about the only one where you can successfully combine business with pleasure.

Of course it isn't all a merry lark; a lot of serious work is to be done and there are a lot of exasperating interruptions.

Take another instance:

Call it about the same time of day as in experience number one. Bound for Puerto Rico this time, third day out. Instead of taking it easy you are hard at it, with the lugs down tight and the static and jamming so bad you are afraid to breathe for fear of missing something. Along the deck comes an inquisitive school ma'm; she sticks her head through the doorway and engagingly remarks:

"Oh, is *this* the wireless?"

That settles it. You take off the lugs, attempt an amiable smile and turn your attention to the visitor.

"Pardon, madam; did you wish to send a message?" you inquire, reaching for the blanks.

"Oh—er—that is—no, thank you," as she makes a quick mental calculation of the contents of the bag swung at her waist. "I just thought that this was that wonderful Mr. Marconi's wireless, and I wanted to be sure."

Marvelous deduction, is your inward comment, but being a first grade operator and an officer of the ship you reply very courteously:

"Yes, ma'm. This is it. Very wonderful, too. You can't truly appreciate its fascination, though, until you see your own thoughts actually transmitted from this key through miles and miles of space to a friend back home. I will be very glad to show you how a message is sent should you care to file one—" and your voice trails off into incoherent mumblings as you see how hopeless this prospect is. The seeker of knowledge is there to stay, however, and remarks with a roguish glance: "It *is* wonderful, isn't it?"

"Yes, ma'm."

"Almost uncanny."

Once again: "Yes, ma'm."

"How does it work?"

"Oh, it is very complex. It would take me hours to explain; that is, unless you have some technical knowledge of circuits. You haven't? Well, really then, it's quite hopeless to attempt an explanation," delivered in your most sugary tones and with an engaging smile. "Anything else, ma'm?" you inquire solicitously.

"No, thanks, I hope I haven't bothered you," and as you reply in the negative and turn back to business: "Are you going to send a message now? Yes? May I stay and watch?"

Of course she can stay; but you wish the dickens she wouldn't. But then you never can tell . . . so crash, crack, go the instruments and you pound away for ten or fifteen minutes cleaning up

(1) The Maine being raised from Havana harbor. (2) Morro Castle. (3) Convicts cleaning city streets under guard

the traffic on hand. You raise your head then, and, hello! a promising looking male figure has joined the inquisitive school ma'm in the doorway, undoubtedly attracted by the noise of the sending.

Business ended for the moment, you swing about and look inquiringly at the copy of the Ocean Wireless News he holds in his hand.

"Have you a minute to spare, Wireless?" he opens up, breezily. "I see that this little newspaper is rather widely read. I have been looking over the ads. Hotel man, myself, on my way to take charge of the new house in San Juan. What'll it cost me to run an eighth-page advertisement in here, do you know?"

You bet you know, if you are on to your job. From a convenient drawer you yank out the rate card, the list of steamers on which it appears simultaneously and give him all the circulation dope, the free message reservation of rooms privilege and a blank form of contract.

He will probably want to "think it over," which worries you not at all, for you can figure, sure as shooting, he'll be back before the ship docks; so you pick up the pencil and figure out what your commission will come to in dollars and cents. Easy money? The easiest ever. Experiences of this kind don't happen as often as you'd like them to, but there is nothing in the world to prevent you getting around to the shops and hotels while you are in port and picking up an order or two by a little genuine effort.

So much for the commercial spirit. The foregoing is just a sketchy suggestion of the thousand and one opportunities that may be turned to good account if you are wide awake. But an operator's life isn't all a mad scramble for additional ducats, by any means, and once ashore we are generally assiduous pleasure seekers.

Many opportunities present themselves. Here is a typical instance:

A long voyage this time—to Rio de Janeiro and Buenos Aires. It is the eighteenth day out and all hands are well acquainted. Due in Rio the following day, the deck sports are over and the prizes are to be awarded after the captain's dinner that evening. Neptune, Doctor Pill and all his satellites, followed by hearty laughter, have departed overboard after the crossing of the Equator and everybody is in a jovial mood. You have just lit up the old jimmy pipe and are taking it easy in the wireless room when along the deck comes that congenial Mr. Survey and his party of five other civil engineers, going down to take hold of a big railroad construction job in Uruguay. They are all young fellows and after eighteen days of confinement to the limits of a ship their pent up spirits are tugging for expression.

Survey starts off this way:

"Say, Sparks, you've been to Rio before, haven't you?"

"Half a dozen times," you affirm.

"At that rate you ought to know the burg pretty well."

You admit the truth of this surmise and your inquisitor tactfully suggests that you might be willing to pilot about a party of young fellows who don't know the "lingo," haven't any definite idea of what to see and imagine they would have a hard time getting about. They would esteem it a great pleasure if you will consent to be their guest, as they plan to hire an automobile for a long ride into the country, lunching at some comfortable Inn and returning in the afternoon for city sight seeing. In the evening they plan to take in a show, and—well, "Are you with us?"

The project sounds inviting and you like the fellows, so you reply: "Be more than pleased to go along, but of course I shall expect to share my proportion of the expense."

This proposition is met with: "Couldn't think of it, old man, no sir, not for a moment. You're asked as our guest, and the obligation is on our side if anywhere—why, we are a lot of greenhorns

Sightseeing de luxe at the kind invitation of passengers

The Municipal Theatre in Rio, second largest in the world

Those we stop with are only too willing to show us around and it's a great privilege for us to see things under the guidance of a man who knows the ropes."

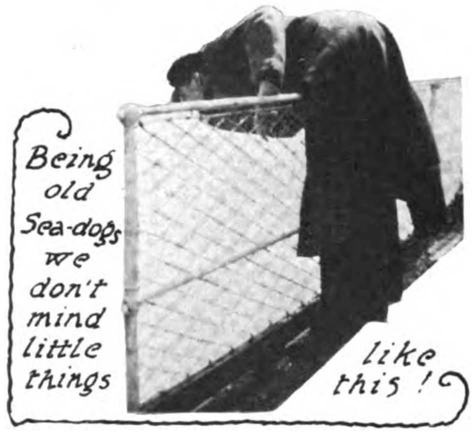
And after a few polite protests you fall in with the plan, and needless to say, spend a mighty enjoyable day amid scenes of many historical events in the most beautiful city in the world.

These trips fall to the lot of the wireless man on almost every voyage. If a fellow is but ordinarily courteous he can become very popular with the passengers and have his choice between several contesting parties anxious to secure his services ashore.

And the benefits to be derived from a knowledge of all countries can only be appreciated by those who have traveled extensively. The wireless operator gets all over the world with the same comfort and convenience that others pay thousands of dollars for. Too, he dodges that bugaboo of tourists, the hotel runner, and the jehus and the dock parasites importuning for the visitors' odd change.

Once in a while, we feel we would like a change from the ship quarters and decide to stop ashore while in port. Natives are usually pleased to accommodate us and we secure a comfortable room and excellent meals at a rate which is fixed reasonably through a ship officer's recommendation. Those we stop with know the country well and are only too willing to show us around and arrange introductions to people in a position to make things interesting during our stay. Thus we get around to places that the tourist stopping at a hotel would never see and become familiar with the people and customs in an intimate way. Which, of course, is far more beneficial than viewing them as they pose before the tourist.

Uncle Sam's "Big Ditch" at Panama is one among many interesting points I have visited as an operator. At Havana, it was my good fortune to witness the raising of the Maine, and to secure as souvenirs, the port key and a patent door catch all covered with barnacles and corroded from thirteen years' immersion in the waters of Havana Harbor; Buenos Aires—the second Paris—Rio and Montevideo, the capital of Uruguay, proved interesting and inspiring and made me realize that my first love, New York,



was not the only metropolis in the universe.

We pick up languages, too; in fact it is a service tradition that after two trips to Mexico and Cuba an operator may be expected to speak fluently "Ward Line" Spanish and to air it on future trips to other Latin countries.

The West Indies are available to the wireless man, including Puerto Rico, now run by Uncle Sam, Trinidad and Barbados, English possessions, Curacao, Dutch, and commonly called Spotless Town, Martinique, with Mt. Pelee as the attraction, and ruined St. Pierre, now covered with wild growths. The Bahamas and Bermuda Islands prove very alluring and interesting; in fact, all of the points I have visited have distinct appeals and have registered pleasurable impressions, which, for perfectly obvious reasons, I will not attempt to describe.

Mild adventure is always our lot. In Mexico I secured several photographs of the insurrectos in camp and on the march, subsequently selling them to a magazine at a very satisfactory figure. Many operators employ their cameras profitably, securing photographs of wrecks, derelicts shipping heavy seas and similar subjects of value to newspapers. As I remarked before, business and pleasure mix well and the commercial opportunities are only limited by the ingenuity of the individual operator.

Once in a while, it is true, heavy going disturbs the serenity of our existence. Caught in the middle of a West Indian hurricane, our interior arrangements are likely to be disturbed, but after a few months we are old sea dogs and don't mind little things like this.

My impressions are mostly of good times and the excellent opportunities to mingle with people of distinction. We get to know some of them pretty well. One of the men in the Marconi service recently had the honor of demonstrating the wonders of wireless to President Wilson, another, as you already know from the February issue, became quite chummy with Secretary Bryan, still another beat Colonel Roosevelt at deck shuffleboard on his recent trip to South America, and last but not least, the redoubtable Christy Mathewson became the boon companion of one of our comrades when returning from Spring training.

Thus far I have purposely refrained from mentioning the future in store for the ambitious operator, for I consider that readers of THE WIRELESS AGE are thoroughly familiar with the wonderful progress being made in commercial wireless and possessed of sufficient imagination to foresee how readily advancement may be secured with proper application to daily tasks.

The sole observation that the Marconi Company has already indicated its preference for experienced men by elevating former operators to some of the highest positions in the service should cover this entire question. There is plenty of room for *good* men in commercial wireless, and no better place to start could be selected than the operating end.

With proper application, less than a year in the Marconi Company's school will equip the right sort of fellow with sufficient knowledge to secure a ship assignment and become self-supporting. After that, it is entirely up to him. He can lead an indolent and careless existence—for a time—or he can combine a certain amount of pleasure with business and still acquire the brand of proficiency that gets him slated for something higher.

Only now, after some time in the service, am I really beginning to appreciate how much better off I am than friends of my boyhood who turned to other branches of commercial activity, for I am contented, nay, happy; and mighty cheerful about the future.

So it must be that the wireless operating game is worth while.

DIRECTION FINDERS ON UNITED FRUIT BOATS

The wireless direction finder, a Marconi invention that will reduce to a minimum the risk of collision in fog, is to be installed on all passenger steamers of the United Fruit Company. The crack cruisers Calamares, Tenadores and Pastores will be equipped within a few weeks, and will be the first passenger vessels in the world to carry this instrument.

The object of the wireless direction finder is to enable navigating officers on ships to take bearings of wireless telegraph stations with a view of finding the position of their ships, or of avoiding collision with other vessels.

It is not claimed that bearings taken with this instrument exceed in accuracy those taken with optical instruments under good conditions, but it is claimed that reliable bearings may be taken with it when direct bearings cannot be taken owing to bad weather.

When trying to locate another ship while going slow in fog the indication of the direction finder will show by a steadily increasing strength of signal if the other ship is approaching, but might leave a doubt as to whether it was approaching on the port bow or overhauling on the starboard quarter. A wireless query as to her course, addressed to the other ship, however, would remove the doubt at once.

VESSELS MORE EASILY LOCATED

The use of wireless telegraphy has lessened the number of ships that disappear leaving no trace of their whereabouts. During 1913 Lloyds posted only twenty-five vessels with an aggregate net tonnage of 31,426. This was eleven less than in the previous year, and included a large number of smaller-sized craft, such as schooners and tugs, which do not, as a rule, carry wireless.

SUPPLEMENT TO STATION LIST

Supplement No. 1 to the List of Radio Stations of the United States, covering all additions and alterations up to October 1, 1913, has been issued by the United States Department of Commerce. The new supplement contains twenty-seven pages.

The John D. Archbold of the Standard Oil Company's fleet. She is equipped with a 2 K. W. Standard Marconi set and an auxiliary set

New Marconi Equipments

AMONG the vessels which have recently been equipped with Marconi wireless apparatus is the new tank steamer John D. Archbold, of the Standard Oil Company's fleet. Built by the Newport News Shipbuilding and Dry Dock Company at Newport News, Va., the Archbold is designed to carry a total dead weight of 10,000 tons on a draft of twenty-three feet and four inches. Her cargo capacity will be about 67,500 barrels. Her dimensions are as follows: Length, 460 feet between perpendiculars; beam, sixty feet; depth, thirty-six feet and two inches. She is equipped with a 2 K. W. standard set and also an auxiliary set. The installation was made at Newport News.

The Archbold is well prepared to withstand the perils of the sea, for she carries double the lifeboat capacity called for by the United States Steam Boat Inspection Regulations. She has telemotor control of the steering gear and is equipped with a McNab revolution and direction indicator by which her captain can see immediately whether the engineer is carrying out the orders conveyed from the bridge by the engine room telegraph.

She is built to burn either coal or liquid fuel, her crew for running on the latter being about forty men. Her engines are of the quadruple expansion type (four cylinders balanced). Steam is supplied from three main boilers with Howden's forced draft; there are three furnaces in each boiler. The working pressure of the boilers is 220 pounds and in addition there is a donkey boiler designed for a working pressure of 180 pounds.

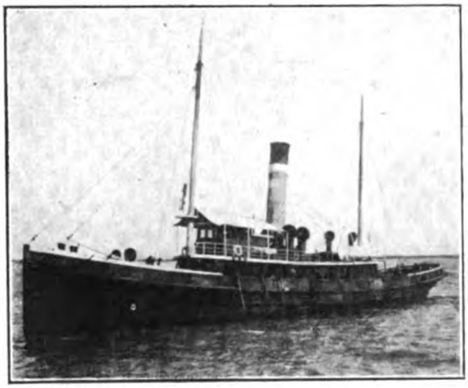
The suction and discharge lines of the Archbold are of extra large size and these, aided by a powerful pumping installation, enable her to handle her cargoes rapidly. She is able to load several grades of oil at the same time. Her oil hatches are trunked from the upper to the shelter deck to prevent gas from entering the shelter deck spaces.

The vessel has nine double main cargo tanks in addition to eight wing or summer tanks. Water ballast is carried in the main tanks, the forepeak, the forepeak tank, in the double bottom under the engine and boiler room and in the after peak tank.

There is a hold for general cargo forward of the main tanks. Forward and aft of the main and cargo tanks are the usual cofferdams for shutting off these tanks from the rest of the ship, while the pump room, which acts as an additional cofferdam, is situated about midships.

Equipped with a bronze propeller with cast iron boss, the Archbold is built to rank with the highest class in Lloyd's Register under their special survey, and to comply with the rules of the United States Steamboat Inspection Service. On her trial trip on March 11 she developed 3,600 horse power and attained a speed of 12.3 knots. She is engaged in the coastwise service.

The main saloon and accommodations for the officers are in a house on the



The tug C. W. Morse, which has been fitted out with a 1 K. W. Marconi installation

shelter deck above which is the captain's room, the captain's office and the wireless room. Above these are the wheel house and the chart room. The engineers and the crew are quartered aft.

The tug C. W. Morse which has been engaged in coast and deep water towing for a number of years, was equipped with a 1 K. W. Marconi set at Port Richmond, S. I., on March 7. The Morse is of 509 gross tons, 170 feet over all in length. She has a beam of thirty feet and her depth of hold is seventeen feet and a half. She has two Scotch boilers, thirteen and one half feet in diameter and thirteen feet in length. She has a surface condensing engine with cylinders thirty by fifty-six inches, with a thirty-six inches' stroke.

Constructed of wood, the Morse is equipped with a steam windlass, a steam capstan, a searchlight and electric lights. She carries a crew of twenty-two men and has bunker capacity for twenty days' steady steaming. She is owned by McAllister Brothers, of 109 Broad Street, New York.

INSTITUTE OF RADIO ENGINEERS

At the regular monthly meeting of the Institute of Radio Engineers held in Feyerwether Hall in Columbia University, March 4, two papers were read, one on "The Effect of a Parallel Condenser in the Receiving Antenna" by President L. W. Austin, the other on "A Method for Determining Logarithmic Decrement" by Louis Cohen of the Bureau of Standards.

In his paper Dr. Austin said in brief: "That the practice of using a variable condenser in parallel with all or part of the inductance in the receiving antenna to receive longer wave is convenient inasmuch as it does away with the necessity of small inductance steps and reduces the total amount of inductance required, but is usually found to be less efficient than pure inductive tuning. Tables showing the effects of different values of parallel capacity for two sizes of artificial antenna were shown. The readings were made with a galvanometer replacing the telephone. As the capacity was increased and the inductance decreased the galvanometer deflection decreased. Replacing one-half the inductance by capacity decreased the deflection about one-third. Practically the same results were obtained with the real antenna."

In his paper Mr. Cohen discussed the Bjerknes formula. Mr. Cohen proposed that instead of detuning the wavemeter circuit until $\frac{I^2}{2}$ is obtained as in the common method, based on the Bjerknes formula, that the resistance of the wavemeter circuit be increased until $\frac{I^2}{2}$ is obtained; then with the inductance, resistance and added resistance of the wavemeter and the frequency known the desired decrement can readily be obtained.

GOVERNMENT PENALIZES AN AMATEUR

The Secretary of Commerce recently approved a penalty of $25 to be collected from an amateur wireless operator in San Francisco, for a violation of the 15th regulation of the wireless act of August 13, 1912, in that the wave length emitted by his wireless station exceeded by 370 meters the limit fixed by law for his class of station.

SERVICE ITEMS

Edward Butler Pillsbury has recently joined the ranks of wireless workers, going with the American Marconi Company as assistant traffic manager. Up to a short time ago Mr. Pillsbury was General Superintendent, Eastern Division, of the Postal Telegraph Company, an office which he held for seven years. His connection with the telegraph business dates back some thirty years, when he served his first apprenticeship as messenger boy in Belfast, Me. He has in turn been telegraph operator, chief operator, division superintendent and general superintendent in the company with which he has just severed his connection to take up the more modern means of telegraphic communication.

E. T. Edwards, who is rounding out his twelfth year in the Marconi service, has been promoted from chief operator to superintendent of the Eastern Division with headquarters in New York.

A. R. Gardner, for three years operator at Siasconset, goes to the Marconi station at Virginia Beach as manager.

David Sarnoff has been appointed contract manager of the Marconi Wireless Telegraph Company of America, filling the vacancy occasioned by the resignation of C. C. Galbraith. Mr. Sarnoff's rapid rise in the Marconi service is notable; starting eight years ago as an office boy, he picked up the code through observation and within a year became operator in the home office, and later filled in a temporary vacancy at the Siasconset station. Shortly after his return he was appointed chief office operator, but soon returned again to the Nantucket Island station for two years' service. Following this he graduated from third operator to the position of manager of the Sea Gate station, leaving there to take charge of the Wanamaker station in New York. With the acquisition of the United assets Mr. Sarnoff was detailed as a ship inspector, and within a few months became chief inspector. Just before his recent elevation to the high position he now holds, the new contract manager received the degree of electrical engineer from Pratt Institute upon the completion of a course of night study featured by that institution.

Otto Rochs has been appointed traffic manager of Marconi's Wireless Telegraph Co., Ltd., of London.

MARCONI WIRELESS AND THE STORM

Following the successful employment of Marconi wireless telegraphy in sending reports over the area swept by the heavy snowstorm in the early part of March, the Delaware, Lackawanna & Western Railroad immediately put into emergency operation a new radio station at Hoboken, N. J. This was employed to dispatch fast freight trains after E. M. Rine, general superintendent of the Lackawanna at Scranton, Pa., had reported by wireless that the trains would find the tracks open and could get through, provided extra locomotives were used.

While the dispatching of the fast freight trains through the storm zone was much appreciated by W. H. Truesdale, president of the Lackawanna, he was better pleased by the report from the Lackawanna Limited train, which left New York at 10 o'clock in the morning of March 3 for Buffalo. It sent exhaustive reports of the exact conditions throughout the whole storm zone as it proceeded on its way to Scranton.

The Marconi wireless service also greatly aided two other railroads, the Erie and the New Jersey Central. Both called upon the Lackawanna to forward messages to New York after the telegraph systems along these railroads had been put out of commission.

These messages detailed conditions along the Erie and Jersey Central Roads to Wilkes-Barre. They were forwarded to Scranton by telephone and telegraph, after efforts to reach New York had failed. At Scranton the Marconi wireless station of the Lackawanna transmitted the messages, and the Marconi station on the roof of the Wanamaker Building in New York received them. The Erie and the New Jersey Central offices then received the reports by telephone from the Marconi station.

In the opinion of President Truesdale the great storm has proved beyond contradiction the value of wireless in modern railroading.

Besides the new station in Hoboken, the Lackawanna now proposes to build a station approximately halfway between Hoboken and Scranton, probably at Port Morris, and another station at Bath, N. Y., approximately halfway between Binghamton and Buffalo.

The Commissioner of Navigation

The Man and His Work

E. T. Chamberlain

IT is the logical thing to expect that a man who has a deal to do with navigation and ships should have his birthplace on or near the water. Eugene Tyler Chamberlain, United States Commissioner of Navigation, has lived up to expectations, for he was born on the banks of the Hudson River or, to be more exact, in Albany, N. Y. For nineteen years he has had a share not only in the administration of laws relating to vessels and shipping, but also in legislation on marine matters.

Mr. Chamberlain was appointed Commissioner of Navigation by President Cleveland in December, 1893. Soon after taking office he began carrying into effect the recommendations of the International Marine Conference held in Washington in 1889. As Secretary of the American delegation to that Conference, which consisted of Admirals Franklin and Sampson of the Navy; Justice W. W. Goodrich, Clement A. Griscom, formerly President of the International Mercantile Marine Company; Captains Shackford and Norcross and General Kimball, Superintendent of the Life-Saving Service, Mr. Chamberlain was instrumental in bringing into operation the revised international rules, inland rules and the Great Lakes rules for preventing collisions and in the establishment of lines defining the scope of application of these regulations.

He was also active in securing the passage of the White Law of December, 1898, for the improvement of the condition of seamen on American ships. The measures of 1898 which required the inspection of certain sailing vessels, and the examination of their officers and prohibited the departure of unseaworthy American ships,—all recommendations of the Washington Conference of 1898—were urged by him.

When the Department of Commerce and Labor was created in 1903, he joined others in urging the importance of wireless telegraphy as a means of promoting safety to life on merchant vessels at sea, and he has participated in the framing of subsequent legislation on that subject. The deaths of two clerks in his office in a motor boat accident led to a practical revision and extension of the laws regulating these small craft, and the establishment in 1910 of the present extended system of federal supervision over 200,000 motor boats is partly the result of his suggestions.

Mr. Chamberlain is one of the four honorary associates of the Society of Naval Architects and Marine Engineers, a member of the Maritime Law Association, and was secretary of the Pan-American Customs Congress, made up of delegates from the United States and the Republics of South and Central America and Mexico, which met at New York in 1903, to promote uniformity in customs and navigation laws among the American Republics. In 1902, by designation of President Roosevelt, he acted temporarily (without pay) as auditor for the Navy Department in addition to his regular duties.

The Commissioner of Navigation is well known to shipping men in this country and abroad through his compilation of the navigation laws issued first in 1895. These are designed primarily for the convenience of the officers and owners of vessels. He has contributed articles on maritime subjects to popular and scientific publications.

Born on September 28, 1856, Mr. Chamberlain was educated at the Albany Academy and at Harvard University. He was graduated from the latter in 1878. After teaching school one year and engaging in business for two years he engaged in newspaper work until 1893.

THE ROMA RUNS ASHORE IN A SNOW STORM

With 427 passengers and a crew of 100, the Roma, of the Fabre line, bound from Marseilles for Providence and New York, was in peril for hours on No Man's Land, south of Gay Head, Martha's Vineyard, where she struck on February 16 in a blinding snow storm. The vessel found herself in the midst of the storm while off Nantucket lightship and her commander, Captain Anton Combernous, ordered the speed of the ship reduced. The snow was so thick that it was impossible to see more than fifty feet ahead.

Heading west by north the steamship was proceeding along when suddenly No Man's Land loomed up and in a few minutes the Roma was ashore. It was then twenty minutes to three o'clock in the afternoon.

When Captain Combernous found that it was growing dark and the weather had not cleared he directed the Marconi operator to send a wireless call for assistance to the agents of the line requesting that a towboat be sent him. That was about 4 o'clock.

Newport got the message first at the training station, but as it was in French it took some time to translate it. When it was finally made out its import dawned upon the receivers and so calls for assistance were forwarded to the revenue cutters Acushnet, Itasca and Gresham as well as to towboats at New London.

The Roma was not pounding hard on the rocks. When she swung from one side to the other there was a grating noise. The absence of a southerly wind that would have sent the combers under her stern and lifted her harder on the jagged rocks gave the officers renewed hope.

When the mess bell rang at 6 o'clock the passengers went to their places and finished their meal. Darkness was then surrounding the steamer, and because of the cold the people remained inside.

Captain Combernous had the engines going full speed astern all the time, and suddenly at half past eight o'clock the bow swung to the left and a moment later the liner slid back into deep water. She scraped some of the other rocks, but not badly enough to hurt her, it is believed. The propeller escaped and as it got a good grip on the water it yanked the Roma out of danger.

In a few minutes the steamer was heading to the west to clear the island. Once out of its reach soundings were made and it was found that the Roma was not making any great amount of water. Every one was overjoyed as the steamer once more headed upon her course.

Meanwhile the revenue cutters were rushing to aid her. The Carmania and the Stepheno sent word they would go to her assistance if required. They were told it was not necessary. Heading northwest again, the course the Roma had missed was reached, and she steamed toward Providence where she landed her passengers.

Latest Views of the Marconi

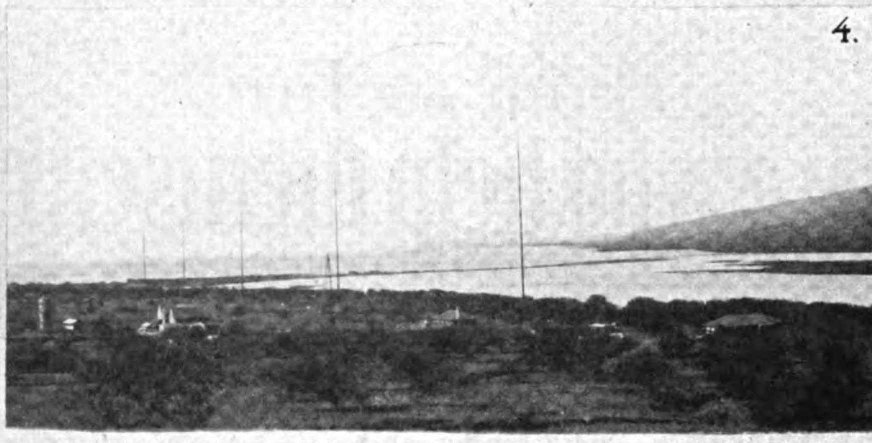
1.

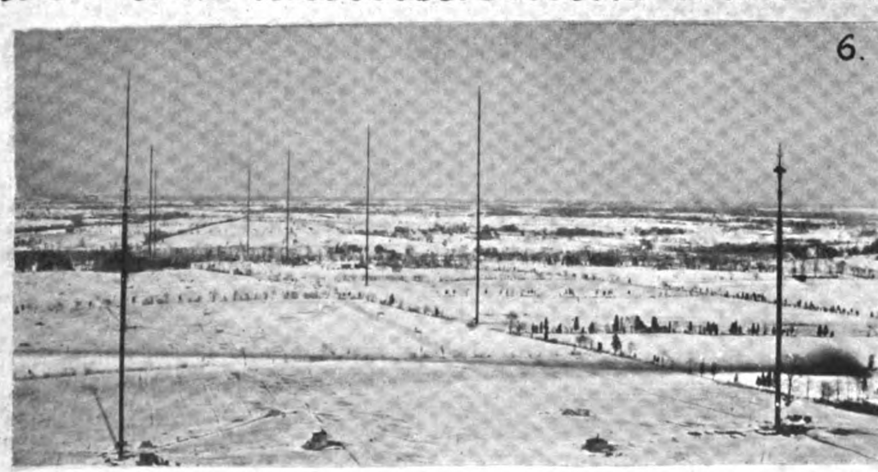
2.

3.

(1) A panoramic view of the California receiving station, showing the operators' hotel and the engineers' cottages. (2) A schooner driven ashore at the Bolinas site during a January gale. (3) One of the smaller towers for the aerial balancing lines.

Trans-Oceanic Stations





(4) The line of completed masts at the Honolulu receiving station, showing a group of the buildings in the middle distance. (5) Rebuilding the road between Bolinas, Cal., and the works. (6) Looking down the line of 400-foot masts of the New Jersey transmitting unit.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

An Improved "Loose-Coupler" Designed for the Elimination of Dead Ends

The average amateur wireless experimenter is generally satisfied with one design of the "loose-coupled" type of receiving tunner. He is apt, however, to adopt a "cut and dried" form of this device, making no effort towards originality of design. I have described in this article a modified type of receiving tunner which may be easily constructed by the average amateur. While the design I show is rather elaborate in construction it should appeal to the amateurs who desire a receiving tunner out of the ordinary.

In addition to the novel construction embodied in the accompanying drawings switching arrangements are provided so that practically all "dead-end losses" are eliminated, for the unused turns are metallically disconnected from the circuit.

A very desirable means for regulating the degree of coupling is provided. This is accomplished by a rotary handle which through a system of pulleys allows the secondary to be drawn in and out of the primary as desired.

Moreover, a double knob, as shown in the sketches, allows by a very slight movement of the hand a variation of the number of turns in use in the secondary, an important consideration in quick tuning.

THE WINDINGS.—The primary coil is wound on a cardboard tube, $5\frac{1}{4}$ inches in diameter and about $10\frac{1}{2}$ inches in length. The winding consists of a single layer of No. 24 B. &. S., D. C. C.,

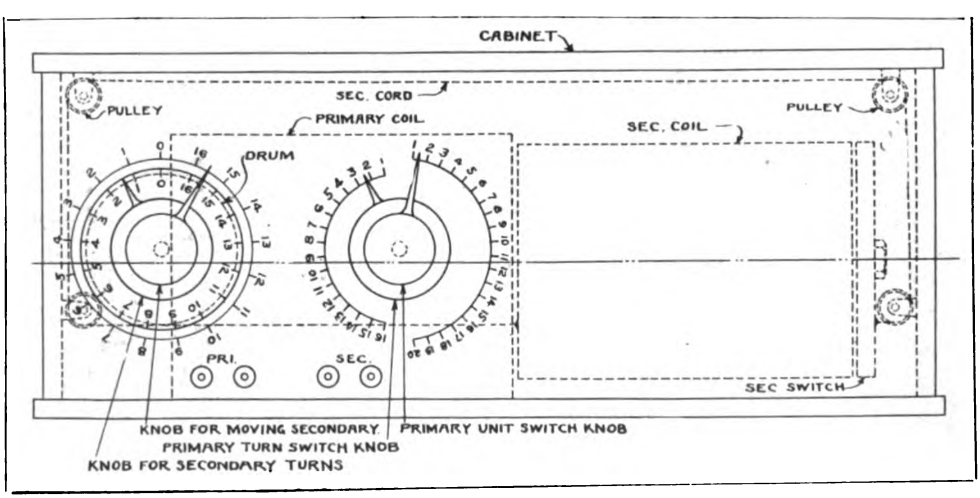


Fig. 1, First Prize Article

S. C. C. Magnet wire, comprising in all 330 turns.

The first 16 turns nearest the secondary end have "taps" or switch "leads" brought out from each turn. The remaining turns are tapped off to a switch point at every sixteenth turn. This construction calls for 16 single turn switch points and 20 unit switch points.

The secondary coil is wound with a single layer of 630 turns of No. 28 S. C. C. magnet wire, tapped off at about every 31 turns, thus requiring a 20-point secondary switch. The tube for the secondary winding is 10½ inches in length by 4⅝ inches in diameter. After completion the winding should be well shellacked for protection against dampness.

THE CABINET.—This tuner is preferably mounted in a hard wood cabinet after the manner shown in Fig. 1. The four knobs used in controlling the various devices previously described are indicated in Fig. 1. Each knob has an indicating needle or pointer which rotates over a graduated dial on the front of the cabinet.

Dials for this purpose may be made by scratching the lines of the scale, with a sharp tool, on a piece of hard rubber and then filling these cuts with "Chinese White" or simply white lead.

The movement of the secondary coil with its rotary control knob is effected by means of a strong cord running around the inside of the cabinet from small pulleys; the cord has its free end secured to the opposite ends of the secondary coil. As shown more in detail in Fig. 3 the cord also passes around a grooved fibre or wood drum and is fastened to the drum in such a manner that when the latter is rotated the cord is pulled, which in turn slides the secondary along two round brass rods which pass lengthwise through the coil.

The cabinet should be made of sufficient size so that the various parts do not interfere with one another during operation.

THE DIAL SWITCHES.—The amount of inductance in use in the primary and secondary coils is varied by the means of specially designed dial switches depicted in Figs. 2, 3 and 4.

Briefly, switches of this construction enable any number of turns from one up to the full number to be switched into the circuit, totally eliminating the unused portions of the circuit. It will be observed by the circuit diagram in Fig. 4 that the windings are divided up

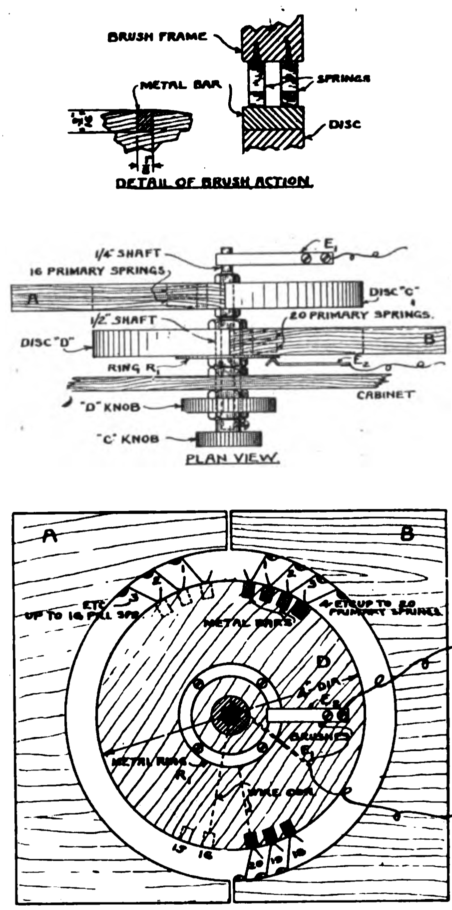


Fig. 2, First Prize Article

into isolated sections. By referring to Figs. 2 and 4 a fibre or hard rubber disc C and D is caused to rotate under a series of pairs of spring contact fingers mounted on a wood or fibre support A and D. The rotary discs carry at their periphery metal bars, as indicated, which short circuit any pair of spring fingers that may be placed underneath them.

The exact switching action will be more clearly understood from Fig. 4, which is a wiring diagram of the primary coil. As indicated, contact for the two common terminals, P^1 and P^2 of the primary winding are made through the

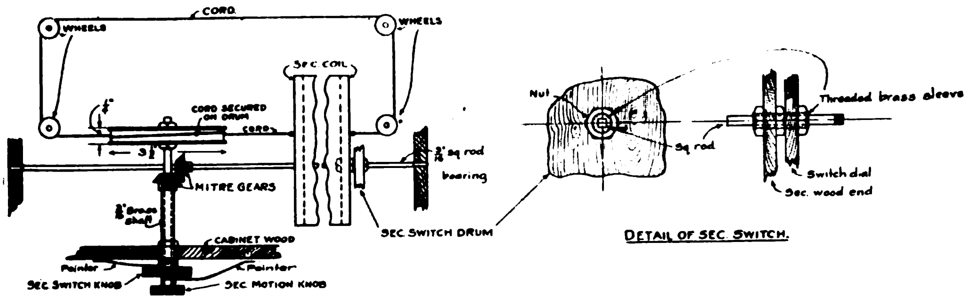


Fig. 3, First Prize Article

shaft of the disc C brush E^1 and the leading metal bar or segment. Contact from P^2 is effected through brush E^2, thence to contact ring R^1, and finally through a piece of copper wire to the leading metal bar or segment No. 20 as shown in detail in Fig. 2.

The secondary switch is not shown in detail, but is similar to the primary disc D. It has 20 pairs of spring contacts mounted on a supporting frame.

SECONDARY CONTROL HANDLES.—The method of arranging the secondary control knobs is shown in detail in Fig. 3. As indicated in Fig. 2, in this arrangement also, one knob shaft turns independently and freely within the shaft of the larger knob, thus greatly simplifying the adjustment features of the instrument.

By reference to Fig. 3, as has been previously mentioned, it will be observed that the secondary motion knob controls the moving of the secondary coil in or out of the primary by means of a fibre or wood drum about 3½ inches in diameter secured to the end of the shaft. The secondary dial switch is rotated by means of a small square brass shaft passing through the secondary coil. This shaft may be rotated about its axis by a mitre gear secured to it. This gear is in mesh with a second similar mitre gear mounted at right angles to the first gear on the knob control shaft.

Albert Johnson, New York.

SECOND PRIZE, FIVE DOLLARS

A Hot Wire Ammeter

Many amateurs try various devices to determine the energy flowing in the aerial circuit of a transmitting set, but the hot wire ammeter still remains the most satisfactory and at the same time the most reliable instrument for the indication of resonance.

The meter should not be connected to any part of the aerial circuit and then used for tuning purposes. As its name implies it measures the current and should be placed as near the ground connection as possible, because at the ground the current value is always greatest.

In an oscillating aerial the voltage is highest at the free end and lowest at the ground, and to obey Ohm's Law the current is opposite; that is, lowest at the free end and greatest at the ground. If out of tune with the closed oscillating circuit, nodes and loops of voltage will be found along its length. As these nodes and loops are shifted with every shift of the clips, it will be plainly seen that when using the meter above the helix you are really tuning to get a loop of current at that point in the circuit where the meter

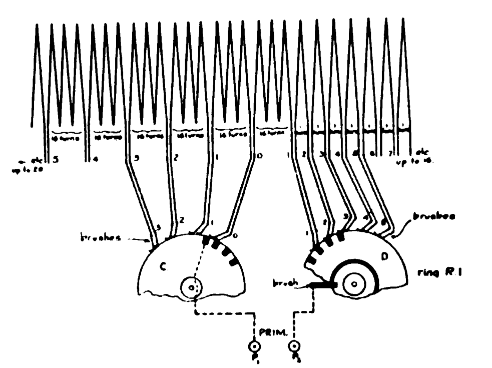
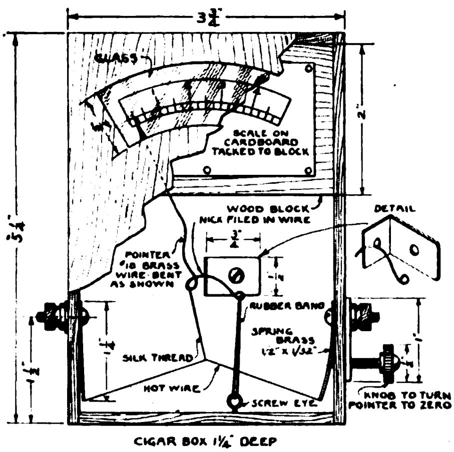


Fig. 4, First Prize Article

is located. This ofttimes results in a complex wave being emitted, and, although the meter gives a high reading, the radiation will be poor.

It will be seen that the ground connection is the proper place to put the hot wire ammeter as a loop of current exists there under all conditions and that current will be greatest when the circuits are in resonance.

The accompanying sketch shows the details of a meter I have just constructed.



Diagram, Second Prize Article

I don't believe an explanation of the sketch is necessary as the amateur generally changes some dimensions to accommodate the box or brass parts he has on hand. A No. 40 copper wire should be used for small sets up to a 2-inch coil. With higher powers use a No. 36 wire, and for still larger sets a shunt may have to be connected around the meter. This should consist of several strands of about No. 30 German silver wire. The exact number should be determined by experiment and then soldered permanently to the brass posts inside the case. While I have stated that probably no explanation of the sketch is necessary, yet it may be of interest to some to go a little more into the details of the action of the ammeter. By reference to the drawing it will be noted that the tautness of the hot wire is adjusted by the thumb nut on the right of the case. This is useful in adjusting the pointer for a zero position. When this meter is connected in series with the antenna, high frequency oscillations flow through the hot wire from the binding post at the left to the binding post at the right. The heat produced by the current causes the wire to expand, which releases the strain on the pointer at point P. This in turn allows the rubber band to contract, which, of course, pulls the pointer across the scale.

The results obtained from using this meter in the manner described will, I believe, more than compensate readers of The Wireless Age for the time and trouble spent in making it.

Peter H. Markmann, Jr., Pennsylvania.

THIRD PRIZE, THREE DOLLARS

A Peroxide of Lead Detector

The following is a description of a peroxide of lead detector I have constructed which has given very satisfactory service and surprising results.

As shown in the accompanying illustrations the base may be made of a good piece of hard wood or preferably hard rubber. The dimensions of the base may be varied to suit the maker's fancy.

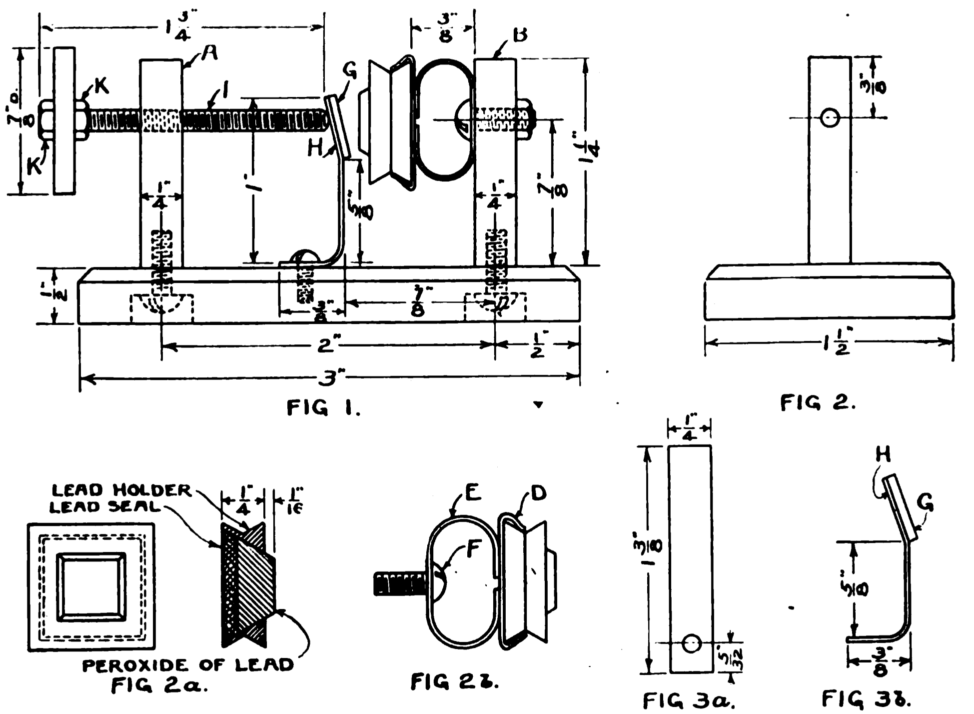
The uprights A and D are ¼ inch brass tapped to take an 8–32 inch screw in the ends for holding them to the base. They are also tapped with an 8–32 thread, ⅜ of an inch from the top and lined up as per the diagram.

From a chemical house purchase a piece of peroxide of lead, also a piece of small platinum foil. The peroxide of lead should now be cut square and should be ⅛ of an inch in thickness. The edges should then be beveled.

Secure a piece of lead a little larger than the peroxide of lead and about $\frac{5}{16}$ of an inch in thickness, then cut a square hole in this piece of lead, beveling the inside edges to correspond with those of the peroxide of lead. Press the peroxide of lead into this lead frame so that it protrudes from the front $\frac{1}{16}$ of an inch, but will not project all the way through the lead frame.

It will be seen that this will leave a depression in the back which is filled with melted lead. When finished in this manner the peroxide of lead will be enclosed in a lead case, except the part in front as shown in Fig. 2A.

With a knife cut a "V" groove around the lead holders as indicated in the sketch. Now cut a square piece of light sheet copper of the same size as the back of the lead holder, leaving a small piece for a tooth to grip the lead holder as shown at D, Fig. 2B. To this square



Diagram, Third Prize Article

piece of copper bend and solder a small piece of spring brass E, Fig. 2B, 2 inches in length and ¼ inch in width, drilled with an 8–32 hole in the middle as shown in Fig. 2B. Assemble the parts and mount them on the upright B, Fig. 1, with an 8–32 bolt.

The next important step is to secure a small piece of spring brass of the dimensions shown in Fig. 3A. It is then bent as shown in Fig. 3B. To the front of this spring and at the top solder a rather thick washer G. The platinum foil is then placed over the front of the washer and the ends bent around to the rear and soldered firmly. This spring is then mounted on the base with a small wood or machine screw at a small distance from the peroxide of lead base, as shown at 8, Fig. 1.

A brass rod 2 inches in length is threaded with an 8–32 thread the whole length as shown at "L," Fig. 1. A round piece of rubber ⅞ of an inch in diameter, to serve as a knob, is fastened at one end of this brass rod with two small nuts, K and K. The rod is then threaded into the upright K as shown, and when properly adjusted it forces the platinum contact against the peroxide of lead with more or less pressure as required.

In any convenient place mount two binding posts, connecting one with the upright B and marking it (—), the other with upright A, marking it (+). The detector should now be connected up in a tuner circuit in the same manner as the electrolytic detector.

While a detector of this type requires considerable time for construction it will more than compensate for the labor expended when the results to be had are obtained.

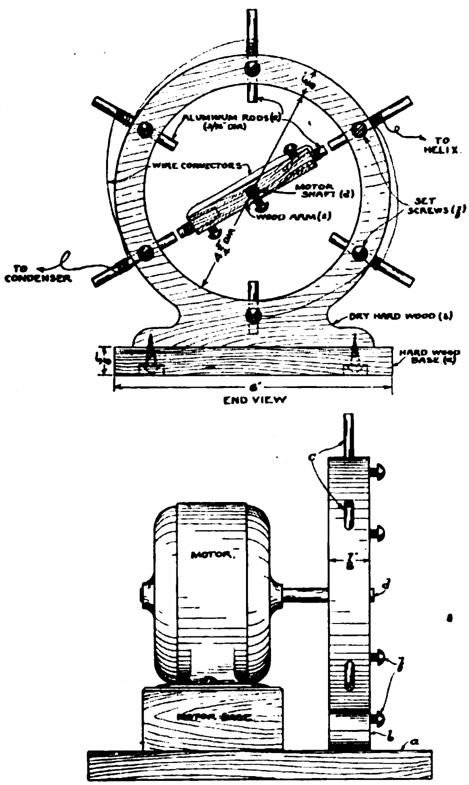
A. L. Savage, New York.

FOURTH PRIZE, SUBSCRIPTION TO "THE WIRELESS AGE"

A Disc Discharger for Amateurs

During the last year rotary spark gaps have come into extensive use among amateur wireless experimenters. The type generally used consists of a small disc having metal studs, revolving between two stationary conductors.

The accompanying sketch shows a rotary gap which is something of a departure from those generally used by amateurs. It consists of an upright *b*, around which are placed at regular intervals six aluminum rods held with screws so as to be adjustable in or out. Affixed to the shaft of a small motor is a piece (*e*) of wood or fiber, having in each end a small section of aluminum similar in size to the stationary rods. The aluminum ends of the rotating piece should be electrically joined together. Three of the rods on one side are connected together, as are also the three rods opposite. The two groups are then connected in the circuit like a plain gap. The upright *b* should be of dry hard wood (preferably maple) 7/8 inch thick; the outside diameter should be about 6 inches, the inside

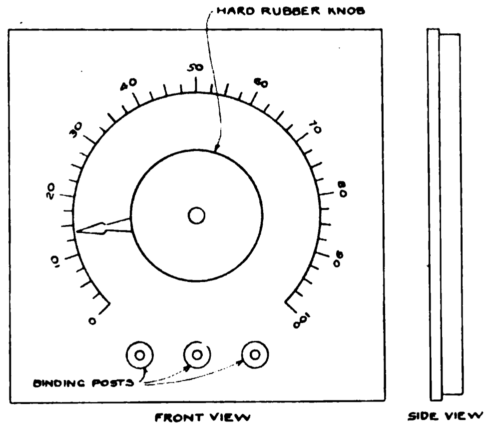


Diagram, Fourth Prize Article

4¾ inches. The aluminum rods are about 1/8 or 3/16 of an inch in diameter. The rotating piece is about ½ inch square or round and 4 inches long, including the metal ends. The distance between rotary and fixed points should be just sufficient for clearance.

Any make of small battery motor may be used. A small rheostat, which can be made of resistance wire, should be used for speed regulation.

When running at a speed of about 2,000 revolutions a minute this rotary



Diagram, Honorable Mention Article, Hayden P. Roberts

sounds more like the Marconi disc discharger than the majority of others, and has the additional advantage of starting and stopping very quickly. This gap may be used in connection with sets up to one-half K.W. capacity.

Walter Burnett, California.

Note.—A rotary gap of this type was originally developed by the Marconi Company and has been in commercial use for a number of years.

It presents a type of construction not generally to be found in amateur stations. It possesses the advantage that cooled surfaces are constantly presented in the path of the spark discharge.—*Contest Editor.*

HONORABLE MENTION

A Rotary Potentiometer

In all modern amateur stations there is a great tendency on the part of the owners to make as many instruments as possible to operate with a rotary movement. This makes the instruments easier to manipulate and improves their appearance.

A rotary potentiometer is easily made under the following directions:

First buy a graphite resistance rod of about 500 ohms; this can be purchased for 50 cents. This rod will be about 5 inches long and should be cut into 3 pieces to form A–B–C.

These are to be fastened with shellac or glue to a mahogany base about 3 inches or 3½ inches square. Four wooden strips (A, B, C, D) are fastened on this base to form the sides. Before fastening the resistance rods down on this base it is well to cut grooves into the wood and fit in the graphite end up before applying the glue.

A hard rubber handle is fastened to the lever with a threaded piece of round brass; a bushing is used out as far as the graphite. Connections are shown in one of the accompanying diagrams, and the other explains itself.

Hayden P. Roberts, Ohio.

HONORABLE MENTION

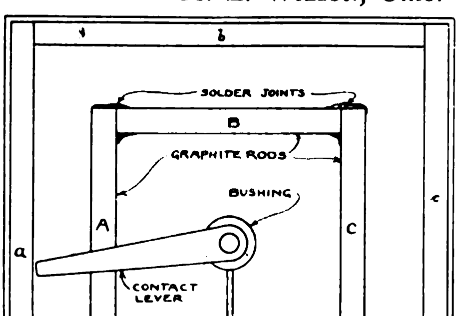
A Detector Stand

The detector which I am about to describe is made of brass rod ¼ inch square, 1 piece 2½ inches in length, and 1 piece 1 inch in length. A hole is drilled in the 2½-inch piece about 1½ inches from the bottom and in the 1-inch piece ¾ inch from the bottom.

The bent spring is of spring brass 1/32 inch thick, and the straight spring is of phosphor bronze 1/64 inch thick. The cup is of brass. The holes are drilled with a No. 29 drill and tapped with 8/32 tap. All screws are of 8/32 thread.

This detector has proved very sensitive, especially with silicon, and has a wide range of adjustment.

M. E. Wilson, Ohio.

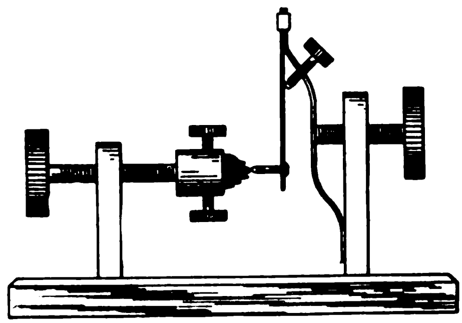


Diagram, Honorable Mention Article, Hayden P. Roberts

AN INDOOR RECEIVING SET

Used for Reading the Time Signals from Arlington

Recently a very heavy snow storm carried away my pole and aerial. On account of inclement weather I was not able to get it fixed up for some time, so it occurred to me to try an indoor aerial for the purpose of reading Arlington's time signals. I turned off the main switch for the house lighting current, then tested the house wiring with a bell and set of batteries to make sure



Diagram, Honorable Mention Article, M. E. Wilson

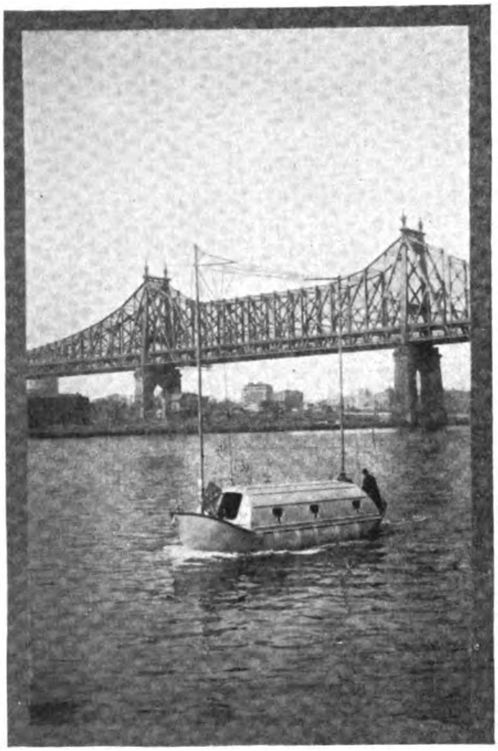
that none of the wires was "grounded" through a pipe or chandelier. After turning on all the switches in the house to increase the capacity as much as possible I connected the house wiring to my station through an ordinary socket plug.

Using a fairly large loading coil, very close coupling between the primary and secondary of the loose coupler, and quite a large capacity across the secondary, I tuned in Arlington on the 2,500 meter wave distinct enough to read with little difficulty. As my station is located on the third floor, the greater part of the aerial is below the instruments, which makes the case all the more unusual.

This was done in a place over 200 miles from Arlington, so I see no reason why such an aerial could not be used very successfully in time-signal work within a radius of at least 125 miles from Washington. In conclusion I might mention that Arlington was the only station I was able to hear outside of amateurs in the vicinity.

Edward G. Henderson, Pennsylvania.

The Lundin Life-boat



Wireless Equipment on the Unsinkable Rescue Craft Undergoes Test

PASSENGERS on vessels passing close to the Ambrose channel in New York Harbor recently witnessed a test of wireless communication between the Lundin lifeboat, designed to save persons on foundering ships, or craft driven ashore in storms, and the tug M. Moran. The lifeboat, which is equipped with a Marconi outfit, is the smallest craft carrying an installation.

The lifeboat left Gravesend Bay at fifteen minutes to nine o'clock in the morning, having Lee Gerson on board as operator. The Moran was in the neighborhood of Pier A, North River. George Gerson acted as operator on the tug, while the tests were in charge of J. B. Elenschneider, of the Marconi Company.

From the Moran came the first message which was as follows:

"How many men on board? Have you tried kite?"

This was the answer sent from the lifeboat:

"Seventeen men besides crew of five. Have not tried kite."

An hour and a half later the Moran inquired:

"Where are you?"

From the lifeboat came this reply:

"Inside the lightship (Sandy Hook)."

When this message was received the Moran had left the vicinity of Pier A and was cruising about in New York Bay. The lifeboat sighted the tug and sent the following message:

"Stop and come alongside."

Aboard the tug was A. P. Lundin, the inventor of the craft which bears his name. The steamship Berlin having Mrs. Lundin as a passenger was outward bound while the tests were taking place and the following wireless message was flashed to her:

"Bon voyage. Love. Lundin."

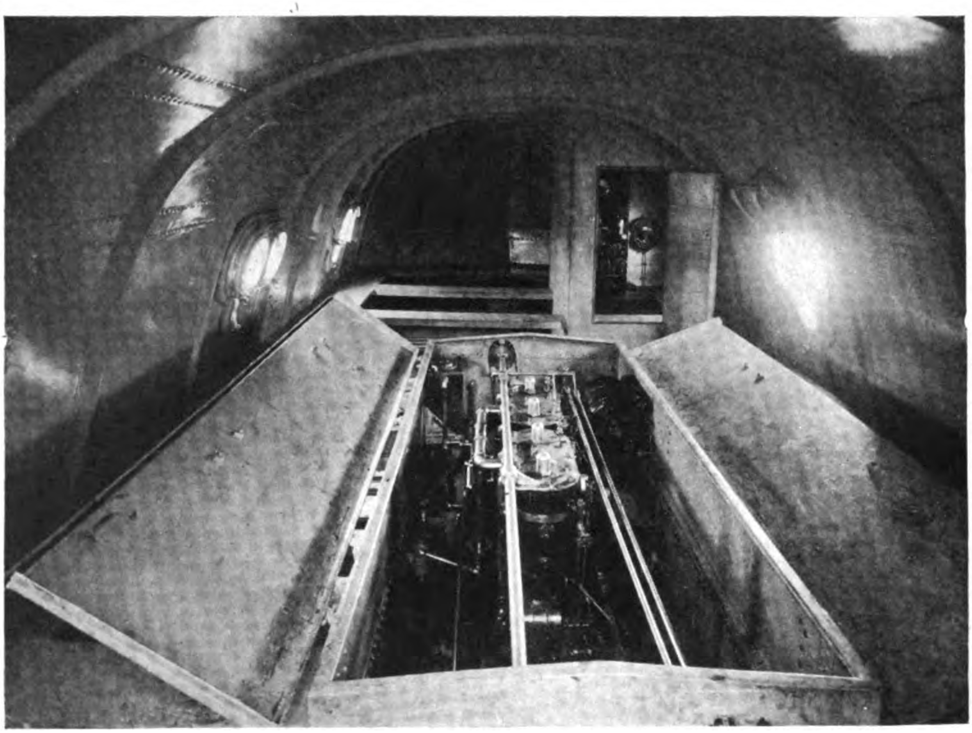
Messages can be sent from the Lundin craft in the daytime as far as fifty miles and at night as far as seventy-five miles. Messages can be received from double these distances. The boat is equipped with 1 K. W. panel set, similar to the installations on United States submarines and torpedo boats. It is operated by a small generator belted to the motor. The latest type of Marconi receiving set is used. The operator is housed in a balsa wood silence cabin.

The Lundin boat is thirty feet in length, equipped with a twenty-four horse power standard motor. The propellers work in a tunnel protected from driftwood. The boat is entirely closed in by watertight iron doors and windows. Forward and aft the boat carries large reels upon which life lines are wound. They can be shot to shore or on board a rescue ship by guns mounted forward. The double bottom has air compartments in its scuppers.

The object of the test was to induce the United States Government to indorse the boat. George Uhler, supervising inspector general of the Steamboat Inspection Service, and eight members of the service from the Atlantic and Pacific ports and the Great Lakes, witnessed the tests from the Moran and expressed themselves as pleased with the trial.

The boat was built by the Welin Equipment Company, of Long Island City, N. Y., of which Mr. Lundin is president. He talked interestingly concerning the test.

"I was aboard the tug," he said, "and was able to communicate with our Mr. Davis on the power boat and give him instructions how to proceed long before the tug came in sight of the power boat. The replies to all of my communications were prompt and accurate. It is my personal conviction, and I think the Board of Supervising Inspectors at Washington agree with me, that it is quite essential and would further insure safety at sea to have one or two boats equipped with wireless on all large ocean-going carriers, if not on all vessels."



Interior view of the Lundin lifeboat, showing the motor in the foreground, and the Marconi panel set and the balsa-wood silence cabin in the background. This boat is claimed to be unsinkable, and, although but thirty feet in length, its capacity is sixty passengers; seating accommodations for this number are provided when the engine covers are closed

Comment and Criticism

IN the matter of the reception of wireless signals on amateur aerials of various lengths, which has been discussed in a previous issue of THE WIRELESS AGE, the trend of opinion seems to point to the desirability of the short aerial.

The subject is apparently one of great interest in the amateur field as we have received a number of communications in which the views of the contributors are expressed in no uncertain manner.

The following communication is of interest:

In the experimental department of the January issue of your magazine is an article praising the efficiency of a long single wire aerial. For the past two years I have been experimenting along this line. I have used aerial wires varying in length from 1,000 feet down to about 50 feet. In order to make comparisons I used multiple strand aerials, containing four wires which if stretched out would be equal to the single wire being used at the same time. With one exception the multiple strand aerial gave far better results than a single wire. To my mind a multiple aerial should not be made shorter than 50 feet and must not contain less than four wires. To give you an idea of the results which I have obtained with the two aerials the following may be of interest.

On July 18th, 1913, at 8:30 P. M. I heard NAR (Key West Naval Station) very distinctly on a 75-foot aerial consisting of 4 copper wires approximately 75 feet in height. I was unable to hear NAA (Arlington Station) loud enough to copy on a single wire 300 feet long and of the same height as a 75-foot aerial.

N. S., New York.

We fear that our correspondents totally neglect the matter of wave lengths being employed at the sending apparatus or the receiving apparatus and do not take into proper consideration the phenomena of electrical resonance so important to long distance working.

Did N. S. take care to tune his receiving apparatus to the wave length of the two stations in question? Were the circuits of the tuner so designed as to allow accurate adjustment to the wave length of Arlington Station (2,500 to 4,000 meters)? That he heard Key West and not Arlington, on the short aerial, does not sufficiently sustain his argument. Perhaps the inability of his receiving apparatus to pick up the signals from Arlington was entirely due to the limitations of his receiving tuner.

We are inclined to believe that with the long aerial of 300 feet the signals from Arlington are apt to be received with greater strength on the single wire than on the 4-wire aerial. Of course the high frequency resistance of the multiple stranded aerial is somewhat less than the single wire and therefore the energy losses may not be so great.

But again, when receiving the longer wave lengths on the short aerial it is necessary to add considerable inductance to attain to the longer wave lengths and the resistance of this inductance may be considerably greater than the resistance of a long single wire.

* * *

Carl Dreher, the contributor of the article which appeared in the January issue on the use of single wire aerials, has made note of the criticisms appearing in subsequent issues and defends himself in the following manner, giving more complete data in respect to certain experiments along this line:

It appears that a number of my fellow wireless experimenters take strong exception to the statements made in the article, The Use of Single-Wire Antennae in Receiving, published in the January issue of THE WIRELESS AGE. The theory of the matter has been ably discussed by the editor of the Comment and Criticism department. I should like to make my position quite plain and to give additional facts and data.

My assertion is, briefly, that given a certain limited amount of wire, say 400 feet, better and more consistent distance work can be done with this conductor stretched out in one length than if it be used in the erection of a short 4–6 strand antenna. By better distance work I mean signals from all commercial stations radiating on 600 meters and up. I do not limit my statement to sets using waves from 1,500 meters up.

I know perfectly well that a great many amateurs do very good work with short antennae, and that the tuning is sharper than on long wires. However, no very great difference is noticeable. On a 250-foot single strand aerial I was able to tune out practically all amateur interference, but not the local commercial stations. Are we to understand from F. L. M. and W. W.'s letter that they can tune out local commercial installations and copy a moderately distant set, say Hatteras (WHA) or Boston (WBF)? If so, I can only say that they are doing very selective work, but that not one amateur in fifty is capable of imitating them. This question of eliminating local interference is not of very great importance in long distance receiving, because, generally speaking, the only occasions on which one can hear stations 1,000 to 2,000 miles away is when there is little static and absolutely no interference or outside noise.

In regard to the letter from the president of the Talo Wireless Club, I may say that I heard Sayville on a 250-foot, not a 400-foot aerial. Also, same is directional and does not favor Sayville. This may account for the fact that I do not get him further than 5 to 6 feet from the phones.

Now, the members of the Talo Wireless Club admit at the start that a long aerial is preferable for distance work provided there is no local interference. They go on to say:

"Getting back to the working properties of an aerial, ask any commercial operator who has plenty of real work to do whether he likes signals to 'pound in' and have interference through forced oscillations, or have a station come in loud enough to read well and not be bothered trying to tune out forced oscillations. He will invariably prefer the latter condition in localities having interference such as is encountered in New York City."

Allow me to point out that amateur work and commercial communication differ so greatly that the analogy is not valid. The commercial operators on the Atlantic seaboard do not try to do distance work. Sea Gate, for instance, communicates as a rule only with ships on the west side of Fire Island, a distance of perhaps 50 miles, and about 90 miles to the south. There are so many coast stations that transmissions of over 200 miles are seldom necessary, except at stations like Cape Cod and Sayville. Hence the aim here is to attain selective and dependable communication rather than distance. In amateur long range work a maximum amount of incoming energy is necessary and sharpness of tuning, while desirable, takes second place.

Last summer during July and August I had a receiving outfit up in the Catskill Mountains. I used a single wire about 200 feet long, directional east, 30 feet high at the open end and 17 feet at the lower. The conductor ran parallel to a clump of trees a few feet distant, and the station was entirely surrounded by heavily-wooded hills over 2,000 feet high. My ground consisted of a ½ inch water pipe about 3,000 feet long, the greater portion buried a few inches deep and some of it on the surface. Static was so bad that I feared my phones would be burned out. In spite of these adverse conditions I easily read Sayville, 120 miles, every night. I did not bother much with short wave work, but I heard Newport Navy Yard, 160 miles, Siasconset, Sagaponack and the ships fairly well. It is worthy of note that I could get none of the New York stations, and that absolutely no signals could be heard in the day time. However, to come back to the subject under discussion, I am quite sure that the gentleman who is president of the Talo Wireless Club could not have heard Sayville at all on his 40-foot antenna, although I do not doubt that he does excellent work with it in the city.

I am at present experimenting with a 4-strand 50-foot antenna on a roof about 50 feet above the ground, with the higher end fastened to a mast 13 feet high. It will be observed that the amount of wire in the flat top is almost the same as in my 250-foot single strand and that the heights are approximately equal also. Hence the conditions of the problem of best disposing of a limited amount of wire have been fulfilled. The limit of the range of this antenna is Savannah, Ga., about 750 miles. On my 250-foot aerial I could read Guantanamo, 1,500 miles, pretty consistently at night from October to March. I think that this data supports my opinion that the long antenna is in nearly all instances to be preferred, but I freely admit that a skilled operator can obtain good results with any kind of aerial. At any rate, it will pay any operator to compare the two types carefully and to draw his own conclusions.

There is no denying the fact that Mr. Dreher speaks from experience, for he has made a number of experiments under varying conditions which lead him to believe that when a limited amount of wire is available, the long single aerial will give the best results.

We note, however, that in the majority of his experiments he is engaged in the reception of wireless signals from stations operating on long wave lengths, such as Key West and Guantanamo operating on wave lengths of 1,600 meters, and Sayville, 2,800 meters.

This accounts to some extent for the benefit he derived from the long single wire because a wire of this length allows him to tune more readily to the long wave length employed at these stations.

We agree with him in connection with his experiments in the mountains that he is "quite sure that the . . . president of the Talo Wireless Club could not have heard Sayville at all on his 40-foot antenna" under similar conditions. We imagine that Mr. Dreher would have obtained still better results if he had increased the length of his aerial wire to, say, 600 or 800 feet. Of course an aerial wire of this length would afford wave length adjustments which are out of resonance with the emitted wave from the average ship station, but wou'd allow more or less efficient tuning to the waves of longer length as emitted by the high power stations.

There are many variable factors in the case to which reference has not been made by any of the parties concerned, such as the type of receiving apparatus employed, the design and proportionment of the circuits of the tuner, the type of detector used, and the degree of damping in the circuits. Accurate data in this respect is imperative before absolute conclusions can be drawn. We do not mean to infer that amateur observations are unimportant and without value even when made in an unscientific manner. In a case of this kind where so many agree on the same point the results cannot be passed over lightly.

It is obvious that an aerial, whatever its type or design, which is of such length that it is more suitable for the reception of the longer wave lengths, is hopelessly inefficient for receiving signals from licensed amateur stations operating on a wave length of 200 meters. The reverse of this statement, however, does not necessarily hold good, for by proper design of the receiving circuit it is possible to receive wave lengths of 3,000 meters on an aerial having a natural wave length of 200 meters; however, the strength of signals to be expected on a 200-meter antenna will by no means equal that to be obtained by an antenna which has a natural wave length nearly equal to that of the long wave transmitting station.

For receiving signals with the maximum degree of efficiency we prefer, as we stated in the March issue, a receiving aerial, the natural period of which is slightly below that of the antenna of the distance transmitting station. A receiving antenna of this type allows a few turns of inductance to be connected in the primary circuit of the receiving transformer for the transference of energy to the local detector circuit. We have not neglected to take account of the fact that an antenna to be receptive to a wide range of wave lengths must represent a happy medium. It can be neither too long nor too short. The actual length will depend on the range of wave lengths to which it is desired to tune the receiving apparatus.

AN AMATEUR'S TOWER

A notable example of amateur construction is shown in the accompanying photograph of the tower and aerial built by Eugene Wilson, of Belleville, N. J., from his own design, and at a cost of less than thirty dollars for material.

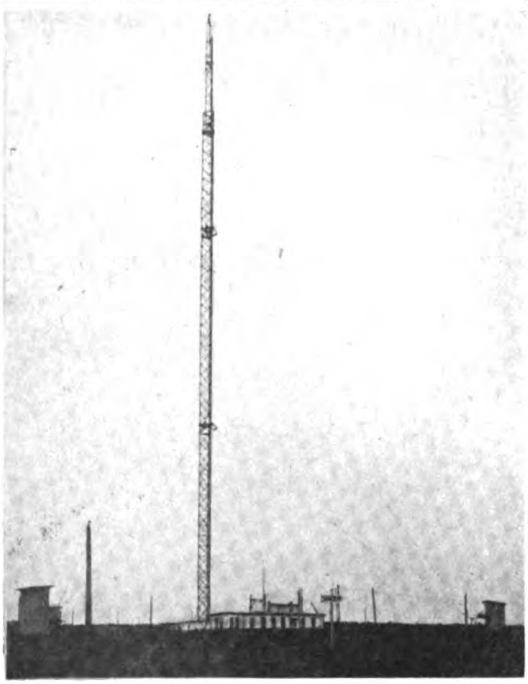
The dimensions give some idea of the size of the undertaking. Height of tower over all, 90 feet; height of tower proper,

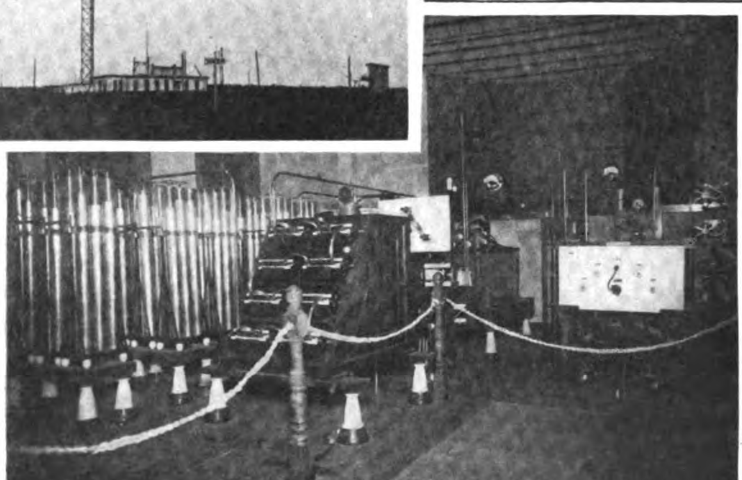
65 feet; base of tower, per side, 12 feet; top of tower, per side, 1 foot.

The main uprights are of angle iron 2 by 1/8 inches, and the cross pieces are of 1 3/4 by 1 3/4 by 1/8 inch angle iron. All the parts are secured together by means of 3/8 inch bolts. Each leg is set in solid concrete four feet deep. The pole at the top extends 25 feet above the top of the iron structure and is a 1 1/2 inch galvanized iron pipe. This pole is braced with iron cable reaching to the upper part of the tower, but no guy wires of any kind are needed to support the tower.

This tower has withstood the recent winds which have brought down so many aerials and telegraph lines, and is surely a credit to the builder.

The Sayville Station





At top, the operating room; in center, an exterior view of the station and mast: below, the transmitter

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

A. F., Washington, N. J., asks:

Ques. (1) With a station consisting of 1 blitzen receiving transformer, 1 inch variable condenser, 1 Murdock Silicon detector, 1 fixed condenser and 1 pair 3,000 Ohm Holtzer-Cabot phones, could I receive Colon, Panama? If not, could you give any suggestions for improvements upon my station so that I could receive that far? My aerial is composed of two strands of wire 525 feet long, and three feet apart.

Ans. (1) With extremely favorable conditions at night time you should be able to receive signals from the station at Colon, provided all your apparatus is in sensitive adjustment and your antennae is at least 70 or 80 feet in height.

Ques. (2) What is the approximate wave length of my station?

Ans. (2) The approximate wave length of your antennae is 800 meters.

* * *

Sergeant A. R. R., Worland, Wy., inquires:

Ques. (1) Is the umbrella aerial as good or better for general working than the common loop "T" or flat top aerial and is not the umbrella aerial cheaper to construct?

Ans. (1) The flat top aerial is cheaper to construct and, generally speaking, the more efficient of the two types. For efficiency the umbrella antennae must be supported from a mast at an excessive height; the same results can be obtained with the flat top aerial of considerable less height.

Ques. (2) Which type of aerial does the Marconi company use at its stations?

Ans. (2) The flat top inverted "L" or "T" type is invariably used.

Ques. (3) Using aerials of the various types described, what height would be necessary with the average amateur instruments to cover a distance of 12 miles with a few trees intervening?

Ans. (3) A small flat top aerial having a height of, say, 30 feet, should enable you to cover the distance with little difficulty.

Ques. (4) How far can I send with a 1½ inch coil run on 75 volts, and what other apparatus do I need to correspond with the set?

Ans. (4) We suppose your current supply is 75 volts direct current; if so, with the 1½ inch coil of the average amateur construction you will require a rheostat in series with the primary winding to control the current flow. We believe you will obtain the best results with such a small coil by simply connecting the spark gap in series with the antennae. Then connect the high potential terminals of the coil to the spark gap. An oscillation transformer is almost out of the question with a set of this size.

* * *

E. E. H., Wilkinsburg, Pa., writes:

Ques. (1) Do you have any books which treat on the theory, design, and manufacture of electrostatic condensers? If not, could you refer me to a list of books giving such information?

Ans. (1) We are not aware of the existence of any such publications, but suggest that you get in touch with some of the large book concerns in New York City.

* * *

J. E. P., Irvington, N. J., writes:

Ques. (1) What is the wave length of an aerial 50 feet long and 50 feet high, 5 wires, space 10 inches apart, lead-in 60 feet?

Ans. (1) The wave length of your antennae is about 180 meters.

Ques. (2) About what is the longest wave a loose coupled tunner can get with a primary winding 4¼ inches long, 3⅛ inches in diameter, having 114 turns, secondary 3¾ inches long, 3 inches in diameter, 300 turns? Tuning is done by switches.

Ans. (2) You should be able to reach wave length adjustments up to 2,000 meters if you have a condenser of .001 mfd. connected in shunt with the secondary.

Ques. (3) What is the best capacity of a condenser for 2,000 ohm phones?

Ans. (3) If you intend to use a fixed condenser its capacity should be about .003 mfd. Twelve sheets of foil, each sheet 2½ inches square and separated by thin paraffined paper, the whole arrangement tightly pressed together between two boards or clamps, will give a capacity sufficient to act as a phone condenser. It would be better to use a variable air condenser.

Ques. (4) What is the cost of the back numbers of The Wireless Engineering Course up to the November issue, 1913?

Ans. (4) Twenty-five cents per copy, but only a few back numbers can be obtained.

* * *

F. M. L., Algona, Iowa:

Ques. (1) Approximately, what is the range of this receiving set with a single wire aerial No. 12 copper, 300 feet long, 100 feet high, non-dead end loose coupler, variable condenser, audion detector, Brandes navy phones and fixed condenser?

Ans. (1) Under extremely favorable conditions and at night time you should be able to hear Arlington, and possibly the Telefunken

Station at Sayville, L. I. Your range is rather hard to estimate as we do not know the general conditions surrounding your station.

Ques. (2) Give hook-up for the outfit described.

Ans. (2) The proper hook-up is given in the January issue of THE WIRELESS AGE in the article entitled, How to Conduct a Radio Club. Do not insert a fixed condenser in the audion circuit in the same manner as you would when employing a "loose coupler" in connection with crystal detectors. Connect the fixed condenser around the head phones.

Ques. (3) The high end of the aerial is fastened to the city water tank, which is of iron construction and is 100 feet in height. Would this have a tendency to cut down my efficiency or would it only cut me off from one direction?

Ans. (3) The presence of the iron water tank would have the effect of decreasing the efficiency to some extent, but not seriously.

Ques. (4) Approximately, give my receiving wave length.

Ans. (4) We are not familiar with the constants of your receiving tunner, but if it is of the average size you should be able to receive signals at wave lengths up to 2,500 meters.

Ques. (5) What kind of a loading coil is most efficient?

Ans. (5) See the article referred to in the answer to your second query.

* * *

A. R. B., Youngsville, Pa., says:

On the 7th inst. at 9.30 P.M. while I was copying Sayville I heard a low buzzing sound which increased to such an extent that I was unable to read signals. When I tried to change the adjustment of instruments I found it impossible to touch any part of the same; I finally disconnected the lead-in and by holding the lead-in wire ½ inch from the ground wire was able to get a thick blue spark for at least three minutes; the current was practically noiseless and did not change in intensity.

This was repeated at intervals of thirty or forty minutes until midnight, but the current was not nearly so strong after 9.30 P.M. There was a brisk north wind with some snow; the temperature was 20 degrees above zero and static could only be heard occasionally. There is no street car or high voltage lines within nine miles of my station. I have never had an experience of this kind; in fact, I have never read of anyone who had and will appreciate any information you can give me in this matter.

Ans. This phenomenon was first observed at a wireless station in the Middle West in 1904 and under identical conditions of weather temperature, etc. It was noted at that time that this current had no effect on the receiving detector, but if the aerial connection to the earth was broken a severe shock would be received by anyone touching the aerial wire. The antennae would discharge sparks 6 inches in length to earth. Of course this is due to atmospheric or "static" electricity, but just why it should be especially prevalent during snow storms has never been fully explained. This phenomenon has recently been noted by others and has been referred to in the Queries Answered Department in a previous issue of THE WIRELESS AGE.

B. M., Farmington, Ill., inquires:

Ques. (1) Which is the best, a long low aerial or a short high one?

Ans. (1) It all depends upon conditions and the wave lengths it is desired to receive. For amateur work you will find it better to erect an aerial just as high as possible under given conditions.

Ques. (2) Is the enclosed hook-up a desirable one?

Ans. (2) No. It would be practically inoperative. Your sketch shows no fixed condenser in the detector circuit. Previous issues of THE WIRELESS AGE have shown a number of receiving hook-ups which might be employed.

Your third query is not understood and it would be useless to print it.

Ques. (4) Give a list of five of the most sensitive detectors in order.

Ans. (4) Audion amplifier, audion, tikker, galena, Perikon or carborundum.

Ques. (5) Is a licensed station a government station?

Ans. (5) Not necessarily. Commercial and amateur stations are also licensed.

* * *

J. M., Waterbury, Conn., writes:

In your January issue you have an article on How to Conduct a Radio Club, which deals entirely with the audion as a detector and as an amplifier of signals. In describing the audion as a detector, and giving instructions for its installation, on page 276 beginning in the lower left-hand column you write as follows: "Particular care should be taken that at point E the negative end of the storage battery is connected to the positive end of the high voltage battery, for if the batteries are connected in opposition at this point the intensity of signals is considerably reduced."

I find that by connecting up in the manner described my audion refused absolutely, but on the other hand if I connect the positive side of the storage battery to the negative side of the H. V. battery my audion works very well indeed. The rest of the hook-up I find O.K. Am I in error when I consider the carbon of a battery as positive and zinc as negative, or where is the trouble?

Ans. Are you quite sure that you have followed the diagram closely as shown on page 275 of the January issue? It does not make any difference which terminal of the storage battery is connected to one particular leg of the filament provided the remainder of the apparatus is connected up accordingly. Carefully noting the diagram on page 275, you will observe that the lead, which is connected from the secondary of the loose coupler to the filament of the audion, has an arrow on it showing that it may be connected to either side of the filament. This is very important, for if the storage battery leads are reversed this lead will have to be changed also.

Carbon is the positive pole of the battery and zinc the negative. At that point in your circuit where the terminal of the high voltage battery connects to the filament you should see that that terminal is of the opposite polarity to the terminal connected to the lighting battery. We are of the opinion that you have not taken into account one connection of the secondary of the loose coupler as being variable, and moreover, that it may be shifted from the D to the A side or vice versa.

Replying to your second query, in reference to the switch and high voltage battery, there is nothing wrong with our sketch and we do not understand what you mean by a high or low potential, in the way in which you refer to it. The switch we show on page 275 of the January issue is properly connected and allows a variation of voltage over a wide range. The results you refer to in respect to distance covered with this set should be quite satisfactory and are just about what may be expected under the conditions.

* * *

R. R. F., Detroit, Mich.:

With the receiving tunner you describe having a small variable condenser in shunt with the secondary windings, you should be able to receive wave lengths up to and including 2,500 meters.

* * *

J. H., Philadelphia, says:

In one of your recent issues of THE WIRELESS AGE there was an article relating to the audion in which the audion was used as a detector and amplifier. I should be very thankful to you if you would let me know where I could buy one without the batteries and rheostats. The Radiotelephone Company sells them, but the entire outfit must be bought; the valve cannot be bought separately.

Ans. Your statement is quite correct and it is now necessary to purchase a complete outfit. This query was covered in the March issue of THE WIRELESS AGE. At the time the original manuscript on the Audion Amplifier was written it was possible to purchase these bulbs independently of all auxiliary apparatus.

* * *

N. S., Ithaca, N. Y.:

Ques. (1) On what wave length does the Tuckertown, N. J., station send and should a person located here be able to hear the signals if that person can already hear Cape Cod?

Ans.—We have not been advised that the Tuckertown station had been engaged in any transmission work; it has simply been employed for experimental receiving tests. Should it *be* sending you would not be able to hear the signals as they employ the Goldschmitt system for producing undamped oscillations, and you would require a special detector such as the Poulsen Tikker to receive these oscillations.

Ques. (2) Are two audions used as amplifiers twice as sensitive as a single audion?

Ans. (2) Not twice as sensitive but approximately 40 times as sensitive.

Ques. (3) Which is preferable, a long ground lead and short aerial lead or vice versa, providing the sum of the two leads is always constant? Would there be any noticeable difference when receiving signals?

Ans. (3) A short ground lead is preferable. The effect on the signals is a matter of degree.

Ques. (4) How does one determine the capacity in microfarads of an aerial?

Ans. (4) The method for making this computation will appear in an early issue of the series, How to Conduct a Radio Club.

Ques. (5) Who is RAS? I have not had access to an International Call list as yet.

Ans. (5) RAS is a Russian Land Station located at Vladivostok, Russia. Do you mean to infer that you are copying signals from this station?

* * *

E. B. M., Torrington, Conn., writes:

I have had some trouble with my sending set consisting of a ½ K. W. transformer coil, Gernsback electrolytic interrupter, spark gap and a home made condenser consisting of 7 plates of window glass 7 by 9 inches, and six sheets of tin foil, size 4 by 5 inches. I get a fine thick spark about $\frac{5}{16}$ of an inch thick and very steady. I find that amateurs one mile away can hardly hear me, When I take off the condenser and substitute a small Leyden jar I get a spark ¾ of an inch long, very thin and unsteady, or rough. The amateurs say my signals come in great, but the spark is too rough to read. I use 110-volt 60-cycle current. I notice that if I come near one of the primary terminals of the coil with some metal object I draw a $\frac{1}{32}$ inch spark.

What is my trouble?

Ans. (1) After careful thought it appears that while undoubtedly you get the best spark with a $\frac{5}{16}$ inch gap, with the condenser capacity employed at this adjustment your circuits are out of resonance and consequently you are not heard at a distance. When, however, you substitute a small condenser even though you get a bad spark you place your transmitting circuits in resonance; that is, you place the condenser circuit and the antennae circuit in resonance, and are heard at a greater distance. If we were on the ground and could get full data as to the conditions of the wave length under which you were working we could remedy the difficulty. When you are using the $\frac{5}{16}$ inch gap, wind up a loading coil and connect it in series with the antennae and see if your signals do not carry further.

The spark which you draw from the primary terminals of your coil is high voltage energy set up by electrostatic induction from the transmitting apparatus. This effect may be observed at almost any wireless station, particularly those employing high voltages in the transmitting apparatus.

Ques. (2) Can I use my coil as an open core transformer without the interrupter?

Ans. (2) We are not familiar with the transformer in question, but no doubt you will be able to get results when connected to an alternating current source of supply.

* * *

J. F. D., Brooklyn, N. J.:

We understand that the Telefunken Station, at Sayville, L. I., sends signals to Nauen, Germany, at night time only. The Marconi Company handles commercial messages across the Atlantic daily between Glace Bay, Nova Scotia, and Clifden, Ireland. This service is carried on without interruption. The high power stations of the Marconi Wireless Telegraph Company of America will be open for commercial business as soon as they are completed.

* * *

T. J., Jr., Woodside, N. Y.:

The books you desire may be purchased from D. Van Nostrand & Company, New York City.

* * *

I. K., Frederick, Md.:

Previous issues of The Wireless Age have contained many hook-ups of "loose-couplers" and loading coils. You should have no difficulty in connecting up the apparatus you have on hand.

* * *

L. C. B., Hackettstown, N. J.:

Complete information as to the Poulsen Arc is given in the February issue of The Wireless Age in The Engineering Measurements of Radio Telegraphy, by Alfred N. Goldsmith. A full answer to your query would require too much space in this department, for you practically request us to cover the entire undamped oscillation transmitting apparatus field. In the Proceedings of The Institute of Radio Engineers you will find an interesting article on arc transmitters by Dr. Lee De Forest.

* * *

C. H. P., Waukeegan, Ill.:

Your query relative to the autotransformer, to be used in connection with the audion amplifier, is fully answered in the March issue of this department. The loud-speaking telephone is an ordinary telephone receiver with an amplifying horn which amplifies the signals to such an extent that it can be set on the table at some distance from the ears. If you desire further information in regard to its construction communicate with the Western Electric Company, Chicago, Ill., or New York City.

* * *

G. T. L., Providence, R. I., writes:

Ques. (1) Is it possible for me to get signals from Arlington at 12 o'clock or 10 o'clock with the following set?

Three slide tuner 3 inches in diameter, No. 22 bare copper wire 11 inches long, a small variable condenser .0005 mfd., a fixed condenser 200 ohm phones, and a perikon detector; this set to be used on an aerial 50 feet high, "T" type, 50 feet long?

Ans. (1) There is sufficient inductance value in your tuning coils to hear signals from Arlington, but the aerial you describe is rather small for the daylight reception of signals. However, by careful adjustment you should be able to receive signals of considerable intensity at night time.

Ques. (2) Is the "T" aerial the best type I can use?

Ans. (2) In many cases the inverted "L" type aerial will give a longer wave length adjustment for a given amount of wire than the "T" aerial.

Ques. (3) Could I with the set described receive signals from Arlington at a station at Newport, R. I.? The latter station has an antenna of the "T" type 60 feet in length and 80 feet in height.

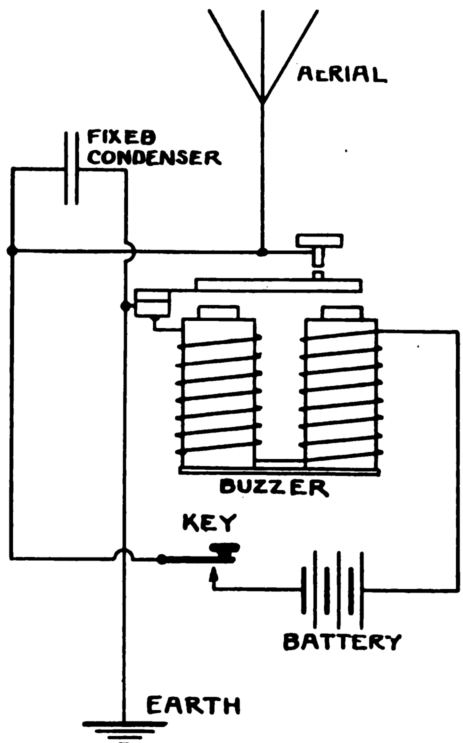
Ans. (3) We are a little bit in doubt as to the reception of daylight signals at this point, but at night time you should hear these signals very loud indeed.

Ques. (4) Can I use a buzzer of the type employed in the Navy (without a helix) connected to an aerial as a transmitting set and comply with the law?

Ans. (4) We do not believe that there will be any urgent objections on account of the limited transmitting range of a set of this type. We do not believe that the authorities would require an oscillation transformer. You should seek advice from the Government wireless inspector in your district.

Ques. (5) Will you kindly give me the connection for the buzzer and fixed condenser used as a sending set?

Ans. (5) We herewith publish a drawing, showing the proper connections. Also note the drawing appearing in the From and For Those Who Help Themselves Department of the March issue of The Wireless Age.



* * *

W. O. H., Cleveland, Tenn., says:

I have just observed the audion amplifier in the February issue of The Wireless Age and it certainly looked good to me. I refer to the article on page 394. What is a microphone transmitter and where can I buy one; also, what is the price?

Ans. (1) The ordinary telephone transmitter is a microphone transmitter and this, we believe, is what our correspondent used. One of the original microphone transmitters consisted of two carbon buttons in very light contact. One button was fastened solidly to a piece of wood and the other button was connected to a piece of spring copper in such a manner that the pressure could be easily adjusted. The microphone was then connected in series with the telephone and a cell of battery. Any sounds which occur in the immediate vicinity of the microphone would cause a variation in pressure between the two carbon buttons which would in turn vary the intensity of the current flowing through the head telephones, thereby producing audible sounds.

* * *

C. E. K., Plainfield, N. J.:

You have not stated the thickness of the glass to be used as the dielectric in the transmitting condenser; therefore we cannot answer your query accurately. We suggest that you note the article in the November issue of THE WIRELESS AGE, entitled a 200 Meter Amateur Set. Full instructions are given in this article for the construction of a condenser to suit the average one quarter kilowatt amateur transformer. If your plates of glass, which you state are 10 by 12 inches, are of the same thickness as those described in the article mentioned, you can easily figure out the square inches of foil on plates of your size to correspond with the square inches of foil as given in the article in the November issue. The oscillation transformer shown in your sketch is quite satisfactory and should "sharpen" up the transmitting waves.

With an antenna 90 feet long and 40 feet high connected to this set you should be able to cover 25 or 30 miles; the distance depends entirely upon the local conditions.

Your request as to where you can purchase bamboo poles has been noted and we are unable to put you in touch with anyone having them for sale.

Replying to your fifth query, it is not well to crowd the quarter K. W. transformer. We do not advise you to use more than 2½ amperes.

* * *

H. D., Cleveland, Ohio, sends us a communication which in addition to being a query contains a full description of an amateur home made station and therefore may be of more than ordinary interest to our amateur readers.

Ques. (1) Will you kindly give me a rough estimate of the distance I should be able to cover with the following equipment? My transmitting set consists of a ¾ K. W. home made, close core transformer, voltage 10,000, glass plate condenser, having 5 plates, each 16 by 15 inches, covered with heavy grade foil, 11½ by 14 inches on each side of each plate; "pancake" type of oscillation transformer, primary winding, consisting of 1½ turns of No. 20 gauge brass ribbon; secondary consisting of 6 turns of the same ribbon; rotary spark gap mounted on a synchronous induction motor rotating at a speed of 1,800 R. P. M.; rotary gap has 16 teeth of the saw-tooth type; the disc is of aluminum. This rotary spark discharger gives me 28,800 sparks per minute or 480 per second.

My aerial consists of 4 No. 14 soft drawn copper wires, spaced 33 inches apart. The height of the flat top is 45 feet; the length 81 feet; the length of the lead is 30 feet; the length of the ground lead, 35 feet; the ground lead is connected to the water, gas and drain pipes in the basement.

The aerial is insulated by 4 2-wire porcelain cleats at both ends of each wire. The lead-in is run through 3 fibre tubes, one inside the other, and the whole arrangement is boiled in wax.

Ans. (1) Roughly, with the equipment you have described you should be able to cover a distance of about 40 miles in daylight. Your night range will vary.

Ques. (2) Does the Marconi Company still sell the Fleming oscillation valve and what would be the average life of one of these valves when used about 4 hours each night at proper voltage?

Ans. (2) These valves may be purchased from the Engineering Department of The Marconi Wireless Telegraph Company of America, 233 Broadway, New York. The length of life of these bulbs varies. The average length of life is 300 hours, although many bulbs have lasted 600 hours.

Ques. (3) What is the theory of the action of the new "Radioson" detector? Is it electrolytic?

Ans. (3) We have never heard of this type of detector and do not know who manufactures it.

* * *

J. D. C., Belvidere, Ill., asks:

Ques. (1) What are the call letters of the new Marconi station in Florida?

Ans. (1) Call letters have not yet been assigned.

Ques. (2) What time does San Francisco send press and at what wave length?

Ans. (2) It sends at irregular intervals; wave length varies; it is generally 4,500 meters.

Ques. (3) What are the call letters of the wireless stations of the Lackawanna Railroad at Binghamton and Scranton, Pa.; also the wave length used by them to communicate with trains.

Ans. (3) The call letters of Binghamton are WTB; Scranton, WTP; train WHT (temporary). Wave length variable.

Ques. (4) Give the call and wave length of Tufts College, at Medford, Mass.

Ans. (4) To our knowledge the call is not officially listed.

Ques. (5) To what stations have the following calls been assigned: WNU, WHD, WHY, WRG, WQM.

Ans. (5) These call letters have not yet been assigned.

* * *

G. P. B., Halifax, N. C., asks:

Ques.—Will you kindly tell me the advantages of a 2-wire aerial over a 1-wire antenna of the same length, say 350 feet, and if two wires are used, what is the correct distance that they should be placed apart?

Ans.—The advantage lies principally in the increased conductivity afforded by the two wires. The additional wire also gives a slight increase in capacity, and therefore a longer natural wave length. Separate the wires 10 feet.

* * *

F. L. C., Elgin, Ill.:

Your query has been answered in the Queries Answered department of the March issue.

THE WIRELESS AGE

Statement of the ownership, management, circulation, etc., of THE WIRELESS AGE, *published monthly at New York, N. Y., required by the Act of August* 24, 1912. *Editor, J. Andrew White,* 450 *Fourth avenue, New York; Managing Editor, J. Andrew White,* 450 *Fourth avenue, New York; Business Manager, John Curtiss,* 450 *Fourth avenue, New York; Publisher, Marconi Publishing Corporation,* 450 *Fourth avenue, New York; Owners: Marconi Publishing Corporation,* 450 *Fourth avenue, New York.*

Stockholders holding 1 *per cent. or more of total amount of stock, Marconi Wireless Telegraph Company of America,* 233 *Broadway, New York City.*

Stockholders of Marconi Wireless Telegraph Company of America holding 1 *per cent. or more of total amount of stock: Grenfell & Co.,* 3 *London Wall Bldgs., London, England; Francis Robert Gregson,* 5 *Lowndes street, London, S. W., England; Heybourn & Croft,* 43 *Threadneedle street, London, E. C., England; Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, London, W. C., England; Simon Siegman, c|o Kuhn, Loeb & Co.,* 52 *William street, New York, N. Y.; Swiss Bankvercin, London, England; Nieuw Amsterdamsch Administratiekantoor, Heerengracht* 136, *Amsterdam, Holland.*

Known bondholders, mortgagees, and other security holders, holding 1 *per cent. or more of total amount of bonds, mortgages, or other securities; none.*

JOHN CURTISS,
Business Manager.

Sworn to and subscribed before me this 19*th day of March,* 1914.

B. M. SWIFT,
Commissioner of Deeds,
New York City, No. 463,
Commission Expires April, 1915.
Residing in New York County.

MAY, 1914

THE RADIO REVIEW

Voluntary Aid in Mexican Crisis

As we go to press Washington dispatches announce that officials of the government are greatly pleased with the offer of The Marconi Wireless Telegraph Company of America to place itself at the disposal of the Government in the present Mexican crisis. Secretary Daniels said it was a most generous offer and it would be accepted.

The Marconi company has voluntarily offered to furnish free service for the transmission of messages to and from American warships on both coasts of Mexico and Marconi stations ashore or afloat, for the purpose of relaying messages to and from the fleet. The Marconi company also has voluntarily agreed to give these government messages preference over all other dispatches. The Navy Department made an official announcement of the offer, as follows:

"The Marconi Wireless Telegraph Company of America has placed at the disposal of the American Government free service and preference over all other business, which includes the company's stations on the Atlantic and Pacific Coasts and all Marconi equipped vessels in American waters for relay purposes.

"The offer includes on the same terms its South Wellfleet station for long-distance work. In making this offer the President of the Company telegraphed that in addition they so far as possible would co-operate with the Government in all such work as can be done at the almost completed ultra-powerful stations at Belmar, New Brunswick, N. J., and Marshalls and Bolinas, Cal."

Wireless Equipped Lifeboat Adopted

Following a series of remarkable tests made with the Lundin housed power lifeboat close to the Ambrose Channel Lightship and later in the East River, which were witnessed by steamboat inspectors from all parts of the country, word has been received that the boat has been approved and adopted by the United States Government. In the tests made in March, and reported in our April issue, George Uhler, the supervising inspector general of the Steamboat Inspection Service, and eight members of that service were present; three metal lifeboats of the Lundin type were used.

The largest boat in the test was a thirty foot metal power boat, equipped with a twenty-four horse power Standard motor, giving the craft a speed of six miles an hour. The propeller works in a tunnel, which protects it from driftwood, the boat carries a Marconi wireless outfit and is the smallest craft fitted with a wireless apparatus. This apparatus is capable of sending messages for a radius of fifty miles and messages can be received from a distance of one hundred miles. This housed lifeboat is entirely closed by watertight iron doors and windows, and in the test for stability off Sandy Hook fifty men were carried in the cabin of the boat, while seventeen men hung on to the outside guard rail on one side without causing the slightest list.

Life lines are carried on reels on both the bow and stern of the boat, and these lines can be shot to shore or on board a rescue ship by guns mounted forward. The double bottom of the boat is fitted with air compartments and scuppers. Rowlocks are also fitted just below the port lights, so the boat by the use of sweeps may get away from a vessel's side.

A capsize test with forty men aboard was made of the twenty-four foot Lundin boat at the foot of the company's wharf in Long Island City. A line was swung under the boat and she was "parbuckled" upside down but "flopped" back in a second.

The Rescue of the Sealers

THOSE who have read Kipling's "Captain Courageous" or of Dr. Grenfell's work in Labrador have an idea of the desperate hazards of the fishermen and sealing crews in those perilous latitudes, but neither the novelist nor the medical missionary have penned anything more harrowing than the tragically brief messages brought by wireless, telling of the fate of the crew of the sealing steamer Newfoundland.

Sixty-four men perished and thirty-seven were rescued after two days and nights of wandering about on the frozen wastes in the midst of a blinding blizzard. It is described as the worst catastrophe in twenty years of sealing. The report of this tragedy appearing elsewhere in our pages gives some idea of the agonies of exposure the men were subjected to. It is difficult to conceive men enduring the hardships undergone by the survivors. Yet with all its harrowing details, the horror of the incident is somewhat mitigated by the comforting thought that through wireless advices the rescue was eventually accomplished and the commanders of the vessels relieved of anxiety terrible to contemplate.

Marconi Phone at Exposition

IT is announced from Rome that Ernesto Nathan, Rome's famous ex-mayor, who has been appointed Italian commissioner to the San Francisco exposition, has just completed negotiations with Guglielmo Marconi for the largest exhibit at the exposition of wireless telegraphy that has ever yet been made. Marconi has also promised that he will have his wireless telephony sufficiently developed by that time to permit all exposition visitors to do a little telephoning.

THE EDITOR.

Annual Meeting of the American Marconi Company

THE annual meeting of the Marconi Wireless Telegraph Company of America was held in the offices of the company, 15 Exchange Place, Jersey City, on April 20. In the speech of the Hon. John W. Griggs, president of the company, it was pointed out that "The business organization of the company has been systematized and strengthened in preparation for the new business that is expected to be done by the long distance stations, and when the stations are ready the company is fully prepared to handle the large amount of traffic." Mention was also made of the successful operation of Marconi Wireless telegraphy on trains of the Delaware, Lackawanna and Western Railroad Company, and the victory won by the Marconi Company in its patent suits against the National Signaling Company. The address was as follows:

"The balance sheet of the company submitted to you by the Board of Directors is made up for the eleven months ending December 31, 1913. The uneven period was taken because of the change made in the termination of the fiscal year, which became operative in the year 1913. The balance sheet shows a surplus of $178,251.29.

To Maintain Surplus for the Present

"In view of the present depressed condition of general business and of the probable expense of operation that will be connected with the inauguration of the trans-Atlantic service, the Board of Directors have considered it wise not to make a declaration of dividend at the present time. They have considered it more to the interest of the stockholders to maintain for the present this surplus than to pay it out in dividends. Its retention strengthens the financial condition of the company and provides against any unforeseen loss in profits that may ensue in the present uncertainty of business conditions. In this respect it is in line with the action of other corporations who are husbanding their profits. Whenever business conditions are such as to warrant the distribution, the directors will feel free to make it at any period of the year.

"Our stockholders will readily understand that it is impossible for the directors or for the management to predict with any accuracy the business which will come to this company on the opening of the high power stations, but there is an enormous volume of business in cabling done between America, the United Kingdom and the continent, and with only a very small proportion falling to this company the result will be most gratifying.

Increase in Ship to Shore Business

"The progress of the work and increase in receipts in the ship to shore business during 1913 has been most satisfactory, for during that year the ship to shore stations of the company sent and received 379,110 messages, which contained 6,728,379 words, and the revenue derived from the transmission of these messages amounted in gross to $125,417.20.

"This result compares very favorably with the result shown and reported last year and as given out in our president's address, which result, although showing a very large increase over 1911, totalled only $109,143.10; therefore the increase for the year 1913 is shown to be $15,474.10.

"To equal this for the coming year and to better it will be the desire of those in connection with the Traffic Department, and we think that this end will certainly be attained.

"There has been unforeseen delay in the completion of the long distance stations which are in process of erection. This has been due to a variety of causes, the principal one being delay by material men in furnishing machinery and other supplies for the work. We are now informed by our engineers that the trans-Atlantic stations between America and Great Britain will be completed within a month or six weeks. The stations in California and the Hawaiian Islands ought to be completed shortly afterwards. A site has been selected at Marion, Massachusetts, for the Norwegian station, and work has begun there.

"The business organization of the company has been systematized and strengthened in preparation for the new business that is expected to be done by the long distance stations, and when the stations are ready, the company is fully prepared to handle the large amount of traffic.

"By arrangement with the Western Union Telegraph Company they are to give us identification in messages delivered, by indicating 'marconigram' on all messages turned over to them for delivery. They also concede us the same land line rates for the wireless letter and also the week-end letter which they give to their own cable company.

"Stations have been planned for two points in Alaska, namely Ketchikan and Juneau. The telegraph business in Alaska is now handled by the United States government, and the rates are very high. We expect to be able to make a lower rate and still leave a margin of profit, provided the business develops as we are led to think it will. Success in the operation of the stations already planned in Alaska will encourage us to erect other stations at Valdez, Nome, and points along the coast and in the central parts of the territory.

Railroad Wireless a Success

"The practicability of the operation of the wireless system for the management of railway trains has been demonstrated by the Delaware, Lackawanna and Western Railroad Company, which now has three of our sets in use on its trains and is negotiating with this company for the installation of several more sets. The work which has been done for the Delaware, Lackawanna and Western Railroad Company by your company has been most satisfactory, and the railroad company is congratulating itself upon having acquired this means of communication, which in times of storms and other casualties putting the land lines out of operation, has proved itself to be most efficient.

"The Board of Directors recommended that the by-laws be changed so as to avoid the great trouble and expense of mailing notices of annual meetings to stockholders, intending to consolidate both the minutes of the annual meeting and the statement of accounts, which should be sent out to all stockholders, but as some of the more important stockholders have objected to any change in the by-laws, the matter has been withdrawn and will not be voted on to-day."

Reference to Judge Veeder's Decision

The following reference to the patent situation was made in a report presented by the secretary:

"It is with great pleasure we are able to announce that under the decision rendered by Judge Van Vechten Veeder on the 19th of March, the patents under contest issued to Mr. Marconi and his associates and contested by the National Electric Signaling Company were held to be valid.

"The decision is regarded by the Marconi Company of the widest importance to Marconi interests, since it puts the control of wireless telegraphy in America practically in the company's hands, and declares the National Electric Signaling Company of Pittsburgh, which has been the principal rival of the Marconi Company in this country, to be an infringer in vital particulars.

"After an admirably comprehensive study of wireless signaling, from its almost prehistoric beginning, in beacon fires on hilltops, down to the utilization of Hertzian waves, Judge Veeder has decided that Marconi was the first man to make of wireless telegraphy a practical means of communication and that the patents for which he applied in 1886 and secured in 1897, 1898 and 1904 are valid.

"As such litigation goes, in matters of such financial importance, this is quick work. Litigation over wireless telegraphy will doubtless continue, in one form or another, for some time to come, but Judge Veeder's decision, confirming, as it does others to like effect rendered in England and France, gives Mr. Marconi a strong position from which to conduct his battle. It is in harmony, too, with public sentiment everywhere, for there has never been any question in the general mind, as to the originator of wireless telegraphy, or to whom fame and gratitude should be accorded for the almost inestimable benefits which the world has derived, and will derive, from this remarkable invention.

"This decision of Judge Veeder's is so satisfying, that we think it will be of further interest to the stockholders, to present to them some literal quotations from it, as the matter in hand cannot be more clearly expressed, than as contained in the decision.

"In commenting on the improvements of Marconi apparatus over the early attempts of Lodge the Judge stated:

"'That this apparatus overcame the difficulties emphasized by Lodge is not disputed. Where Lodge compromised, Marconi reconciled. With this definite control over radiation, effective selectivity was maintained.

"'So far as possible with a coherer, it enabled full use to be made of the principle of sympathetic resonance.

"'In combination with the increased available energy in the transmitter, the distance over which messages could be sent was enormously increased.

"'With this apparatus Marconi communicated across the Atlantic in 1901, and the claims of issue constitute the essential features of apparatus which has since made possible communication over a distance of 5,000 miles.

"'It is used in more than 1,000 installations by Marconi, and is admittedly an essential feature of the wireless art as at present known and practiced.'

"Referring to the attempts of the National Electric Signaling Company in making the defense, the matter is very concisely summed up as follows:

The Fessenden Defense Deficient

"'The Fessenden defense is deficient because not a single piece of apparatus claimed to have been used is produced; not a scintilla of corroborating written evidence that such apparatus as Fessenden illustrates in his 1913 sketch was in fact used; no corroborating written evidence as to when, where, how long, or to what extent any such apparatus was used. It is supported only by the oral testimony of witnesses with respect of occurrences happening a dozen years ago. And this evidence is conflicting and contradictory.

"'It was not until June 19, 1902, therefore, that Fessenden stated anywhere that the condenser circuit must be tuned.'

"The bearing of all this upon Fessenden's extensive claims of prior knowledge and use of tuning is significant. As Judge Hand has neatly put it: 'How much he or anyone knew is not capable of ascertainment except by what he said, and neither in his patent nor anywhere else, did he say anything in the least resembling it.'

Pupin on the Possibilities of Wireless

"In summing up, the judge, in quoting Professor Pupin, of Columbia University of New York, who is on the consulting staff of this company, says:

"'What we want then is, in the first place, to be able to put a great deal of energy into our radiators; secondly, very rapid succession of sparks; thirdly, radiators and receivers of small damping; and as a result of all these things an efficient tuning of the receiving to the transmitting apparatus. The solution of these problems will increase the sphere of future possibilities of wireless telegraphy more than anything else that I know of.'

"Referring to this the judge further states:

"'The enumeration in the final paragraph of the particulars of the problem to be solved, is a clear summary of the disclosures of the patent in issue.

"'My conclusion is that the claims in issue are valid, not anticipated and infringed.

"'Decrees in accordance with the foregoing conclusions may be settled upon notice.'

"I may state further, in behalf of the directors, that matters are actively in hand to bring all infringers to terms which will be satisfactory to the best interests of the stockholders of this company."

The following officers were elected for a term expiring in April, 1915, or until their successors be elected:

President, Hon. John W. Griggs; first vice president, Guglielmo Marconi; second vice president and general manager, Edward J. Nally; third vice president and secretary and treasurer, John Bottomley.

Guglielmo Marconi, James W. Pyke and J. Van Vechten Olcott were elected directors for a term of five years, or until their successors be elected. The following were elected as members of the Executive Committee for the ensuing year: John W. Griggs, Guglielmo Marconi, Edward J. Nally, James W. Pyke, James R. Sheffield and John Bottomley.

The Report of the Directors

THE report of the directors and the statement of accounts for the year ending December 31, 1913, was in part as follows:

The balance sheet and profit and loss account, in accordance with the amendment to the by-laws, is made up for eleven months ending December 31, 1913. It will be noted that the balance sheet shows a surplus of $178,251.29.

In connection with the balance sheet, your directors desire to point out that it was necessary to make very large and unusual expenditures during the year, but it is confidently expected that the extraordinary conditions which called for them will not occur again.

In round figures these expenditures aggregate over $60,000.00, and were caused:

First: By the dismantling of sundry ship and land stations, the latter of which were found to be unnecessary owing to the consolidation of the property of your company and the defunct United Wireless Company.

Second: Increased ship and maintenance expenses were necessary to bring our ship stations up to the standard required by the government.

Third: We were put to large increased expenses on account of stock transfers, caused by the issuance of the new stock and the transfer of temporary securities into those of a permanent nature.

Fourth: Owing to disturbed labor conditions on the Pacific coast, we were put to an increased expense in order to maintain the integrity of our service and to preserve our independence in the conduct of our business.

Another important matter which should be taken into account, and which makes for considerable difference in our balance sheet, is the number of large orders unfilled both on private contracts and contracts with the United States government, which remained open at the close of the year, and which, while showing a profit, could not be properly taken into the account inasmuch as the profit had not then been definitely ascertained. Since the close of the year the majority of the orders have been filled and profits assured for the current year.

The work of erection of the high-power long distance stations is progressing and unless unforeseen circumstances should arise, we hope they will be completed and open for business early in the summer.

As to the Pacific stations; everything seems favorable to our being able to start service with Honolulu prior to June 1st.

Nothing much has been done in regard to our proposed Philippine station because of many obstacles which have been placed in the way of our securing concessions and rights from the United States and Insular governments. A bill, however, has just been passed by the Philippine Assembly, granting us, subject to the approval of the secretary of war, the right to erect a high-power station which will work with Honolulu, Japan and China, and we hope at an early date to receive the approval of the War and Navy Departments enabling us to proceed with the work of location and installation.

The imperial Japanese high-power station, which is being constructed to work in connection with our Honolulu high-power station, is not yet completed and we are unable at this writing to obtain definite information from the Japanese Embassy as to the exact date when this station will be ready for business.

Norwegian Station Under Way

Land has been purchased at Chatham and Marion, Massachusetts, the former for a transmitting station and the latter for a receiving station, for high-power work with Norway. The Norwegian government station also is now under way.

Satisfactory arrangements have been completed with the Western Union Telegraph Company under which connection will be made between its main operating rooms in New York, San Francisco, Boston, etc., and our new high-power stations in New Jersey, California and Massachusetts. These wires will be equipped with the latest devices for direct and expeditious exchange of traffic.

Inasmuch as we shall be in competition with the Western Union Telegraph Company, as well as all other cable companies, for trans-Atlantic business, it will be necessary not only for us to influence patronage in our favor in all large cities, but we shall have to keep it coming. Therefore, a business-getting organization has been perfected and representatives will be located in New York, Chicago, New Orleans and San Francisco who will be in charge of a capable corps of canvassers which will keep in touch at all times with the cabling public and inform them of our superior facilities and reduced rates.

The tendency of governments everywhere to enforce and enlarge wireless regulations, making it obligatory for all ocean and lake going craft to be equipped with wireless, increases the demand for our equipment.

The very severe storms on the Great Lakes last season demonstrated the necessity for wireless. Many vessels were wrecked and many lives lost, but no losses occurred where ships were equipped with wireless.

Another striking instance of the value of wireless in times of storm and stress was given during the recent snow storm in the vicinity of New York which played havoc with all overhead systems of wires. One railroad, however, which this company had equipped with its wireless apparatus, was able to run its trains and handle its traffic without cessation or delay. We were able to extend facilities and aid to other railroads, giving them service with New York, Philadelphia and Baltimore. Thus the value of wireless on trains as an auxiliary service in time of storm is now generally recognized and as a result we have had many inquiries from railroad officials and we expect to build up a substantial business in train wireless.

This company is arranging to construct several high-power stations along the Alaskan coast and in the interior, and steel has already been shipped for stations to be constructed at Ketchikan and Juneau for commercial business with Seattle and Astoria, Washington. There are good prospects for good business.

We are in negotiation with the Cuban government to take over and operate on a joint basis several wireless stations which that government has been maintaining independently.

We are gratified to be able to report a favorable decision by Judge Van Vechten Veeder of the United States District Court, in our suit against the National Electric Signaling Company for infringement of patents, by which the validity of all three patents on which the suit was brought is fully sustained and by this decision Marconi is now for the second time officially recognized in this country as the inventor who made commercial wireless telegraphy a possibility, and this decision as it stands to-day will have a far-reaching effect on competing wireless companies.

The balance sheet will be found on the page following.

THE SHARE MARKET

NEW YORK, APRIL 27.

The tone of the general market is weak to-day. Brokers believe that the war in Mexico has something to do with the decline in which standard securities established new low levels for the year for the preceding three successive days. This movement was accompanied by marked declines in all classes of stocks and the weakness of Marconis is looked upon as part of the temporary slump in all securities.

Bid and asked prices to-day:

American, 3⅝—3⅞; Canadian, 1⅞—2⅛; English, common, 15—17½; English, preferred, 12—15.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA

General Profit and Loss Account—For the Eleven Months ended December 31, 1913.

ADMINISTRATION EXPENSES, including Salaries of Directors, Executive Officers and Consulting Engineers, Rents, Taxes and General Office Expenses..	$159,831.61
LEGAL, PATENT AND STOCK TRANSFER EXPENSE........................	19,971.18
DEPRECIATION ON BUILDINGS AND EQUIPMENT......................	33,232.54
PROFIT, CARRIED TO BALANCE SHEET.	178,251.29
	$391,286.62

PROFIT FROM OPERATION OF LAND AND SHIP STATIONS, SALE OF APPARATUS AND OTHER RECEIPTS.........	$177,913.63
INTEREST ON TEMPORARY INVESTMENT OF SURPLUS FUNDS...............	213,372.99
	$391,286.62

BALANCE SHEET—DECEMBER 31, 1913.

ASSETS

CASH IN BANKS, ON HAND AND AT CALL:		
Cash in Banks and on Hand..............	$67,312.23	
Bankers' Certificates of Deposit............	720,000.00	
Bankers' Collateral Call Loans..............	550,000.00	$1,337,312.23
INVESTMENTS AND LOANS (At Cost):		
Railway Bonds and Notes..............	$1,832,607.62	
Bankers' Time Collateral Loans..........	99,839.94	
Foreign Government Bonds..............	195,625.00	
Municipal Bonds and Notes..............	400,000.00	
State Notes..........	300,000.00	
Shares of Other Companies..............	1,470.00	2,829,542.56
SUNDRY DEBTORS AND DEBIT BALANCES..........................		278,476.52
WORK IN PROGRESS, MATERIALS AND SUPPLIES ON HAND...............		407,371.06
PLANT, MACHINERY AND TOOLS......		75,060.62
REAL ESTATE, BUILDINGS AND LAND STATIONS......................		1,992,148.90
SHIP STATIONS....................		258,496.77
PATENTS, PATENT RIGHTS AND GOODWILL..........................		2,741,539.16
		$9,919,947.82

LIABILITIES

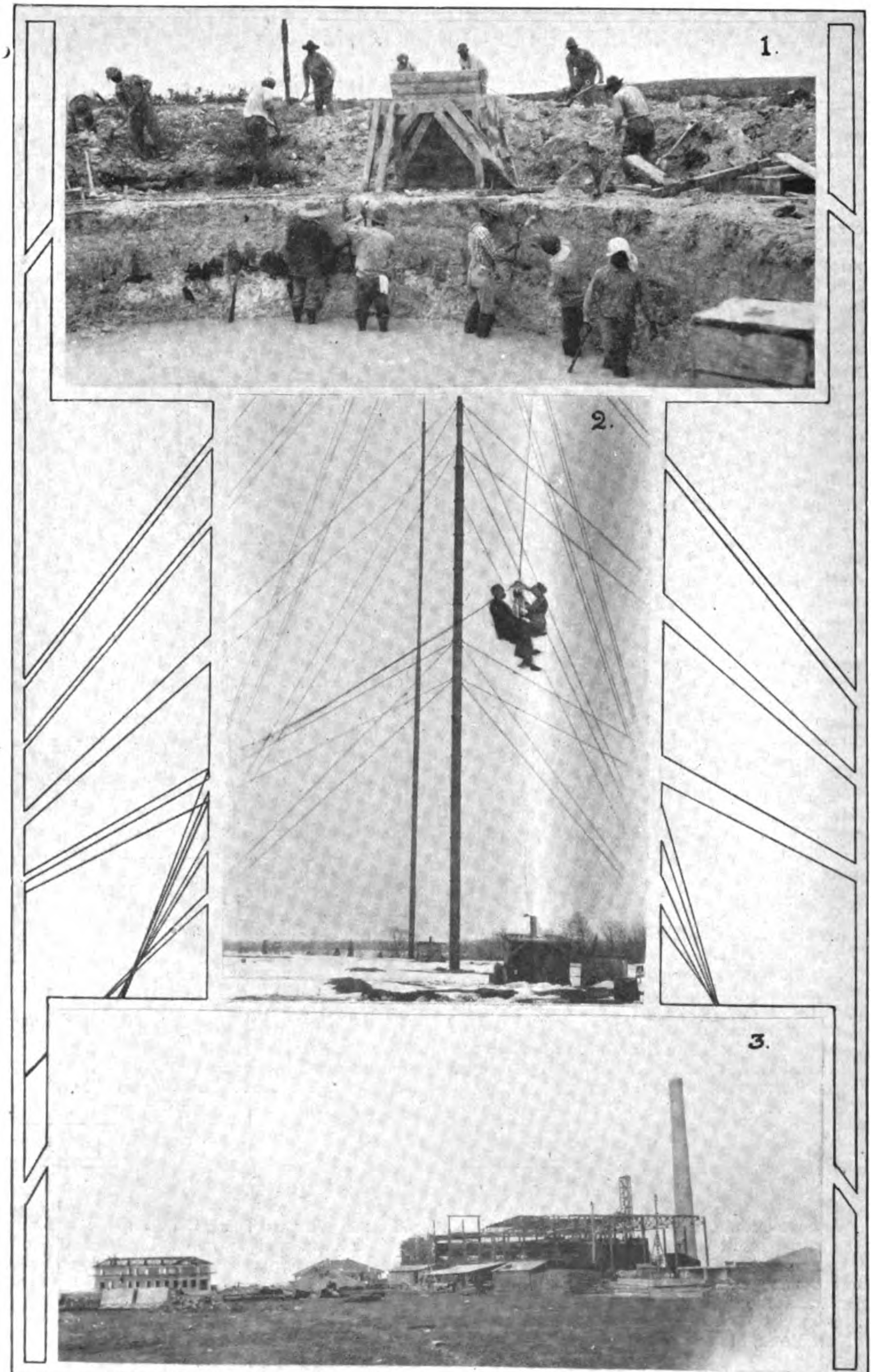
CAPITAL STOCK:		
Authorized:		
2,000,000 Shares, par value $5.00 each, fully paid and non-assessable.........	$10,000,000.00	
Less:		
Subscribed for but not yet issued: 119,486 Shares par value, $5.00 each.........	597,430.00	
	$9,402,570.00	
Less:		
Stock held in Treasury...............	500.00	$9,402,070.00
SUNDRY CREDITORS AND CREDIT BALANCES..........................		303,184.28
SURPLUS:		
Balance, per Certified Accounts, January 31, 1913...........	$224,483.65	
Less:		
Dividend paid as of August 1, 1913....	188,041.40	
	$36,442.25	
Net earnings eleven months ended December 31, 1913.........	178,251.29	214,693.54
		$9,919,947.82

We have examined the accounts and records of the Marconi Wireless Telegraph Company of America, and as a result thereof have prepared the above balance sheet and accompanying general profit and loss account. These, subject to the value placed upon its patents, patent rights and good will, in our opinion correctly represent the financial condition of the company on December 31, 1913, and its transactions for the eleven months ended that date.

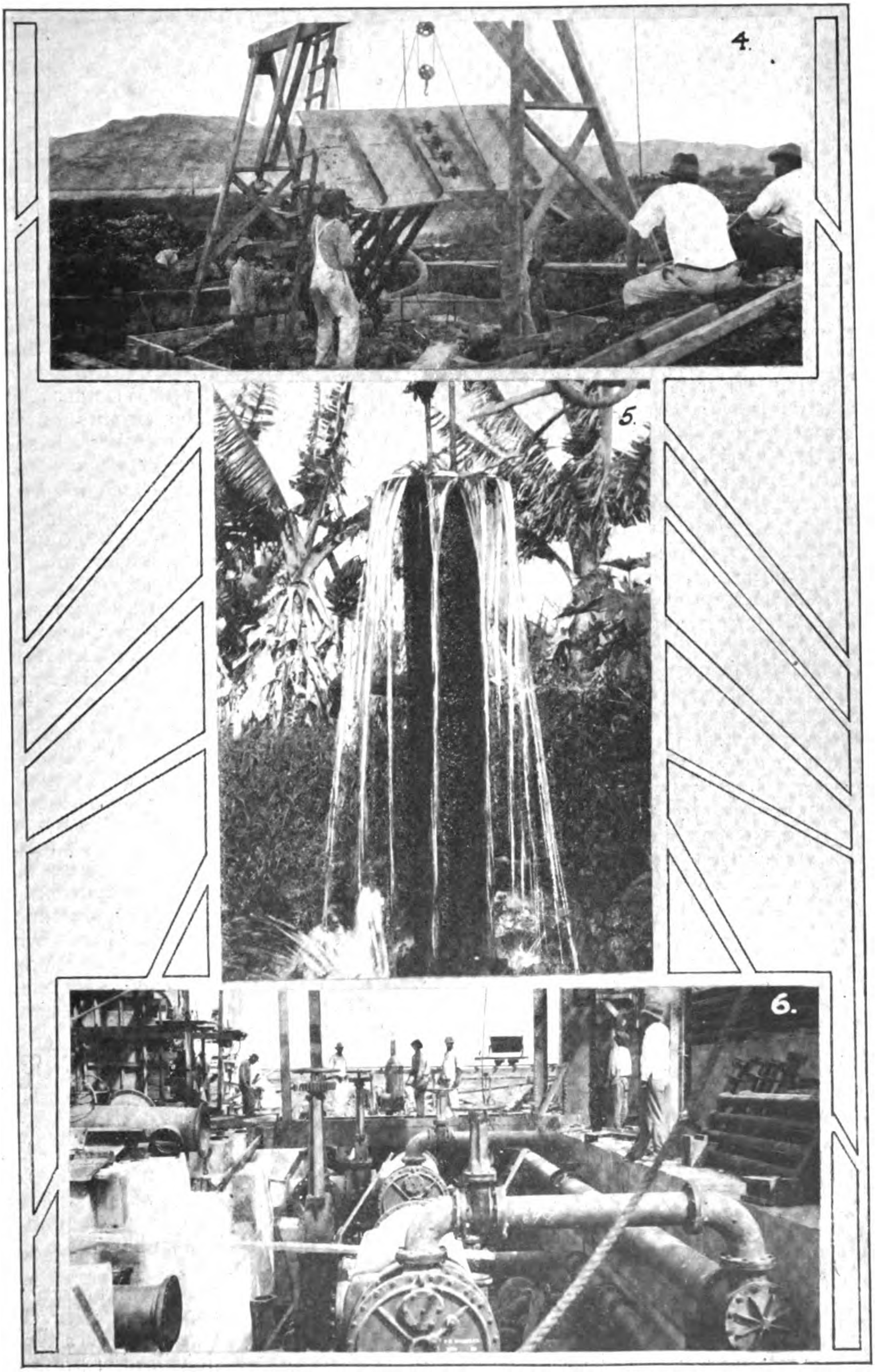
NEW YORK, MARCH 24, 1914.

ARTHUR YOUNG & COMPANY,
Accountants and Auditors.

A Few More Views of the



(1) Excavating for fresh-water reservoir. (2) The first woman to ascend the masts at New Brunswick daughter of the former owner of the land. (3) A typical general view of station building



(4) Pouring concrete for the mast anchorage foundations in Honolulu. (5) The artesian well at Koko Head station. (6) The steam condenser pit of the power house

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE IV

THERE is ample evidence at hand to show that the inductively coupled receiving tuner is the most popular type of this apparatus in use among present-day amateurs. Experimenters will be interested to learn that in a recent United States court decision Mr. Marconi was for the second time given full credit for the invention of the device, the claims of his patents having been fully sustained.

That the inductively coupled receiving tuner affords a certain flexibility of control and adjustment with a degree of simplicity that cannot be approached in other types of receiving tuners may account to a considerable extent for its present popularity.

The writer has discovered through experience that many amateurs do not fully understand the theory of the operation and the mode of manipulation of this tuner. This knowledge is necessary in order to obtain the greatest possible efficiency. In a later article the matter will be discussed in detail.

For the present the writer will confine himself to the description of a type of receiving tuner which is little known in the amateur field, but has been employed to some extent commercially. It will be well to bear in mind that the arrangement of circuits of this new tuner is the subject matter of a patent* issued in 1911.

Before entering into details concerning the subject, a well-known circuit in use to-day by a commercial company will be briefly discussed. At first sight it seems to bear a certain resemblance to the one to be described, but in reality it relies for its operation on a totally different principle. Reference is made to the Marconi multiple tuner.

* U. S. Patents Nos. 997,515, 997,516.

Doubtless many amateurs who have read the educational articles appearing from time to time in THE WIRELESS AGE, are familiar with the circuits of this tuner. They will remember that an intermediate circuit is employed for the sole purpose of giving sharp resonance effects, allowing a no uncertain degree of separation of wave lengths to be obtained. Those who have had experience with this or similar circuits will agree with the writer that the degree of selectivity obtained is sometimes disagreeably sharp, requiring an exceedingly accurate adjustment to pick up certain stations.

For the benefit of the amateurs who have had no experience a sketch of the circuits employed on the "tuning side" of the Marconi multiple tuner is shown in Fig. 1. L is the primary of the receiving transformer which is inductively coupled to the intermediate circuit at L1. The intermediate circuit comprises the inductance L1, the variable condenser C, and the inductance L2. The inductances L1 and L2 are so proportioned that when used in connection with the variable condenser C, the combination gives wave length adjustments suitable for resonance with the antennæ circuits.

The intermediate circuit is then coupled to the local detector circuit at L3. Furthermore, the two fixed inductances L1 and L2 are so arranged that they can be turned at right angles to L and L3. To be more explicit, L1 and L3 are wound on balls or spheres in such a manner that they can be rotated in a 90° arc; considerable flexibility of coupling is thus obtained.

The members of amateur organizations who have had no experience with this circuit would do well to construct a tuner along these lines as it will afford an un-

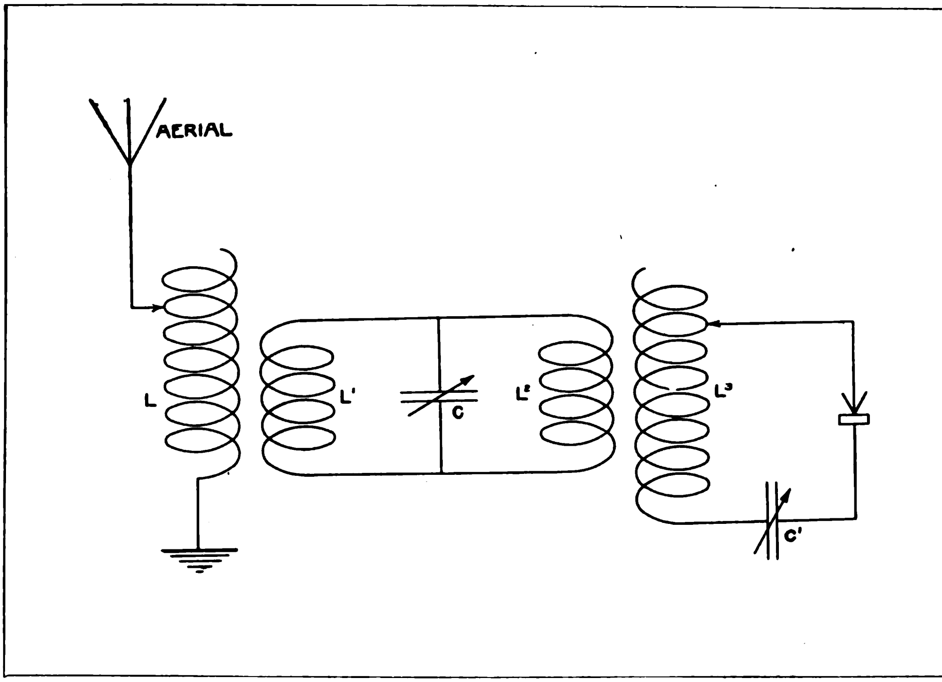


Fig. 1.—Elementary circuit Marconi multiple tuner

believable degree of selectivity which is obtained, of course, somewhat at the expense of the strength of received signals.

Let us suppose, on the other hand, that an amateur is possessed of two single slide tuning coils and through lack of funds is unable to purchase or construct the much desired "loose coupler." He need feel no sense of discontent on this account because we shall furnish him with data and advice on a new type of inductively coupled tuner which will give equal, if not better results, than any other type of amateur receiving tuner.

We herewith introduce such experimenters to the "linking circuit," an invention whereby an amateur may quickly convert two single slide tuning coils into an efficient "loose coupler" in less than an hour. The arrangement of the circuits is shown diagrammatically in Fig. 2, and photographically in Fig. 3. The latter shows the "linking circuit" as used for receiving at the wireless laboratory at the East Side Y. M. C. A., New York.

Referring to Fig. 2, A is an ordinary single slide tuning coil of the type found in the average amateur station. It is connected in series with the antennæ as shown. B is also a single slide tuning coil of the same type. These two coils are electromagnetically linked through the "linking circuit" coils C and D.

Now our entire story lies in the circuit C D, and it is believed that all amateurs will agree that nothing simpler could possibly be imagined. In fact the circuit C, D consists of nothing more than a *very few* turns of wire wound around the lower end of coils A and B. Suppose, for example, that A and B were single slider tuning coils about 12 inches in length and 2½ inches in diameter; then, for the "linking circuit," we would secure a few feet of No. 16 insulated magnet wire and wind about 3 or 4 turns of it tightly around the turns at the base of coil A. We then continue this circuit and wind an equal number of turns about the coil B. Thus coils A and B are inductively coupled through a loop of small inductance, negligible resistance and practically zero capacity. It should be understood that the "linking circuit" C D is in no sense resonant with the antennæ circuit or the detector circuit; the loop simply acts as an energy transfer circuit between the two coils A and B.

It will be evident that the wave length of the detector circuit can be increased or decreased by means of the slider S1, and likewise the wave length of the antennæ circuit at slider S; therefore any tuning to be effected may be done in the simplest manner, for it is only necessary to adjust for resonance at sliders S and S1. Furthermore, no attention need be paid to the degree of coupling as the position of the "linking circuit" remains constant and it will perform its duties quite independently of the values of inductance in either coils A or B. This statement may seem somewhat unreasonable, but it is suggested that doubters make their own experiments and draw their own conclusions.

Numerous tests of the "link" were recently made at the laboratory of the East Side Y. M. C. A. and it was found that this circuit would give louder signals from far distant stations than any other type of apparatus in the possession of the experimenters.

It may seem at first thought that considerable increase of signals could be expected if the linking circuit contained a greater number of turns about each coil, and he is apt to try it in this manner; if he does he will meet with defeat. The patents on this circuit state specifically that the "link" should contain a few turns of inductance, very low resistance and zero capacity. These are the only conditions under which it will work properly and effect the purpose for which it was designed. Experiments with a greater number of turns are useless. In fact fair signals can be secured when the loop consists of a single turn of wire about coils A and B.

Particular care should be taken to keep coils A and B at a considerable distance from one another, say, 3 or 4 feet. If this cannot be done, they should be placed at right angles to each other; thus we avoid the direct transference of energy from A to B which might happen were they too near each other.

The writer made some early experiments with the "link" several years ago. Several peculiar effects were noted, one of which was particularly interesting. It was found that with certain aerials, when receiving signals from ships emitting two waves in the neighborhood of 600 meters, the aerial circuit could be set at one value of inductance; that is to say it was adjusted to a distant transmitting station and then by moving the slider in the closed circuit at B the entire length of the coil from a nearly zero value of inductance to maximum, two points of resonance could be found; one of these, in the majority of cases, gave

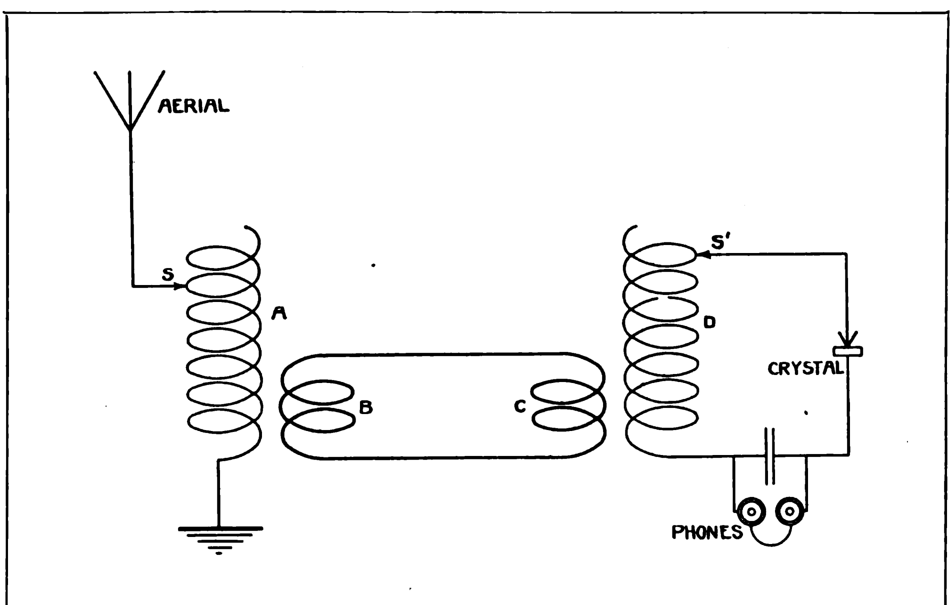
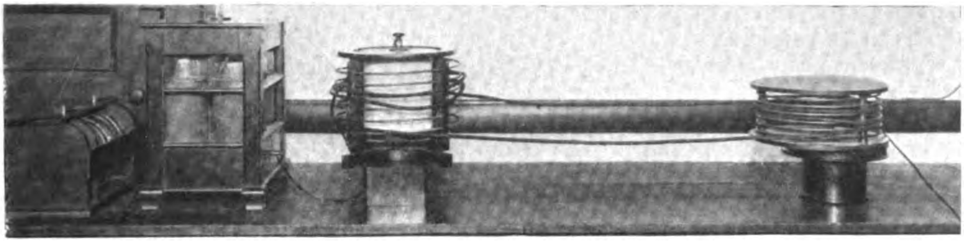


Fig. 2.—The linking circuit applied to the receiving transformer



The linking circuit, consisting of one or two turns of very coarse wire

a greater intensity of signals than the other. Thus by a simple movement of the slider it was possible to plot mentally a resonance curve of the distant transmitting station.

In some cases the shorter wave length would have the greater intensity; in others the longer wave length. Occasionally a ship would be heard where both waves emitted would be received with equal intensity. It is not believed that this was an effect to be attributed to some peculiarity of the circuits employed, for the wave lengths actually received were the same as those of the distant transmitting station.

The writer had an opportunity to check up with a wave meter some of the transmitting sets from which signals were received and invariably these transmitters contained two wave lengths as noted on the "linking circuits." Furthermore, in the cases where it was known that the transmitter emitted but one wave, only one point of resonance could be located on the receiving tuner.

Variable condensers may be adapted to the circuits shown in Fig. 2 in the regular manner, such as in shunt to the coil B, in series with the earth at coil A, or in shunt to coil A. Such condensers should not be connected in any manner to the "linking circuit" C, D or the signals will be destroyed.

The "linking circuit" has been found to be of some value in connection with the audion or similar gaseous detector. A sketch of connections is shown in Fig. 4 where A_1 is the aerial tuning inductance, F is the short wave condenser, and the single slider tuning coil is represented at A. The earth connection is indicated at G. The intermediate circuit is represented by the loop C, D. The single slider tuning coil B is shunted by a very small variable condenser C_1. The terminals of the inductance coil B are connected directly to the audion as shown, avoiding the use of the fixed stopping condenser ordinarily used in such circuits. The circuits of the audion were fully described in the first article of this series and should not require further explanation.

Careful consideration of the foregoing description of the "linking circuit," as applied to the receiving apparatus, should reveal the fact that it is equally applicable to the transmitting apparatus. It is here that it should make a distinct appeal to amateurs. Experimenters who do not possess a wave meter, much less a decremeter, are at a loss to tell whether or not their transmitting set emits a pure wave. We can assure them that if they employ the "linking circuit" their transmitting set will emit a pure wave without any special precaution on their part.

We have applied the "linking circuit" to the transmitting apparatus in Fig. 5. L is the primary winding or, perhaps, the plain helix of an amateur transmitting oscillation transformer; C the condenser, S the spark gap. The coil L′ may be called the secondary winding of the oscillation transformer. The aerial is represented at A.

The "linking circuit" M N consists of one or two turns of very coarse wire wound closely about L and L′. The inductances L and L′ should be widely separated so that direct transference of energy by electromagnetic inductance cannot take place. That is to say, all the energy arising at L′ from L should be transferred by the link. If the inductances L and L′ cannot be conveniently separated they should at least be placed at right angles to each other. Before describing the operation of the circuit, the dimensions of the circuit of this type, as suited to amateur needs, will be more explicitly set forth.

If the closed oscillatory circuit L C S is of the dimensions of the average amateur ½ K.W. set, the transmitting helix L need not be changed at all. In case it is necessary to construct inductance L it is suggested that if possible it be made of $\frac{3}{16}$-inch copper tubing or of wire of similar diameter. Then the "linking circuit," consisting of winding M, which is wound tightly about L, and winding N, which is wound tightly about L′, may be made of No. 4 or No. 6 D. B. R. C. wire. No. 4 is preferable. Two turns about M and two turns at N are sufficient. The inductance L′ may be a helix of the ordinary type, such as that used as a loading coil at an amateur station. In the event that no such helix is at hand one may be constructed of 10 or 12 turns of No. 8 D. B. R. C. wire wound closely on a cardboard tube, or any other insulating support 6 to 8 inches in diameter.

Winding L should have a variable connection T and winding L′ a variable connection T′. In large transmitting sets, if the link is employed, it may be necessary, on account of the high voltages, to separate the turns of the link an inch or so from L and L′. Otherwise disastrous sparking may ensue.

The writer has tested this arrangement on transmitters of 2 K.W. size and has found that heavily insulated D. B. R. C. wire held without dissipation the voltages encountered in such sets.

The operation of the "link" in connection with the transmitting apparatus is of interest. As stated previously in connection with the receiving apparatus, the "linking circuit" is in no sense in resonance with the antennæ or closed circuit and, on account of its extremely low capacity, it possesses no distinct natural frequency. However, the frequency of the oscillations passing through it is of the same order as that of the spark gap circuit. This is a point of particular interest, for on this account, within a reasonable range of accuracy, the wave

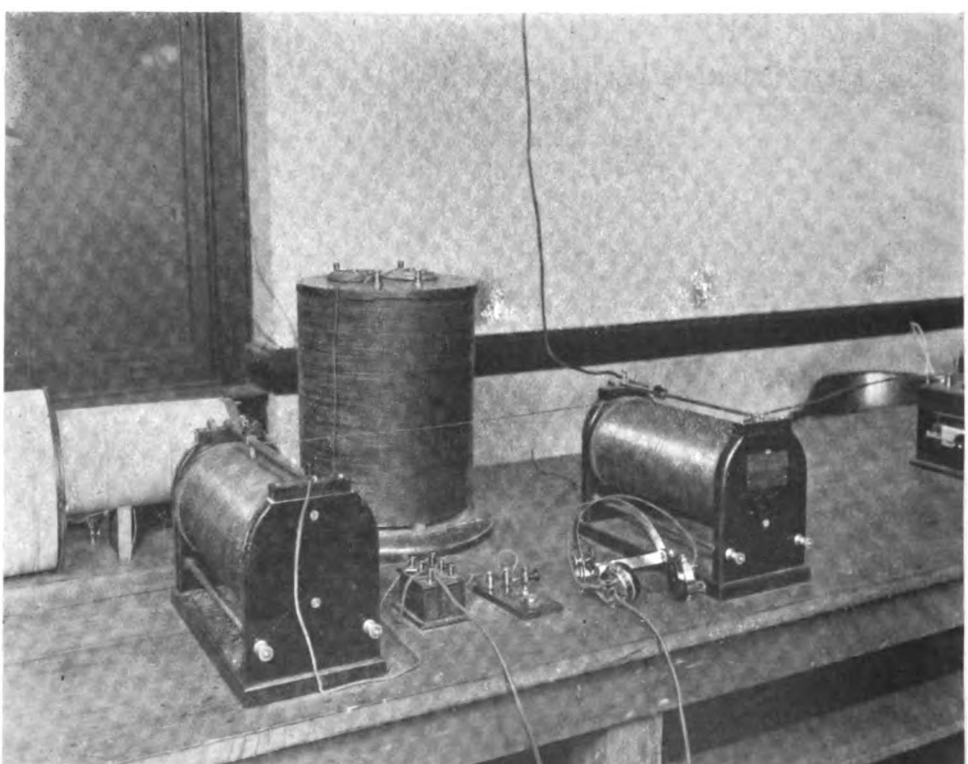


Fig. 3.—The linking circuit in use at the East Side Y. M. C. A. radio laboratory

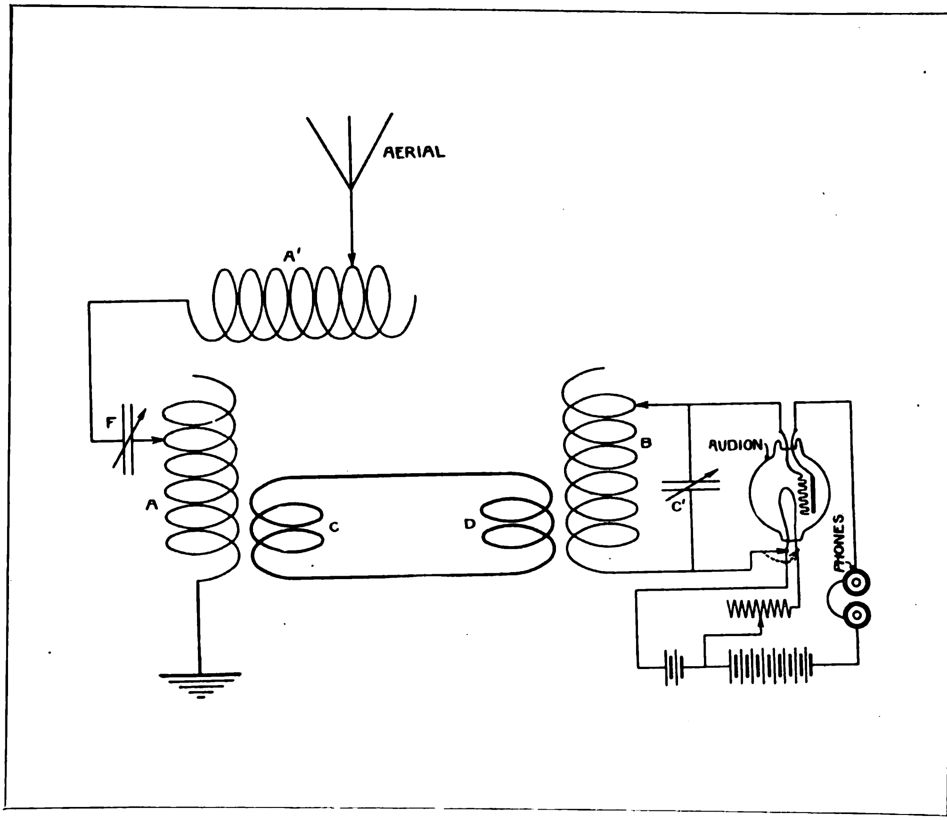


Fig. 4.—The linking circuit in connection with the audion detector

length emitted from the antennæ will be that of the closed circuit; but the greatest number of amperes will flow in the aerial circuit when the aerial circuit is in resonance with the spark gap circuit. This point of resonance is easily determined by a hot wire ammeter connected in series with the aerial circuit as shown in the sketch.

When tuning with a hot wire ammeter the variable connection in the aerial circuit is set at some distinct value of inductance. The closed circuit accurately tuned to it by a variation of the number of turns of inductance in the closed or spark gap circuit.

By no means an unimportant point is the fact that in the case of the "linking circuit" there is little or no reaction from the antennæ circuit to the spark gap circuit. Thus the aerial does not emit a complex wave, but one of single frequency. This should make the link of more than ordinary interest to the amateur who is concerned about the radiation of his aerial.

Even though there should be a slight reaction between the two circuits referred to, resulting in the emission of two wave lengths, it has been found that the energy of one wave predominates—*i.e.*, contains the most energy; the other wave is of insufficient strength to carry any distance.

For rapid changes of wave length at the transmitter the "linking circuit" is ideal because no attention need be paid to the degree of coupling; it is only necessary to adjust the spark gap circuit and the aerial circuit to resonance by the two variable contacts shown in Fig. 5.

Finally, the dimensions of the tuning coils of the receiving apparatus, the actual number of turns employed in the link, and the dimensions of the two helices in the transmitting set may all be varied to suit conditions and the apparatus at hand at a given station. But if the general principles laid down in this article are followed, the amateur

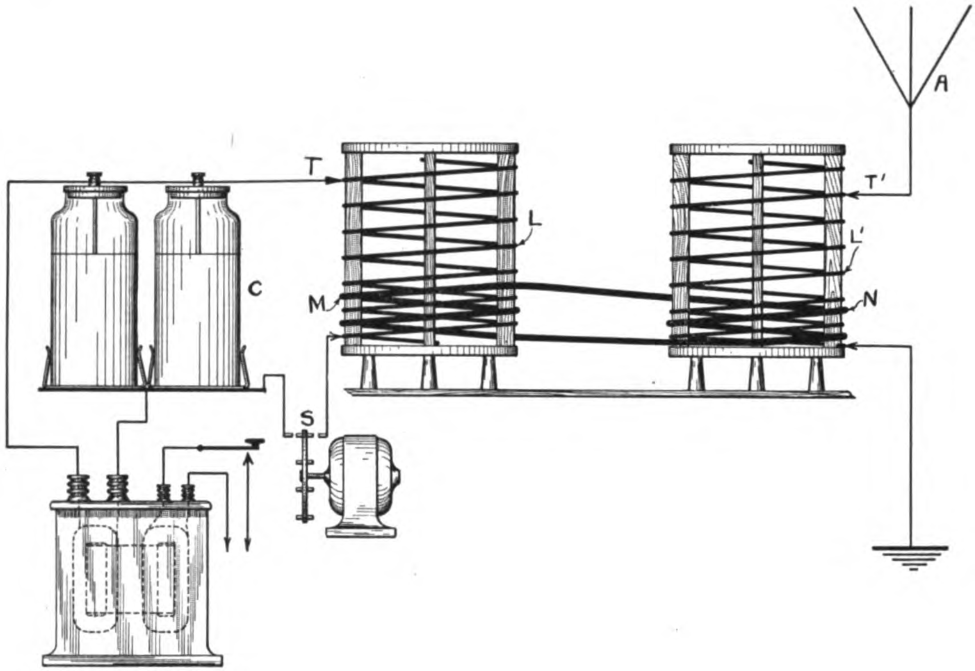


Fig. 5.—Linking circuit applied to amateur transmitting equipment

will find himself in an interesting field of experiment and research.

It is advisable for all radio clubs to construct or purchase a wave meter as soon as possible, because the experiments to be described in succeeding issues of this series necessitate the possession of such an instrument.

(*To be continued.*)

A STEP IN THE RIGHT DIRECTION

In an effort to abolish the use of slang expressions among radio students and operators the following resolutions have been adopted by the students in wireless telegraphy at the East Side Association Institute:

"Fellow-workers: We hereby declare that we do not 'push the key,' 'slam down' or 'flop over' the aerial switch, nor 'juggle' the variable condenser. We depress the transmitting key, raise or lower the aerial switch, and alter or change the capacity of the variable condenser.

"Electricity in our language is not 'juice'; neither is radio interference 'jamming.'

"Electrostatic induction is not 'kick-back.' We do not 'fiddle' the potentiometer; we adjust it. The transmitting condensers do not 'blow up,' 'explode' or 'go up the flue'; they puncture.

"The secondary winding of the power transformer is not 'baked,' or 'fried out'; it is burned, or short-circuited.

"A hot bearing at the motor generator is not 'frozen.' It melted and stuck fast.

"The aerial does not 'squirt juice'; it brushes.

"Wireless messages are not 'smashed' through the ether; they are transmitted through the ether.

"We have long since forgotten the term 'loose-coupler'; we are, however, quite familiar with the inductively coupled receiving transformer.

"The term 'jigger' in our tongue is obsolete; we know all about high-frequency oscillation transformers.

"Finally, we are optimists from the very bottom. We believe that the English language will not suffer by our declaration."

Impressions of Hatteras

THE Board of Trade doesn't say so, because no such organization exists, but that doesn't alter the fact that tradition, the native's and the whole atmosphere of the island give credence to the report that the famous treasure of Captain Kidd is buried on Hatteras. That may be an inducement to some to go there and it is featured because inducements of a more tangible sort are few and far between; unless, of course, you happen to be a botanist, a wireless operator or an exponent of the rapidly disappearing doctrine of Simple Life.

Which is another way of saying that Cape Hatteras is still unspoiled by the assiduous tourists. Yet local color is splashed all over the place and material galore for the romanticist fairly blinks at you from all sides—once you get there.

Merely getting to Hatteras is a unique experience. The nearest railroad connection is at Elizabeth City, N. C., about 90 miles distant, and since the island is some 50 miles off the coast of North Carolina the intervening distance must be covered in small sailing vessels. The good sloop Defender, a thirty-footer, about as broad as she is long, is the favored conveyance, and while making your dicker with the owner you learn that, weather permitting, the passage will take about two days. This owner, by the way is yclept Midgett, and there are a dozen or more six-foot Midgetts, all named after some state or territory of the Union; either Alaska, Oklahoma or Nebraska will probably be selected to pilot you through the waters of North Carolina.

On your way to Cape Hatteras, dreaded by sailors for the dangerous shoals which annually exact such heavy toll, you sail for twenty miles down the Pasquotank river, the stream from which our battleships secure drinking water for long cruises. This water will remain fresh under the most adverse conditions and is agreeably woody to the taste. Your pilot will suggest that you sample this famous water and you will display proper reluctance, for it is inky black in appearance, until dipped up, when it is found to be clear as crystal.

Entering Croatan sound then, you finally pass into Pamlico sound, a body of water about 250 miles in length separating the mainland from Hatteras Island. Roanoke Island is passed on the way and you will learn that it was here Sir Walter Raleigh made his headquarters during his exploration of the American coast. Croatan sound takes its name from the fact that when Sir Walter returned from England he found that his entire colony had disappeared, leaving no traces. The word "Croatan" had been cut in a tree, meaning literally, according to the natives of Hatteras, "the crow ate the hen." Roanoke Island has another claim to distinction; it is the birthplace of Virginia Dare, the first white child born on American soil. The county in which Hatteras is situated is known as Dare County, the oldest in the country.

Thirteen years ago the U. S. Weather Bureau erected a wireless experimental station on Roanoke, but it was discontinued before the end of the year.

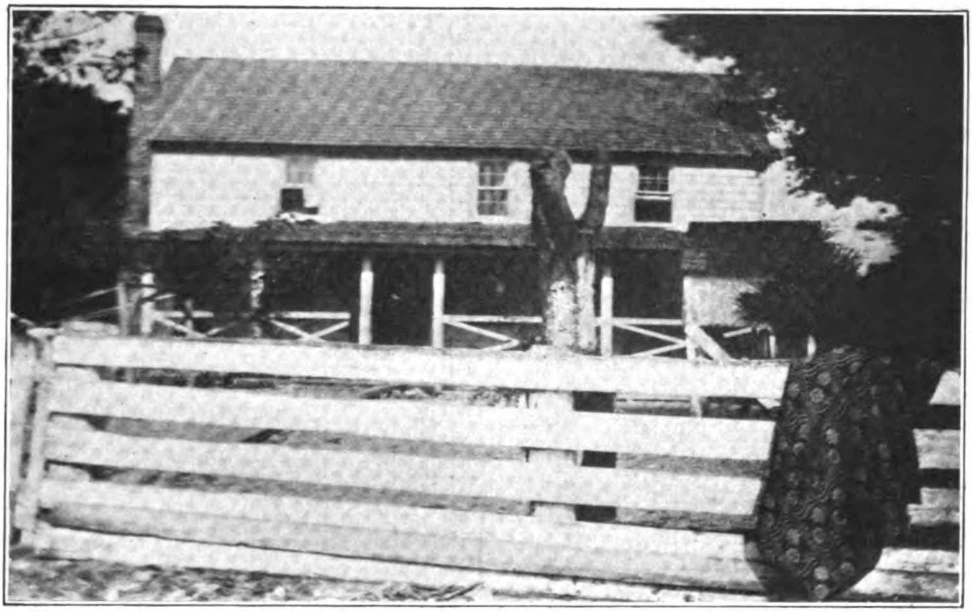
Passing Roanoke Island, to the left may be seen Killdevil Hill, the scene of the Wright brothers' early experiments in aviation and selected by them mainly because of its isolation.

An eight-hour sail brings you to Hatteras, or rather, within three miles of Hatteras. Having threaded her way through unchartered shoals reaching seven miles out at sea, the zigzag progress of the sailing vessel is halted about three miles off shore. The balance of the trip is made in shallow rowboats and on the backs of the natives, for, to quote our pilot: "There be plenty o' water, but it's spread out a mite too thin." Whereupon you must laugh or thereafter be reprimanded by the deep, hurt silence of the unappreciated.

Viewing Hatteras Island itself, it is found to be about forty miles long, from two to four wide and comprise six towns or villages, namely: Chicamaconico, Clarks, Kinekeet, Cape Hatteras, Trent and Hatteras; although the postal authorities recognize them under the names of Rodanthe, Salvo, Avon, Buxton, Frisco and Hatteras, respectively. There are about eighteen hundred people on the island, about a quarter of this number being located at Hatteras and engaged mainly, from all appearance, in the business of life saving.

There are eight life-saving stations from New Inlet to Hatteras Inlet. One Benjamin J. B. Dailey has the distinction of being the first keeper of the Cape Hatteras station and many are the rescues credited to this man; likewise many the stirring tales he loves to tell. Just thirty-one years ago, on the completion of the station, he was appointed keeper; before a year had elapsed keeper and crew were famous for heroic work. By act of Congress they were each awarded a gold medal in recognition of their services in connection with the wreck of the barkentine Ephraim Williams. This memento is cherished by Dailey and if you catch him right he will, in addition to permitting an examination, unfold graphic descriptions of wreck rescues from when he was serving his time as surfman at Little Kinnekeet down to the present

The good sloop Defender is the favored conveyance, and while making your dicker with the owner you learn that, weather permitting, the passage will take about two days



Hatteras has one hotel, named the Chateau de la Miller by the wireless men, where the main article of provender is razor-back hog; in the morning it is served as bacon, at noon as ham, and in the evening, shoulder—three hundred days in the year!

day. Hearing these tales you will begin to appreciate all his medal stands for. The medal, incidentally, contains eighty-four dollars' worth of gold and was made by Tiffany. An eighth-inch thick and one and one-half inches in diameter, it bears on one side the national emblem, name of the hero and the service performed, with the inscription: "In testimony of heroic deeds in saving life from the perils of the sea." On the reverse side is engraved a scene where life savers are rescuing a woman from the hungry maw of the sea.

Another local celebrity, particularly if you happen to be a wireless man, is Charlie Olson. Your heart warms to this big Norwegian right away, for in his capacity as cook he prepares the only food worthy of the name in all of Hatteras. Olson, by lining their stomachs with delectable culinary morsels, has contributed more to the contentment of operators than any possible form of entertainment could. At last report a die was being prepared for a medal for Olson, bearing an apple pie argent and a portrait of an individual wearing the composite Steeplechase smile of wireless men since the first stations were built. His services are ever in demand, but over the seething kettle he will tell you that he was engaged as head painter when the Brooklyn Bridge was built, thinks there is no place on earth the equal of Hatteras, has settled there for the remainder of his life, assisted in the erection of the first wireless station thirteen years ago, and—do you like your meat rare or well done?

How this Norwegian ever reached the island is one of its unrecorded facts; but the date is set about eighteen years ago, when he presumably blew ashore and subsequently married one of the young ladies, in turn becoming a father and a fixture.

If you inquire the occupation of the islanders you will be given the impression that fishing and life saving are the principal industries. A large percentage of the men are employed in the government service and the others exist somehow; just how, nobody seems to know. The natives say by fishing, but as near as you can determine through investigation the piscatorial industry is not a profitable one. Some lumber is shipped from Hatteras, but in small and irregular quantities. The ideal method of earning sustenance is by gunning, a sport not only enjoyable

Wild geese are so plentiful that the inhabitants "edge them on" with corn and they become so tame that they can be caught as easily as their domesticated brothers

but sometimes profitable. Rabbit, deer, wild birds, ducks and geese are plentiful and marketable in season.

Life at Hatteras is exceedingly dull, but to the honest, easy-going and friendly inhabitants nothing in the great universe quite compares to their island. Several men of forty-five years or more have never left the place and the majority of the natives have yet to see a steam train, an electric car or an automobile.

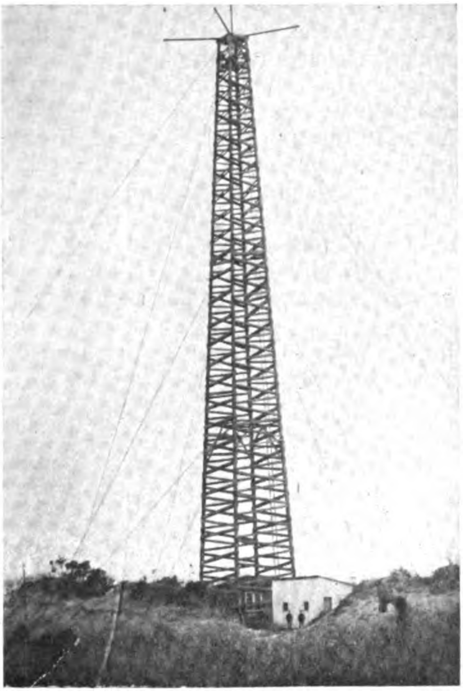
Educational advantages are about on a par with the average country village. School terms are designated as pay and free terms, the country appropriation providing for the maintenance of the school for a period of three or possibly four months; then a pay term of four or five months is held with the individual scholars charged two or three dollars per month for tuition. The stability of the pay term is uncertain, for the length of time it is held depends on the financial standing of the community.

Following the traditions and habits of several generations back the natives know nothing of the complexities of modern civilization. They cannot conceive of the strenuous conditions of the north, nor do they want to. Once in a while though, a venturesome spirit starts on a lone pilgrimage to other localities, but soon returns a wiser, and certainly sadder man. One dear old fellow, Miller by name and a veteran of the Civil War, admits that he had to cut his week's stay in New York down to three days—the excitement was too much for him. That elevated railroad, now; never did hear such an infernal racket, and all those people and teams and autos on the streets; powerful dangerous to human life, he reckons.

Another young blood of some 28 years made a famous trip to Norfolk, Va., riding on steam vessels and steam trains, neither of which he had ever seen before. His absolute amazement on beholding the city of Norfolk left him speechless for hours; but when he was taken to a theater—he nearly had a spasm!

The social gathering, ordinarily such a prominent feature of small community life, is unknown on Hatteras. When asked what is their form of entertainment you learn that "there ain't none in particlar; just sort'er wile away time." The young men call on the younger members of the opposite sex, of course, but it is a rigidly observed rule that only one caller may appear at a time. Six o'clock

The first wireless station was constructed under great difficulties; it was often necessary to wait two weeks for material and tests had to be made piecemeal



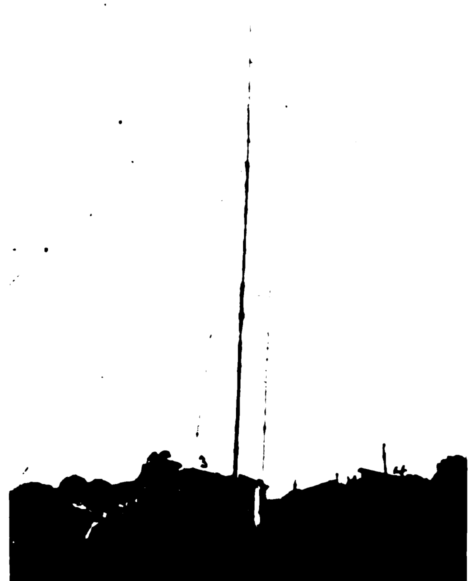
Salvage lumber collected by natives from a wrecked schooner was used for the first tower, a 210-foot structure which went down in a hundred-mile-an-hour hurricane

in the evening is the fashionable calling hour and the departure is taken about the time we would arrive, nine o'clock. He who makes his appearance first is the honored one, for previous engagements are seldom made. But even in such case the caller must present himself in advance, to insure against possible intrusion from others, for scarcely ever does the girl make known a previous engagement, for fear of wounding the first caller's feelings.

The men, while shrewd, reliable, honest and friendly, are very jealous and often suspicious. Once their friendship is gained, however, they can be relied upon in all emergencies. The women are comely, simple and wholesome, yet most of them are addicted to the usage of snuff in large quantities. No manner or amount of argument is sufficient to convince them that this is not a ladylike accomplishment. The fact that the practice is frowned on throughout the country makes no impression; yet the girls take particular pains to destroy all traces of its use before their callers arrive.

The one big event of the year is the Methodist revival meeting, held each summer and lasting ten days. The natives look forward to this anxiously, for they are all very devout and obey the Bible to the letter. Tramps and negroes are never seen and stealing is practically unknown, not one case of ordinary theft having been reported in years. Yet through some indefinable process of reasoning the community at large considers wreckage as their absolute property, and when a vessel comes ashore the entire population turns out to collect the salvage.

It is hard to reconcile this universal pillage with their otherwise exemplary lives; that is, it is difficult for the stranger to reconcile it—the natives show no concern in the matter. It is nothing unusual to see them climb trees in rough weather and anxiously scan the horizon for the first appearance of wrecks, which, alas, are all too frequent in those waters. Some visitors have vouchsafed the explanation that this is a hereditary trait, coming down from the days when the buccaneers

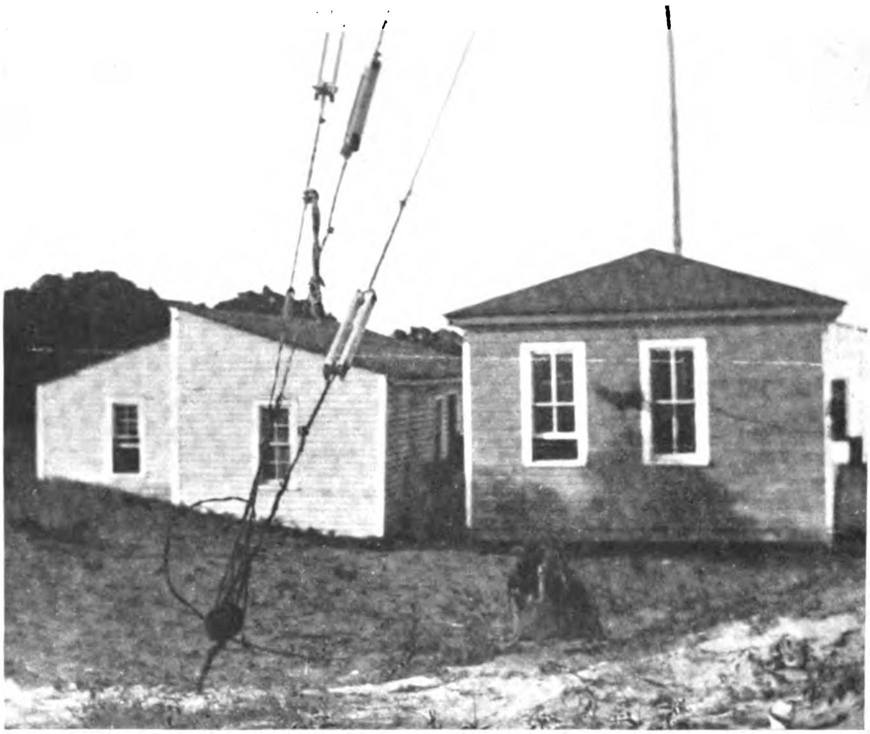


The masts in use to-day are 171 feet and 181 feet high, respectively, spaced five hundred feet apart made Hatteras a central and strategic point for their depredations. The younger and more enlightened generation takes but passing interest in the tales of Captain Kidd and other pirate chiefs, yet superstition is prevalent to a remarkable extent and men have dug innumerable hours in search of treasure.

Marine disasters are not anything like as numerous as in the days before wireless was discovered. Yet during a period of four weeks around Christmas time it is nothing out of the ordinary for a dozen wrecks to be reported in the vicinity. The heavy losses to the merchant marine formerly centered about Diamond Shoals, about fourteen miles southeast of Cape Hatteras lighthouse. In 1897 a lightship was moored in about one hundred and eighty feet of water and some five miles out from Diamond Shoals. This flush deck, schooner rigged steam vessel is now equipped with wireless and frequently reports vessels not so equipped. Powerful lens lanterns are on each mast showing fixed white lights twelve seconds, eclipse three seconds; three lanterns encircling each masthead can be distinguished thirteen miles. Her fog signal has a twelve-inch chime whistle, with a blast lasting five seconds of each minute.

The famous Cape Hatteras lighthouse, which sheds its rays over millions of voyagers, stands a lone sentinel with its light, 196 feet above mean high water, flashing white every ten seconds. The present structure, built in 1870 to replace the first tower erected by the British seventy-two years before, throws a beam twenty nautical miles. The lighthouse is spirally banded black and white, and so symmetrically that old seadogs maintain the tower was first painted and then twisted.

There is considerable art in climbing the two hundred and seventy-four steps that lead to the top without becoming unduly tired. Visitors are instructed to keep close to the wall, pause slightly at each step, throwing the weight firmly



At the Marconi headquarters comfortable accommodations are provided for the operating staff in a separate house containing three bedrooms and a generously proportioned living room upon the foot, and to descend as rapidly as safety will permit. During heavy gales the tower sways several inches in each direction, though at right angles to the wind. It is explained that this is due to the fact that the greatest wind pressure on round objects is, figuratively speaking, on the side rather than directly in front or behind.

Four years were required for the erection of this famous light as the material used in its construction had to be hauled piece by piece in small sailing vessels. For the same reason the first wireless station, started in 1901, was six months in construction. Salvage lumber collected by natives from a wrecked schooner was used for the tower, a 210-foot structure from which was suspended a large aerial. As many as fourteen men were engaged on this installation, the machinery for which was transported in small skiffs, dragged ashore for miles by natives wading in the water. Gasoline for the power equipment had to be sent down from Norfolk, Va., and frequently delivery was delayed two weeks or more.

The first wireless messages received were sent to the Western Union office at Norfolk via the Government cable and land line connected with the lighthouse. This line was seldom in operation, however, for the slightest storm would put it out of commission, so another wireless station was erected on the mainland at Elizabeth City to take the Hatteras messages. Later, communication was established direct with Norfolk and the Elizabeth City station was discontinued.

Some years ago the laboriously constructed Hatteras wireless tower went down in a hundred-mile-an-hour hurricane; it was replaced by the two masts in use to-day, 171 feet and 181 feet high, respectively, spaced five hundred feet apart.

The Marconi station at Hatteras is of immense value to shipping as it occupies a commanding position for communication with coastwise vessels and can immediately report distress calls to all vessels in the vicinity as well as to the various life-saving stations on the island. In touch with practically every vessel making southern ports, Hatteras handles a considerable amount of wireless traffic each month. The station also sends press to passing vessels and keeps commanders posted on weather conditions. Comfortable living quarters are provided for the operating staff in a separate house containing three bedrooms and a generously proportioned living room.

The climate of Hatteras is ideal, snow is scarcely known to the inhabitants and many of the trees keep their foliage throughout the year. One of the strangest sights imaginable is to see this island heavily wooded with trees growing right out of pure white sand. There is no grass on the island except along the edges of the swamps where a few stray clumps may be seen. Hardy northern trees and tropical palms grow side by side, turpentine pines and fig trees are neighbors throughout the island, and semitropical shrubs are mixed in with goldenrod and ferns. Naturalists claim that there are fifteen species of tree peculiar to Hatteras and not known in any other locality.

While some garden truck is grown at the edge of the swamps in the island's center and the natives are forever making fig preserves, all the groceries are brought over from the mainland in the small sailing vessels. The island abounds with wild geese, ducks and deer but the main diet is razor-back hog. In the morning it is served as bacon, at noon as ham, and in the evening, shoulder—three hundred days in the year! Why they don't alternate with venison, duck or fish is one of the inexplicable details of Hatteras life that make it distinctive if not desirable.

And, on the whole, that is the impression the island leaves with the visitor: An interesting place to visit—once.

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Engineering, The College of the City of New York

ARTICLE VIII.

Proceeding to the measurement of inductance at radio frequencies, a method of inductance measurement at radio frequencies and low voltages is described. A method of determining the effective capacity and effective inductance of an antenna is then fully considered, together with certain deductions which show the limiting accuracy to be expected of this method of measurement.

THE methods of measuring inductance so far described have all been at audio frequencies. The values of the inductance thus obtained are applicable only when the inductance is to be used at such low frequencies. A discrepancy arises if this value is applied to coils used at radio frequencies, particularly if multi-layer coils of unstranded wire are employed. We shall, therefore, consider a series of measurements of inductance at radio frequencies, the values of inductance thus obtained being valid at the high frequency used in the measurement.

Section 23.—MEASUREMENT OF INDUCTANCE AT RADIO FREQUENCIES AND LOW VOLTAGE BY THE RESONANCE METHOD. The marked phenomena of resonance which arise between two coupled circuits of equal period and small damping afford a convenient basis for the measurement of inductance.

(a) Theory. If a circuit of inductance L_1 and of capacity C_1 be coupled *loosely* to a second circuit of corresponding constants L_2 and C_2; and if a free or forced alternating current of its natural frequency flows in circuit I, the current produced in circuit II will reach a maximum when the periods of the circuits are equal. That is to say, we shall secure resonance when

$$L_1 C_1 = L_2 C_2.$$

In adapting this principle to actual measurements, a number of different arrangements of apparatus and of procedure may be used. Some of these are shown in Fig. 45, the one most strongly recommended because of its simplicity being (C), though methods (A) and (B) are useful for checking up the results obtained.

Method (A) requires two standard calibrated condensers and one standard known inductance. The exciting circuit $L_1 C_1'$ and the secondary $L_2 C_2$ are first tuned to resonance, with the double-throw switch in such a position that the only inductance in the secondary is L_2. Then the switch N is thrown into such a position that L_x, the unknown inductance, is placed in the secondary circuit, and the primary condenser varied until resonance is again obtained. The resulting value of the primary capacity is called C_1''. Then the following relations hold:

$$L_2 C_2 = L_1 C_1' \quad \text{and}$$

$(L_2+L_x) C_2 = L_1 C_1''$, whence it may be found that

$$L_x = \frac{L_1 (C_1'' - C_1')}{C_2}.$$

Method (B) requires two standard calibrated condensers and one standard calibrated inductance. The exciting circuit $L_1 C_1'$ and the secondary are first tuned to resonance, with the double-throw switch N in such a position that the standard inductance L_n is in the secondary circuit. Then the inductance L_x, which is unknown, is inserted in the secondary instead of L_n, and the circuits again brought to resonance by varying the primary condenser to the value C_1''. In this case, the following relations hold:

$$(L_n+L_2)\,C_2 = L_1\,C_1'$$

and $(L_x+L_2)\,C_2 = L_1\,C_1''$.

From the preceding equations it may be shown that

$$L_x = \frac{L_1\,(C_1''-C_1')-L_n C_2}{C_2}.$$

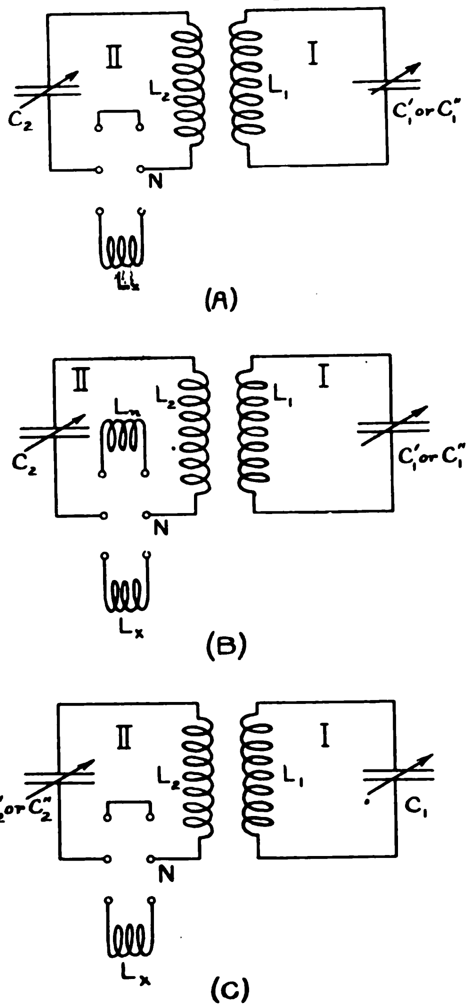


Fig. 45

In Method (C), one standard calibrated condenser is required (in the secondary circuit), and one standard fixed inductance. The two circuits are first tuned to resonance by varying the secondary condenser to the value C_2' with the switch N in such position that the only inductance in the secondary circuit is L_2. Then the switch N is set so that the inductance L_x is inserted in the secondary, and the condenser in the secondary is varied until the maximum indication is obtained as before. Under these conditions:

$$L_2\,C_2' = L_1\,C_1$$

and $(L_x+L_2)C_2'' = L_1\,C_1$, so that

$$L_x = \frac{L_2\,(C_2'-C_2'')}{C_2''}.$$

A fourth method, no diagram of which is shown, requires the use of a standard calibrated *variable* inductance for use in the secondary circuit. The primary and secondary are first tuned to resonance with the unknown inductance in the secondary or primary circuit. The unknown inductance is then replaced by the variable standard inductance, and resonance again obtained. Clearly, the unknown inductance is equal to the final value of the variable standard inductance. In applying this method, which is very convenient in practice, the use of sliding contact variable inductances for the standard is not strongly recommended, because they are subject to a variety of defects, such as: short circuiting of adjacent turns by the slider, "dead-end" effects at certain frequencies due to their distributed capacity (see Article IV of this series, January, 1914, page 268), and uncertainty as to the exact point of contact. Generally some type of variometer inductance is preferable, for example, concentric coils wound on spherical surfaces and rotating one within the other. The only disadvantage of importance in this type is that the entire resistance of the inductance is in circuit even for small values of the inductance, which may give rise to high damping, particularly at short wave lengths.

All the methods described permit measuring the inductance at any desired wave length or frequency.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. In Fig. 46, a wiring diagram of the completely assembled apparatus is shown. The method of buzzer excitation of the primary circuit is one of a number which may be employed. Across the contact point of the buzzer E, which is fed by the battery B regulated by the resistance R, is placed the condenser C. The condenser C is of fairly large capacity, say

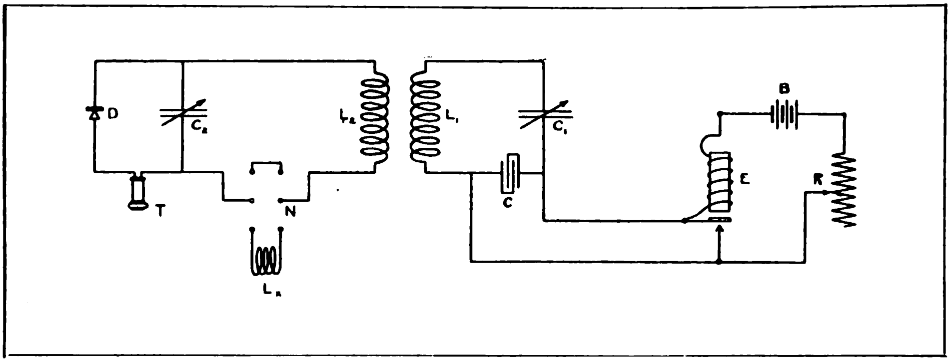


Fig. 46

2 microfarads. Its reactance for currents of frequency of 500,000 cycles per second is, therefore, about 0.15 ohm. In other words, it will not materially decrease the radio frequency current flowing in the primary circuit, L_1 C_1. (The reactance here given is calculated from Formula 11 of Article I of this series, October, 1913, page 57.) Let us further see to what extent it changes the capacity of the primary circuit; that is to say, what deviation from the value C_1 occurs in the primary circuit when C is inserted in series with it as indicated in the diagram. For this purpose we shall use Formula 10 of the article just cited. Suppose that C_1 is 0.00100 μf; and that C is 2 μf. Their combined capacity is found to be 0.0099995 μf. In other words, the percentage error thus produced is 0.05%, which is completely negligible. The method of buzzer excitation shown is one which gives steady results, because there is a minimum of injurious sparking at the contact points. The damping of the primary circuit is also kept at a small value. The primary and secondary are coupled *loosely* through the coils L_1 and L_2. The double throw switch N permits inserting the unknown inductance in the secondary circuit or of short circuiting the point of its insertion. Across the secondary condenser C_2, the detector D and the telephone receiver T are placed in series.

An alternative arrangement of circuits is shown in Fig. 47. As will be seen, the main battery current which feeds the buzzer passes through the inductance L_1 of the primary, and the variations in this buzzer current caused by the normal operation of the buzzer start the slight damped trains of free alternating current in the primary. The condenser C is shunted across the buzzer contact point to reduce sparking. The secondary circuit has also been altered in a minor detail. The condenser S (of about 0.05 μf.) has been placed in parallel with the telephone receiver. The sensitiveness of the arrangement is somewhat improved by the introduction of this condenser for reasons which are somewhat in dispute.

The photograph of Fig. 48 shows the actual apparatus which was used in the experiment. To the right is seen the box containing the high pitch "Lungen" buzzer and the controlling resistance R. The latter was a 12 ohm, 1 ampere battery rheostat of the Manhattan Electric Supply Co. The primary condenser (of approximate capacity 0.002 μf.) and the condenser C of 2. μf. are also visible. The coils L_1 and L_2 were the primary and secondary of a large receiving coupler. The coupling was readily varied by altering the angle between the planes of the coils, and the coupling was readily adjusted to an appropriately loose value. The inductance of the primary and secondary were respectively 0.164 millihenry and 0.238 millihenry (mhy). The unknown inductance was a single layer helix shown in the foreground at the left. The secondary capacity was also a 0.002 μf. air condenser. The detector (silicon), and the 2,000 ohm telephone receivers are to the left.

(c) PROCEDURE. Method (C), described above, was employed. First of all, the circuits were tuned to approximate resonance at fairly close coupling. The coupling was then made looser, until the only sound heard was just at the resonance point. The capacity C_2' was then noted. L_x was then inserted in the secondary circuit; and keeping the primary circuit unchanged, C_2 was varied until resonance was again obtained, the value of C_2'' being then noted. It is desirable that the value of C_2' shall fall on the upper part of its scale, say about 160°, so that the scale readings may be accurately made. It is also desirable that the detector adjustment shall not be altered during a measurement, and that the detector shall be adjusted for maximum sensitiveness (so as to permit very loose coupling).

(d) ERRORS OF THE METHOD, THEIR ELIMINATION, AND PROBABLE ACCURACY. The presence of the detector and telephone across the secondary condenser make the equation used for calculating L_x slightly inaccurate. It can, however, be shown that if the detector and telephone are both of high resistance, the error thus introduced is not serious. It is further to be noted that if the inductances of any of the circuits have a high resistance, and therefore introduce considerable damping into these circuits, the accuracy of the measurement will be much decreased.

A simple measurement follows:

$L_1 = 0.164$ mhy. $L_2 = 0.238$ mhy.
$C_1 = 0.00184$ μf.
$C_2' = 0.001260 \pm 0.000005$ μf.
$C_2'' = 0.000868 \pm 0.000005$ μf.
$L_x = 0.139 \pm 0.001$ mhy.
Probable Error = 1.%

It will be seen that this measurement was carried out at a frequency corresponding to a wave length of 1035 meters.

As a practical, and highly useful example of an inductance measurement, we shall consider the measurement of the inductance and capacity of an antenna near the fundamental frequency. This will differ from the so-called static capacity of the antenna to ground, because the distribution of current and potential along the antenna is non-uniform when free alternating currents are present in it. In consequence, the effective capacity of the antenna will be less than the calculated capacity of the antenna regarded merely as one side of a condenser, the other side of which is the earth; the higher portions of the antenna contributing more in proportion to the total effective capacity than might be expected. We shall, therefore, consider a method for finding the effective inductance of the antenna.

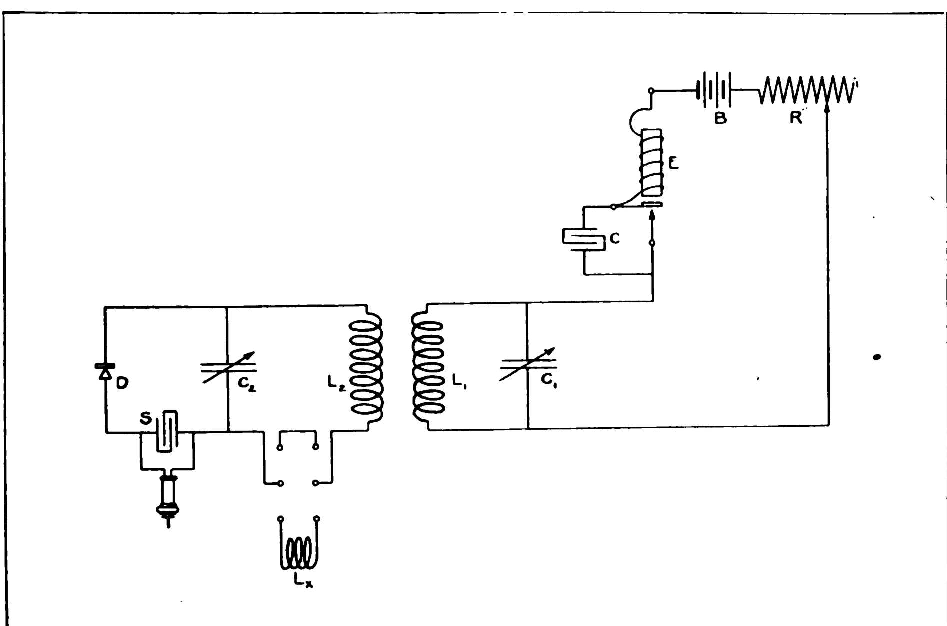


Fig. 47

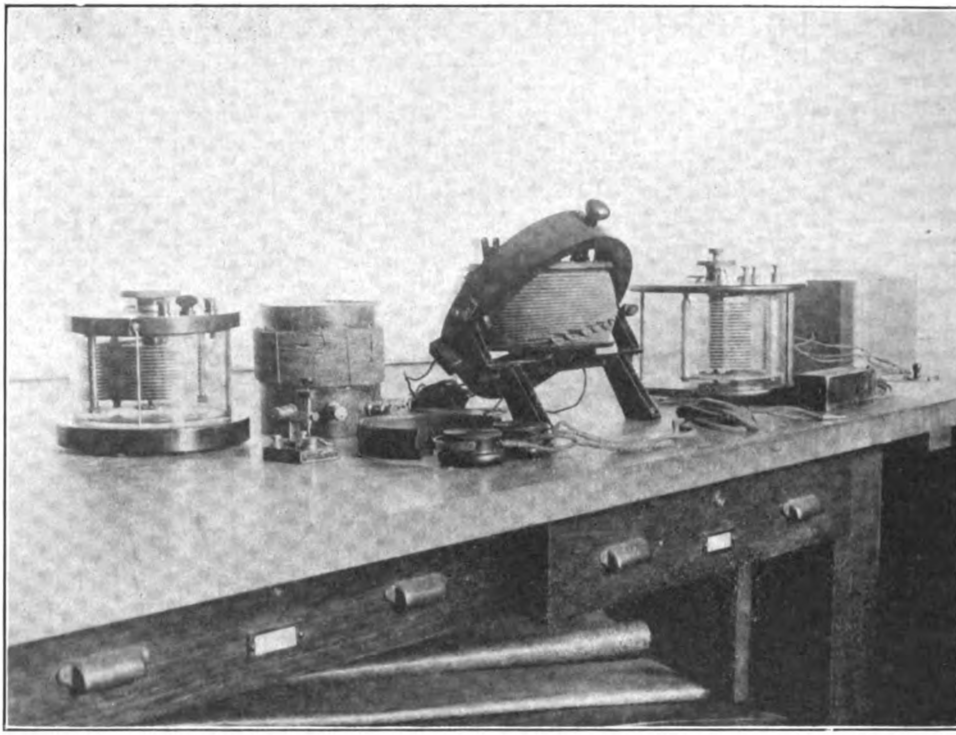


Fig. 48

Section 24.¶ MEASUREMENT OF INDUCTANCE OF ANTENNA AT RADIO FREQUENCY AND LOW VOLTAGE, USING THE SERIES INDUCTANCE METHOD (near the fundamental wave length). Inasmuch as the capacity for energy storage of an antenna is dependent on its electrostatic capacity, it becomes of importance to be able to determine this quantity with some precision. A difficulty at once arises, because the capacity in which we are interested is not its capacity for a static (that is, stationary) electric charge, but rather its *effective capacity* relative to the ground when there is present in it a rapidly alternating potential and current. The capacity for a stationary charge and the effective capacity at radio frequencies are not the same quantity, as the following considerations will show. The distribution of potential along an antenna is by no means uniform when there is flowing a radio frequency current. In fact, at the bottom of the antenna the potential is zero, and at the top it reaches a maximum value. In consequence, the portion of the total (distributed) capacity which is contributed by the upper parts of the antenna is rela ively greater than when a stationary charge is being considered. Since we define the effective capacity of the antenna at a wave length λ by the equation

$$C = \frac{\lambda^2}{36 \pi^2 (10)^{16} L}$$

it is evident that we must obtain the quantities λ and L before we can determine C. In the above equation, λ is expressed in meters, and L, the effective inductance, in henrys. The capacity will be given in farads. Relative to the non-uniform distribution of potential along the radiating antenna, the experimenter is again referred to the discussion on the effects of distributed capacity as given in Article IV of this series, January, 1914, page 268 and Fig. 19.

(a) THEORY. Let us regard the antenna as a closed circuit of inductance L_1 and capacity C_1 at the fundamental wave length, λ_1, excited by a source of radio frequency energy at A (Fig. 49). In series with the antenna may be placed the inductances L_1' or L_1'', as indicated. Coupled loosely to the antenna is a secondary receiving circuit (or wave meter). This latter is the circuit L_2 C_2, the indicator being I. Let us assume that the resistance of the indicator is sufficiently high to permit regarding the secondary circuit as a simple circuit of inductance L_2 and capacity C_2. Suppose that this secondary circuit is in resonance with the antenna circuit with no inductance inserted. Then we have

$$L_f C_f = L_2 C_2 \quad \text{(A) and}$$
$$\lambda = 6\pi (10)^8 \sqrt{L_2 C_2}, \quad \text{(B)}$$

the wave length being expressed in meters, the inductance in henrys, and the capacity in farads. Now insert the additional inductance L_1' in the antenna circuit. If the new setting of C_2 is C_2', and the corresponding wave length λ', we will have

$$(L_f + L_1') C_f = L_2 C_2' \quad \text{(C) and}$$
$$\lambda' = 6\pi (10)^8 \sqrt{L_2 C_2'}. \quad \text{(D)}$$

A third inductance, L_2'', is now inserted in the antenna circuit instead of L_2', and the corresponding secondary capacity and wave length are C_2'' and λ''. The relations that hold are

$$(L_f + L_1'') C_f = L_2 C_2'' \quad \text{(E) and}$$
$$\lambda'' = 6\pi (10)^8 \sqrt{L_2 C_2''} \quad \text{(F).}$$

By a simple algebraic process of elimination between equations (A), (C), and (E), we obtain

$$C_f = \frac{L_2(C_2'' - C_2')}{L_1'' - L_1'} \quad \text{(G)}$$

and

$$L_f = \frac{C_2 \; (L_1'' - L_1')}{(C_2'' - C_2')} \quad \text{(H)}$$

Similarly, if we eliminate L_f from equations (A) through (E), we get

$$C_f = \frac{\lambda''^2 - \lambda'^2}{36\pi^2 (10)^{16} (L_1'' - L_1')} \quad \text{(I)}$$

and

$$L_f = \frac{\lambda^2 \; (L_1'' - L_1')}{\lambda''^2 - \lambda'^2} \quad \text{(J)}$$

Equations (I) and (J) enable us to substitute a calibrated wave meter of the usual type for the secondary circuit employed here, and do not require any knowledge of the secondary capacity and inductance themselves.

It is to be noted that the values of C_f and L_f which are found by the above method are not strictly accurate, because in equations (C) and (E) we have assumed that C_f remained constant as the wave length was changed. This, however, is not the case. By working at wave lengths near the fundamental, this error is reduced to a minimum.

If we take a series of such observations, varying the inserted inductance gradually from small values to fairly large values, we will obtain a series of values of C_f. If these values are nearly equal throughout a wide range of wave lengths, the antenna is behaving like a closed circuit, and not radiating particularly well (under usual conditions), but if these values are widely different, the antenna is behaving more like an ideal open oscillator.

(b) ARRANGEMENT AND DESCRIPTION OF APPARATUS. In Fig. 50, the wiring diagram of the apparatus as actually used is shown. Here GEF is the buzzer exciting circuit. Across the contact point of the buzzer is placed the capacity A, which serves as the method of charging and discharging the antenna. If A is a large capacity (say 2 μf.), its effect on the tuning of the antenna will be negligible as shown in the preceding measurement of this article. B is the antenna, and L_1' or L_1'' the additional inductance which is to be inserted

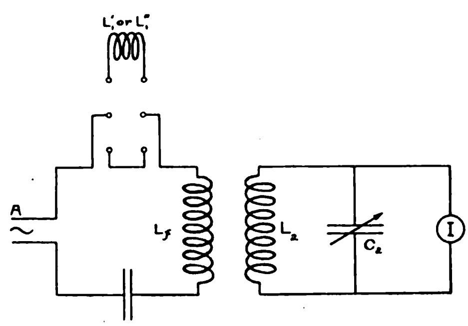


Fig. 49

in the antenna. L_c is a small coupling inductance, which may consist of a turn or two of wire placed near L_2, the secondary inductance. As usual, D is a crystal rectifier and T a high resistance telephone receiver.

In the experiment, G was a small, high-pitch "Lungen" buzzer, F a 12 ohm

1 ampere "battery rheostat," A a 2 μf. No. 21-D Western Electric condenser, and L_1' an inductance of heavy wire variable in steps between 2.5 and 67.0 μhy. (1 μhy. = 0.000001 hy.). One of the antennæ of the laboratory was used. It had an inverted "L" form, highest point about 180 feet (55 meters), running slightly downward about 200 feet to a height of about 120 feet, and thence dropping at a steep angle for about 200 feet to the laboratory. Because of the comparative closeness to it of certain portions of the building, its capacity and fundamental wave length were somewhat larger than might otherwise be anticipated. The coil L_2 was a single layer helix of inductance 192. μhy. C_2 was a calibrated variable capacity, of maximum capacity 0.0020 μf. The detector, D, was an ordinary silicon detector, and the telephones were 2,000 ohm double head band receivers. The ground connection, H, consisted of about 20 stranded wires (each 7 strands of No. 22 phosphor bronze), which were attached to water and steam pipes and buried conductors.

(c) PROCEDURE. With no additional inductance in the antenna, the antenna was excited by the buzzer, and the fundamental wave length (or the capacity C_2 corresponding to it) was determined in the secondary circuit. In making this measurement care was taken to have the coupling between L_c and L_2 as loose as was consistent with securing a clear, sharp, maximum sound point in the telephones. The coupling was sufficiently loose, as was shown by the simple test of making it somewhat closer. When this was done, it was found that the position of the point of maximum sound was not altered by the increase in coupling.

The additional known inductances L_1' and L_1'' were then inserted, and the corresponding values of the secondary capacity (or of the wave length) were recorded for the resonance position, exactly as before. It was found that the coupling between L_c and L_2 had to be altered slightly for accurate work as the inserted inductance in the antenna circuit was varied.

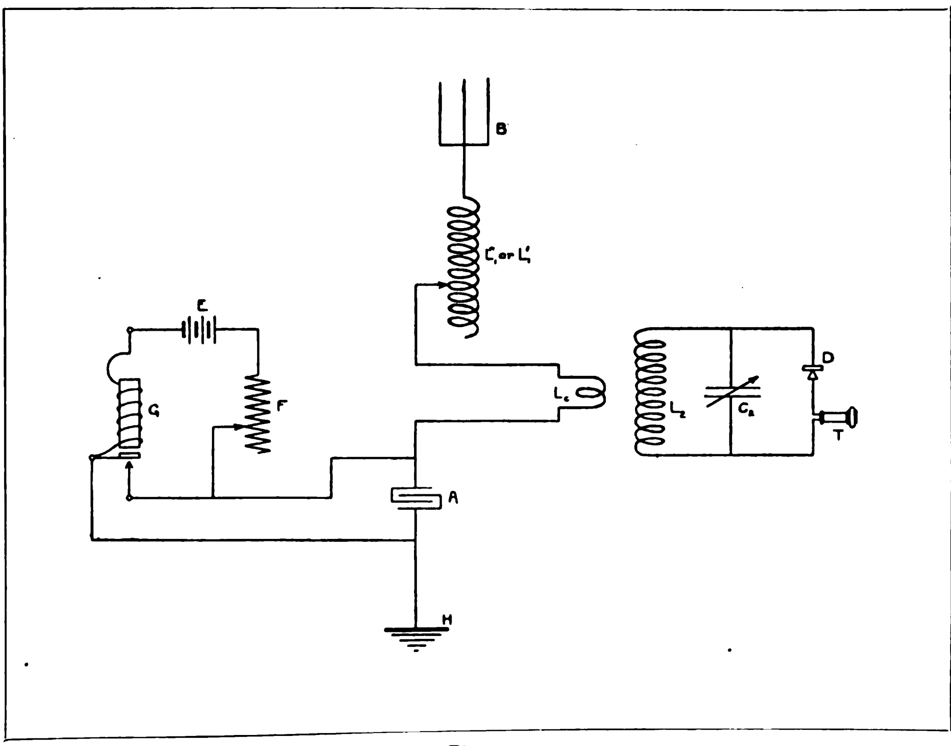


Fig. 50

(d) ERRORS OF THE METHOD, THEIR ELIMINATION, AND PROBABLE ACCURACY. Attention has already been called to the most serious theoretical error in this measurement, namely, that resulting from the varying distribution of current and potential along the antenna as the wave length is altered, that is, the error resulting from the presence in the antenna of distributed inductance. It is not possible to eliminate this error directly, though it may be minimized as indicated.

Slight errors are also introduced by the presence in the antenna of L_0 and A, but these errors may easily be kept very small.

As examples of a sample measurement, the results given below will be of interest. $L_2 = 1.92(10)^{-4}$ hy. At fundamental of antenna, $C_2 = 5.2\ (10)^{-10}$ f. λ F = 595 meters.

The effective capacity was determined at wave lengths between 620 and 903 meters. The average was $C_t = 0.00166 \pm 0.00018$ μf. and for L_t, $L_t = 6.0(10)^{-5}$ hy. The average error was therefore apparently 10%. Actually it was less than that, the discrepancy between individual readings being due to the influence of certain metallic conductors in the neighborhood of the antenna rather than to inaccurate measurement.

This is the eighth article by Dr. Goldsmith, in a series on the engineering measurements of radio-telegraphy. The ninth will appear in an early issue.

WIRELESS APPEAL FOR THE BLIND

Forty-five vessels on the Atlantic received King George's wireless appeal on behalf of the National Institute for the Blind sent out by the Marconi Company from Poldhu at midnight on Saturday, March 28.

From the forty-five ships the message sped onward to all ships with wireless that sail the sea. It was repeated to North Sea trawlers, to great merchantmen, and to humbler craft that ply from port to port.

The Lord Mayor's fund in support of the National Institute for the Blind now amounts to $50,000.

THE ECLIPSE AND WIRELESS TELEGRAPHY

The total eclipse of the sun on August 21 will give excellent opportunities for observing the effect of light and darkness upon wireless telegraphy. From Greenland across Norway, Sweden, Russia and Persia to the mouths of the Indus the eclipse will be total. The total eclipse will last a little more than two minutes in Russia. A bulletin issued by the British Association for the Advancement of Science points out the advantages of scientific study during the eclipse. It is likely that the propagation of signal-bearing waves through the air in the umbra and penumbra will obey laws different respecting absorption and refraction from those obeyed in illuminated air. There may be a difference in the strength, frequency and character of natural electric waves and of atmospheric discharges. An investigation of the propagation of signals across the umbra will necessitate the arrangement of wireless telegraph stations on either side of the central line of the eclipse to transmit signals at intervals while the umbra passes between them. Before, during and after totality, therefore, it is desirable that the Scandinavian and Russian stations should transmit frequently throughout several minutes. The stations, with the exception of those in proximity to the central line, should try to keep a detailed record of the variations of signals during the eclipse. Between ten o'clock in the morning and three o'clock in the afternoon, Greenwich time, European stations west of the central line, and stations in the Mediterranean and Asia Minor may discover noticeable changes in the strength of signals, particularly long-distance signals; in the afternoon it is likely that the stations in India and East Africa and ships in the Indian Ocean may feel the effects of the penumbra. Eastern Canadian and United States fixed stations and vessels in the Atlantic, will, it is likely, be affected by the penumbra in the morning. The eclipse (partial) is at its greatest at eight minutes to four o'clock in the morning, standard time. Those possessing the required facilities who are willing to make observations during the eclipse are requested to communicate with Dr. W. Eccles, University College, London, W. C.

Enid

Chasing a Title

A Fiction Story

By JAMES W. VALANDI

IN a whirl of dust and a clatter of pebbles that rained against the sheet iron sides of the pier buildings the big red runabout came to a halt at the entrance. The driver fairly catapulted from his seat before the roaring of the motor had ceased and dashed down the long dark reaches toward the openings that let in a view of the river and the light of a misty morning. At the first opening he stopped abruptly in his tracks. The big liner Ostentacia was swinging slowly out into the stream amid shrilling of tugs and waving of handkerchiefs.

He sat down suddenly on a near-by cotton bale and gazed helplessly at the huge vessel slowly moving toward the harbor. Too late. John Farrish groaned aloud. By the rail he could dimly discern the cause of his perturbation, Enid Flower, and two auxiliary causes, the austere yet motherly Mrs. Flower—and the Duke. Farrish gritted his teeth. For most dukes he had a distinct aversion; for this one, a supreme contempt. Not that he had ever met him; his condemnation was assured by the mere fact that the title had an undisputed charm for femininity in general and Mrs. Flower in particular. Then, too, this Harold de Brentan duke person was the cause of all the trouble.

Mrs. Flower had objected from the beginning to John's attachment to Enid, but it looked as if time would overcome this. Then came the duke. Papa Flower told John shortly afterward that Enid was too young to marry, and Mama Flower told John that he was, too. The young couple voted this parental reasoning absurd, of course, and impetuous John Farrish proposed an elopement. At the time they were speeding in the red runabout and it was but a few miles to the Connecticut state line. In a moment of what might be termed auto-intoxication Enid had tacitly consented and the roadster was headed toward Greenwich. But John was a man of honor and at the last minute his saner judgment prevailed.

"No, Enid, dear," he put it, "I'll fight for you in the open. I will win your mother's consent this very night." The machine was turned back to New York.

Enid had not replied, but, nestled down in the cushions as they spun back through the wooded roads, wafted an enigmatical smile to her suitor. As sweet as love could make a miss of nineteen was Enid Flower, a picture of girlish charm, winsome and demure, with blue eyes and hair of burnished copper.

She bade him good-by at the door, a little less lovingly than he had reason to expect, but John blithesomely prepared for the breaking down of barriers that evening. He had not counted on all the twists and kinks of strategy in the hands of a managing mama, however. Tall, broad-shouldered and direct thinking, he overestimated his powers in the game of love. He did not reach Mrs. Flower that evening; she had a dinner engagement.

The morning papers revealed what he was certain was the reason, and he repented bitterly his chivalry of the previous afternoon. At the breakfast table his eye chanced on a paragraph that threw a flood of light on the situation. It ran: "The Duke de Brentan, who was the guest of honor at a dinner given last evening by Mrs. Henry Flower at Port's, sails to-day for London."

Farrish growled something about being sidetracked for a duke, and found little consolation in the titled impediment's departure. The fiasco of the night before stuck in his mind and at the bank he was ready for anything but figures. After an hour, in sheer desperation of spirit, he called up the Flower home. The butler answered the telephone.

"Miss Enid, please," requested John.

"Miss Enid?" The butler's tone betrayed surprise. "Why, both Mrs. Flower and Miss Enid are sailing at eleven!"

"At eleven?" he gasped; "where, on what?"

"On the Ostentacia, for London," came the reply, and the conversation terminated abruptly with the click of John's receiver hook.

His watch showed him that it was then seven minutes to eleven. John dashed down the steps, cranked up the roadster and taking the corner on two wheels broke all speed regulations on a dash northward through the crowded streets.

But he was too late. There, out in the middle of the Hudson, the Ostentacia was already kicking up a froth at the stern and moving slowly downstream. Seated on the pier the whole thing flashed through his mind in an instant. The parental objections were revealed to him in their true light—and Enid was complaisant to the nefarious scheme! Perhaps that was why . . . but maybe she wasn't? She might be an unwilling participant in the plot!

"I'll beat them yet," murmured Farrish as he sprang to his feet, wheeled about and dashed down the pier. He leaped into the throbbing machine, opened the throttle and shot into high amid a grinding of gears. The motor snorted and the car fairly jumped from the ground. Dodging lumbering trucks and street cars he skilfully swung around a few street corners, made a wild dash straightaway and pulled up in front of the White Line offices.

His memory had not played him false! The express steamer Atlanticus was due to sail late that night.

"Give me a stateroom," he demanded of the clerk, "one on the first promenade deck, if possible."

The clerk shook his head. "Sorry; promenade or any other deck, I can give you nothing. Every stateroom is taken. Not a thing left. Now, next week on the——"

"Never mind about next week," he interrupted breathlessly; "find me something—anything—for *this trip* on the Atlanticus. I am Abner Farrish's son——"

"Oh, in that case, I dare say the purser can make some arrangement, Mr. Farrish," stuttered the wide-eyed clerk. "Come aboard before midnight and he'll manage to fix you up somehow, I am sure."

"Right-o!" called John over his shoulder as he dashed down the steps.

That night found Farrish on the deck of the fast trans-Atlantic liner, pointing her nose through the Narrows and heading for the open sea. He watched the receding lights of the city for a time, then sought consolation in the smoking saloon. But his thoughts were anywhere but with the animated groups about him. The bridge players, all of them, and particularly the one with the watery blue eyes at the next table, irritated him. The book readers annoyed him, too; they were so complacent in the midst of a veritable catastrophe. Thoroughly disgruntled, he went below early. The next morning when he awoke the great leviathan was plowing her way through the even swells of the broad Atlantic.

He scanned the horizon but found no trace of the Ostentacia. A faint smudge of smoke held out hope for a while, but inquiry of the deck steward dissolved that; the Ostentacia was twelve hours ahead and making good time. The day was clear and the air invigorating; before noon Farrish was feeling more cheerful. "We'll beat them yet," he thought. "Gee, I wish I could believe in that blooming mental telepathy they talk about. There must be something in it, at that. Why—hello!" The exclamation was occasioned by a sput, snap, crack! overhead. He glanced aloft; the wireless was working. "The very thing!" he murmured.

He almost fell down the steps to that

purser's office. He found that functionary studying room schedules and checking tickets.

"Oh, purser," he burst out, "can I send a marconigram—in a hurry?"

"Nothing to prevent it, sir," was the answer; "the blanks are right at your elbow. Hope there's nothing wrong."

"Everything's wrong," breathlessly announced Farrish, as he commenced scribbling. "Find out, please, if the operator can get the Ostentacia."

"He'll pick her up easily," responded the purser. "Your message?"

"Here you are."

On the pad was written:

> Enid Flower, S.S. Ostentacia: I am aboard the Atlanticus. I know that duke person is with you. Answer.—Jack.

"I guess that will be a bomb in camp," he mumbled as he strolled into the smoking saloon, much relieved. Everything looked better, he thought, as he found himself again seated at the table adjoining one at which the watery-eyed obsession of the night before was playing cards. My! how he had hated the sight of that person the night before. And for no reason. How silly to let one's nerves jump off at a tangent. Ruminating on the possible effect of the marconigram, he began to enjoy his surroundings; and casual inspection of the adjacent poker game gradually developed into close interest as he noted that he of the fishy eyes was winning steadily. The others took their ill-fortune good-naturedly, particularly a rather distinguished-looking foreigner who sat opposite and evinced more interest in the regularity of the arrival of his brandy and soda than in the game. He was carrying more than his share of the losses, too, and Farrish mentally observed that here at last was true sport.

A steward came through, calling John's name. At a nod the man brought him a marconigram. He tore open the enve'ope and read:

> What if the duke is with us? Pleasant voyage.—Enid.

"Confound him!" John exploded. "I'll spoil his face—that's what!" Rushing to the purser's office he wrote:

> Enid Flower, Ostentacia: I will challenge him to a duel the minute he steps off the gangplank at Fishguard.—Jack.

"Pretty spectacle I'll make of that lovely ladies' man," thought Farrish, returning to the smoking saloon. Dropping in his old seat his attention was riveted for an instant on the poker game. The watery-eyed individual was dealing and his deft handling of the cards fascinated him. The play went on and the good-humored foreigner played with characteristic abandon. When the call came he proved to be a heavy loser. He smiled carelessly and settled for the pot.

Just then, another marconigram was handed to Farrish. It read:

> Did you bring your foils along? —Enid.

John scribbled on the envelope:

> I will fight him with my fists.—Jack.

"Send that," he said to the steward.

Out on deck, he paced up and down with a nervous step. The memories of days when they had driven together through the country made the present attitude of Enid doubly distressing. He thought of the many hours when hand in hand they had spoken their love and made plans for the future.

"Message, sir," the steward's voice interrupted.

> The Duke says he will tweak your nose, sir, when he meets you.—Enid.

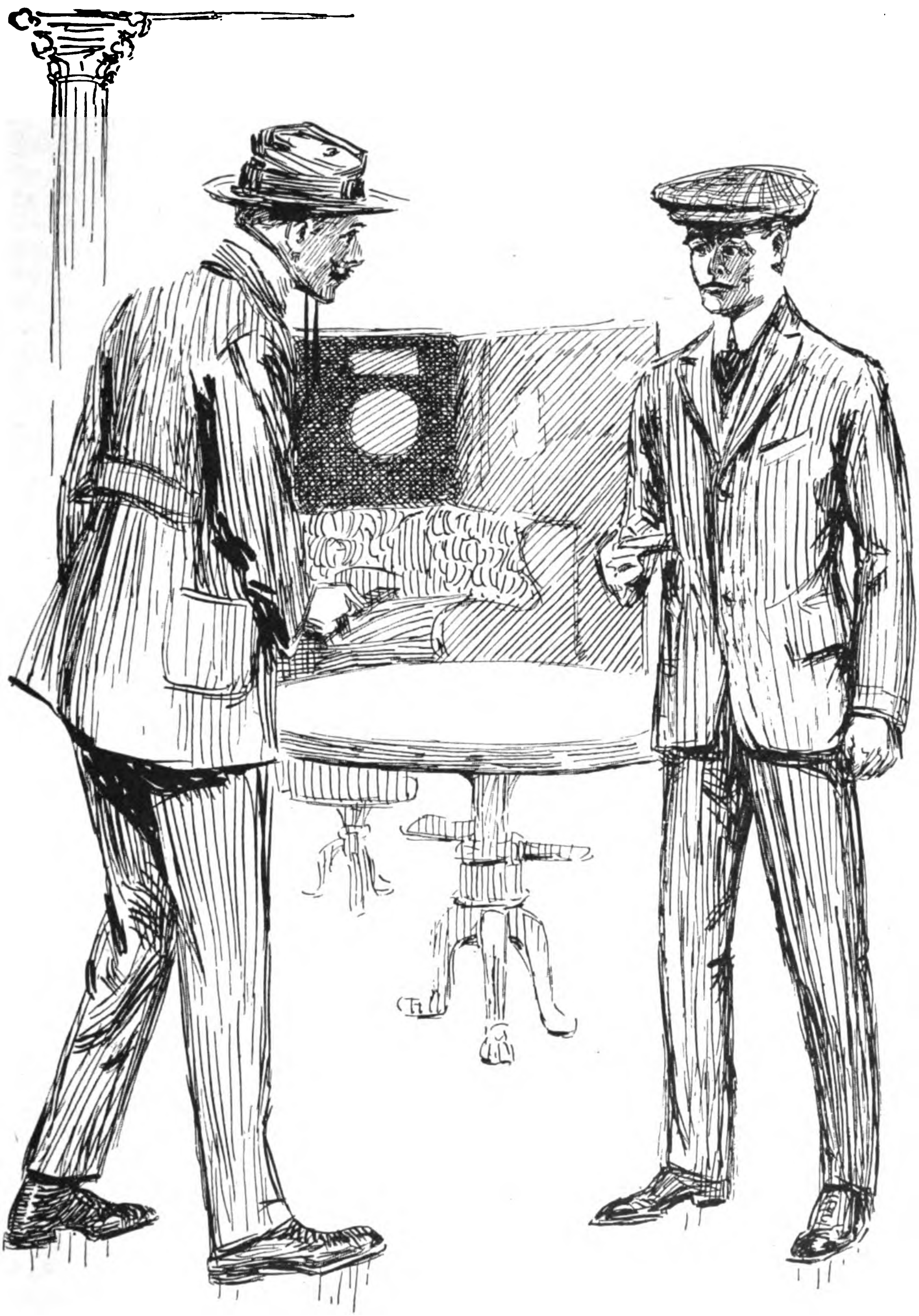
"He will, will he?" snapped John. "Well, he shall have the opportunity . . . the puppy! Here, steward!"

His reply read:

> The Duke de Brentan, Ostentacia: I will smash yours on sight.—John Farrish.

The steward scurried off. "Bah!" thought Farrish, "what's the use of wasting electricity on the fool?" He returned again to the smoking saloon.

It was an unhappy man that dropped into the seat. Fine pilgrimage, this. Out on the ocean, shooting wireless threats of violence through the air to a



"Well, Mr. Duke de Brentan—that is your name?"
"It is my title."

man he had never met. Not that that made any great difference. The nobleman was a scoundrel, it was certain; but this long-distance defiance was undignified, even childish. The trouble was he had made no definite plans. Acting on his first impulse he had boarded the only ocean liner with a record of swiftness that topped the ship which was carrying his sweetheart to a foreign shore. But, now, through his impetuousness, it was certain that Mrs. Flower was aware he was following. She would probably change her plans. The whole thing was a fine mess for him; he would have to rely on the newspapers reporting the progress of the party because of the real live duke in tow, and trail along as best he could.

At a muttered imprecation a man sitting alongside Farrish looked up. John was too busy with his own affairs, however, to notice his presence. The stranger, one of the players in the poker game who had dropped out for the moment, showed some concern as his neighbor continued muttering to himself.

"Pardon me, sir," he remarked, "you seem to be in trouble. May I venture to offer my assistance?"

Farrish looked up and flushed, conscious that he must have expressed his feelings in somewhat forcible language. He gave the stranger a blank stare.

"Bound for London?" the traveler inquired.

"Er, no; that is—yes. I may stop off there for a day or so," stuttered John.

"My card. I am well acquainted in the English metropolis, and perhaps—" the voice held a suggestion of solicitude.

John Farrish was enough of a cosmopolite not to be offended. He glanced at the pasteboard.

"Happy to make your acquaintance, Mr. Thomas," he announced. "And I thank you for your kindly intentions. My name is Farrish—John Farrish."

"Of Farrish & Co., by any chance?" queried the new acquaintance.

"My father is Abner Farrish."

"I know the firm well. We bank with you." Thomas stuck his hand out cordially. "You'd better join the game for an hour or so, old man," he added cheerily, "something is on your mind and it may do you good to forget all about it."

Introductions were mumbled in the usual vague way and John bowed abstractedly to the others. They played with varying fortunes until dinner time and continued the session later. The game grew monotonous after a time, for the phenomenal luck of the watery-eyed individual returned and the foreigner resumed his reckless betting and utter indifference to losses. As the hour grew late a consolation pot was suggested as a windup. It happened that the watery-eyed man held the deal. Thomas opened after the pot had been sweetened four times and the dealer raised. Everyone saw the raise and the game whip-sawed back and forth until all but two had dropped out. The draw was called and the foreigner took one. The watery-eyed plunger laid down his hand and dealt himself three cards, picking up two as he dealt, and glancing at them slyly. He then quietly picked up two from his discarded hand and announced a raise almost before the foreigner's bet had been pushed forward. The foreigner laughed and threw down his hand, jokingly remarking that he had failed to fill his flush. The watery-eyed one reached for the pot.

"Not so fast, there!" exclaimed John, "just hold on, Mr.—I've forgotten your name," looking straight at the winner.

"My name is Browning, sir," he said.

"Well, Mr. Browning," continued John, "I don't know much about cards, not half as much as you do, probably, but I know a double deal when I see it!"

Browning glared and put his hand over the chips.

"You mean that I have been cheating, young man—you are a liar!"

Farrish's right arm shot out and Browning toppled over. He struggled to his feet and made a rush toward his antagonist. The timely interference of the other players prevented a serious row. With an oath the fellow threw the money and chips on the table and left the room.

"Thank you, Mr. Farrish," said the foreigner. "You know I thought his luck most extraordinary, but I really suspected nothing. Outside of the crookedness, though, one hates to think of being fleeced by so old a trick. I admire your action, sir, I am quite sure I would not have had the courage of my convictions, had I discovered what was going on."

Drawing a card from a thin gold case, he presented it to John.

"Should be pleased to have you look me up in London, the St. Francis Club, you know," said the foreigner.

John glanced at the card. As he read the blood tingled and raced through his veins. It read:

Harold de Brentan

"Well, Mr. Duke de Brentan—that is your name?"

"It is my title."

"Yes, to be sure; I beg your pardon. But there is a Duke de Brentan traveling across the ocean this minute on the Ostentacia, with Mrs. Flower and her daughter, my fiancée—or at least she was my fiancée, and I hope she still is."

"You are joking."

"No, indeed. Never was more serious in my life."

"By jove, this sounds like a penny thriller. You're not a newspaper man?"

"No, I wish I were. I might ferret the thing out."

"Some mistake then, most likely. Have you ever seen this other—er, person?"

"From a distance only. But I know something of him; I've sent him a wireless message and challenged him to a duel."

The duke thought a moment and his expression changed.

"By jove, could it be my man Hoffman?"

"Your man?"

"Yes, he left me in Portland."

"The Flowers were in Portland last month!" exclaimed Farrish. "I'll wireless the captain of the Ostentacia and expose him. . . . And later I'll smash his face."

"With me as referee."

"The impostor! I'll get him!" continued John excitedly. "He has stolen your clothes, hasn't he? I'll get a message over to the London police and they'll nab him when he lands."

This was the marconigram sent from the Atlanticus before they turned in for the night:

> Wireless Captain Ostentacia: Arrest Hoffman, booked fraudulently as Duke de Brentan. Charge theft. Will appear against him when we make port. Observe secrecy. — Duke de Brentan.

Three days ater the duke handed John a message to read.

> Ostentacia reports man wanted not aboard.—Scotland Yard.

"Something wrong somewhere!" announced Farrish. "We'll resort to strategy." He took a message blank and wrote:

> Mrs. F. D. Flower, Ostentacia: John Farrish seriously ill, high fever. Requests you inform daughter.

"We'll sign my father's friend, Thomas', name to it; he won't mind," observed John.

All that afternoon and the following night John looked for an answer. None came. By the middle of the afternoon he could wait no longer. He filed this message with the purser:

> Enid Flower, Ostentacia: Enid, I love you. I am not ill. Other message was untrue. May I see you in London?—Jack.

He felt better when this message had been clicked off. He was happy; he could not tell exactly why, but his mind was relieved.

Ten minutes later the deck steward brought him his answer.

> John Farrish, Atlanticus: Dine with mother and me to-morrow night at the Savoy.—Enid.

* * *

"And so there wasn't any duke—real or bogus—aboard?" John laughed as he pressed Enid's hand under the table the following evening.

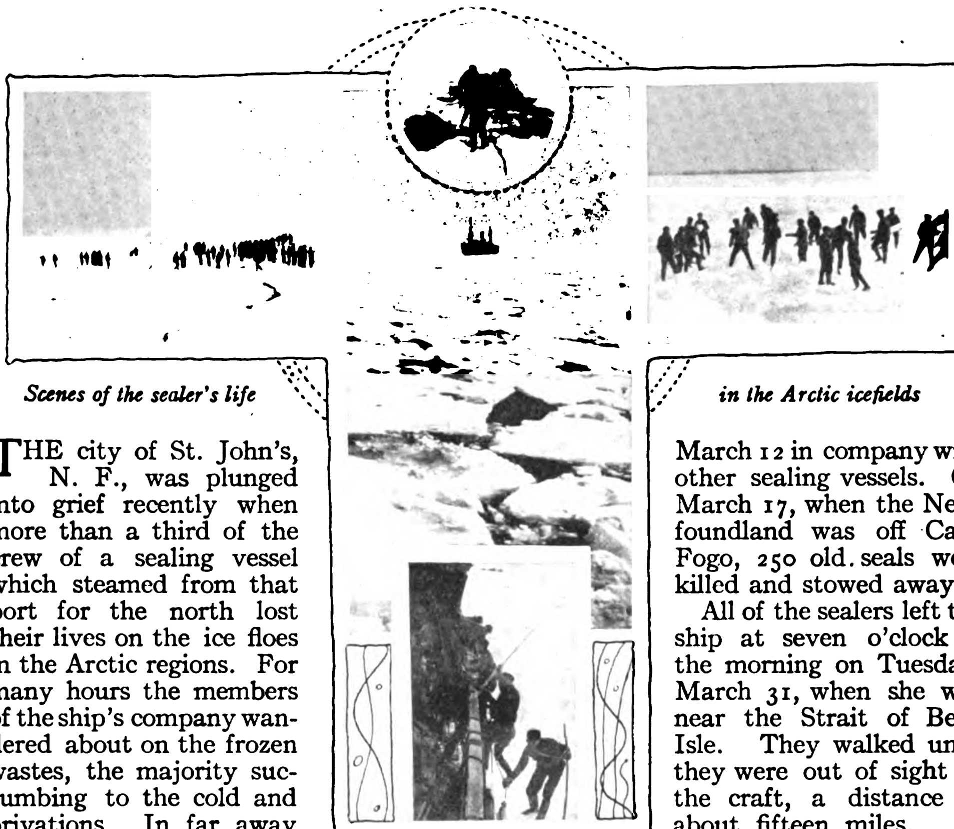
Enid smiled an affirmative.

"But why did you let your foolish suitor believe there was?" asked John.

"You, yourself, gave me the idea in that first message. And I thought there might as well be some one—I wanted to find out how much you really cared—and you seemed to think the Duke de Brentan was with us, and——"

But the laughter of the real Duke de Brentan, sitting at Mrs. Flower's right was so hearty the sentence remained unfinished.

Threescore Lost in the Arctic—Story Told by Wireless



Scenes of the sealer's life in the Arctic icefields

THE city of St. John's, N. F., was plunged into grief recently when more than a third of the crew of a sealing vessel which steamed from that port for the north lost their lives on the ice floes in the Arctic regions. For many hours the members of the ship's company wandered about on the frozen wastes, the majority succumbing to the cold and privations. In far away St. John's, where the unfortunate men had relatives and friends, the news of the disaster arrived by means of Marconi wireless telegraphy, having been transmitted to a coast radio station and then relayed via land lines. As the work of rescue proceeded, details concerning the casualty were flashed to the city, and when the ship carrying the dead and saved reached port, those on shore were practically in possession of the full story of the tragedy.

The sealing vessel Newfoundland left St. John's, N. F., on March 10 with a crew of 154 men and proceeded to Wesleyville where thirty-five more sealers were signed, making a total of 189. With Captain Wesley Kean in command, the Newfoundland left for the north on March 12 in company with other sealing vessels. On March 17, when the Newfoundland was off Cape Fogo, 250 old. seals were killed and stowed away.

All of the sealers left the ship at seven o'clock in the morning on Tuesday, March 31, when she was near the Strait of Belle Isle. They walked until they were out of sight of the craft, a distance of about fifteen miles. At half past eleven o'clock the men boarded the Stephano to obtain food. A heavy swell in the sea, accompanied by snow flurries, was noticed an hour afterward, but even then the weather glass did not indicate that a storm was approaching. However, some of the Newfoundland's crew hesitated about leaving the Stephano because of the snow flurries and heavy seas. At length they set out to reach a patch of seals two miles away and the Stephano steamed away to pick up a contingent of her own men who were on the ice.

Captain Abram Kean, the commander of the Stephano, was unable to find all his crew, but he received a wireless message from the Florizel, transmitted by the Marconi operator on the latter, that the missing men from the Stephano had boarded that ship. The Stephano, after taking these men on board, steamed back to within a mile of where the Newfoundland's crew were supposed to be. Captain Kean estimated that the Newfoundland's men would have walked that distance during the interval. There was no sign of the sealers, however, and Captain Kean assumed they had walked toward their own ship. The Stephano kept her whistle blowing all Tuesday night to attract any men who might be on the ice, and when none had reached the vessel up to noon Wednesday, those on board the Stephano fully believed the Newfoundland's crew had reached their own or some other ship before the storm became too severe.

It took the Newfoundland's men about ten minutes to walk from the Stephano to the seal patch. The seals were scarce, however, and only fifteen were killed. A decided change took place in the weather conditions about three o'clock in the afternoon, and the snow began falling heavily, although it was not cold. The men decided to make their way back to the Newfoundland, and started on a course which they expected would bring them to the vessel, expecting every minute to hear her whistle.

Nightfall, however, found them still struggling on. The wind then veered to the north and blew at a hurricane rate. The weather became intensely cold, too, and the less courageous ones among the crew began to express fears concerning their safety. It was impossible to see a yard ahead, but up to this time the men had kept together; now, some of them, exhausted by the buffeting of the storm, dropped out and were left behind, although their companions did their utmost to save them. When daylight came at least a dozen were missing or dead.

All the next day the storm continued and the death roll increased. Men of the crew who looked physically able to withstand the severest hardships succumbed to the cold and exhaustion; some, their minds weakened by their sufferings, danced on the ice until they fell exhausted. Others removed their boots, saying that it was "time to turn in," and fell dead the next minute; in one instance three men met death simultaneously in these circumstances.

The sealers spent the following night huddled behind a pinnacle of ice. Several of the men, declaring insanely that they were "going into the galley," stretched themselves out and died; others went to sleep and never awakened. Almost a score of men died during the n'ght.

All suffered from lack of food and water. Eating snow relieved their thirst, but left their lips parched and dry. Toward daylight there was a change in the weather; the wind had abated somewhat, but the snow was still drifting and there was no relief from the bitter cold.

About daybreak the half-frozen band saw the steamship Bellaventure in the distance and made their way toward her; their progress was slow, the strongest of the men being unable to walk faster than a child. Before they had gone far, however, the crew of the Bellaventure saw them and came to their aid with food and medicines.

After a count of the living had been made, news of the misfortune was sent out by the wireless operator on the Bellaventure. A statement authorized by Colonial Secretary Bennett said that sixty-four men had perished, and thirty-seven had been rescued.

Captain Randell, of the Bellaventure, talked as follows about the disaster:

"On the morning of the day the Newfoundland's men started on their ill-fated hunt the weather conditions were

When a patch of seals is located a party of men go out over the ice, often miles away from their vessel; in the catastrophe described more than one hundred men were lost in a blinding blizzard not bad. The glass gave no indication of an approaching storm, and, seals being reported in the vicinity of the Newfoundland, it was not unreasonable for Captain Kean to have his full crew on the floe. That morning I had my men on the ice after a patch of old seals, but the seals were driven off, and the men returned to the ship. About noon the barometer indicated a likely storm, and it was snowing lightly, with the wind about S.E.

"By three o'clock in the afternoon the mild weather had given place to a regular blizzard, the wind blowing at hurricane force; but it was not intensely cold. As the day grew, so did the storm, though late in the afternoon there was a change for about one hour when the wind veered to westerly, making it very mild, and wet snow fell. Up to night the temperature was such as not to invite frost bite, but about that hour the wind suddenly chopped to the north, with intense violence, and the temperature fell to in the vicinity of zero.

"Wednesday morning showed no change, and the weather continued frosty. About noon Wednesday there was an abatement in the storm, and at two o'clock it ceased to snow. Even though these conditions were brought about by the change, there was a 'ground' drift on the ice, making it impossible for those on the ship to see men at any great distance, though the men on the ice would be able to see the ship, and yet be unable to reach or signal them.

"Wednesday afternoon the Bellaventure's men were on the ice and killed about 300 seals, and during this time we worked toward the Newfoundland.

"Thursday morning, soon after daylight, one of the men remarked that he saw a couple of men on the ice. When told I remarked that there must be a good patch of seals inside the Newfoundland, or Kean would not have his men out so early. A second report from the barrelman was the men were 'wobbling' about, and looked as if the men had been on the ice all night. The Bellaventure was then forced toward them, and some of them sent out to meet them. One of those sighted walked to the ship, and reported that he was from the Newfoundland's crew, and that more than 100 of them had been on the ice since Tuesday, and that many were dead.

"Full speed was put on the Bellaventure when the tragedy was made known, and our crew were sent out in relays with medicines, foods, stretchers, wood to light fires, and such things as would be of service in rescuing the survivors.

"The ice was so tight that progress was necessarily slow, but our men continued on, and rescued those who had outlived the storm in twos and threes, and brought them aboard.

"In the interim a second man from the Newfoundland walked to the Bellaventure and reported the death toll, even greater than the first. We continued at the work of rescue all day, our men assisting those who could walk to the Bellaventure, and those who could not were brought along on stretchers."

NEW LIGHTHOUSES ON THE FRENCH COAST

Wireless lighthouses are being established along the French coast, the first two being located on islands near the approach to the port of Brest. It is planned to erect two more for the port of Havre. The lighthouses will be operated by a system almost like that of ordinary lighthouses, except that, instead of light waves, wireless waves will give the information to approaching ships.

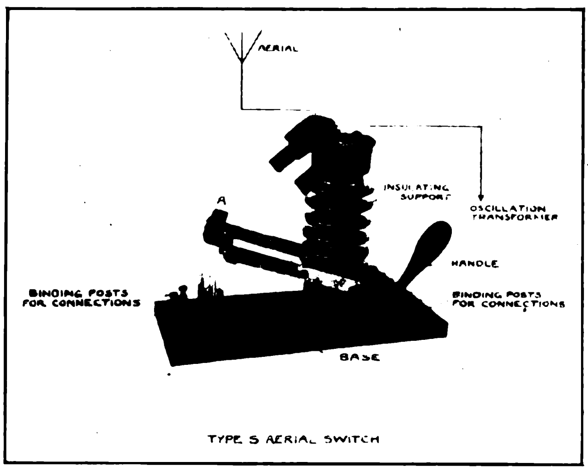
One of the advantages of the wireless lighhouses is that fog will not take away from their efficiency. When a ship approaches Brest and is within thirty miles of the islands, wireless signals will be picked up. If the vessel has an instrument to detect the direction from which the signals come it will be easy to apply the information; but even if it does not have such an instrument, the receipt of any signals at all will be of material aid, for the exact positions of the two lighthouses are known and a comparison of the strength of the signals from each will assist in estimating the ship's position.

Each station, like an ordinary lighthouse, will send out flashes every few seconds, together with special signals, to indicate which station is sending. The sending apparatus is automatic and is constructed so that it will run for thirty hours without any attention.

CHAPTER VIII

To facilitate the operation of standard Marconi sets, an aerial transfer switch known as type "S" has been designed, with several new features added to the usual ones embodied in a switch of this type.

This device, shown photographically, consists essentially of a double-throw two-blade switch which, when thrown upward, places all apparatus in a receiving position and when pressed downward effects the proper connections for sending.



The use of the switch in connection with the new type 103 receiving tuner is shown in Fig. 26.

When the switch is thrown upward, the blade connected to lug 5 makes contact with the clip at binding post 1, thus connecting the antenna to the aerial post of the tuner.

The earth connection to the tuner is made through lug 6 and the blade to binding post 2, and thence through the transmitting oscillation transformer secondary to the earth.

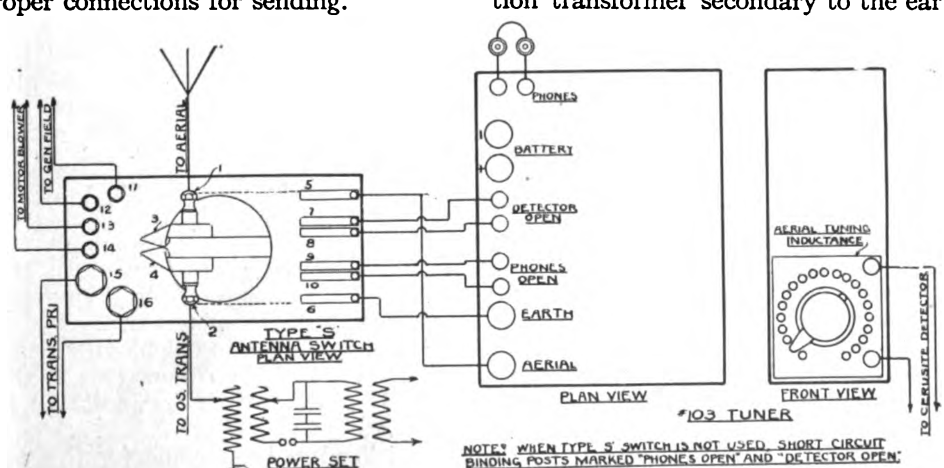


Fig. 26

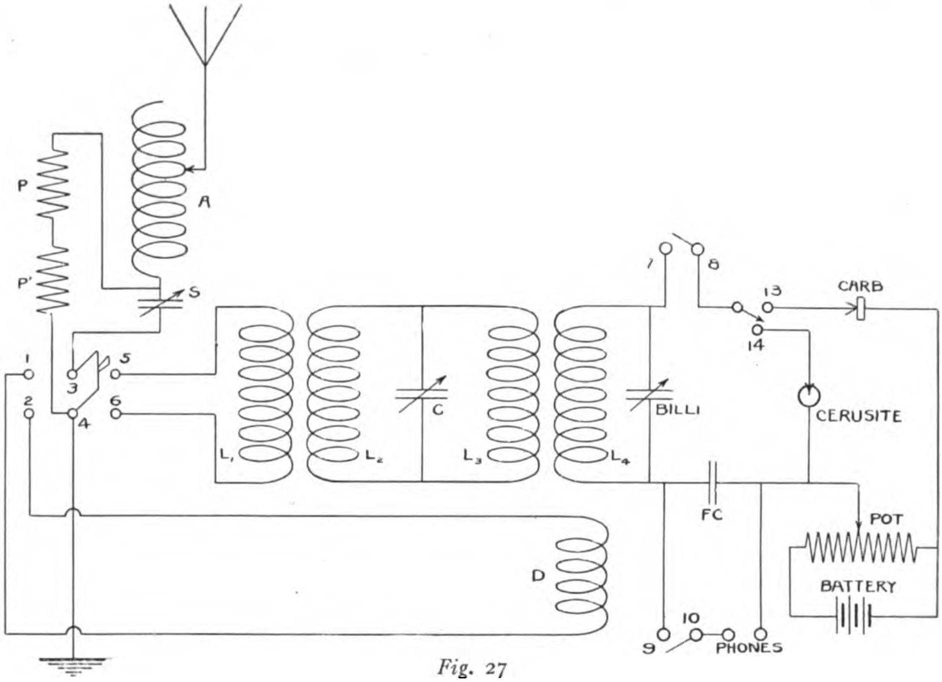


Fig. 27

Simultaneously, lugs 7 and 8 are connected together closing the circuit to the detector, and lugs 9 and 10 closing the circuit to the head telephones.

When receiving the oscillations are prevented from flowing to the earth through the transmitting oscillation transformer at spring contacts 3 and 4, for when the blades of the aerial switch are in an upright position a small fiber wedge mounted on the insulating bar (between the two blades) electrically separates contacts 3 and 4, causing the oscillations to pass to the earth through the receiving tuner.

It will be observed that when transmitting this construction eliminates the spark plate or anchor gap, the losses of which are productive of increased decrement of the emitted wave.

When the handle of the switch is pressed downward all apparatus is connected for transmitting, the contacts referred to are broken; contacts 3 and 4 are then joined, connecting the antenna wires directly to the transmitting oscillation transformer. Contacts 11 and 12 then close the circuits to the generator fields; simultaneouly 15 and 16 close the primary circuit to the transformer, while contacts 13 and 14 may be used to operate a blower or may be employed to close the circuit of any distant control switch which may be necessary in connection with the power equipment.

It has been found desirable to disconnect the generator fields while receiving, for in many cases should the motor generator be left in rotation without disconnecting the field windings of the generator, alternating current flowing through the instruments on the switchboard may set up by induction resulting in objectionable humming noises in the receiving telephones, seriously hindering the reception of weak signals. Additional protection is afforded by the elimination of all "live" circuits while signals are being received, thereby protecting the operator from shock due to accidental contact with any of the power wires.

Type 103 Tuner.

The receiving tuner (type 103), to which reference has been made, is a modification of the standard valve tuner using carborundum or cerusite as the detector, no provision having been made for the use of the Fleming valve. A plan view showing the external binding posts of this tuner and the connections to the type "S" aerial switch are indicated in Fig. 26.

Provision has been made for the use of the cerusite detector through connections made to the two binding posts issuing from the tuner just below the aerial tuning inductance.

The circuits of tuner 103 have been simplified as shown in Fig. 27. The aerial tuning inductance is indicated at A, the short wave condenser at S, and the protective chokes at P and P_1. A two-blade double-throw switch allows connection to either the stand-by or tuning circuits.

When thrown to the left the antenna and earth are connected through contacts 1 and 2 to special winding D, which in turn is closely coupled to the fixed inductance of the local circuit L_4.

When the switch is thrown to the right, winding L_1 is connected to the earth and antenna, causing the oscillations in the aerial circuit to act upon the detector circuit through the intermediate circuit comprising inductance L_2, variable condenser C and inductance L_3.

The circuit to either of the detectors, carborundum or cerusite, is opened up at binding posts 7 and 8. This circuit is closed by the type "S" aerial switch.

The telephone circuit is opened at binding posts 9 and 10. When receiving these contacts also are closed by the type "S" switch.

A single blade double-throw switch makes connection to contacts 13 and 14, allowing the use of either the cerusite or carborundum detectors. It is of interest to note that no local battery current is used when the cerusite is brought into action as it performs its functions without the use of auxiliary current.

When carborundum is employed as a receiving detector it is possible that certain crystals may be so mounted that when they are placed in the crystal holder the battery current flows in the wrong direction. In such cases the external connections to the battery binding

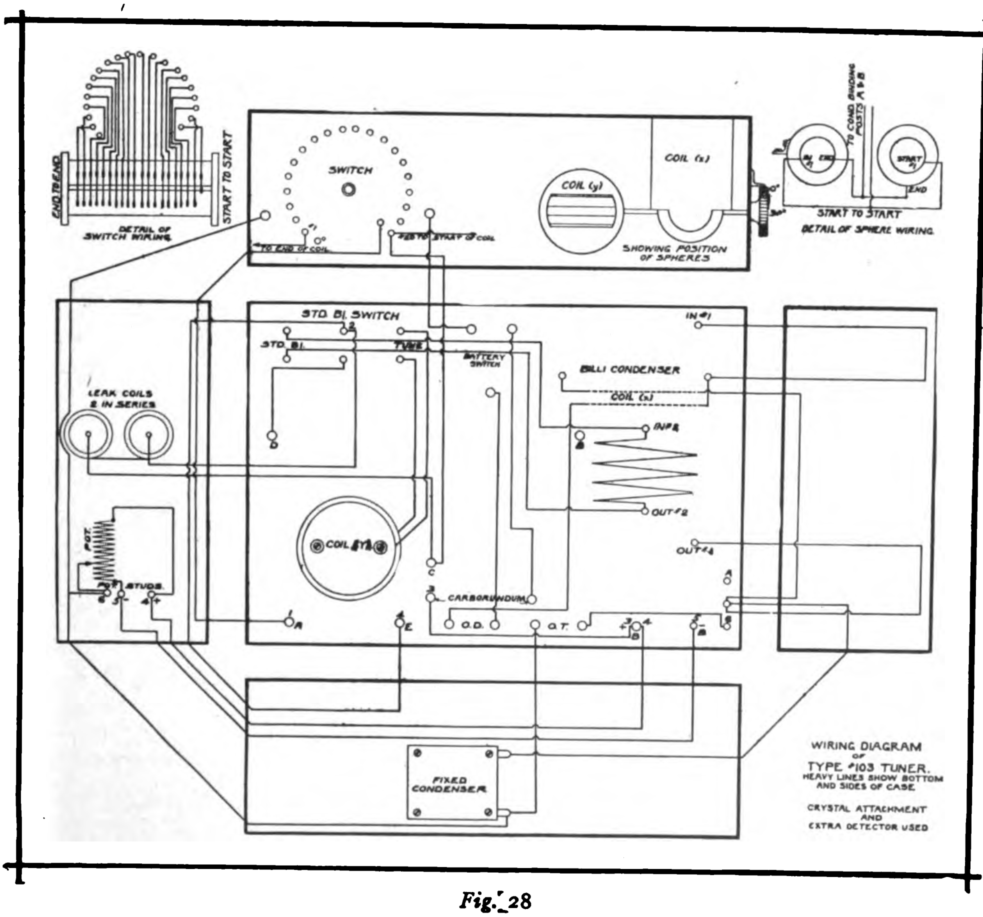


Fig. 28

posts should be reversed and a trial made while receiving weak signals from a distant transmitting station.

Fig. 28 is of interest because it shows the exact inside wiring of tuner 103 as it appears when viewed from the bottom of the tuner. This drawing is invaluable to the commercial operator, for in case of accident to the apparatus it may be referred to and the location of each wire be readily determined.

The operation and the use of the fundamental circuits of this receiving tuner are so well understood by the average Marconi commercial operator that detailed explanation should not be necessary. It is well, however, to keep in mind that when this tuner is used in connection with the type "S" aerial switch it is not necessary to raise the two blade double-throw switch (to the left of the tuner) to a vertical position for the protection of the circuits when transmitting, as the proper disconnections are effected by the auxiliary contacts on the type "S" aerial switch.

(To be continued)

THE INTERNATIONAL ICE PATROL

For the purpose of carrying on the International Ice Observation and Ice Patrol Service provided for by the recent London conference, the United States revenue cutters Seneca and Miami have been detailed for this service.

The object of the Ice Patrol Service is to locate the icebergs and field ice nearest to the trans-Atlantic steamship lane. It will be the duty of patrol vessels to determine the southerly, easterly, and westerly limits of the ice, and to keep in touch with these fields as they move to the southward, in order that wireless messages may be sent out daily, giving the whereabouts of the ice, particularly the ice that may be in the immediate vicinity of the regular trans-Atlantic steamer lane.

The Miami was scheduled to leave New York April 1 for this duty. Later she will be relieved by the Seneca, which has been performing ice observation service since February 19, 1914. During May and June, and as much longer as necessary, these two vessels will alternate on patrol, making alternate cruises of about fifteen days in the ice region; the fifteen days will be exclusive of the time occupied in going to and from Halifax. The movements of the vessels will be so regulated that on the fifteenth day after reaching the ice region the vessel on patrol will be relieved by the second vessel if possible, at which time the first vessel will proceed to Halifax, replenish her coal supply, and return in time to relieve the other vessel at the end of the latter's fifteen-day cruise. It is important that the patrol be continuous, and the vessel on patrol will not leave her station until relieved by the other vessel unless it is absolutely necessary to do so.

All time in wireless messages will be sent in seventy-fifth meridian time. Having located the ice, the patrol vessel will send the following daily wireless messages:

(*a*) At 6 p. m. (75th meridian time) ice information will be sent broadcast for the benefit of vessels, using 600 meter wave length. This message will be sent three times with an interval of two minutes between each.

(*b*) At 6.15 p. m. (75th meridian time) the same information will be sent broadcast three times in similar manner, using 300 meter wave length.

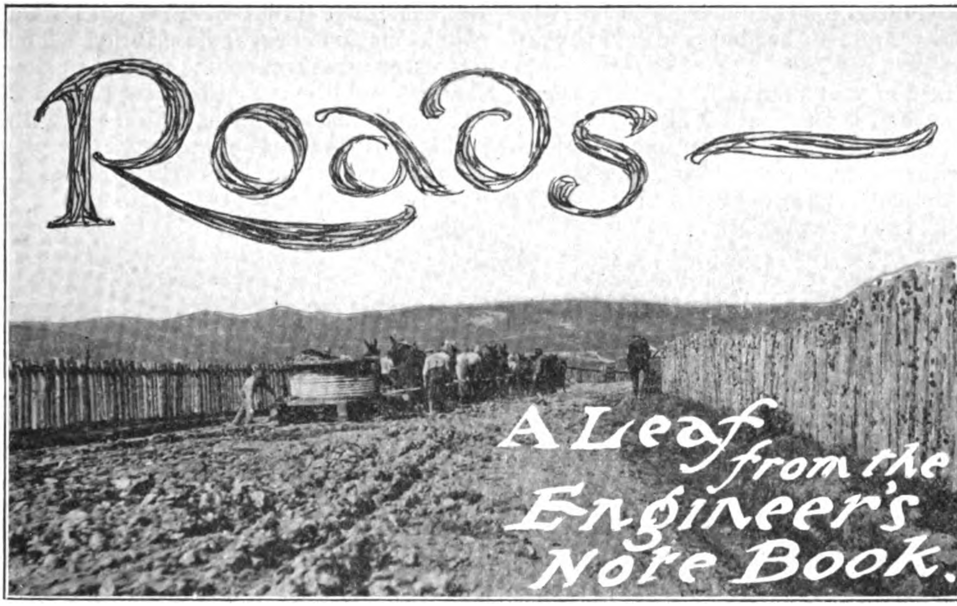
(*c*) At 4 a. m. (75th meridian time) a radiogram will be sent to the Branch Hydrographic Office, New York City, through the nearest land radio stations, defining the ice danger zone, its southern limits, or other definite ice news. The telegraphic address of the Branch Hydrographic Office is "Hydrographic, New York."

(*d*) Ice information will be given at any time to any ship with which the patrol vessel can communicate.

Ice information will be given in as plain, concise English as practicable, and will state in the following order:

(*a*) Ice (berg or field).
(*b*) Date.
(*c*) Time (75th meridian time).
(*d*) Latitude.
(*e*) Longitude.
(*f*) Other data as may be necessary.

While on this duty, the patrol vessel will endeavor by means of daily radio messages to keep ships at sea advised of the limits of the ice fields, etc.



IF anyone imagines that the construction of transoceanic wireless stations is a sinecure, that individual is mistaken. Not that many take this view; for, to the innocent bystander, the thousand and one blue-prints and the maze of figures attached to each little detail of apparatus and structural equipment appear very formidable. And they are, or rather, were, a source of no little psycho-agitation, expressed in mental gymnastics and burning of midnight oil, before resolving themselves into what we passively term the solution of an engineering problem.

Considerations of equal importance arise, however, which the outsider seldom appreciates. For instance, the transportation of the completed equipment to the particular location selected. And the ever-interesting detail of how to get there yourself, when you decide to see how things are being put together.

A little over a year ago I had the pleasure of personally selecting the property for the station at Bolinas, the transmitting unit of the high-power equipment to connect with Honolulu. I term it a pleasure because the broad view of the ocean from the high bluff, rough and rugged and descending sharply to the water's edge, alone compensated for the three thousand mile trip which preceded the purchase. Then, too, physical conditions were ideal from a wireless standpoint, which was unusual; and a glorious vista was thrown in, which was nothing short of unique. The roads forming the approach to the site were not so good, but neither were they as bad as some we had encountered in the past. Taking it all in all, the location was well favored and promised well.

A few weeks ago I made my inspection trip—and awakened. Jupiter Pluvius had entered into an alliance with California Mud and the result was unspeakable.

The first warning came shortly after I had forsaken the broad highways (and a commuter's home) in New Jersey and landed via the Overland Limited at Ogden, Utah. The cheery telegraph message bore the signature of our Pacific Coast General Superintendent and stated that there was serious doubt whether I would be able to get to Bolinas, owing to the condition of the roads. Making some rapid calculations I found that I could just connect with the Shasta Limited and by proceeding first to Seattle the roads would have a chance to get on their good behavior and dry out. Two or three days sufficed for the business in hand in Seattle and I headed south for San Francisco.

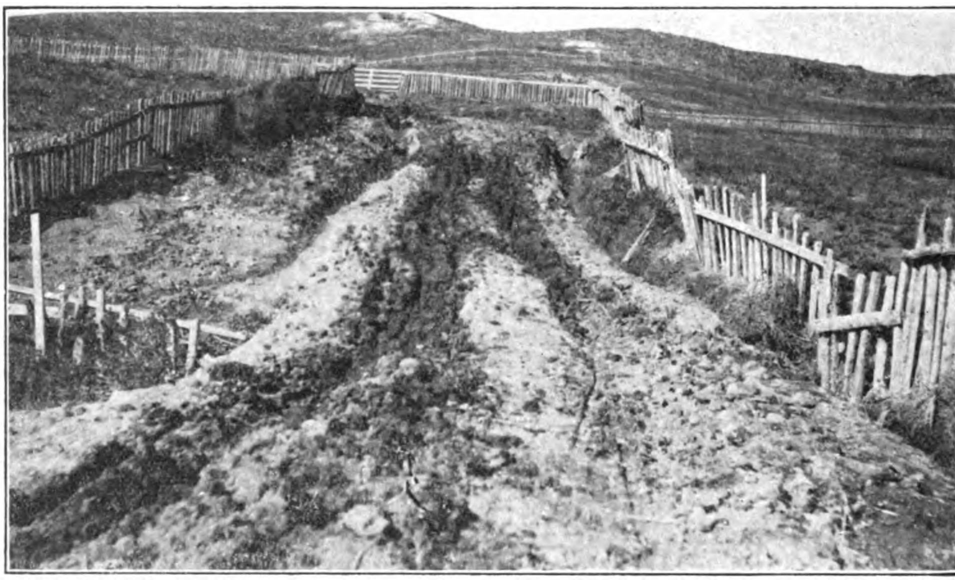
The sun was shining beautifully then, in fact had been for a couple of days, so the trip to Bolinas was arranged for the following day, in spite of the general superintendent's assurances that a successful journey was problematical.

Ferry and train transported us safely to the station at San Anselmo, where we were met by a six-cylinder Packard car, driven by our good friend Mr. Crane, of Crane & Langford, operators of the stage line to Bolinas. This was reassuring, for having driven many miles with both Mr. Crane and Mr. Langford I had a profound respect for their skill in wheel manipulation and knowledge of the roads.

Numerous hairbreadth escapes marked our journey across the mountains, but we eventually arrived intact at the point overlooking Bolinas Bay. To good fortune and careful driving is due the credit, however, for on several occasions the auto darted out of a deep rut or one of the numerous washouts and headed straight for the almost perpendicular hillside and the valley below.

Rounding the head of Bolinas Bay and arriving almost if not quite within the Bolinas town limits we met with road conditions that beggar description. The nearest comparison to one section in particular would be a southern swamp after a freshet—the mud was hub deep, with incidental logs and eucalyptus boughs thrown across in an effort to make it passable.

Up to this time our pilot had neither faltered nor hesitated in his careful negotiation of the road; but here he stopped. The question as to which side of the mud hole was the safer to attempt was determined with attendant scratching of head a few minutes later and we resigned ourselves to inactive participation in an extended battle between mud and motor. The Crane judgment was fortunately upheld and after a time our hubs emerged amid a churning of mud and grinding of gears.



The rate of speed at which we traveled never exceeded a mile an hour. In many places the road had been cut away by the action of the water and the wheels of the rig had but a scant inch or two of anything approaching solidity under them

This was Main street, we were told, and slowly proceeding down it we drew up just below the village smithy's shop. Here we were informed that we had gone as far as possible by automobile; a transfer to the waiting four-horse stage was necessary. As we climbed in this equipage we noticed in front of the smithy's shop a huge sled made of timbers and

In attempting to negotiate this road on wheels a wagon had sunk almost out of sight and the machinery skids rested on the normal road level. The machinery was eventually rescued by one of the sledges built by the village smithy and pulled along the road by sixteen mules

bound with iron runners. Inquiry disclosed the fact that it had been built to make possible the transportation of one of our heavy pieces of machinery over the road.

Our driver (it may be of interest to know that he was the Road Overseer) informed our tenderfoot party at the start that the journey of one mile to the Marconi trans-Pacific station would take about an hour. This surmise proved correct.

When we turned off the road that leads to our property, formerly known as the Ingerman Ranch, we progressed scarcely 100 yards before the horses were floundering in mud of the consistency of plum pudding before baking. The wagon lurched first to starboard and then to port, with the mud well over the forward hubs.

Adopting as a standard that so long as we could see the leaders' ears above the mud it was safe to stick to the ship, and coupling this with the driver's assurance that the wagon had a long gear we lurched along with surprising fortitude. Upon reflection, I feel certain that had we capsized the driver would have but placidly observed that the gear was not as long as he thought it was. As to just what a long gear is, I must confess ignorance; it was to be desired evidently, but I cannot say whether from the standpoint of increased power to buck the mud, or a shorter distance to fall if the rig tipped into the ditch.

Scarcely a quarter of a mile had been traversed when one of the horses tangled up his feet in the eucalyptus boughs (placed there by some kindly disposed individual in an effort to corduroy the road), stumbled and fell and floundered about in the mud. The harness alone kept the animal on the surface. It was distressing and our humane qualities were aroused. Yet there was nothing resembling an argument as to who should have the honor of extricating the noble animal and assisting him to his feet. After a period, the driver, assuming the rôle of a martyr, handed the reins to the writer and gingerly commenced operations. The traces were refractory and he finally had to cut the neck strap so the horse would have freedom to rise. But the animal displayed the much vaunted horse-sense and lay still for several minutes in the soft bed, no doubt debating on the futility of hastening to struggle to his feet to continue such a task. Then, being a horse, he struggled to his feet and with the harness repaired with a manila halter the journey was resumed.

The rate of speed at which we traveled never exceeded a mile an hour. In many places the road had been cut away by the action of the water, now on one side, now on the other, occasionally on both, so that the wheels of the rig had but a scant inch or two of anything approaching solidity under them to support the conveyance in a horizontal position.

A half mile had been covered at the expiration of thirty or forty minutes when we encountered a section of road even worse than that which had gone before. All hands disembarked, clambered over a near-by fence and walked in the field, allowing the rig to lurch forward in its drunken way for another hundred yards or so.

Walking in the fields not being good, several members of the party returned to the wagon, willing to take the long chance of arriving some time at the Ingerman Ranch and the Marconi station. Our local engineer and myself were less adventurous than the others and preferred to strike out across country on foot; we arrived simultaneously with the wagon party, which was fairly recognizable; the horses, however, had taken on the appearance of hand-dipped chocolates.

Having enjoyed a good meal and made the inspection for which we had traveled 2,999 miles at an average speed of 50 miles an hour, and the 3,000th mile at one mile an hour, we again boarded, rather reluctantly, the conveyance which we had christened the good ship "Mudlark." Our journey back to town was a repetition of the experience outward bound, except that we discovered even a worse place directly in front of the Ingerman Ranch house. Here, it is no exaggeration to state, the horses, like Dr. Foster of the nursery rhyme, "stepped in a puddle up to their middle and (let us hope) never went there again." The front wheels disappeared entirely from sight, but fortunately the viscosity of the mixture was not so great that it refused to release us, as we feared. A few vigorous strokes of the whip and good coöperative work between horses and driver served to pull us safely through, to our great relief.

About halfway back to town we passed one of our teams struggling with an iron girder weighing perhaps a couple of tons, an essential part to the continuation of the work immediately in hand. It had been placed on two sledges and with four horses tugging and straining was hitching along the road a few feet at a time. To pass this party in distress necessitated some careful maneuvering; at the imminent risk of capsizing we lurched forward into the ditch and back again on to the apology of a road and rocked our way onward. Strewn along the—let us call it a road, anyhow—could be seen, first

Rebuilding the road between Bolinas and the Marconi trans-oceanic station in California to right and then to left, not only steelwork and building material, but groceries; sacks of potatoes, flour and what not had been temporarily abandoned to lighten the load of some unfortunate teamster, who trusted to luck that some less heavily burdened Samaritan would pick them up and carry them to their destination.

A sigh of relief arose as we reached the junction and made the transfer to the waiting automobile.

As we were preparing to start three rigs hove in sight, two with six horses each and the other with four, pulling about a ton of steel apiece. The drivers informed us that they had been on the road 38 hours, en route from St. Reyes to Bolinas, a distance of approximately 25 miles. Further inquiry disclosed the fact that in attempting to negotiate this same road on wheels a somewhat heavier piece had sunk to a point where the wagon was almost out of sight and the machinery skids rested on the normal road level. With one of the sledges built by the village smithy this piece of machinery had eventually been rescued and pulled along the road by sixteen mules. Even then it had been found impossible to negotiate the remaining mile we had just traversed and the machinery was being stored in a barn for several weeks—so near and yet so far from its destination.

Aside from the question of the delay and the addition of another problem to the engineers' many, there is no excuse for these conditions. You hear a lot of, and from, California's sons praising the glories of their home state. Surely a spot such as Bolinas—of all the scenes in California not one exceeds in beauty that view of Bolinas Bay, the town nestled on its westward shore and the beautiful expanse of the Pacific with the Faralons on the horizon—no place, I repeat, is more entitled to good roads. The residents should institute a systematic campaign for them. People from all over the country will certainly want to see the huge Marconi trans-Pacific station we have built. If on their first trip they find the roads in the condition we found them in January they will never come again. On the other hand, with reasonably good highways Bolinas may soon become an objective point for thousands of residents and tourists.

SERVICE ITEMS

Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, and William W. Bradfield, general manager of the English Marconi Company, left for England on the steamship Mauretania on April 7. Mr. Bradfield, who spent two weeks in this country, inspected the new Marconi trans-Atlantic stations at Belmar and New Brunswick, N. J., during his visit.

* * *

Lee Lemon has been appointed commercial representative of the Marconi Wireless Telegraph Company of America with headquarters in the Webster building, Chicago, Ill. He will direct the activities of a corps of assistants who will be located in all the larger cities of the middle West. Mr. Lemon has had a wide experience in the operating and executive branches of telegraphy, having been employed at various times by the Western Union and Postal Telegraph companies and the Baltimore and Ohio Telegraph Company. At one time he was superintendent of the fire and police telegraph in Baltimore, Md.

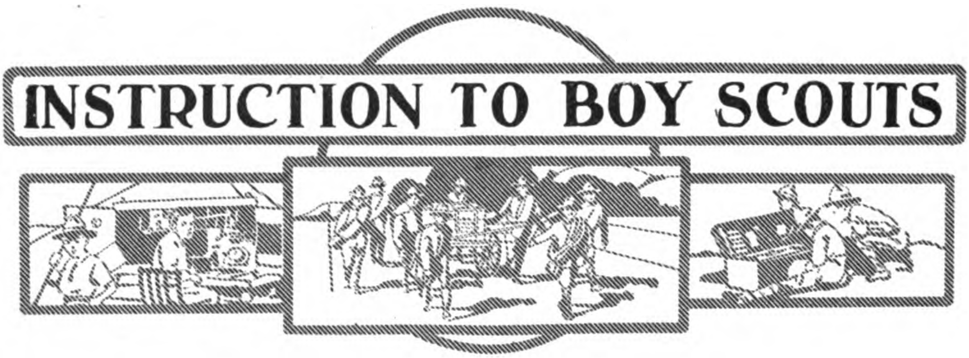
IN COMMUNICATION WITH PORT NELSON

A dispatch from Ottawa says that communication by wireless telegraphy has been established by the Canadian government with the Port Nelson terminus of the Hudson Bay Railway. The minister of railways received the following message from Chief Engineer McLachlan: "All well; comfortable, busy here."

TOWER FOR THE STUDY OF ATMOSPHERIC PHENOMENA

A dispatch from Brussels says:

In the presence of members of the International Commission on Wireless Telegraphy, the first metal section was erected close to the royal residence at Lacken recently of a huge tower intended to facilitate international scientific study of atmospheric and electrical phenomena. When completed it will be in the shape of a pylon, 333 metres (about 1,082 feet) high, 33 metres (about 108 feet) higher than the Eiffel tower.



By A. B. COLE

CHAPTER X

A Portable Transmitting Set

IN this set no helix or oscillation transformer is used, as better results for our purpose will be obtained without them and the size and weight of the set will be decreased by their omission. In at least one particular this set is unique; no aerial switch is required to change the aerial from the sending to the receiving set, or vice versa, for this arrangement permits more rapid operation and a smaller set than the old methods.

The one-inch spark coil previously described is employed to charge the aerial to high potential. The operator may build his own coil if he has the facilities, or may purchase it; in the latter event the apparatus in the portable case will have to be arranged in a slightly different manner. The present directions apply to the home-made coil which for this purpose should be made up without the containing case.

Carrying Case

In Fig. 57 are shown the dimensions of the portable carrying case of the set. It is made of wood ¼ inch thick and consists of a body and a cover. The cover is secured to the body by means of two hooks (H) and screws (B). The instrument case (A) is ½ inch thick and fits inside the body of the case so that ¼ inch projects above it, to hold the cover in place. Two straps (S) of brass or copper strip are bent so that a leather strap, with which the case may be carried, may pass through them and around the case.

Fig. 58 is a top view of the body of the case with instrument base (A) removed. It is divided into three main

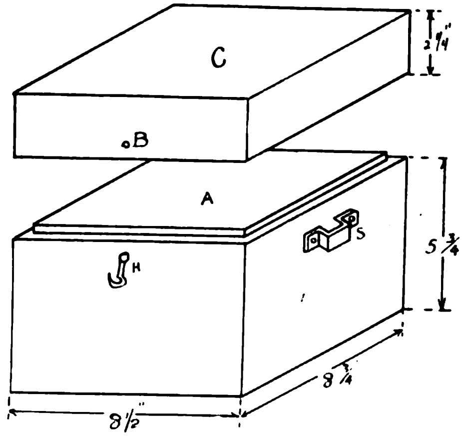


Fig. 57.—Carrying case

parts (D) (F) and (K) by wooden walls. Section (D) is to contain the sending condenser, and is 1½ inches wide. Section (F) is 2½ inches square and will contain the spark coil. Section (K) is ½ inch wide and will hold the primary condenser of the spark coil, and as this space is only 5½ inches long, this condenser will have to be shortened, which may be

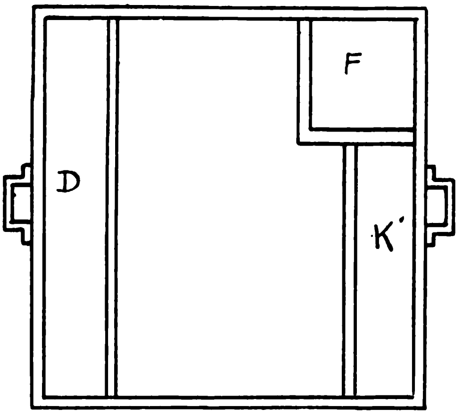


Fig. 58.—Top view of case

done without difficulty during its construction. These three parts are spaced so far apart in order to prevent any leakage of the high tension currents developed in the coil and sending condenser to the primary condenser.

Fig. 59 illustrates a top view of the instrument base (A) shown in Fig. 57, with the exposed parts of the set in place. The telegraph or small wireless key (E) should be purchased, as a good one cannot be made easily. The interrupter of the coil (I) is mounted back of the key and the end of the core of the spark coil passes through the instrument base, projecting ⅛ inch above its surface directly beneath the disk on the vibrator spring. Binding posts (B) (B) are the battery connections for operating the coil. Binding posts (A) and (G) connect to the aerial and ground respectively, and wires for the receiving set are taken from binding posts (R) and (T).

Spark and Anchor Gaps

The construction of spark gap (SM) and anchor gap (RT) is shown in Fig. 60. They are very simple and consist of two binding posts, known as the "double" type, having two holes through each. Through the upper holes pass zinc rods ⅛ inch in diameter and 1½ inches long. The ends of the rods are threaded to take the hard-rubber handles. In the anchor gap the inner ends of the rods are ground down to points, whereas those of the ends of the spark gap are left flat. The binding posts are set on the instrument base of the case and connections are made to them beneath the base.

Fig. 61 illustrates the method of placing the spark coil in section (F), Fig. 58, of the case. The upper end of the core fits exactly a hole in instrument base (A), and the lower end passes into a hole in a square block of wood (B). This end of the core is held also in place by means of a flat head wood screw passing through the bottom (D) of the carrying case and secured directly between the core wires, thereby preventing any side motion of the coil. The entire space around the coil is filled with hot paraffine after the necessary connections have been made, and this provides good insulation and holds the coil in place.

Sending Condenser

The sending, or high tension, condenser is made from glass photographic plates measuring 4 by 5 inches. Eleven plates are required for the purpose. The emulsion is first washed off in hot water, and after the plates are completely dry, the condenser may be assembled rapidly.

Ten sheets of tinfoil, each three inches wide by five and one half inches long, are

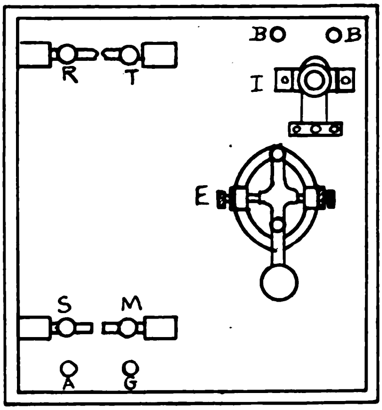


Fig. 59.—Case with instruments in place

used between the glass plates. One glass plate is coated with shellac and placed on a table, and one of the foil sheets is placed upon it, leaving a margin on each of the two longer sides of ½ inch, and on one shorter side of one inch, as shown in Fig. 62 (A).

Then another sheet of glass is coated with shellac and placed above the first, and a second sheet of foil is placed on this as shown in (B), Fig. 62, projecting from the glass at the opposite end. The third

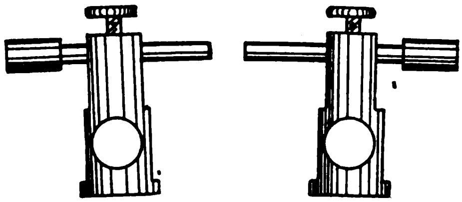


Fig. 60.—Spark and anchor gaps

glass sheet and foil are arranged the same as the first, the fourth the same as the second, and so on until eleven glass sheets and ten foil sheets are used, forming a pile.

When completed, the condenser will appear as in Fig. 63. All five projecting foil sheets at each end are rolled together and each of these two sets of five acts as a terminal of the condenser. The glass and foil sheets will be held together to some extent by the shellac between them, but the completed condenser should be bound together by several layers of insulating tape, placed as shown in Fig. 63. The tape will serve also to keep the glass plates out of contact with the containing case and will act as a cushion to prevent breakage of the glass when the case is carried about in actual service. Sufficient tape should be used to insure a close fit of the condenser into the section (D) of the containing case, Fig. 58.

Wiring the Set

All wiring inside the case of this set must be done with automobile cable of a quality between that known as "magneto cable" and that termed "high tension cable." "Primary" cable should not be used, as all the wires in the case are liable to be subjected to the high voltage of the secondary of the coil in case of accidental contact between them. Care should be taken to secure all the wires so that they will not be moved out of place by the shaking to which the set may be subjected. Especial caution should be observed in regard to preventing contact between the primary wires, which include the connections of the primary condenser, and the high tension wires of the spark coil or of the sending condenser.

The diagram, Fig. 64, shows the best method of wiring the instruments. In this diagram the letters refer to the same instruments and parts as in Fig. 59. The aerial and ground are to be connected to this set at the binding posts (A) and (G) respectively, and the aerial and ground connections for the receiving set lead from binding posts (R) and (T) respectively. The battery of five dry cells or three cells of storage battery is connected to posts (B) (B).

Battery Case

The batteries to operate the set are not placed inside its case because they are heavier than the balance of the outfit and should be carried by another member of the party, and because they require

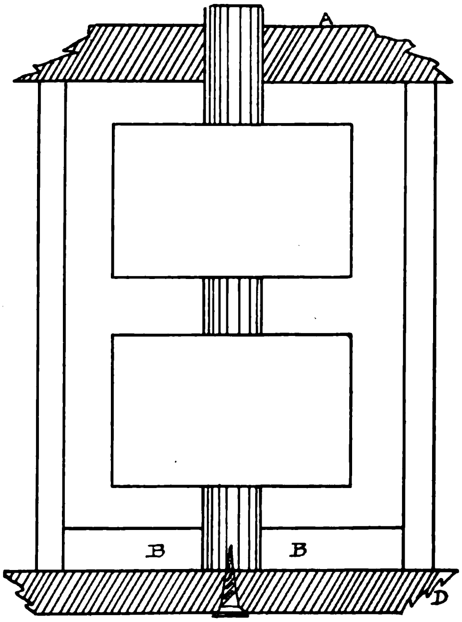


Fig. 61.—Spark coil in place

renewal from time to time. They should be contained in a separate case of any desired or convenient shape having two binding posts as battery terminals.

Operation of the Set

The aerial to be used in connection with portable sets will depend upon local conditions for its height, length and number of wires. It should be remembered that an aerial for transmitting purposes must be better insulated from the earth than one for receiving purposes only. It

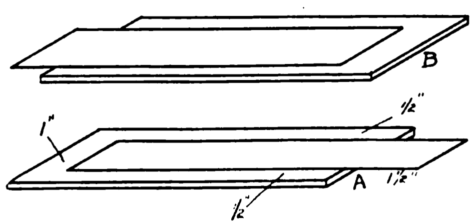


Fig. 62.—Condenser construction

is suggested that two or three porcelain cleats in series or composition insulators be employed. Only two or three insulators are necessary for an aerial.

The best kind of wire to use for this work is No. 20 Old Code lamp cord. This wire consists of two large strands, each composed of many strands of fine copper wire, with rubber insulation. This insulation must not be depended upon, however, for transmitting purposes. The lamp cord should be untwisted before use. It will be found to be very flexible, and will stand much wear.

Wherever a portable transmitting set is used, the operator should arrange to stand or sit upon some material which will insulate him from the earth, such as a dry board, for otherwise there is a possibility of receiving a shock, which although quite harmless, is not exactly pleasant.

In the transmitting set described in this chapter it is essential that the rods of the anchor gap be brought very close together, since this gap is in series with

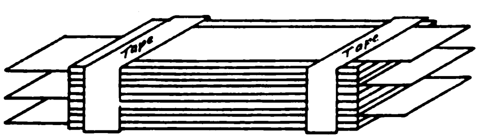


Fig. 63.—Completed condenser

the ground wire of the outfit, and consequently carries all the high tension currents, and because if the gap is too long a less amount of energy will be radiated by the aerial, due to the high resistance of this gap. Moreover, in this event, the voltage across the gap will be quite high and will injure the crystals in the detector, since the receiving set is connected to the gap terminals. The anchor gap should be adjusted to a separation equal to the thickness of an ordinary sheet of writing paper. If no space were left between the terminals, the receiving set would be short-circuited, and no signals could be received. The proper adjustment of the anchor gap is therefore of vital importance to the efficient operation of both the transmitting and the receiving sets.

The adjustment of the spark gap is also an important matter, and the most

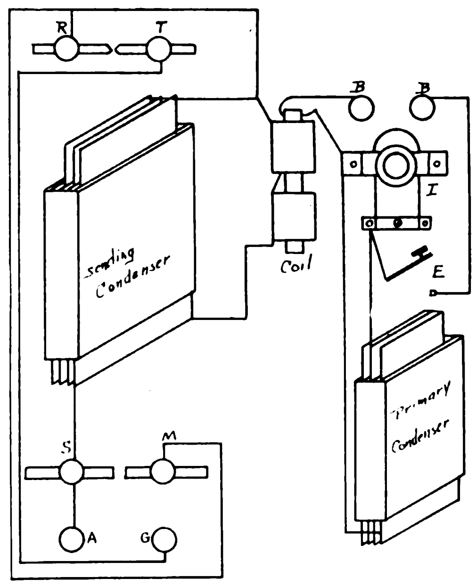


Fig. 64.—Wiring diagram

desirable spacing of the terminals will be found best by experiment. If the gap is adjusted to a point where the spark is of maximum length, the signals received at the distant station will not be clear, and if the gap is too short, the signals will have a "mushy" sound. A point will be found between these two where the spark will be of almost maximum diameter, and where best transmission will be obtained.

For the benefit of those of our readers who have as yet not mastered the code, we print herewith the characters of the continental code, which is almost universally used in wireless communication. This can be learned readily by the use of a small buzzer giving a high pitch, in connection with a telegraph key and a dry cell.

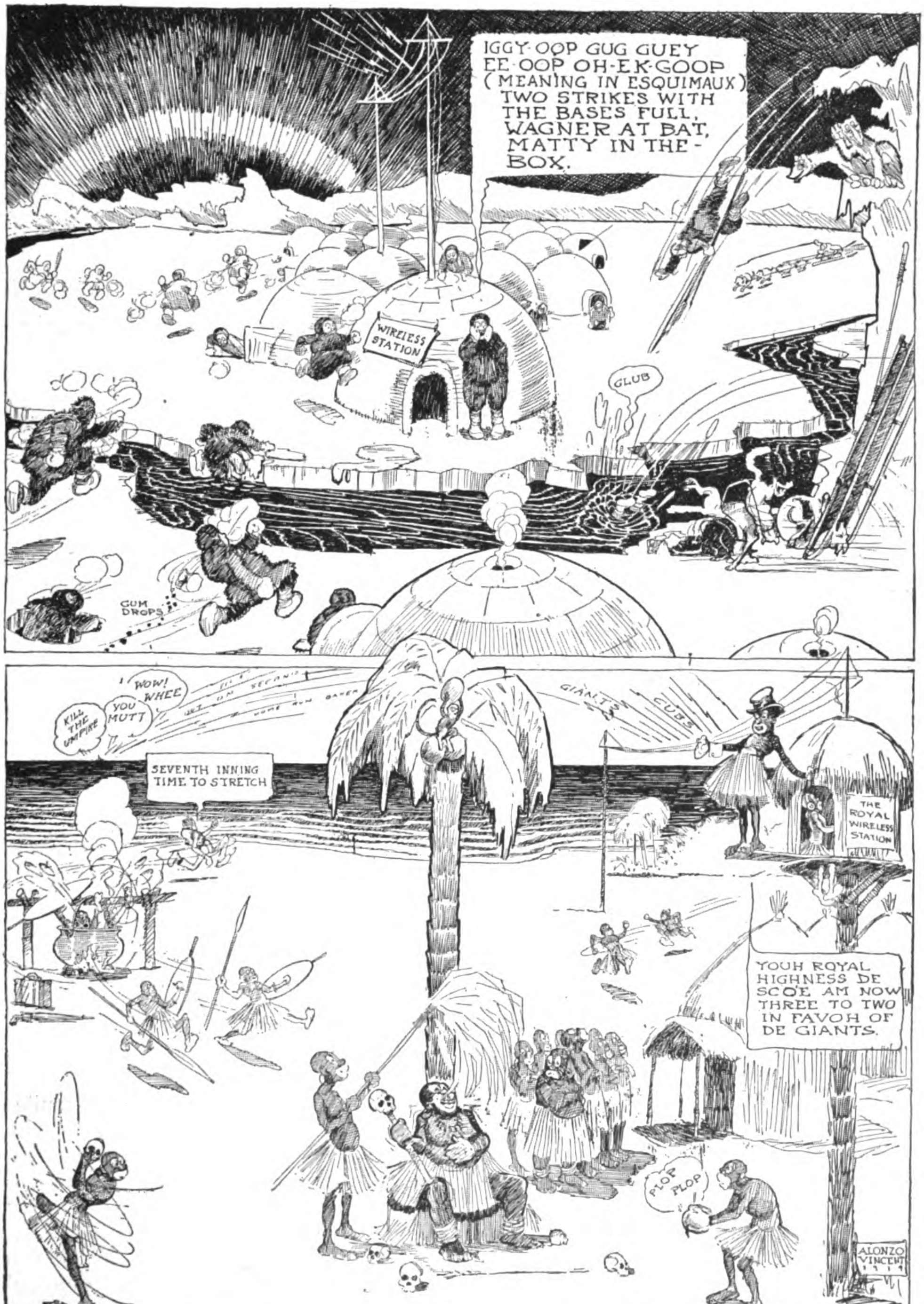
This is the seventh installment of Instruction to Boy Scouts. The eighth lesson by Mr. Cole will appear in an early issue.

WIRELESS CONTINENTAL TELEGRAPH ALPHABET

A	· —
B	— · · ·
C	— · — ·
D	— · ·
E	·
F	· · — ·
G	— — ·
H	· · · ·
I	· ·
J	· — — —
K	— · —
L	· — · ·
M	— —
N	— ·
O	— — —
P	· — — ·
Q	— — · —
R	· — ·
S	· · ·
T	—
U	· · —
V	· · · —
W	· — —
X	— · · —
Y	— · — —
Z	— — · ·
Wait	· — · · ·
Understand	· · · — ·
Don't Understand	— · · · · — ·
Period	· · · · · ·
Interrogation	· · — — · ·
Exclamation	— — · · — —
1	· — — — —
2	· · — — —
3	· · · — —
4	· · · · —
5	· · · · ·
6	— · · · ·
7	— — · · ·
8	— — — · ·
9	— — — — ·
0	— — — — —
Call	— · — · —
Finish	· — · — · or —

The Opening of the Season

Results observed following the Giants' world tour



The Protection of Land Line Telegraph Circuits in the Vicinity of Wireless Transmitting Stations

By DONALD McNICOL

RECENTLY the writer was called upon to provide and install protective devices for the land line telegraph circuits connected with the Telefunken wireless station at Sayville, L. I., and the Marconi station at Sea Gate, L. I. The purpose of this article is to describe the method of protection employed and to illustrate the devices and circuits as installed.

As is well known, all long-distance radio stations located along the sea coasts have direct land line connection with the large relay offices of the Western Union and Postal Telegraph Companies nearest at hand for the purpose of facilitating the delivery of wireless messages to and from the radio station.

In most cases the telegraph and telephone circuits leading to the wireless stations consist of metallic loops, to avoid the evident objection of an "earth" connection at the radio station. The land line instruments are generally located on the same table with the wireless apparatus, and within reach of the operator. This being the case, it is evident that in some cases troublesome electrostatic induction will take place between the wireless system and the land line circuits.

In some cases these disturbances are excessive, making it imperative that a path to ground be provided for the high-frequency surges superimposed upon the Morse circuits.

Fig. 1 illustrates the arrangement in use at Sayville on a Morse loop about 50 miles long. The line wires are shown attached to binding posts at the top of the regular fuse and air-gap lightning arrester block, while the leads to the Morse relay and key are shown connected to binding posts at the bottom of the block. The 10-ampere line fuses are shown; LA, are air-gap lightning arresters on each side of the line, and

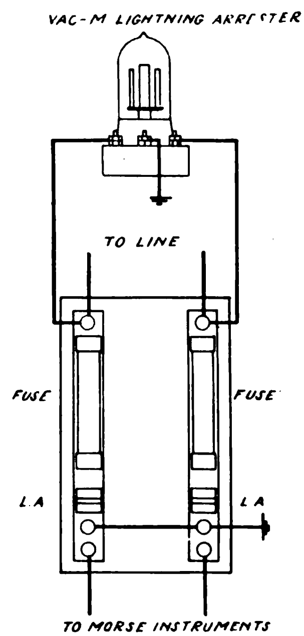


Fig. 1

VA is a vacuum lightning arrester consisting of three carbon blocks sealed in a glass globe—resembling an incandescent lamp bulb—the globes being exhausted to a fairly high degree of vacuum. It will be noted that each side of the line is connected to one of the outside carbons, while the center carbon block is earthed. This device provides a fairly constant and dependable drain for high-frequency surges from the Morse wires to ground. If, while the radio transmitter is in operation, the operating room is not brightly illuminated, the outgoing signals may be read in the vacuum-gap arrester, the signals appearing in the form of bright, bluish brush discharges between the line and ground carbon blocks.

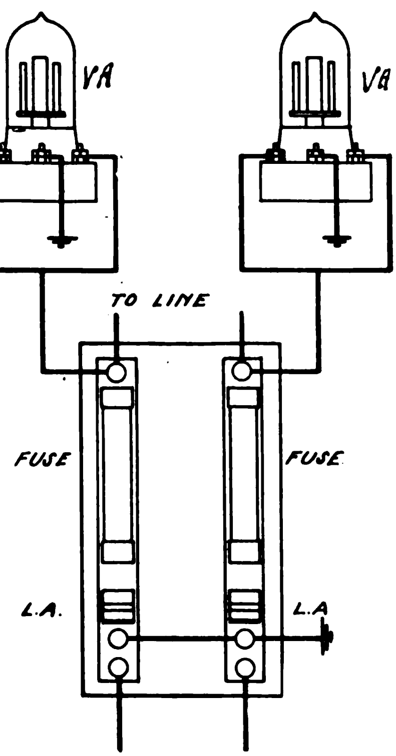


Fig. 2

Fig. 2 illustrates the arrangement employed at the Sea Gate station on Morse loop 20 miles in length. This is the same as the method previously described except that two vacuum-gap arresters are employed instead of one. The two outside carbons are strapped together and connected to one side of the line, while the center carbon in each case is grounded. This modification simply doubles the surface of the carbon block connected with the line wire, increasing the capacity of the arrester to that extent.

A telephone loop may be protected as shown in Fig. 3, using a standard telephone fuse and lightning arrester unit. From each side of the line a tap to ground is made through a low-capacity condenser, say, .004, or .005 microfarad each. When this method of protection is employed the discharges are dissipated and telephonic transmission is not impaired, either locally or over long distances.

Note.—This article should be of interest to those who desire to protect wire circuits which are exposed to electrostatic induction from high-voltage radio transmitters. It is generally found that such inductive troubles are not due to the nearness of the wire instruments to the wireless transmitting apparatus, but are caused by direct electrostatic induction from the sending stations' aerial to the exposed wire line. This points to the desirability of having the telegraph or telephone lines placed in conduits under ground at a distance of five or six hundred feet from the sending antenna. Such practice will completely eliminate inductive troubles without the use of arresters, as is readily understood. On account of the fact that antenna voltages with present-day transmitters are of considerably less value than those to be obtained with the earlier types, the adverse effects of electrostatic induction are not so noticeable. If, however, conditions are such that the necessary precautions cannot be taken, the use of devices as described by the author are imperative. The reference to the protection of telephone lines without disturbance to regular telephonic communication is of particular interest.
—*Technical Editor.*

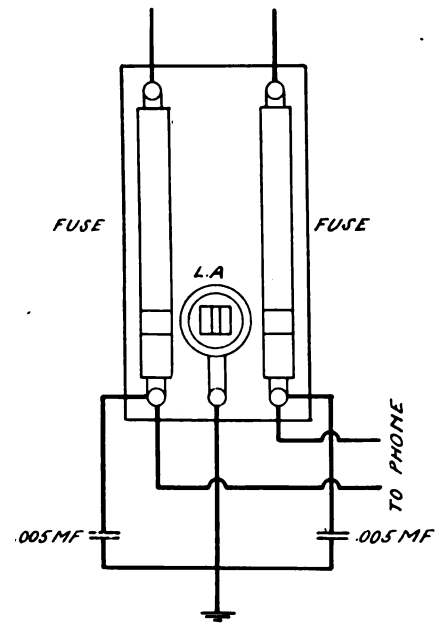


Fig. 3.

In the Morning's Mail

I have read many books and papers on wireless, but I find that THE WIRELESS AGE covers this subject most completely, both from the professional and amateur standpoint.

H. C. McD., *New York.*

* * *

Your numbers of THE WIRELESS AGE have been greatly enjoyed. They contain much valuable information which I have never been able to find in even the latest works on radio telegraphy. It, therefore, gives me great pleasure to renew my subscription to so worthy a publication.

E. J. B., *U. S. Navy.*

* * *

THE WIRELESS AGE is the *only real* wireless magazine worth reading, among a number of so-called wireless magazines.

W. B. D., *Rhode Island.*

* * *

I think it is the best publication on wireless at the present time.

A. R. R., *Connecticut.*

* * *

I cannot say too much in praise of THE WIRELESS AGE and its efficient work.

O. E. C., *Massachusetts.*

* * *

I beg to remain a constant reader and a booster for THE WIRELESS AGE.

C. E. S., *U. S. Army.*

* * *

As one of your subscribers, and a student of radio engineering, I wish to express my appreciation of the new magazine, and say that I consider it all that can be desired in its field.

D. T. S., *Minnesota.*

* * *

Your magazine is interesting from the first page to the last.

A. S., *New Jersey.*

I wish to express my heartiest appreciation for the new magazine you have brought before the wireless public. The need for a publication such as THE WIRELESS AGE has long been felt and I am sure every progressive wireless man welcomes its entrance into the wireless field. I had been under the impression that the various wireless magazines covered every phase of the wireless art which would be of interest to amateurs; and was agreeably surprised when I found such articles in your publication as "The Engineering Measurements of Radio Telegraphy" and "Elementary Engineering Mathematics."

THE WIRELESS AGE, in my opinion, is as near a perfect magazine as can be obtained.

H. L., *New York.*

* * *

For a long time it has been my intention to write, complimenting you on the various articles published in THE WIRELESS AGE. In my estimation it is one of the best magazines for amateurs and I have recommended it to my friends.

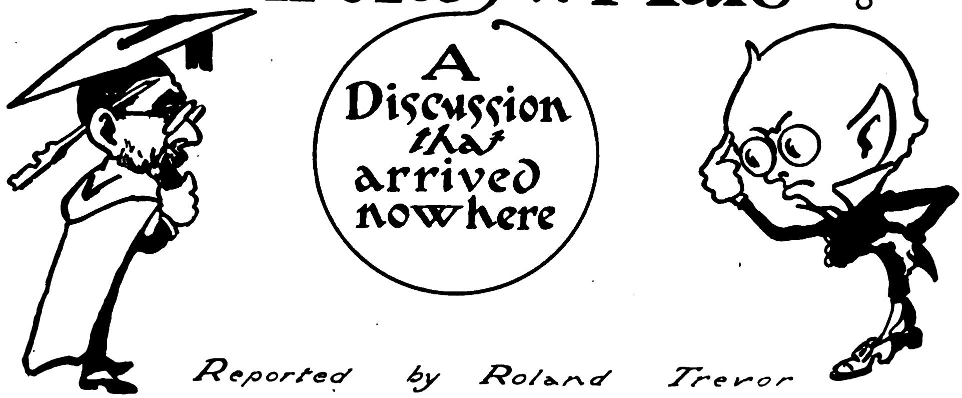
G. K., *New York.*

* * *

It sure is a sixty-one-seconds-to-a-minute magazine. For four years I have been looking for magazines which would thoroughly cover the wireless field. I think you have more than succeeded; I would not take a dollar apiece for my back numbers. I have been in the wireless game for five years and in all that time never saw anything as interesting as THE WIRELESS AGE. I wanted to quit high school in order to go to the Marconi school at San Francisco, but my folks said wait until June, when I graduate. I am anxious to get in the Marconi service. But "enuf is enuf"; hope to see your magazine unchanged for many years—I don't say better, because I hardly think it's possible to make it any better.

C. R., *California.*

? Wireless to Mars ?



WHEN the Layman blew three successive smoke rings, flicked the ashes from his thirty-five center and from the depths of the club's most comfortable morris chair languidly addressed him, the Engineer temporarily ceased his mental juggling of equations covering the week-day behavior of certain circuits, and affected an air of interest.

"Great thing, this wireless game you're mixed up in," the Layman was saying. "Railroads using it to transmit orders to moving trains, highbrows reconstructing laboratories so the world's time may be accurately determined, and all that sort of thing—no end of possibilities, eh, what?"

"Oh, yes," answered the Engineer, with a pitying glance. "Lots of stunts done every day, though, that beat these more practical applications a mile, so far as the spectacular element is concerned."

"Which is practically an admission that wireless has its limitations?" queried the irrepressible Layman.

"Uh-huh, something like that."

"What are these limitations?"

"Financial, mainly," came the grunted response.

"You mean lack of funds to carry on the work?" persisted the assiduous seeker.

"No; financial conscience. Most of us are built so that we cannot reconcile ourselves to burning up some one else's coin chasing a radio rainbow—you know, all those cute little capers the papers like to report; about as useful, even if true, as an automatic hat-tipper for a Broadway masher."

"You mean, then . . ."

"That all these unknown but alleged scientists, with their discoveries that are to immediately 'revolutionize' wireless communication, seldom have anything that the Board of Directors would recommend purchasing."

"Then wireless is not so very wonderful an industry after all; it's really just a phlegmatic telegraph business."

"In the last analysis, yes. And that is the great trouble. Those who don't look at it from a cold dollar-and-cents basis often get excited over something that is all right in its way, but doesn't bring any ducats over the message counter. But you are wrong in thinking that wireless is not wonderful. Regardless of the fact that dividends are the objective point, you can't get around the basic wonder of telegraphic transmission without wires. Take the new Marconi trans-oceanic stations, for instance: New York to London direct, San Francisco to Honolulu, and so on, for that's what it amounts

"They inquire our attitude on the recognition of the Huerta government in Mexico, and we reply '23'"

to; nothing very ordinary about that! You'd understand better if you had listened to a message winging its way through space, thousands of miles——"

"Whew! Thousands of miles, eh? Why, next they'll be communicating with Mars, and——"

"There you go again," interrupted the Engineer wearily. "Now, what in Creation's name would be the sense of working up a conversational medium with the Martians? To get the new midsummer styles for the ladies? Or perhaps a few points on——"

"But the scientific fellows——"

"Never *have* any money. Of course it is possible they might raise some, but the best that could be expected would be a more or less useless lot of astronomical data and unintelligible lingo, even if success followed the expenditure of 'steen millions of good dollars. No; it will do us all more good if the real money of this sphere we are living on is applied to tying up the commercial activities of its own inhabitants."

"There can be no question but that you are right," agreed the Layman. "But don't you think this communication thing with Mars will soon be attempted?"

"Somebody has been telling you that, I suppose," yawned the Engineer.

"Saw it in the paper," responded the other. "Some fellow out in Ohio, one of those scientific chaps, mixed up with aviation, I believe, gave out an interview in which he outlined plans to establish communication with this earth's neighbor. Sounded really quite feasible——"

"Yes, they all do," announced the patient listener. "This is about the four-hundred-and-ninety-second announcement of the kind. Did he say just when he was going to pull off the great experiment? No? How surprising! He must indeed be a nonentity—nearly all the others gave out a date, somewhere in the near future usually. Made their announcement sound so much more sincere—self-confidence, and all that sort of thing, you know."

"Then this aviation person, in your belief, does not even intend to carry out his experiments?"

"He may. There are two kinds of people you never can depend upon: fools and notoriety seekers. This fellow may try to break his neck. But I doubt it."

The Engineer here indicated his slight concern with the outcome by an ill-concealed yawn.

"It's funny how the public falls for that stuff regularly," he resumed a minute later. "Outside of a deplorable lack of scientific knowledge of any description you, for example, are a well-balanced being. Yet you have swallowed this fabrication, hook, line and sinker. And, though you probably don't realize it, you have accepted somewhat similar statements seriously in the past. And you are not the exception. Most laymen will believe nearly anything about science if the yarn is spun with an air of sincerity. It's an old axiom, but a true one, that the public has no memory. This latest version of the communication with Mars thing I dare say—and I haven't seen the article—follows along the lines of great Naughty Nine project that stirred up the whole country for a time. It was the classic; the others all more or less weak imitations."

"Tell me about it," encouraged the Layman.

"It is a long yarn, and not worth the telling; but, briefly, the ball was started rolling by a well-known aeronaut—they hadn't commenced calling them aviators then—and appeared first in the form of an interview in a New York daily. The aeronaut, a prominent and popular figure, announced that in conjunction with a well-known University scientist he had completed plans for a voyage to the edge of the world's atmosphere in a mammoth balloon, equipped with special wireless apparatus that would set up communication with Mars.

"The newspapers played the thing up big and the aeronaut was clever enough to withhold all details of the equipment until public interest had reached white heat. Then one morning, about this time of the year, he announced: 'We will be talking to the people of Mars before the 15th of next September!' The universe gasped. Two or three days later a description of the equipment leaked (?) out. The daring scheme necessitated most remarkable paraphernalia, including two hermetically-sealed glass-fronted aluminum cases, with tanks of oxygen attached for breathing, speaking tubes connecting one tank with the other, a powerful wireless set with ten miles of wire trailing down to the earth and all manner of navigating instruments. According to the prominent aeronaut the professor would occupy one case and himself the other, resorting to the oxygen tanks at a height of five or six miles. At the edge of this world's atmosphere the wireless was to pick up messages from Mars and the ten miles of ground wire would carry them straight to the earth, there to be recorded. Great scheme that, when dressed up with all the details." The Engineer smiled.

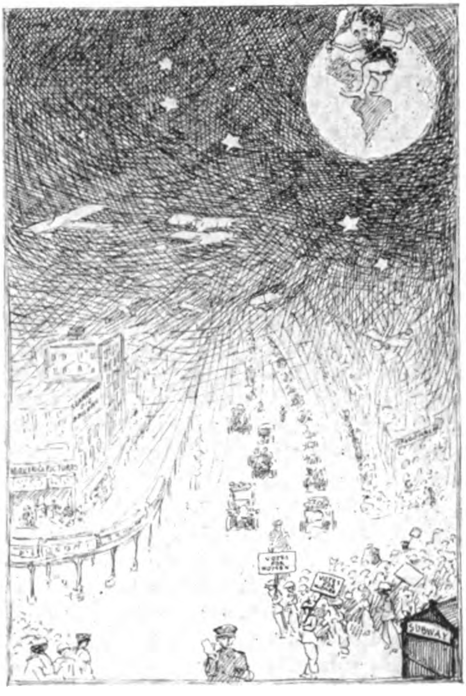
"But the result?" asked the Layman.

"The usual one—the public had no memory. The scheme was kept alive up to the middle of August, then tailed off until it was completely forgotten when the 15th of September, the date set for the experiment, rolled around." The Engineer lit a fresh cigar, announcing between puffs: "Thus endeth the Naughty Nine lesson—called that, because it happened in 1909. Nothing has been heard of it since."

"Even so," persisted the Layman, "you haven't said that the feat is an impossibility."

"My dear sir," answered the Engineer, "we do not recognize the impossible in wireless. The impractical, yes; the worthless, yes—but the fancies of to-day are the facts of to-morrow."

"Which observation is perfectly justified," agreed the other. "Anyone who would have suggested fifty years ago that we would be communicating without



"These Mars fellows are supposed to have had an up-to-date civilization centuries before we shed our skin clothes"

wires between points even fifty miles apart would have been hung as a believer in witchcraft. Now, why shouldn't an apparatus be devised by which Mars could be connected by wireless?"

"Or might we not invent something in the way of a talkless mother-in-law, a boreless popular magazine, or something really useful?" innocently inquired the Engineer.

"Merely another indication that your mind thinks in kilowatts," returned the persistent Layman. "The scientific formula is the epitaph on the grave of progress. You fellows bury your imagination under a mass of skepticism and—"

"Your type of man sticks his head out of the window looking for the Millennium every time a huckster toots his horn."

"No, no; here is the point," said the Layman impatiently. "Only a few years ago Marconi sent a single wireless impulse but a few hundred feet; now he is sending countless messages every hour through thousands of miles of space; increase that range to millions of miles and there you are—in touch with Mars! To quote you: 'the fancies of to-day are the facts of to-morrow;' then all that is necessary is for some worthy plutocrat to put up the cash."

How sublimely convincing was Newton's discovery of the law of gravitation. Had it been the hired man he would have only contaminated the atmosphere with cuss words

"And if the Martians don't get the message or don't know how to reply, what becomes of the ten million and what good does it do?" asked the Engineer.

The Layman glared his impatience. "One has to take a chance on everything in this world," he snapped, "or out of it, for that matter. Statistics show us that $12,000,000 were gambled away in one metropolitan city in a single year. If it costs the shaving public that much in twelve months to indulge in a little recreation, what need we care about a smaller sum to put us into communication with our sister sphere of the solar system? Just think of the ideas we'd get on almost every subject from those Martian chaps!"

"On how to build canals, I suppose," superciliously volunteered the Engineer. "Why not save time and ask Colonel Goethals?"

"Canals are not everything," replied the Layman irritably, "we might learn from them—"

"How to run ours," interjected the Engineer, who had heard of the Hay-Pauncefote treaty.

"No sense of argument," muttered the Layman. "Stick to the subject in hand; these Mars fellows are supposed to have had an up-to-date civilization centuries before we shed our skin clothes, and just so soon as we establish communication with the Martian national bureau of information we can learn the latest wrinkles in all the vexatious problems now confronting us."

"Said information being supplied in Esperanto, I take it," returned the Engineer, "always considering the danger that Mars may have developed simplified conversation to such an extent as to place it beyond our grasp. Let's see . . . we, for example, wireless the Esperantan equivalent for 'What is the nature of your protective tariff on messaline and swiss cheese?' and the operator in Mars' capital answers 'X-Y-Ż,' which in the highly simplified code, would represent seven volumes of the congressional record in Martianese, which might take us 7,000 years to translate. Or they inquire our attitude on the recognition of the Huerta government in Mexico, and we reply '23;' they might construe this simple answer as a detailed history of American independence from July 4, 1776, to the end of the Standard Oil dynasty."

"Irreverent flippancy, which proves nothing," growled the Layman. "Of course it is going to be a hard problem to get together, no matter how careful we might be, but doubtless the proper kind of scientist," with a baleful glance at the Engineer, "the proper kind of scientist would figure out each move in the game with the formulated logic of science. Despite the mercenary croakers, science is a wonderful thing. What we need is another Newton. How simple, yet how sublimely convincing, was his discovery of the law of gravitation! One day while walking in an orchard—bing! an apple landed on his head. Did Sir Isaac stop to contaminate the atmosphere with cuss words and scout the idea of objects still continuing to fall? Not a bit of it! He looked at the apple, saying to himself, 'apples do not grow on the ground. This must have fallen from a tree. What caused it to fall? Some mysterious force of nature. The problem is a grave one—' "

"Therefore, I will call it the law of gravitation," interposed the Engineer blandly.

"So the difficulties are not insurmountable," continued the unperturbed Layman, "people had always known that heavy bodies took a downward course when released, but a jolt on the pate of a thoughtful man pointed the way to solving the problem, where otherwise it would only have led to a string of profan—"

"As in the case, had it been the hired man who was bumped on the bean with the apple while walking in the orchard, he would have said 'Damn!' and we would have had the law of damnation!"

"Bah!" exclaimed the Layman, wrathfully, "I referred to the Newton episode merely to illustrate the working of the genuinely scientific mind. A serious man working on the problem of wireless to Mars would reason like this: The planet is very far away. What is lacking to establish intercourse between the world and Mars? Communication, of course. There must be a method of extending present wireless communication. The rest is trite—just as was the minutiæ of what made the apple fall. It is merely a matter of working out detail and—"

"Wasting a lot of money that would better be applied to linking up things on this earth!"

An 8,000 Miles' Communication

Another wireless record has been made. The Marconi station on the Filene building in Boston, Mass., has recently been in communication with a vessel nearly 8,000 miles away, or almost one-third the way around the world from Boston.

The operator who was sending when this record was made is Harry R. Cheetham. Amid a number of other signals, he said, he received a signal from the Pacific mail steamer Mongolia. Answering this signal he got into immediate communication and for several minutes he "talked" to the operator on board the Mongolia. In the course of the "conversation" he learned that the Mongolia was then 200 miles east of Nagasaki, Japan.

That this feat was performed at the Boston station is all the more amazing when it is realized that the range of the Filene installation is guaranteed for only 300 miles. According to people who understand wireless, though, the performance was a "freak." That is, conditions were just right, and there was an element of luck. "If the station tried to get that distance again," said a wireless authority, "they could not do it. But, still they might."

This same station recently was in communication with the steamship Carrillo every night of her round trip to Colon, including the nights she stayed at Colon, which is 2,300 miles away.

Records of this sort are becoming more common every year. The condition which allows them is not wholly one of the atmosphere, but may be accounted for by constant improvements in transmitting and receiving apparatus, which establish new standards of efficiency.

It is a known fact that conditions on the Pacific Ocean are especially conducive to long-distance wireless transmission. Given distances may be covered with much less power than it is necessary to use on the Atlantic coast.

The New England coast, however, is notoriously detrimental to the transmission of wireless telegraph signals, this condition being attributed to the underlying rocky soil. In view of this fact the news of the 8,000 miles' record will cause no little interest.

Records of this nature are made at night time only. For daylight work over long distances, very high-power stations, similar to those now being erected by the Marconi Company in the United States, are required.

Comment and Criticism

THE auto-transformer, described in the January issue of THE WIRELESS AGE as used in connection with the audion amplifier, has induced much criticism and inquiry from amateurs. While the data given in the article was brief, still, in connection with the accompanying diagrams, it should have been quite sufficient to allow immediate construction.

Apparently the function of this transformer is to act as a temporary storage for the energy from the high voltage battery in the telephone circuit of the first audion. The variations of current through this transformer winding produce magnetic lines of force which cut the turns of the coil, setting up an electromotive force which is applied to the filament and grid of the second audion. Here the intensity of the current is again increased by the "trigger" action of audion No. 2.

Amateurs should know that all audions do not possess the same characteristics of adjustment and therefore specific directions for working can not be given. A little experience will enable the experimenter to overcome such variations without difficulty.

The data given for the constants of the auto-transformer (in the January issue) should not be considered as final. It is simply a record of the actual values used in the certain experiments in which very good results were obtained.

Later tests have indicated that the design of the windings in core of the transformer may vary over a wide range, and efficient results will be obtained as long as corresponding changes of voltage are made at the filament or at the high voltage battery. When the resistance of the winding of the auto-transformer is inserted in series with the local battery circuit, it is generally necessary to increase the number of cells in that circuit. The voltage of the filament battery is then decreased in value. This statement, however, may not apply in all cases.

It is not absolutely necessary to go to the expense of especially constructing a transformer for this purpose. The secondary windings of induction coils, of open or core power transformers, like those found in the average amateur's station, may be used. It is not even necessary to use an inductance having an iron core, provided the windings are made sufficiently large to give an equal number of magnetic lines of force.

Again this transformer need not be of the auto type. An inductively-coupled transformer may be employed but better results are generally obtained with the single coil transformer.

One of our readers writes:

> I noticed the statement is made that some times 60 volts are required at the high voltage battery. I have made many tests of audions, and I have never found a single bulb requiring such a voltage, although I am aware that the actual voltage necessary will depend on the degree of vacuum.

Experiments do not bear out the first part of this assertion. While the average bulb requires from 30 to 35 volts, many which have been highly exhausted require considerably higher values of voltage and it has been our experience that such bulbs produce the best signals. It is interesting to know that the degree of vacuum may be altered by holding a small alcohol flame close to the bulb. Try it.

* * *

Another reader objects to the winding of the receiving tuners, also described in the January issue. He states that he has tried windings of all types and sizes, but he invariably finds that while the coarse wire tuners are theoretically correct they do not give the best results. He therefore favors the finer winding.

We agree with him in the case of strictly potentially-operated detectors such as the audion or those of crystalline structure. For maximum signals it is best to so design the receiving circuits that the maximum voltage will be produced at the terminals of the detector. We further advise that upon investigation the writer of the series on How to Conduct a Radio Club, found that the secondary winding of his tuners, which he supposed was No. 28 wire, was actually No. 30.

Our experience has been that if a tuner is to be used in connection with the audion only, the secondary winding of the receiving tuner may be made of wire as small as No. 36. If wire of this size is used, it will be found that the tuning coils described in the January issue may be considerably decreased in length for the given range of wave-lengths.

If the receiving tuner is to be used in connection with crystal detectors we prefer secondary windings in the neighborhood of No. 28 or No. 30 S.S.C. In the case of the crystal detector the resistance of No. 36 wire affords too much resistance, causing undesirable energy losses and very broad tuning.

The data for the windings given in the January issue are suitable for both the crystal and audion detectors. It should not be forgotten that as the size of the wire decreases the value of resistance increases, and therefore the desired gain of potential through the use of small wire may be absent.

The finer wound secondary *do* possess an advantage in the case of potentially-operated detectors, because the value of distributed capacity for a given wave-length is at a minimum. Therefore, a higher voltage is available for the detector.

Our critic says:

I once had the idea that the larger the wire I wound on a tuner the better for everything concerned. Theoretically, this is quite true, so I commenced making tuners. I even went so far as to construct a special stranding machine which would make an evenly wound cable of a large number of strands of insulated wire. The wires of the strand, you understand, were insulated from each other. I made a couple of tuners with this kind of cable, which you will recognize as being similar to that employed by the Telefunken Company. I secured results, but they were no better after careful tests than those from any other "coupler" wound with finer wire. Then I wound a primary coil with No. 17 S.S.C. wire, the secondary with No. 23 S.S.C. wire.

I secured certain results on the shorter waves, but I did not think much of the working of the tuner, so I took it apart and wound it again. For the primary winding, this time, I used No. 24 S.S.C., for the secondary winding I used No. 32 D.C.C. I used no sliders at all, tap-offs being taken to switches and contacts of the latest design. I also used the interpolating system of connection.

I was certainly surprised at the results. The signals seemed to be much louder. I found I could use the coil over a range extending from the shorter wave-lengths up to the very longest, with no trouble. The peculiar part of it is that this coil seemed to give much louder signals than the tuner first described even on the shorter waves.

* * *

Another of our readers had made note of the argument in our columns concerning the relative merits of the long and short aerials. He describes a series of experiments with freakish aerials in the form of triangles and rectangles. Since aerials of this type are not to be compared with that described by Mr. Dreher, publication of the details has been omitted. The communication, however, indicates that the writer has conducted a series of serious experiments. Apparently he finds that freakish aerials, when abnormally large, possess characteristics similar to those of any long aerial.

He declares that long aerials are productive of unnecessary interference and if they possess a considerable value of resistance, long distance working can not be expected. He finds that aerials of this type are quite responsive to plain aerial spark transmitters, but tuning is out of the question. He says:

From these and observations of numerous other aerials I draw the following conclusion:

For wireless waves of all kinds and particularly for the now common slightly damped waves, it is preferable for the prevention of interference, both local and distant, to use an aerial having a low value of resistance. Such aerials are conducive to the reception of the maximum strength of signals.

If the length be increased, keeping the resistance unaltered, the range is increased, especially for long wave-lengths. But at the same time three other effects are increased; the directiona effect, static, and the interference from loca sources. The latter is probably due to forced oscillations. To construct an aerial having a low value of resistance is an expensive and often impossible job, thus making the interference a still worse proposition.

To bear out the foregoing I might mention that a tin roof of low resistance, some 25 feet square, even with its leakage has always been my stand-by as an aerial. It is good for 500 miles in dry weather. Furthermore, an aerial about 60 feet in length, consisting of 8 wires, having a spread of 8 feet, and height of 25 feet, brings in NAR (Key West) loud enough to be read through static any night.

If any one advocates the use, for year-around work, near to other stations, of a long (not large) aerial, he will have to show me an extraordinarily well behaved specimen, and not any I have ever seen in an amateur's station.

Much interest has been created by the article appearing in the Jahrbuch der Drahtlosen Telegraphie, Vol. 7, page 75, describing some experiments made by the author with various elevated conductors or capacities as a substitute for the ordinary used aerial wires.

The author reminds us of the fact that when near to very high power stations, it is only necessary to stretch out a pair of cords connected to a 2,000-ohm telephone receiver, in a horizontal position to read the signals. We advise that the signals so received are produced by electrostatic induction and not Hertzian radiation.

He says that for ranges of, say, 50 miles a metal rod of any kind may be used such as a leader pipe or fire-escape ladder. The gas-pipes of a house may also be used as an aerial and the earth connection made to the water system.

He declares that up to distances of 150 miles an aerial may be erected indoors. He has even tried rectangular clothes driers so common to the roofs of many apartment houses in New York. Again, a lightning rod fastened to a brick chimney responded very well. When smoke belched forth from the chimney the signals became considerably louder. He believes the smoke was conducive to electrical oscillations and therefore had the effect of lengthening the aerial. He also describes other arrangements which were employed. Practically every test which the author writes of was performed in the United States some years ago. Tests were made in this country eight years ago on telephone lines, very satisfactory results being obtained. It was observed that these experiments could be carried on without interfering with telephone conversation, provided the radio-receiving apparatus was connected to earth through a condenser of small capacity, say, .001 mfd.

Messages were received in this manner several hundred miles overland. Tin roofs on apartment houses were next tried and it was found that they acted in some cases with great efficiency and on the shorter wave-lengths it made no difference whether the roof was grounded or not. In one case where the house had a copper rain gutter of exceptional capacity, signals could be received up to a distance of 1,600 miles. The capacity of this roof was found to be .025 mfd. and the natural wave-length 550 meters. When the roof was grounded the aerial simply acted after the manner of the well known loop, formerly employed by the American DeForrest Company. In this system one leg of the aerial, when receiving the shorter wave-lengths, was invariably directly connected to the earth.

The action of fire-escapes in this respect was observed 6 years ago. In one particular case it was possible to copy signals at a distance of 500 miles. The apparatus was connected to the high end of the fire escape and earthed to the steam pipes.

Indoor aerials have been in quite common use among amateur experimenters for a number of years, particularly in New York and its vicinity. In fact for amateur communication in the average city it is not at all necessary to erect outdoor aerials only in cases when exceptional distances are to be covered.

Water tanks have been used and it makes no difference if the tank is earthed or not. If a wire is connected to the tank about half way up or, better still, to the top, signals may be received at considerable distances.

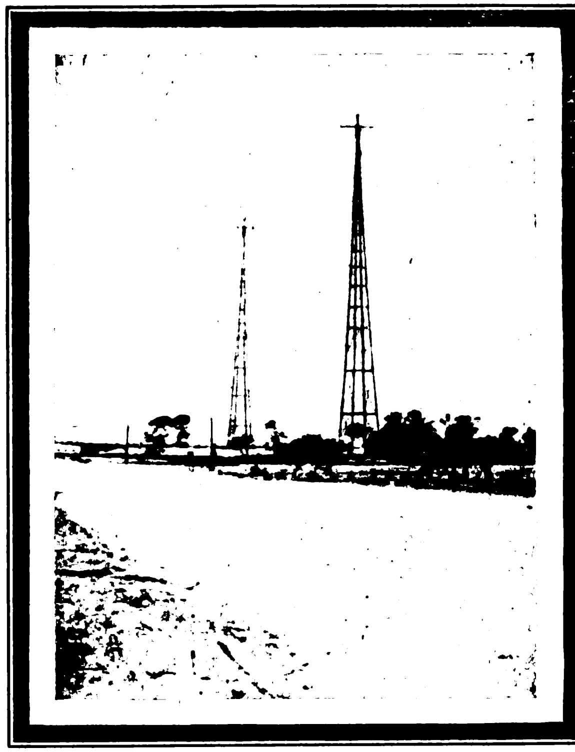
Any tree may be used for receiving from ten to fifteen miles. A nail is driven in the tree about 15 feet from the base and a wire is led to the receiving apparatus. The sap is sufficiently conductive for electrical oscillations to allow energy to be tapped off to the detector circuits. It is best that the nail be driven in a branch at some distance from the earth.

With a sensitive audion amplifier the time signals may be copied from Arlington at a distance of 200 miles with 200 feet of bell wire coiled up in the room. It has been found in some cases that the energy so received was really reradiated energy from the water pipes in the house and unless the bell wire bore a certain position to the water pipes the signals would disappear. It sometimes has been found to be of considerable advantage to string a receiving aerial parallel to telephone wires. An increase of signals was effected on account of the reradiated energy from the phone wires.

When employing telephone wires as an aerial up to 15 miles in length, it is

(Continued on page 685.)

The New Station at Miami



The towers from the land side

MIAMI, called "the magic city," because of its rapid growth, has gained added fame through the establishment there of a Marconi wireless station. This new link in radio communication has taken a place among the important commercial wireless stations in the United States. The growing demands of commerce necessitated the erection of the Miami station, which will fill the gap in the long stretch between those at Jacksonville and Key West.

The new station is located in a community which is filled with bustle and life. In July, 1896, Miami was incorporated as a city with 300 registered voters, as required by the laws of Florida. Afterward several adjacent settlements were taken in and the total population now numbers about twelve thousand. In the city, which is at the mouth of the Miami River, may be found many handsome buildings built of Miami rock, and well paved streets.

In the country districts not far from Miami is a wealth of tropical foliage. Cocoanut, magnolia, palmetto and flowering trees dot the landscape, and thousands of acres are devoted to the cultivation of pineapples, oranges and grapefruit. The Marconi employees at the station will find no lack of recreation, for fishing ranks high among the sports and those fond of hunting will have an opportunity to follow this pastime.

There are also many points of interest near Miami, among them being Cape Florida, Fowey Rocks Light, Florida Keys, Norris Cut and the Miami Rapids. William Jennings Bryan and other well known men make their winter homes in the city.

Work on the new station was commenced several months ago and progressed rapidly. Previous to that time Frederick W. Sammis, chief engineer of the Marconi Wireless Telegraph Company of America, visited Miami, secured the site and made arrangements for the construction of the buildings. There are two towers of the self-supporting type which are located close to the ocean. A 5-kilowatt set has been installed. A comfortable cottage containing a living room, dining room, kitchen and three bed rooms has been built close to a small lake. This structure is the home of the operating staff.

In addition to breaking up the stretch between Jacksonville and Key West, which will considerably facilitate the handling of messages, the new station will control much of the business which now passes through the government station at the latter point. A connection will be made between Nassau and the Miami station, it is expected, to supplement the ship to shore business.

The pavilion adjoining the station buildings

AUSTRALIAN STATIONS PLANNED

Residents of Casterton and Strathdownie, in Victoria, Australia, expect to be able to communicate by wireless telegraphy in a short time. The commonwealth postmaster-general has issued instructions for the stations to be erected as rapidly as possible as he is anxious to have a practical test of the efficiency of the system before establishing it between other centers.

DOMINICAN GOVERNMENT OPERATES A STATION

Apparatus has been ordered from the United States for the installation of a wireless station at San Pedro de Macoris, to be operated in connection with the wireless stations at Santo Domingo and La Romana. The wireless service is operated by the Dominican government, and wireless messages are now being accepted for Europe and the United States, the latter being sent via La Romana to Guanica, Porto Rico and thence to San Juan, Porto Rico.

FIXING THE LONGITUDES IN THE WILDS

Word has been received in London that Commander Herbert A. Edwards, who was loaned by the British government to command the Bolivian Survey Commission, has once more reached a point of civilization after a journey of many miles in the wilds. The members of this expedition fixed all of their longitudes through time signals sent by wireless telegraphy from the Marconi station at Porto Velho, located 120 miles from the base of operations. Commander Edwards carried with him a receiving set and a long wire which was rigged up on trees.

INSTALLATION IN DUKE'S CASTLE

A dispatch from Berlin says that Duke Ernst II, of Saxe-Altenburg, the greatest lover of science among German princes, is about to have a wireless installation fitted at his castle in Altenburg. It will be used specially for communicating with airships. The Duke has long taken an interest in wireless telegraphy and telephony.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

An Amateur's Receiving Tuner

After considerable experimenting with various types of receiving tuners, I have recently constructed one in which fixed values of inductance are used in the antenna circuit for obtaining certain wave length adjustments. I have found this tuner more desirable than any of the ordinary amateur type, where only a portion of the turns are in actual use. It is a well-known fact that if the natural wave length of a tuning coil is about the same as the wave-length of the antenna circuit, plus the number of turns of the coil included in that circuit, considerable energy will be lost on account of the dead-end effect. It is apparent that it would be better if possible to avoid this waste of energy by a special design of the receiving tuner.

The effect of dead-ends on a tuning coil is not equally disastrous in all cases. It is only when the coil having dead ends and the aerial circuit are in approximate

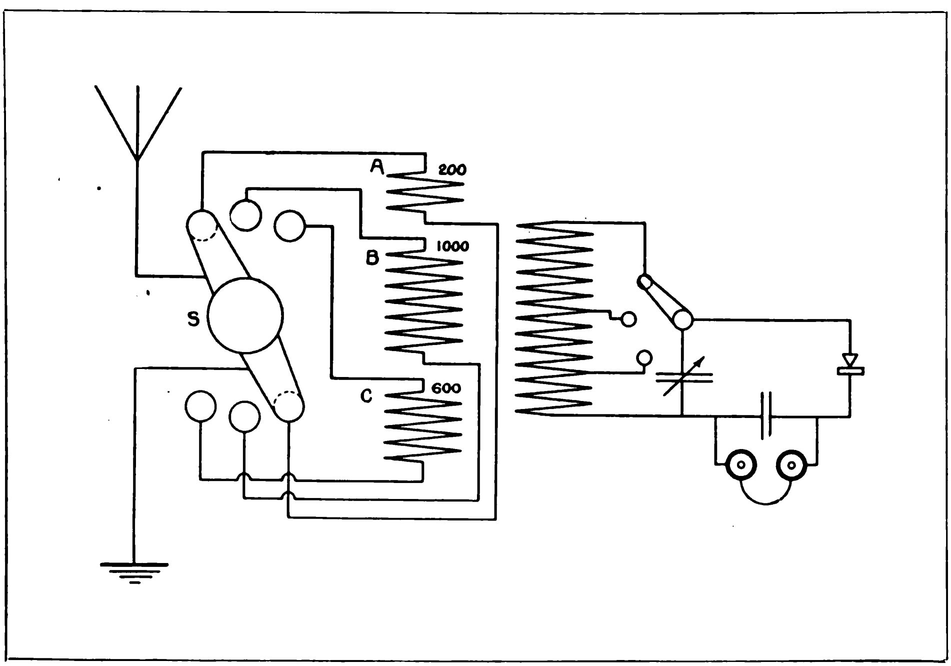


Fig. 1, First Prize Article

resonance that energy losses may be expected. Still, there are some losses under all conditions, and it is therefore better to avoid such construction.

A schematic diagram of the receiving tuner I have designed to overcome dead-end losses, is shown in Fig. 1. It will be observed that the primary winding consists of three coils A, B and C. These coils are thrown in series with the antenna circuit independently of each other by means of the switch S. The coils contain values of inductance so that when A is thrown into the circuit the antenna is adjusted to 200 meters; when B is thrown into the circuit the antenna is adjusted to 1,000 meters; when C is in the circuit the antenna is adjusted to 600 meters. The coils A, B and C are actually separated on the winding tube by about 3/8 of an inch. It is evident, then, that my design practically overcomes the losses due to dead-ends, for I insert just sufficient inductance in the antenna circuit to give me the wave-length adjustment desired.

The actual values of inductance of coils A, B and C may be determined by experiment or by calculation. The average amateur may find it easier to first wind up coils on a tube of the same size to be used in the actual tuner; thus a little experimenting will enable him to adjust his antenna circuit to some amateur station which he knows is sending on a 200-meter wave-length. In the same manner coils suitable for 600 and 1,000-meter wave-lengths may be constructed.

I find that in the case of the 600-meter wave, which is used by all commercial stations, it is best to adjust the antenna circuit for a wave-length of, say, 580 meters, because it must be remembered that some of these stations radiate wave-lengths below and above 600 meters.

It is therefore more desirable to adjust the antenna circuit to less than 600 meters, for I find that by a slight increase of coupling between the primary and secondary windings, or by judicious use of the variable condenser across the secondary windings, I am enabled to reach the 600-meter adjustment without difficulty. I find this arrangement far more preferable than making the primary winding of such value that it is necessary to insert a series condenser to bring the wave-length down to that desired.

Amateurs will readily understand that I can not give any definite data in advance as to the size of these fixed coils for the reason that their antenna are rarely alike, that is to say, the condition of inductance and capacity of these antenna vary.

In connection with my specially constructed primary winding I have found

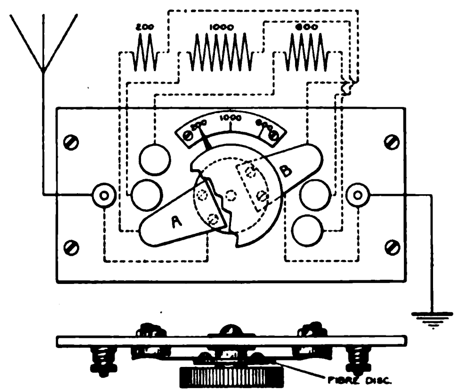


Fig. 2, First Prize Article

a single winding quite sufficient for the secondary coil to cover the wave-lengths given. The secondary winding I actually use consists of 266 turns of No. 30 S. S. C. wire wound on a 3-inch tube. A switch is provided so that 60, 180 or the full 266 turns may be used.

The primary winding is made of bare No. 24 copper wire, the turns being separated by thread. The diameter of the primary tube was 3½ inches. I do not favor the use of enameled wire, for unless it is spaced and treated as bare wire, considerable loss, due to capacity, will occur.

A more detailed sketch of the switch and its connections to the primary windings is shown in Fig. 2. The two spring contacts A and B are screwed to a fiber disc as shown. The earth and the antenna leads are connected by means of flexible wire to the spring contact A and B. A hard rubber knob H allows the switch to be placed in any position desired. A small pointer may be fixed to the hard rubber knob and made to work over a scale as shown in the drawing.

Fig. 3 is a more detailed sketch of the tuner I have constructed. It gives the actual dimensions of the supports and other details. To the binding posts A and B I connect a variable condenser of about .0004 M. F. I prefer the condenser made by the Clapp-Eastham Company, which seems the most desirable of the cheaper condensers on the market.

It should be understood that with each change of wave-length in the primary winding the degree of coupling between the primary and secondary coils will need to be changed for the maximum degree of efficiency, because the relative positions of these two windings are changed, depending upon which of the three primary windings are actually in use. As a "standby" circuit it may be necessary to "tighten" the coupling, but after a certain station is heard the coupling should be varied until the loudest signals are obtained.

A pointer fastened to the secondary winding should slide over divisions on a scale so that it will show either the distance from center to center of the primary and secondary winding respectively or the coupling co-efficient at various positions. In fact any empirical scale which at a glance will give the observer a relative idea of the value of coupling in use will be of advantage.

If it is desired to tune to a wave-length of more than 1,000 meters the 3 coils may be connected in series by a special switching arrangement or extra loading coils may be inserted in series with the antenna and detector circuits. Other modifications of the design and application of this tuner can be made at the discretion of the builder; it is assumed that he is able to work out the details to suit his own ideas.

In conclusion, I might state that it is best at all times to connect the receiving tuner to the antenna as near to the actual earth connection as possible for the pri-

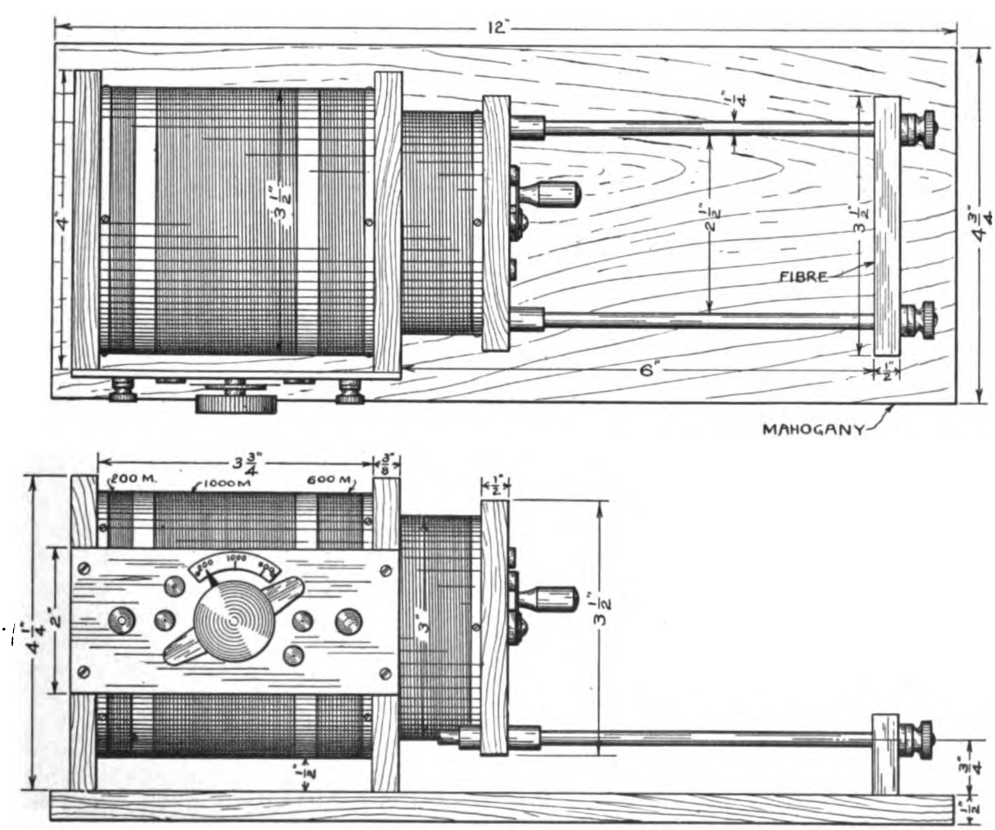


Fig. 3, First Prize Article

mary winding is then connected at a node of potential and a loop of current. The primary winding, therefore, sets up the maximum amount of magnetic lines of force which are effective in producing a potential at the terminals of the detector.

CHARLES S. BALLANTINE,
Pennsylvania.

NOTE.—While the writer of the First Prize article has practically eliminated the dead-end losses in the primary windings of his receiving tuner, he evidently does not consider it so important to employ similar construction in the secondary winding. We do not doubt the desirability of the construction which he has described. We recommend it to the entire amateur field. A precalibrated tuner is always an advantage, for it removes in no uncertain manner the degree of uncertainty which exists in the manipulation of the average amateur tuner. Should amateurs desire to calibrate the antenna circuit with a wave meter we refer them to the article appearing on page 416 of the February issue of this magazine, and also to Fig. 24 on page 418.—*Contest Editor.*

SECOND PRIZE, FIVE DOLLARS

The Audion Magnetically Intensified

The usual audion amplifier, consisting of two of the bulbs connected in cascade, is very satisfactory in operation, but the expense is rather high for the average amateur. In a series of experiments to secure similar results with cheaper apparatus the writer employed the magnetic method, which is simple and inexpensive.

The apparatus consists of a permanent horseshoe magnet, the poles of which are far enough apart to allow the audion bulb to be introduced between them, so arranged that it may be rotated around the bulb until the point of maximum sensitiveness is found and clamped there. In Fig. 1 A is the audion bulb, M the magnet, S a standard to support the magnet, and R, a pair of concentric brass rings, machined to the shape shown in Fig. 2 between which the standard S moves, and clamped at any point by the nut N. This allows the magnetic field of M to be rotated with respect to the audion A, and held at the most sensitive position.

The effect of the magnet when properly placed is surprising. Stations which were formerly inaudible come in clearly, and others which were very faint may now be read with the phones lying on the table. I believe that the action of the apparatus is as follows:

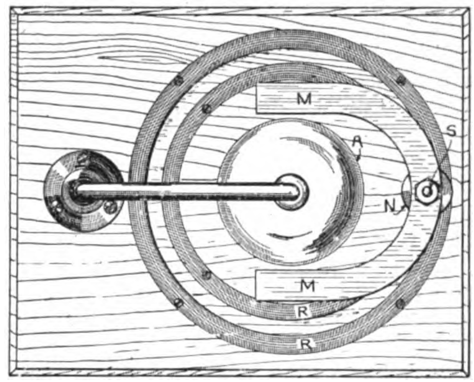


Fig. 1, Second Prize Article

As is well known, if the current flowing through an audion at varying voltages be plotted, a non-linear, or in this case a saturation curve results, as shown in Fig. 3 (1). As this curve shows, until the voltage reaches 16 there is little change in the current strength, but on raising the voltage only 3 volts the current is increased to 170. At 22 volts the current has reached 210, and any further increase in voltage has but a slight effect on the current strength. Thus it will be seen that there is a critical point in the curve where a very slight increase in voltage causes a large increase in current. The audion is kept at this point of the curve and when the weak wireless waves are impressed upon it the critical point is passed, and an increase in current in the phone circuit takes place.

The steeper the curve the greater the current increase for a given voltage increase will be, and therefore the more sensitive the audion. Note the effect of the magnet upon the shape of the curve (2), which shows the effect of the magnet when improperly placed, the curve being flatter. But in (3) the correct position has been found, and the curve is much steeper than in (1) and (2). The magnet has deflected the cathode rays, which carry the current between the wing and the grid, out of their normal path sufficiently to bring about the following condition. Just enough electrons pass to bring the curve to the critical point. The strength of the magnet or its position must be such that a very slight increase in voltage will cause as large a number of ions to return to their former path as possible, increasing the conductivity of the audion and making the curve steeper.

Any amateur will be well repaid for his trouble in making up this simple piece of apparatus, as it will increase the sensitiveness of a good bulb to a great degree, while a poor bulb will be less affected.

A. A. SKENE, Pennsylvania.

NOTE.—The method described by the writer for increasing the sensitiveness of the audion bulb is not new, but was well known in 1906-1907. It should however be of interest to those amateurs who have been unaware of the effect of the magnetic lines of force upon the action of the audion. We take exception to the inference that a single audion with a properly adjusted magnetic field will equal the double amplifier. A series of experiments covering a number of months have indicated that the sensitiveness of some audions is not increased by the magnetic field, but is actually decreased. Certain bulbs, however, were enormously increased in sensitiveness in the manner described by the author. Two audion bulbs properly connected in cascade however will invariably give decided amplifications. The experiment described by the author is well worth trying.—*Contest Editor.*

THIRD PRIZE, THREE DOLLARS

An Amateur Sending Outfit

The following description and drawing of the sending set I am now using may be of interest to amateur experimenters. Many amateurs having a 1-inch coil and wishing to improve their set both in efficiency and in appearance would do well to construct apparatus along similar lines. I am using my set for talking around town to friends within about a 1-mile radius. It is easily read at this distance, and although I have never been able to test it, I believe it will work over 5 miles: at least the makers claim this distance for the coil.

The necessary materials are:

One 1-inch spark coil, 1 spark gap, ½ pound No. 6 aluminum helix wire, six plates of glass, 8 x 10 inches, of an even thickness; battery switch, about 25c worth of tinfoil, a 1-foot phosphor bronze or brass spring strip, No. 28 gauge and ½ inch in width, and 4 binding posts.

It is best to buy the coil, gap, wire, binding posts and spring from any reliable supply house. You may get the glass from any local store and the tinfoil from a florist.

The woodwork may be of oak or mahogany, the former being more within the reach of the average amateur. For the cabinet you will need for the top and bottom 2 pieces ¾ x 12 x 16 inches (it may be necessary to glue these), 2 ends, ¾ x 3 x 10 inches, and 2 pieces ¾ x 3 x 14 inches for the front and back. You may mitre the corners or use any other standard joint. The top is hinged at the back and has some sort of a catch in front. The bottom is screwed on.

You may use any finish. I used dark oak stain and filler followed by two coats varnish. This makes a shiny finish and brings out the grain.

The helix is sawed from two pieces of material ¾ x 10 x 10 inches in the form of a circle 9 inches in diameter. Next cut five mortises, as shown in the accompanying drawing, for slats. Make the slats ⅝ x 1 x 10 inches. On the first slat cut 11 notches for the wire, beginning 1½ inches from the top and every ¾ of an inch apart. On the next, start down 1½ inches from the top and only cut 10 notches. Start 1⅜ inches down on the third, 1½ inches on the fourth and 1⅝ inches on the fifth. Cut 10 notches in

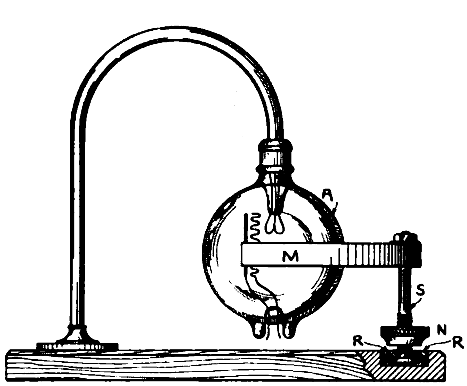


Fig. 2, Second Prize Article

all but the first. Put the helix together, using 1½-inch blued round, head-wood screws. Fasten wire at A, using a battery binding post and wind wire from one to two and so on, placing wire in slots cut for this purpose. It is best to stain and finish helix before winding. Fasten the end of winding at B in same manner as at A.

After the cabinet and helix are stained and finished you are ready to assemble. First screw the coil down and then the helix. The latter is fastened by two wood screws run through the lid of the cabinet into the bottom of the helix. Place the spark gap on top of the helix as shown. It may be fastened with 3/8-inch wood screws. Use about 8 or 10 blued 1¼-inch screws to fasten the coil as its weight might wrench it loose in handling if too few were used. Then place the switch and the binding posts. A snap switch may be used if preferred.

The connections are made as per diagram. The wire to the spark gap is run through center of helix. It may be found necessary to sink the primary wiring into the bottom of the lid as it looks better. Green lamp cord may be used for connections.

To make the condenser take 6 plates of glass 8 x 10 inches of even thickness. Cut the tinfoil in sheets 6 x 8 inches. These are fastened to glass with varnish. Care should be taken not to get any air bubbles under the tinfoil, as the condenser will not work well and may puncture. Now take a piece of tinfoil and fold it several times until it is 1½ inches wide and about 6 inches long. Lay it at C on the bottom of the cabinet. Next lay the first sheet of glass on it. Then lay the piece of foil at D and place plate of glass on it and so on until the entire condenser is completed. Connect these flaps with a battery binding post as at E. For contact on the top sheet of foil use a spring from the lid, at O. Make two helix clips as shown at F. Fasten these to wires running from G and H, these wires being of sufficient length to reach all parts of helix.

The key is not shown as many prefer to place it on the table in a handier position.

On my set the coil and gap are of the Electric Importing Company's make and if a coil of another make is used, it may be necessary to change the dimensions slightly.

I think amateurs will agree with me in saying that after construction they will have the best looking and the best working one inch coil set in town.

H. E. Welch, Oregon.

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

Where to Connect the Receiving Set

Many amateurs in connecting up their sending and receiving sets use a small spark gap, commonly known as an "anchor gap," in either the aerial lead-in or the earth wire. This, of course, puts additional resistance in the open circuit.

With the direct couplings which were formerly in general use the potentials in

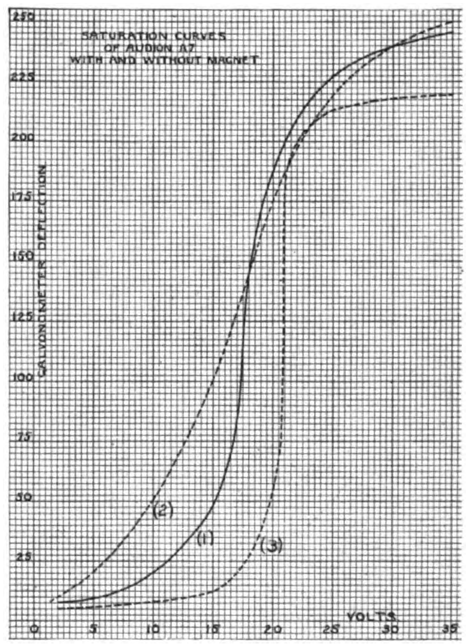
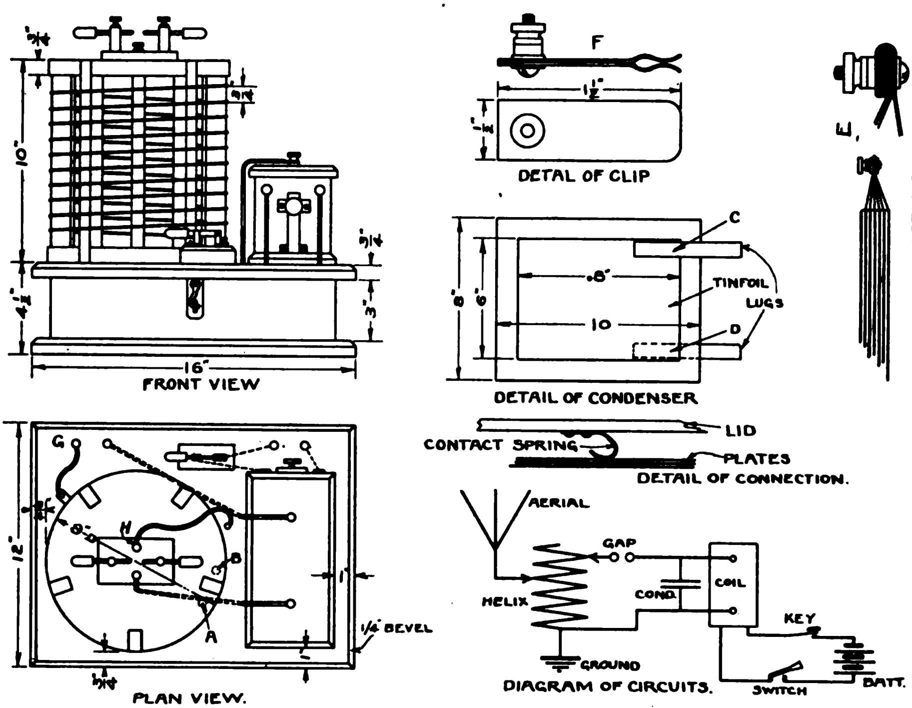


Fig. 3, Second Prize Article

the open circuit were of such value that the current would readily jump the anchor gap. Therefore the effect of the gap was not so disastrous as it would be under present United States regulations. With the loose couplings which are required under the new wireless regulations the potentials in the open circuit are much lower and the use of an anchor gap should be avoided wherever possible.

In the accompanying diagram is shown a method of connecting in the receiving set which not only eliminates the anchor gap, but also has several other advantages.

The earth wire, the receiving tuner, and the primary circuit of the transformer are all connected to a D P, D T



Diagram, Third Prize Article

switch as shown in the accompanying diagram. As this switch is connected to the earth wire instead of the lead-in wire, no special insulation is necessary. Any switch having blades large enough to carry the earth current may be used.

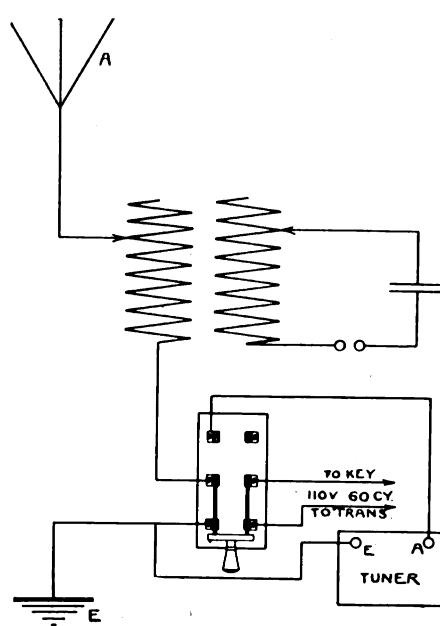
With the switch in the receiving position the primary circuit of the transformer is open and there is a break in the earth wire around which the receiving set is connected. With the switch in the sending position the primary circuit of the transformer is closed, as is also the break in the earth wire, and the aerial post of the receiving set is disconnected.

This method of connecting in the receiving set lowers the resistance of the open circuit to its lowest value with a consequent sharpening of the radiated wave, gives better insulation of the aerial lead-in than when connected to a switch; and when transmitting, sparking, in the receiving set and disagreeable noises in the head phones formerly experienced, are now absent.

CLINTON D. HEINLEN, Ohio.

NOTE.—An expensive, high potential changeover switch is unnecessary, when the arrangement described is in use; in fact, a double pole double throw 15-ampere switch is all that is required to change the apparatus from a sending to a receiving position.

It should have been mentioned that this



Diagram, Fourth Prize Article

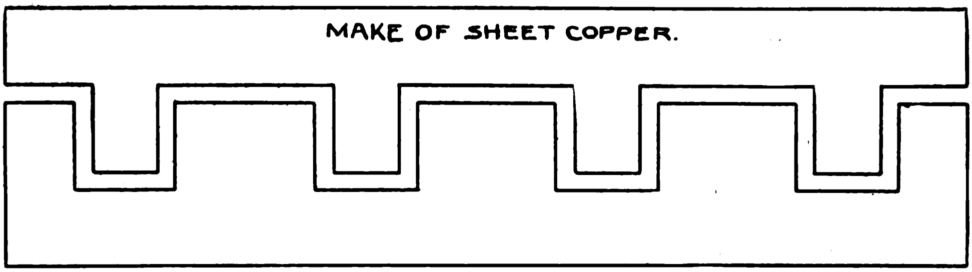


Fig. 1, Honorable Mention Article, Peter Coleman

switch must be placed as near to the actual earth connection as possible; otherwise a difference of potential between the connections to the switch and the earth wire may arise, causing sparking.—*Contest Editor.*

HONORABLE MENTION

A Method of Using a Rotary or Quenched Gap on any Spark Coil

Many amateurs who have taken the trouble to introduce the rotary or quenched spark gap into their stations have found that instead of a musical or high-pitched tone the spark, unless, or even when finely adjusted, gave a ragged note. Commercial stations secure such notes by use of an alternator giving 500 cycles current with the aid of the synchronous type of revolving gap. This means that for each reversal of current the condensers charge and discharge in synchrony. As a makeshift, the amateur is apt to install the non-synchronous type of gap, which in many cases has proven unsatisfactory, particularly when used in connection with a set securing its energy from batteries. I have successfully used a type which I will now describe. If my diagrams are carefully followed the amateur will find himself amply repaid for the labor expended.

Having a high-speed motor, I extended the shaft for the mounting of a commutator. I then cut a commutator 2 inches in diameter from some sheet copper. I cut two pieces, each piece consisting of four teeth, as per Fig. 1. I then laid them together as per Fig. 1. I then cut out a circular piece of wood, on which I screwed the pieces of sheet copper (as cut), making sure that one does not touch the other. The complete commutator is then fastened to the motor shaft.

The commutator, having four teeth on each side, makes 8 reversals of current per revolution. The action of the complete outfit can readily be seen and easily understood. When a pair of plugs on the rotary come opposite the

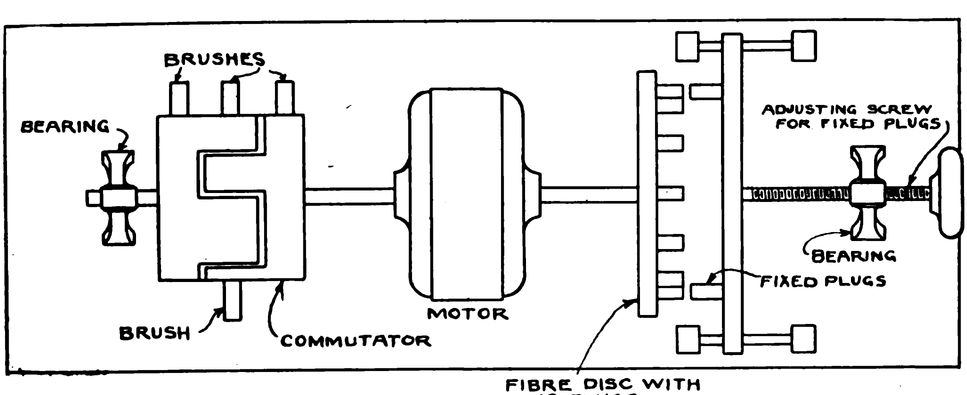


Fig. 2, Honorable Mention Article, Peter Coleman fixed or stationary electrode a reversal of current takes place at the commutator. This gives the same result as if an alternator was being used. By means of a very high-speed motor and a rheostat you get any pitch you wish.

By cutting off at the dotted line, as indicated in Fig. 2, you can use this arrangement with great success on a quenched gap.

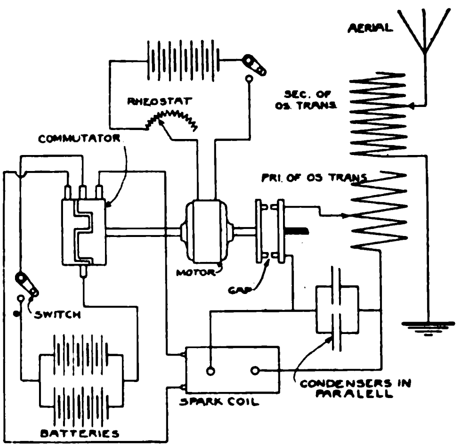


Fig. 3, Honorable Mention Article, Peter Coleman

Connections for use with a rotary are shown in Fig. 3; connections for use with a quenched gap are shown in Fig. 4.

One more word in regard to the adjustment of the rotary spark gap: Great care must be taken that the stationary or fixed electrodes are in line with the rotary plugs, and also when the brushes pass from one segment to the other, so that the spark jumps at each reversal of current of the commutator.

PETER COLEMAN,
Care Charles Metzler, New York.

Note.—Before commenting we should prefer to see this device in operation. We are of the opinion that it would be desirable to have the stationary spark points so arranged that they may be shifted in the arc formed by the disc, thus allowing the spark to discharge at the proper time and to the best advantage.—*Contest Editor.*

HONORABLE MENTION

An Efficient "Break-in" System

After experimenting for several months with various hook-ups and apparatus in an endeavor to find a "break-in system" that had no disadvantages and which could be used successfully in long-distance work, I finally adopted the system which I am about to describe.

In the system now employed by the Marconi Company a "sparkplate" or anchor gap is inserted in the earth lead of the transmitting set as near to the actual earth connection as possible. This spark plate consists of two brass plates separated by a thin disc of mica slightly smaller in diameter than the brass plates, around which are connected the aerial and earth binding posts of the receiving set, as per Fig. 1. In this system the received wave passes through the aerial inductance and secondary of the oscillation transformer, then through the tuner to the earth. When the transmitting key is pressed the current jumps the minute air gap in the spark plate in preference to flowing through the tuner. The nearer this spark plate is placed to the actual earth connection the lower will be the potential of the aerial side of the spark plate.

This system has slight disadvantages, viz.: the sparking at the spark plate making an unnecessary noise, liability of the spark plate becoming shorted by carbon deposit from the sparking (thereby earthing signals), cutting down the radiation of antennæ and also the difficulty of keeping a crystal detector in adjustment. The spark-plate system works well in conjunction with a valve or magnetic detector, but will not give satisfactory results if the transmitting set is a powerful one and a crystal detector is used.

In my system I use a closed-circuit relay in place of the spark plate (see Fig. 2), which eliminates the undesired sparking, and which also earths the tuner at the instant the transmitting key is touched. I first tried operating the relay by having two extra contacts on the front of the key, making contact as the key was depressed, thus closing the relay and grounding the tuner. This proved to be unsatisfactory, as sometimes the key would arc, causing a spark to jump while the relay was open, thus knocking the crystal out of adjustment.

I then changed the relay into a closed-circuit relay by putting the contacts on

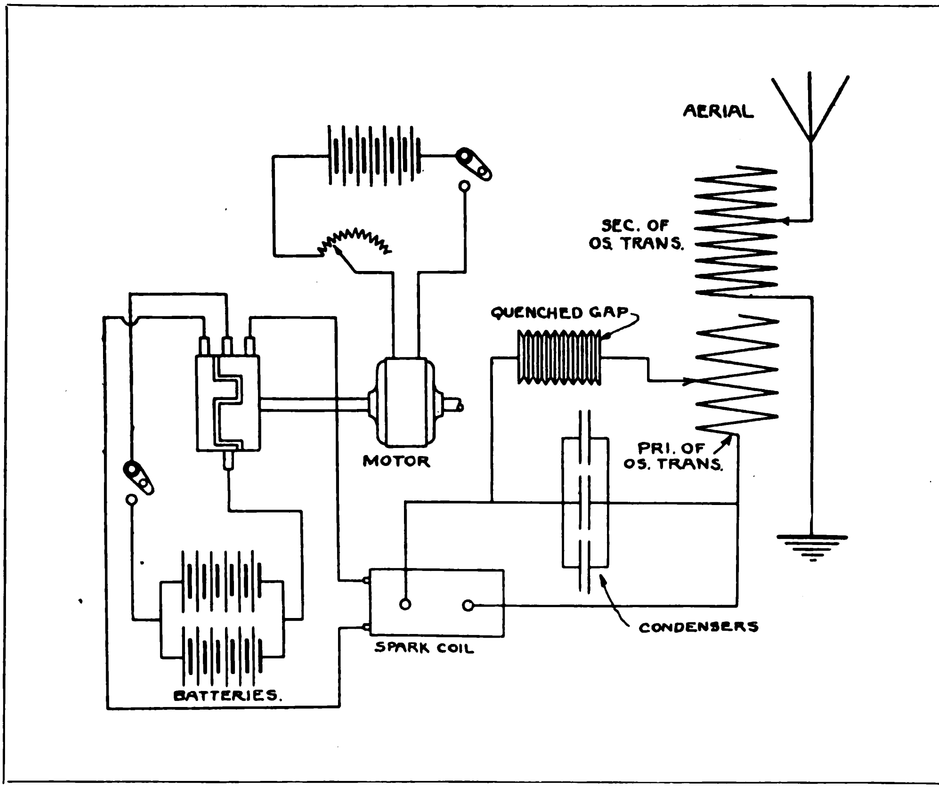


Fig. 4, Honorable Mention Article, Peter Coleman

in such a manner that they opened the circuit when current was in the magnets, and then attached a small extension of hard rubber about 1½ inches long to the front of the key, on which I fastened two contacts, one on each side; next I made a small fibre support to hold the two upper contacts, as shown in Fig. 3. These two sets of contacts must be adjusted so that they both make contact, and stop the upward motion of the key. One set of these contacts operates the relay, the other set opening and closing the detector circuit.

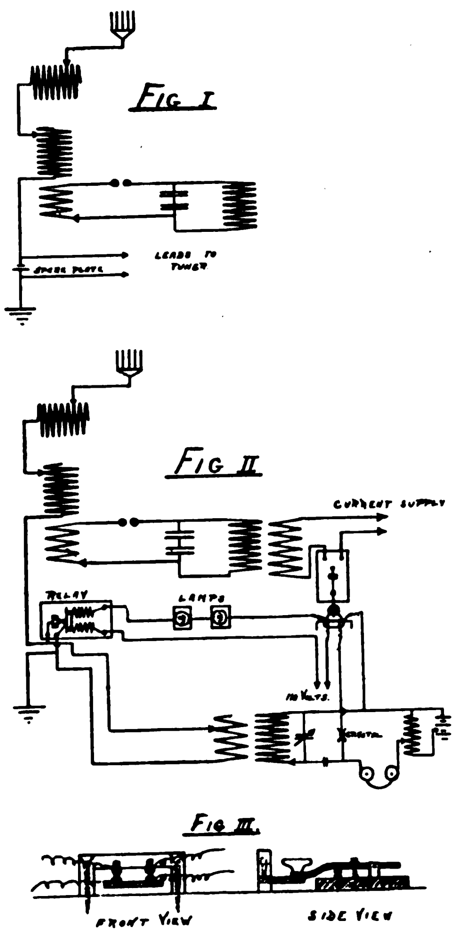
The writer is using a 175-ohm relay on 11c volts, with two 16-c. p. lamps in series, but batteries may be used instead. If this system is to be used with a large transmitting set it will be found advisable to put heavy silver key contacts on the relay, having quite a stiff spring pulling them together. The armature of the relay need have but very little play, as no current is broken at the contacts.

The action is as follows: When receiving, the current is flowing through the magnet coils of the relay, thereby holding the aerial and earth contacts of the relay apart, and the signals pass into the tuner. When the key is touched these contacts meet. This action causes the tuner to be cut out of the circuit, short-circuited and grounded (before the A. C. contact is made); the detector circuit is also opened. When the key comes up the contacts on the extension and the fibre bridge meet again, closing the circuit in the magnets of the relay, which in turn separates the aerial and earth contacts of the relay. The detector circuit is again closed. This action is very rapid and will work perfectly, even if the A. C. key is operated by a vibroplex automatic speed key at 30 to 45 words per minute.

This system has been used successfully for several months by the writer in connection with a 2-K. W. radiating, 20 amperes in the antennæ, with the tuner but 2 feet from the aerial inductance. With this system and carborundum detector I have worked a "break-in" while communicating with stations at a distance of 1,000 miles many times, adjusting detector but about once a week to make sure that it was giving maximum strength signals.

Homer B. Black, New York.

Note.—The arrangement of circuits, as shown, is not new, having been used a number of years ago. The article, however, has been printed on account of the number of inquiries received from amateurs on the subject of "break-in" devices. It should be known that the Marconi Wireless Telegraph Company of America has abandoned the use of all anchor gaps and ground spark plates from the antennæ circuit.—*Technical Editor*



Diagram, Honorable Mention Article, Homer B. Black

HONORABLE MENTION

Rotary Spark Gap

As an improvement on Mr. Hengerer's rotary spark gap, described in the January Wireless Age, I am submitting an account of a gap that is probably a trifle more expensive, but I think will give much better results.

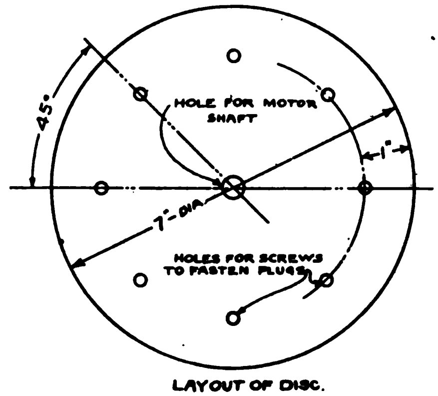


Fig. 1, Honorable Mention Article, H. Haines

To make this gap, procure from a dealer in phonograph supplies one of the old 7-inch disc type Columbia records. The back is to be divided into eight parts, as shown in Fig. 1. Now measure 1 inch in on each of the eight lines, and place a cross as shown in the diagram. Here you will find that the distance between the crosses is 2 inches. At each of the cross marks drill a hole with a 6/32 slip drill, but before doing this be sure that the cross marks are in

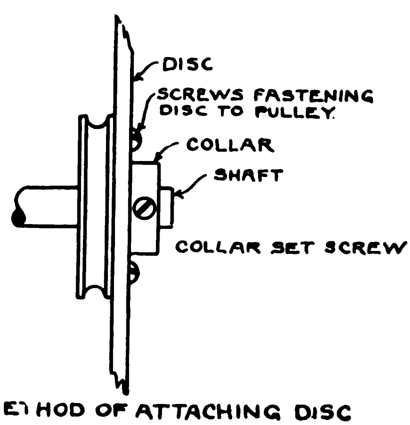


Fig. 2, Honorable Mention Article, H. Haines

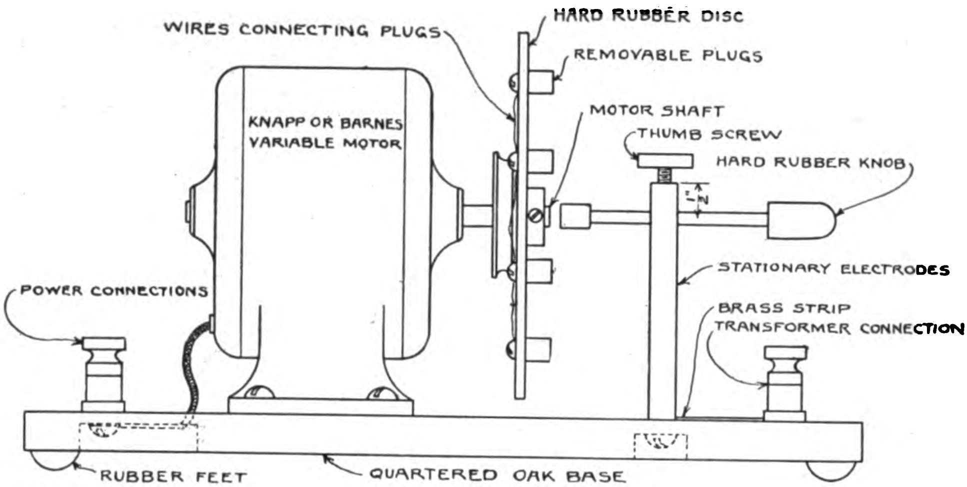


Fig. 3, Honorable Mention Article, H. Haines

their right places or you will spoil the disc.

Next turn out, or have turned out, 8 zinc plugs ½ inch long. Drill and tap these for 6/32 machine screws. These plugs can be made from battery zincs which are of the right diameter and serve the purpose admirably. The plugs should then be mounted, taking care that they bear a bright, even surface to the stationary electrodes. Brass or copper washers should be put on the machine screws, and they should then be connected on the opposite side with brass strip.

The disc may be attached to the motor by first procuring an aluminum or brass pulley wheel, as used on motor shafts for running small toys, etc. (Fig. 2); then the hole in the disc should be enlarged to fit firmly on the smaller part of the pulley wheel so that it will rest tightly against the larger part of it. When this is done drill two holes opposite each other with a 6/32 tap drill through the hard rubber disc and about half way through the pulley wheel. Tap these holes for 6/32 machine screws; these are absolutely necessary to hold the disc in place when used at the high speed required.

The stationary electrode posts should be made of ¼ inch square or ⅜-inch hexagon brass rod, cut ½ inch longer than the distance from the base of the motor to the center of the motor shaft to be used (Fig. 3). These electrodes should be drilled and tapped at the bottom for 8/32 machine screws; at the top they should be drilled and tapped to the depth of ½ inch for 6/32 thumb-screws.

When this is done, measure down 1.2 inch from the top of these electrodes and drill holes with an 8/32 slip drill right through the center of the rod. This is for the rod holding the stationary electrodes. Next cut two pieces of 8/32 brass rod about 2½ inches long, and thread on each end about ¼ inch. Then make two plugs the same size, as on the disc, only drill and top for 8/32 machine screws to the depth of ¼ inch. These should be screwed on the threaded brass rod, then put through the hole in the stationary electrodes, and 8/32 hard rubber knobs screwed on the other end.

For a base procure a piece of quartered oak, about 5 x 8 inches, and mount the motor firmly. Make power connections to binding posts at the rear of the motor. Drill two holes in the base about 2 inches from the disc, and mount the stationary electrodes. Connections for this should be made with brass strip on the upper side of the base to the binding posts provided.

The cost will probably figure up as follows:

Second-hand 7-inch record	.05
Quartered oak base	.10
Brass posts	.10
One wet battery zinc	.05
Pulley	.15

(Continued on page 685.)

One of the recent converts to the ranks of wireless telegraph enthusiasts is Master Reggie Sheffield, 13-year-old actor, who has rigged up a set in his bedroom. Master Reggie is regarded as more or less of a scientific prodigy, but is better known as Eric Desmond of the Cinema "movies"

Queries Answered

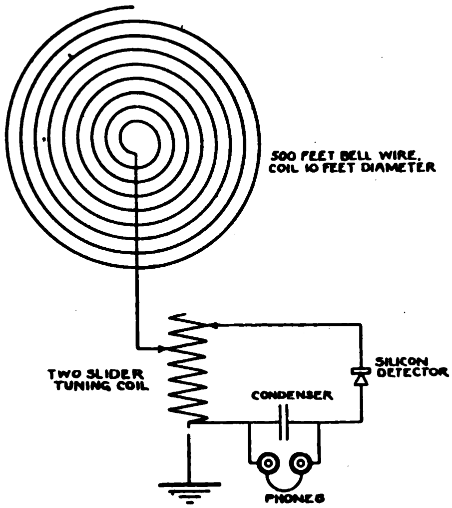
Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

H. A. L., Philadelphia, asks:

Ques.—(1) I live within a mile and a half of the Marconi station at Wanamaker's (WHE) and within a few miles of the League Island Navy Yard Station. I should like, if possible, to get them without an aerial and as few instruments as possible. Please tell me if this is possible, also the instruments needed. I am situated in a nest of high office buildings.

Ans.—(1) Wind up about 500 feet of No. 18 bell wire in a coil, on the ceiling of your room as per the accompanying sketch. Purchase a 2-slide tuning coil, a fixed condenser, a silicon detector and 1 pair of 500-ohm head telephones; connect them up as shown in the diagram.



Ques.—(2) Give the calls of the following steamers:—Mongolian, Carthaginian, Sardinian and Pretorian, of the Allan Line.

Ans.—(2) Mongolian, MON; Carthaginian, MHN; Sardinian, MDN; Pretorian, MFN.

Ques.—(3) What is the pay of second and chief operators on ships with Marconi apparatus and what is the lowest age at which young men are employed.

Ans.—(3) The pay varies according to ability and seniority. It ranges from $25 to $60 a month. In addition commissions on receipts are allowed. Lowest age, 18 years.

* * *

A. L. A., Brookes, Va., asks:

I have recently built a large receiving transformer and with it can copy Key West (NAR) on 1,500 and 4,000 meters in the day time. Now on a very long wave (apparently 7,000 or more meters) I hear a station working practically all the time. It seems to be copying from some other station until about one or two o'clock in the morning and then sends messages and SP'S. It never signs (to my knowledge), and I am quite anxious to find out what station this is. It sends a number of messages originating from Toronto, Montreal, New York, and other large cities. The station has a high frequency spark about the same tone as WSL. My aerial is 75 feet high at the highest end and 210 feet long; it is composed of 14 No. 12 wires spaced 5 feet apart.

Ans.—The station you hear on 7,000 meters' adjustment is very likely the trans-atlantic station of the Marconi Company at Glace Bay, Nova Scotia.

* * *

E. A. M. Jr., inquires:

Can you inform me where the wireless stations with the calls BCT, MBI, VBG, MMM and CDN are located? Does the Marconi Corporation publish a list or lists of call letters of stations in various parts of the world equipped with apparatus of the Marconi System or of other systems? If so, will you please forward information and prices of such lists.

Ans.—BCT, S.S. Buccaneer; MBI, not listed; VBF, not listed; VBG, not listed; MMM, Morro Castle, Havana, Cuba (Land Station); CDN, Clifden, Ireland (Marconi High Power). Copies of International Call lists may be purchased from the International Bureau at Berne, Switzerland. A limited number of copies may be purchased from the Traffic Department, Marconi Wireless Telegraph Company of America, 233 Broadway, New York. Price, $1.00 per copy.

* * *

H. G., Brooklyn, asks:

Ques.—(1) I have a 3-inch spark coil in which the secondary is separated from primary with empire cloth. If I immerse this coil in kerosene oil, will its insulation be improved?

Ans.—(1) The insulation may be improved, but kerosene oil should not be used on account of the danger from fire. Get in touch with Swan & Finch, New York. This firm will be able to supply you with first-class condenser oil having high insulating properties.

Ques.—(2) Which is most efficient for the coil referred to—a mechanical converter as described in the April issue of Modern Electrics and Mechanics, or a mechanical interrupter producing 6,000 sparks per minute? The mechanical converter in my case gives 200 cycles.

Ans.—(2) Difficulty in the nature of arcing is apt to be experienced with the mechanical converter, in any except very small sets. We advise the mechanical interrupter.

Ques.—(3) Will the capacity of a variable condenser (rotary) be increased if I immerse the plates in kerosene oil?

Ans.—(3) Yes, but it is not advisable to use kerosene. A good grade of castor oil will give the desired results.

Ques.—(4) An audion, when in use, requires about 44 volts; please tell me what fraction of an ampere is used.

Ans.—(4) One quarter to one half an ampere.

* * *

C. F. C., Freeport, L. I., asks:

Ques.—(1) How far should I be able to receive signals with the following: "T" shaped aerial and instruments, 74 feet long, 45 feet high; 4 No. 14 copper wires spaced 20 inches apart; leading, 2 No. 10 bare copper wires, 20 feet long; ground, 20 feet long attached to waterpipe; 1 small loading coil; 2 slide tuner, "loose-coupler," 2 fixed condensers, detectors (2 Galena and Silicon), and 1 variable condenser tubular?

Ans.—(1) Properly connected up you should have signals 1,000 miles at night time; in the day time you should have signals from 150 to 200 miles.

Ques.—(2) Will it improve my set to dispense with any of the instruments named?

Ans.—(2) It all depends on the "hook-up" at present in use. We can not understand the use of the 2 slide tuning coils in connection with the "loose-coupler." What is it used for? Unless it is employed as a loading coil, it may as well be dispensed with.

Ques.—(3) Should a "T" aerial be connected across the 4 wires at both ends?

Ans.—(3) Yes, preferably.

Ques.—(4) Is it any advantage to have a heavy wire or 2 wires for a lead-in?

Ans.—(4) The lead-ins are preferably equal in diameter and conductivity to the wires of the flat top; lead-in wires should be bunched rather than spread.

* * *

W. B. D., L. I., asks:

Ques.—(1) Will you please give me full instructions as to how to operate a "loose-coupler"?

Ans.—(1) A full answer to this query would require too much space in these columns. A complete explanation will appear in an article of the series on "How to Conduct a Radio Club." Have you read the articles entitled Operators' Instructions, appearing in this magazine? Complete instructions, fully covering various types of inductively coupled receiving transformers, have been given in these articles. We advise you to get in touch with some of your amateur friends who have back copies of the WIRELESS AGE and study the articles thoroughly. Circular 144B, issued by the Traffic Department of the Marconi Company, may be secured for ten cents a copy. It gives full instructions for the operation of "loose-couplers."

Ques.—(2) My wireless set consists of the following apparatus: Amco loose-coupler; ferron detector; fixed condenser, consisting of 15 sheets of tin foil; loading coil, 3 inches in diameter, 8 inches long, wound with No. 24 S. C. Wire; 2 250-Ohm receivers; ground, No. 14 wire about 18 feet long; aerial, 1 wire, about 250 feet long, 35 feet high. The only station that I have heard is Sayville, L. I., and its signals are very faint. Can you tell me what the trouble is and how I can increase my range?

Ans.—(2) The hook-up shown in the sketch accompanying your query is quite correct and can not be improved upon, with the exception that your drawing does not show the secondary winding of the "loose-coupler" as being variable. It is quite important that this circuit be accurately tuned to the aerial. Why you do not hear stations other than Sayville, we can not say, because we are not familiar with the local conditions.

Ques.—(3) A certain firm is marketing a single pole 1,000-ohm phone which it sells at a reasonable price. Has it an advantage or a disadvantage over the double pole 1,000-ohm phone?

Ans.—(3) A well constructed single head phone may give better signals than a poorly constructed double head set. But in every instance a double head set is the most preferable, provided it is sensitive. We are not familiar with the head phone you mention.

Ques.—(4) Why do the land operators get more salary than the ship operators? The latter stand a chance of losing their lives, thereby cutting off the support of parents or those under their care.

Ans.—(4) Because the duties of land station operators require greater skill, and labor. The land station operator must be familiar with both the American Morse and Continental telegraph codes. He must be able to work the wire lines and wireless apparatus with equal facility. He is required to have knowledge in many instances of gasoline engines or other prime mover power equipment. His work is more laborious than that of the ship operator, for he is required to handle wireless traffic from all ships within radius. The land operator does considerable more actual operating and routine work than the ship operator. Commercial land stations must be manned by men who, possessing both initiative and ability, have had wide experience in wireless matters at sea.

The land station operator, provided he possesses the proper qualifications, is invariably recruited from the ship service. It is right that he should be properly compensated for his experience. Furthermore, let it be remembered that the land station operator is required to pay for his food and in some cases for his lodging; he is also under other incidental expenses from which the ship operator is totally free.

The actual risk incurred by the operator aboard ship or the chance of losing his life is exceedingly small. When one considers the thousands of ships equipped with wireless apparatus, and the actual number of operators who have lost their lives while at their posts, it will be evident that the percentage of risk is close to a negligible quantity.

* * *

F. A. T., San Francisco, writes:

Ques.—(1) In the Wireless Engineering Course in the November issue of THE WIRELESS AGE, H. Shoemaker, the author of the article, states that the maximum voltage is 1.41 times the effective voltage. Does this hold true on all powers, frequencies, and voltages?

Ans.—(1) The statement holds good under all these conditions provided the current is of pure sine form; otherwise it does not. For instance if the generator gave a very peaked wave form, the maximum voltage may be considerably more than 1.41 times the effective voltage.

Ques.—(2) If the statement in my first query does not hold good under all conditions, kindly give the formulæ for finding the maximum voltage from the transformer secondary voltage.

Ans.—(2) Note page 508, the March issue of THE WIRELESS AGE, where a method is given for obtaining the maximum voltage of a transformer by measuring the length of discharge when it takes place between two brass balls ½ inch in diameter.

Ques.—(3) If the closed or condenser circuit of a transmitting set is tuned for 300 meters and the antenna or open circuit is tuned for 200 meters, the coupling being very loose between the secondary and primary, what wave-length will be tuned at a distant receiving station?

Ans.—(3) It is doubtful whether a transmitting set under such conditions could be heard at any considerable distance, as the circuits are so far out of resonance that the antenna current would be very slight. We have recently made some tests under the exact conditions you propose and have found that frequencies, corresponding to both wave-lengths were present in the antenna circuit.

* * *

J. F. W., Roanoke, Va., inquires:

Ques.—(1) What is the approximate wave length of the following aerial, used for receiving only: 4 single strand antenna wires, 140 feet long, spaced two feet apart, elevated 50 feet above ground; lead-in about 40 feet long? Please give an example of how to figure the length in meters.

Ans.—(1) The approximate wave length is 340 meters. Computation of the wave length of a flat top aerial can only be made by mathematical formulæ, the discussion of which would require too much space in these columns. Very roughly the wave-length of an aerial of the type you describe is 5 times the linear length of the entire aerial, including the flat top and the lead-ins.

The wave length of a single vertical aerial wire, when connected to earth, is 4 times its linear length, but when flat top-multiple wire aerials are used, the statement must be considerably modified, depending on the design, distance from the earth, etc.

In an aerial of standard construction like the one you describe the following formula has been proposed for amateur's use. It is only very roughly accurate:

$$W = V + \frac{L}{4} \times 4$$

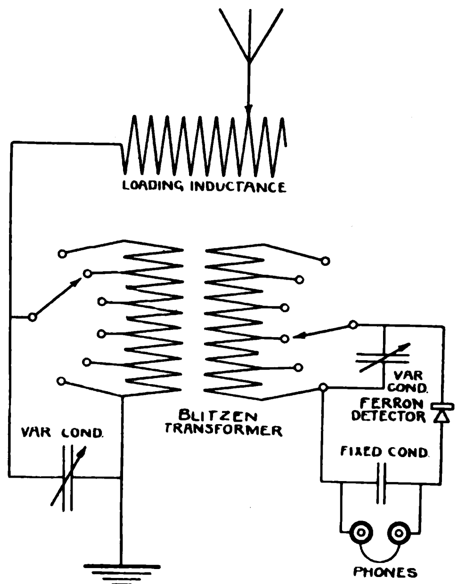
Where W = wave length in meters
V = Vertical height of flat top
L = Length of flat top (4-wire aerial-wires spaced two feet apart)

In the case of your aerial,

$$W = 50 + \frac{140}{4} \times 4 = 320 \text{ meters,}$$

corresponding closely to our first statement.

Ques.—(2) Can you say as to about what I could do in receiving with the following set on the aerial referred to under normal conditions with ground connection 60 feet long, connected to water pipes? The set consists of a Blitzen receiving transformer, two Blitzen variable condensers, one fixed condenser, Ferron detector, Murdock loading inductance, and 2,000-ohm Brandes receivers. The receiving transformer is said to be capable of adjustment to 1,500 meters.



Ans.—(2) You should be able to hear signals 1,000 miles at night time.

Ques.—(3) Please give diagram of connections of instruments referred to.

Ans.—(3) Herewith is published a diagram of connections.

Ques.—(4) The Radio Apparatus Company of Pottstown, Pa., is turning out a new loose-coupler with one switch on secondary and two switches on primary, claiming a range of wave lengths up to 4,500 meters. Do you consider this any better than the Blitzen transformer?

Ans.—(4) Having had no experience with either, we can not answer.

* * *

H. M. C. D., Brooklyn:

We cannot give you definite data as to the wave-lengths you may expect to obtain with the receiving apparatus you have described as we do not know the capacity and inductance of the aerial at present in use. You should have given us the height of the flat top aerial above the earth and not the distance above the sea level. We have made some calculations on the assumption that the capacity of your aerial is approximately .0003 Mfd. and the inductance 76,000 Cms. The inductance of the coil which you are to use as the secondary winding of the receiving tuner is 3,600,000 Cms; the capacity of the variable condenser is approximately .001 Mfds. Therefore, this condenser when connected in shunt at its full capacity to the above coil will allow wave-length adjustments up to 3,600 meters.

The inductance of the loading coil is approximately 1,788,020 Cms. The inductance of the primary coil is approximately 1,132,660 Cms. Therefore, the combined inductance of the entire antenna circuit is 2,996,680 Cms. Assuming that the capacity of this antenna is .0003 Mfds, you may obtain wave-length adjustments in that circuit up to 1,800 meters. Of course, should you desire to receive wave-lengths of 3,600 meters, you will require a loading coil of increased dimensions for the aerial circuit.

* * *

L. K. Lawrence, Kansas, asks:

Ques.—(1) Can radiation resistance be determined or calculated in any comparatively simple way?

Ans.—(1) The following equation is sufficiently basic to cover your query:

$$R = K\frac{h^2}{\lambda^2}$$

Where R = radiation resistance of the aerial
H = height of a flat top aerial in meters
λ = wave length of the aerial in meters
K = 1,600 (a constant)

Ques.—(2) Does the formulæ for the capacity of concentric tube condensers give the capacity as directly proportional to the overlap?

Ans.—(2) Yes, all other things being equal.

Ques.—(3) There is on the market a rather curious high tension transformer of only 75 watts; the secondary potential is 20,000 volts. This is a true transformer and not a spark coil. Would 75 watts at 20,000 volts represent a sufficient amperage to make the charging of condensers for a 200-meter set possible?

Ans.—(3) On the assumption that the current supply is 60 cycles, the secondary terminals of the transformer should be connected to a condenser having a capacity of .003 microfarad. For a wave-length of 200 meters the condenser should be connected in series with a helix having an inductance value of 3,630 centimeters. You should obtain fairly satisfactory results with this set. You will probably find that it will be necessary to use small spark electrodes at the gap in order to obtain a uniform discharge.

* * *

W. G., Sayville, N. Y., asks:

Ques.—(1) Would it be possible to use No. 36 enameled wire instead of No. 34 in the construction of the auto-transformers? I have several pounds of the No. 36 wire on hand, and would like to use it if possible.

Ans.—(1) Yes, No. 36 wire will do.

Ques.—(2) If so, should the resistance be increased to make the number of turns approximately equal to the number of turns if No. 34 wire were used? A No. 34 wire having a resistance of 9,000 ohms would be approximately 35,000 feet long. A No. 36 wire of equal length would have a resistance of approximately 14,500 ohms. Would this resistance be too high to produce results?

Ans.—(2) It is not the resistance, but the value of the inductance obtained which determines the efficiency of this arrangement. We suggest that you wind up all the No. 36 wire you have on hand, dividing the winding between the contacts of a 5-point switch. You will find that a little experimenting with various values of inductance, to enable you to determine the most efficient arrangement, will aid you in your work.

The data given in the article in How to Conduct a Radio Club in the January issue of THE WIRELESS AGE, may be varied. It was not intended that the statements made should be taken as final; they were given to show the values used in certain experiments.

Ques.—(3) Would it be of advantage to decrease the length of the wire?

Ans.—(3) This question was replied to in the answer to your second query.

COMMENT AND CRITICISM

(Continued from page 666)

a peculiar fact that wave-lengths as low as 600 meters may be received with considerable success. It is found that the closed or detector circuit must then be tuned quite accurately to the wave-length of the distant receiving station, whereas the aerial circuit may be set at one value of inductance for a range of wave-lengths from 600 to 5,000 meters. In an open and unobstructed location aerial wires 3 feet from the earth will give surprising signals, particularly on the longer wave-lengths.

The use of an iron bedstead as an aerial has become so well known that it will not be discussed.

Good signals are and should be received on the gas pipes of New York houses; it is not generally known by amateurs that these pipes are insulated from the earth near to the meter in the basement by a fiber bushing.

FROM AND FOR THOSE WHO HELP THEMSELVES

(Continued from page 680)

Binding posts, brass strip, etc.......	.25
Hard rubber knobs................	.10
Soft rubber cushion..............	.10
	$.90

This, of course, excludes the cost of the motor, the make of which is at the option of the builder of the gap.

The motors best suited for this work and to operate on 110 volts are either the high-speed Knapp or a "Barnes" variable-speed motor.

This gap can be used on up to ¾ K. W. without fear of ruining the electrodes. With a motor giving 3,500 revolutions this gap has a frequency of 467, which gives a very pleasing note in the receiver.

H. HAINES, New York.

THE WIRELESS AGE

JUNE, 1914

THE RADIO REVIEW

A Demonstration of Wireless Effectiveness in Mexico

THE great service of wireless telegraphy at sea is a matter of common knowledge nowadays for every reader is familiar with the many incidents wherein lives and property have been saved at sea as the direct result of this means of communication. On land the value of wireless has not been as strikingly exemplified, but it is evident from what happened at Vera Cruz recently that its possibilities in war are at least as great.

Heretofore, when a detachment of an army has been cut off from communication with its base by wire the only method of transmitting information has been by the heliograph and this at its best has proven uncertain and unsatisfactory, and more often not available at all.

Now an army needs to depend on neither wire nor heliograph for maintaining communication with its base. Equipped with wireless apparatus, a detachment, no matter how far separated from the main body of the forces, can keep in constant and instant communication with it.

How valuable this service may be was shown when the Mexicans called on the detachment which was guarding the water works at El Tejar under Major Russell to surrender. The force was a small one and might easily have been overwhelmed by the Mexicans had it not been able to reach Gen. Funston at Vera Cruz.

But as it was when Major Russell received the demand to surrender, he sent the messenger making the proposal back to his commander and at once sent a wireless message back to headquarters.

What followed is told by the Associated Press dispatch as follows:

"The wireless message brought about a quick change to active army duty.

"Within a few minutes it had notified Major Russell that reinforcements were on the way and in little more than an hour, instead of the 240 marines at the outpost there were 1,200 men, while the entire garrison of Vera Cruz was ready for any movement that might be ordered.

"Seven companies of the Fourth Infantry regiment were sent forward under the command of Col. Robert C. Van Vliet, as well as two battalions and three companies of marines commanded by Col. John Archer Lejeune.

"When the reinforcements arrived at the water works station, Major Russell and his men were not at all hard pressed. The Mexicans had contented themselves with a scattering fire consisting of not more than four or five shots. From Major Russell's lines only one shot was fired. The water works station post in the American lines was placed so far out of the city only because the authorities regarded it as essential to protect the city's water supply."

If the war in Mexico is to continue, there is no doubt but the incidents of this sort will become very common. Between the aeroplane and wireless surprises and ambuscades will be very rare in warfare hereafter, a thing which would give us an almost inestimable advantage in the sort of campaign we should have to engage in in Mexico.

"Safety First" on the Refugee Train

WHILE the Railway Telegraph Superintendents convened at New Orleans are considering the merits of wireless as an auxiliary to "safety first" in railroading, news comes from Vera Cruz that our fighting men have applied railroad wireless to safeguarding passengers in a broader sense.

An outfit has been installed on the refugee train which almost daily penetrates the Federal lines between Vera Cruz and the capital to bring foreigners into the zone of safety afforded by the United States flag. Five wireless stations on the western side of the city keep vigilant watch day and night for the call of "S. O. S.," this being the signal agreed upon to give notice that the train has been attacked and foreigners are in danger.

The apparatus is rigged on the rear platform of a Pullman car and stands about five feet above the roof of the car. Its construction is due to the inventive genius of Ensign Maddox of the battleship Utah. Chief Electrician C. P. Porter of the battleship New Jersey has been detailed to ride back and forth upon the train to keep the wireless plant in order and to flash the warning signal if danger makes it necessary.

The "Perils" of Wireless Again

A NEWSPAPER editor in Boulder, Colo., voices his alarm in learning the great peril in which the world is placed. He observes: "This matter of handling electricity is getting to be a dangerous thing. At Madrid, Spain, Señor Igelsias recently 'lighted and extinguished at will fifteen electric bulbs at a distance of 600 yards.' It is also claimed that in February Marconi lighted an electric bulb at a distance of six miles, by a wireless current. Electricity to do this must be very powerful. In the hands of a villain, electricity may yet be so used as to set whole cities on fire, kill individuals at will without being liable to even the least suspicion. And if individuals can be slaughtered, why not entire armies and whole communities? One cannot tell where all this will end."

We are indebted to the man who culled this clipping for the pertinent observation that after much careful consideration the only remedy he can see is that we who have enemies who are electrically inclined refrain from carrying around with us in our pockets receiving plants strung up in series with a pound of dynamite. This would be a great sacrifice, and yet, for the sake of the world, we should do it.

THE success of the wireless telephone experiments which Mr. Marconi has been and is still conducting calls to mind the fact that the inventor whose epochal discovery has meant the paving of thousands of lives passed his fortieth milestone on April 5th.

Oversea Phone Predicted

It is expected that he will now be honored by election to the Italian senate, to which he was elected over a year ago but was prohibited from taking his seat because of the provision that an Italian senator must be not less than 40 years of age.

Mr. Marconi has recently left London to personally superintend telephony tests between mercantile ships and the powerful English shore stations. On his departure he is quoted as saying: "I think we shall be able presently to telephone wirelessly from England to America. It may be a question of years—I do not know how soon, but I think it will come. Our chief difficulty is in controlling sufficient power to carry a message that distance."

Considering how conservative Mr. Marconi's public utterances have always been it now seems certain that the practical wireless telephone has arrived at last.

The Editor.

Wireless Telegraphy in Railroad Service

An address read before the Convention of Railway Telegraph Superintendents New Orleans, May 19-22

By L. B. FOLEY

Superintendent of Telegraph Delaware, Lackawanna & Western R. R.

THE Lackawanna Railroad company has had in contemplation for the past five years the installation of wireless telegraphy for break-down, or emergency service and in 1909 conducted some experiments in that direction, but the apparatus at that time was not sufficiently developed to be of practical use. During the spring and summer of 1913 we erected steel towers at Scranton and Binghamton, obtaining wireless apparatus of the Marconi company for two 2 K. W. stations, one at Scranton and one at Binghamton, with a 1 K. W. installation on our limited train running between Hoboken and Buffalo.

On the roof of our Scranton passenger station we erected a tower 70 feet in height, giving a total elevation above the surface of the ground of about 175 feet, and from this point to a stack 175 feet high at our locomotive shops, 750 feet distant, installed a four-wire flat top antennæ. Lead wires were brought from the eastern end of the passenger station over the edge of the roof of the building to the operating room on the second floor. In this station is located a 2 K. W. radio-telegraph equipment. The transmitter includes a motor generator installed in the basement of the station and which, running at 1,750 r.p.m., converts the sixty-cycle three-phase central station energy into the required frequency at 250 volts for the radio outfit. The current is then led through a sending key to a transformer, where the electromotive force is stepped up to 20,000 volts and is used to charge a bank of six copper-plated Leyden jars (total capacity .012 microfarad) which discharge through a multiple plate quenching spark-gap in the usual manner, giving a high-pitched musical spark.

Inductively coupled transmitting circuits are used, the radio-frequency transformer and inductances being wound of strip copper in flat spiral form, clock spring fashion. A hot wire ammeter in the antenna circuits gives a reading of 14 amperes when the station is sending on a wave-length of 1,620 meters. The station is equipped with a small control panel carrying voltmeter, ammeter, wattmeter, frequency meter and generator field rheostat. The motor generator is started and stopped by two signal relays operated by a hand switch. The detector used is of the double crystal form. The receiving tuner is of the inductive coupled type with a switch for connecting the detector circuits directly to the antenna for "picking up" under broad tuning adjustment. No difficulty is experienced from interference and a broad-tuned circuit is used altogether for working with Binghamton and the train. Messages received at Scranton from Binghamton (63 miles distant) are copied on a typewriter. The Binghamton towers are 175 feet in height, with a four wire flat top antenna 400 feet long and have lead wires from the middle point to the station office which is located on the second floor of the Binghamton passenger station building and is equipped with the same apparatus as that used at Scranton. A change-over hand switch is used to transfer the antenna from sending apparatus to receiver. The quenching gap and blower are located just behind the operator.

On the "Lackawanna Limited" train the aerial or antenna is formed of wire arranged in four rectangles, one on the roof of each of the four forward cars, lengthwise, with an additional wire lengthwise, and all wires parallel with the top of the car, each rectangle being carried on porcelain insulators at the corners and center of each car, with wire linking connection between cars. The installation of the additional wire lengthwise and parallel with the top of the car, which at first was omitted, increased the transmission radius from the moving train to fixed stations from 50 miles to 87 miles, i.e., 37 miles. The four car-antenna form a flat top about 280 feet long, 10 feet wide and 12 feet above the rails. The wires clear the tops of the cars about 18 inches, being low on account of bridges and other overhead interferences; therefore, the radiating power is limited, but it is expected to make changes later, in the aerial on the train, to obtain a radius of 100 miles or more. The lead is taken from the middle of the antenna through the side of the second car, near the roof, into a compartment two feet by four feet, which contains the wireless apparatus and operator. The wireless apparatus upon the train is of 1 K. W. rating and similar in principle and operation to that at Scranton and Binghamton. The motor generator on the train is operated on 30 volts direct current from the car-lighting generator, which carries on its lines a set of storage cells. This motor generator draws about 40 amperes and provides alternating current at 250 volts for the radio transmitter, including a ten-unit quenching gap, three glass jar condensers of .002 microfarad each, and the usual radio-frequency transformers. The antenna current is high, due to the peculiar antenna conditions.

During the months of January and February we were obliged to make use of our wireless system to handle messages and train orders between Binghamton and Scranton on account of telegraph and telephone wires being damaged and communication interrupted by storms. On Sunday, March 1st, one of the most disastrous sleet storms known in this section of the country, followed by a heavy fall of snow and high winds, began in the afternoon and continued for a period of 18 hours, prostrating poles and wires within a radius of 100 miles from New York in Pennsylvania and New Jersey. The only service we had for a period of five days was by wireless; we handled all of our telegraph work by wireless between Hoboken and Scranton for a period of ten days. During the ten days 1125 messages were sent and received; on March 6th, 120 messages were handled by wireless between the above points between 9 A.M. and 6 P.M., many of the messages containing fifty words or more.

In addition to wireless installations at Scranton, Binghamton and on the Buffalo limited train, temporary wireless stations were installed at Hoboken and Dover.

The Lackawanna Company now has five wireless stations as follows:

Location	Call	Wave-Length
Hoboken	W B U	2100 meters
Dover	W B X	1000 meters
Scranton	W P T	1620 meters
Binghamton	W B T	1620 meters
Limited Train	W H T	1000 meters

We are equipping a 5 K. W. station at Buffalo which, when completed, will give us wireless service between Hoboken and Buffalo.

On April 1st our company had a special train, equipped with wireless telegraph apparatus, from Ithaca to Hoboken, carrying 550 Cornell students; our operator on board the train handled 128 radiograms from the train to fixed stations at Binghamton, Scranton and Hoboken for the accommodation of the students, who were en route to their homes for Easter.

Our experience with the wireless telegraph during the few months that we have had it in operation has been invaluable in many ways and it has been decided to extend the service over the entire system.

We have recently made some experiments with the wireless telephone in connection with our present installations, having transmitted communications a distance of 63 miles between fixed stations and a distance of 53 miles with a moving train.

The wireless telegraph can be depended on between fixed stations and between moving trains and fixed stations. The transmission is as rapid and reliable as that obtained over a Morse telegraph wire; therefore its many advantages and uses in railroad service can readily be understood by practical telegraph men. The cost of apparatus is a matter of negotiation and may later on be standardized by the Marconi company on the lines of the present standard telephone railroad agreement.

After a few weeks' use of the wireless we discovered many ways to use the service to advantage and, at the suggestion of one of our associate members, now in the wireless field, Mr. Nally, I compiled a list, on December 16th last, of some of the advantages to railroads of having wireless service as an auxiliary to the telegraph service. Later on, in the great storm of March 1st and 2d, we discovered that the wireless was not an auxiliary to the telegraph, but was a valuable substitute.

To the members who may not have read the communication referred to I take the liberty to quote a few of the conclusions:

"Communication by wireless telegraph to and from stations and moving trains is no longer an uncertainty. There are many fields for the wireless telegraph in railroad train operation. It will not be necessary to increase the number of trainmen, as a trainman can easily learn the telegraph alphabet, or a telegrapher can be utilized to operate the wireless, also performing the duties of a trainman. Later on it may be found necessary and profitable to install a telegrapher on limited trains running long distances without stopping to handle commercial telegrams for the public. Telegraph offices on trains, in the future, may be of as much value to the public as branch offices in hotels or other places where large numbers of people congregate. With direct communication the train dispatchers can keep in touch with the conductor of a train; in fact, the wireless permits the dispatchers to board every train. The Lackawanna company has used the wireless for handling train orders and finds it as accurate and reliable as the telegraph or telephone in transmitting these orders. The total loss of means of communication between stations, caused by prostrations of poles and wires, is a thing of the past."

THE SHARE MARKET

New York, May 18th.

The Mexican influence has been felt strongly during the week and the developments in the share market as a whole have not been favorable. Yet notwithstanding familiar discouragements and the pessimism to which many are weakly submitting there are fundamental reasons for taking a more confident view of the future.

The crop outlook is good and business conditions are generally sound. Persistent liquidation has served to weed out the weak spots, but because business has been conducted on a bedrock basis commodity prices have shown a very considerable decline. Right now there is no oversupply of desirable merchandise, and with basic conditions exceptionally sound the situation is positively ripe for a fresh movement. Confidence is the chief element lacking.

The unreasoning antipathy toward business enterprise is a state of mind which will have to exhaust itself. Sober second thought and average common sense strengthens the belief that the present spell must soon run its course and reason prevail, for it would seem that the very worst had been discounted.

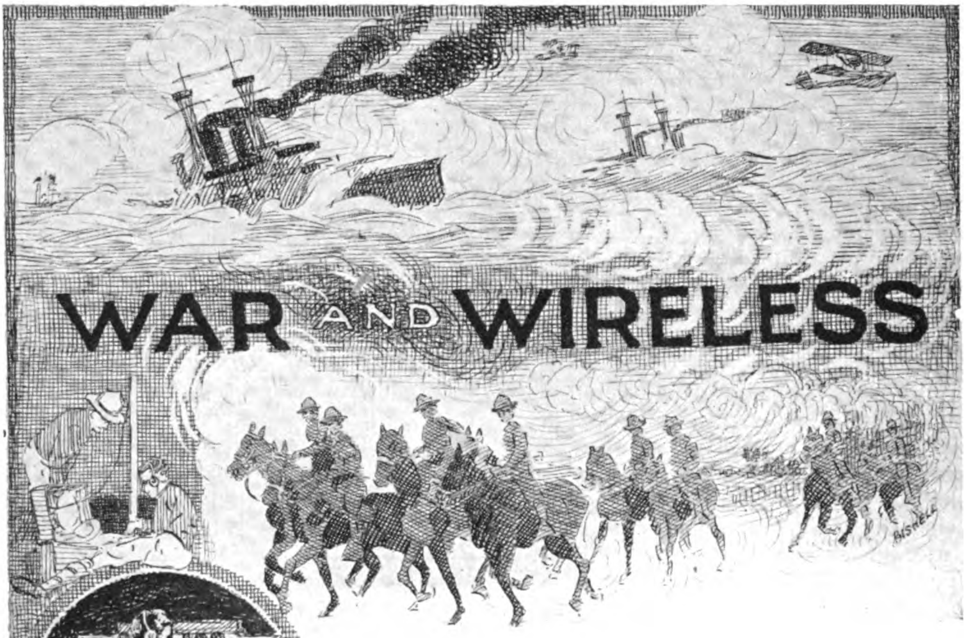
The slight gain in American Marconis may be a sign of incipient reaction and the fact that the local market stood the recent strain well affords promise of better conditions.

Bid and asked prices to-day:

American, 3¾—4; Canadian, 1⅝—2; English, common, 15½—17; English, preferred, 12—14.

MOTOR LIFEBOATS FOR LINER

A cablegram from Glasgow, Scotland, says that the first British motor lifeboat has just been supplied to the new Clyde-built Allan liner Alsatian, now sailing between Liverpool and Canada. The boat is 28 feet in length with a beam of 8 feet and is very compact. She is supplied with a four-cylinder Gleniffer paraffin motor, but her most striking feature is the complete wireless installation which she carries. The installation has a range of 100 miles.



WAR AND WIRELESS

I.

Plottin' routes on war-maps;
Gettin' sleep in cat-naps;
Tellin' flustered colonels exactly where they are.
Reelin' out on buzzer lines,
Peelin' eyes for smoke signs;
Info' for the "Old Man"; gathered near and far.

II.

Ridin' with the scout-screen,
Seein' what's to be seen,
Radio goes trottin', mule team on a spree.
Soon it's "Open Station!"
Workin' like 'tarnation,
Settin' up the pack-set; poundin' on the key.

III.

Huskies on the hand cranks
Makin' the old mill clank;
Humpin' up their shoulders, turnin' out the juice.
Operator sweatin',
Section chief a-frettin',
Gotta get headquarters; won't take no excuse.

IV.

Driver of a reel cart—
Tell you, that's a real art
Handlin' of your clutches; payin' out the line.
Lancemen ridin' after
Ain't got time for laughter;
Toilin' with their pikepoles; dasn't waste their time.

V.

River swiftly flowin';
Got to keep on goin',
Ain't no ford across it? Wig-wag, swim or flash.
Lines of information,
Miles of separation,
Must at once connect 'em, by the dot and dash.

WARFARE teems with stories of strategy and if the hostilities between the United States and Mexico continue it is likely that many of these tales will be linked with stories of the achievements of wireless telegraphy. In any crisis which confronts a military force efficient communication is an all-important factor. When the far-reaching use to which wireless can be put in warfare is carefully considered its possibilities in times of strife seem endless.

Even in the early stages of hostilities in Mexico wireless has already shown its worth; the air has been filled with marconigrams telling of the progress of the strife and containing news about Americans whose fate was in doubt. Perhaps the best tribute to the value of wireless is contained in the story of how the commander of a United States force, ordered to surrender by Mexican troops, utilized the art.

The Mexicans outnumbered the Americans, but the commander of the latter, instead of yielding to the demand for surrender, sent a wireless message to the commander of the United States troops at Vera Cruz; and in about an hour the small detachment of Americans had been reinforced by almost a thousand men. It is needless to say that there was no American surrender.

In the army the chief users of wireless telegraphy are the members of the Signal Corps. These men are detailed to accompany the main body of the independent cavalry, far ahead of the army. The commander of the independent cavalry is instructed to keep in communication with the principal American force—that is, to send information as speedily as possible concerning what he has learned of the movements of the enemy.

The advance proceeds without incident for some time. The men of the cavalry are scattered far over the country, keeping a sharp lookout for the enemy, blocking its patrols from reconnoitering and preventing hostile soldiers from obtaining a position from which an attack could be made in force. Day by day the advance proceeds without any signs of the foe. Then, without warning, a clatter of rifle fire comes from the front. This is the signal that the cavalry has come into contact with the enemy. The commander of the field army is far in the rear and it is imperative that he should be informed at once of the proximity of a hostile force.

In years gone by mounted messengers would have been sent galloping back. The portable wireless set has made this unnecessary.

The commander of the cavalry nowadays hurriedly writes a message to the general giving him the essential information and hands it to the sergeant riding at the head of the Signal Corps.

Then the section chief calls "open station" and the riders turn and dismount. The horses are linked in a circle and placed in charge of one man, while the others turn their attention to the pack animals. These animals accompany the detachment, bearing boxes containing wireless equipment, and sections of poles attached to the pack saddles. The burdens borne by the pack animals are hurriedly yanked off and then begins the task of putting the wireless apparatus in position.

The leading pack horse bears a small iron frame. The instant the latter touches the ground one man springs upon it, holding 'a section of pole from which radiate the wires of the antenna. Four men are paying out these wires from hand reels. The man on the frame raises the pole, another man glides under it; there is a snap, it is made secure and the pole goes up higher. Section after section is added and the mast finally extends sixty feet in the air.

A wave of the hand from the section chief starts a squad of men driving insulated pegs into the ground. They fasten the ends of the antenna and drag out four long lines of rubber-covered wire, composing the counterpoise or artificial ground. A chest is opened and adjustments of wires are made; then the chest is coupled to a wire from the mast and connection is made with the ground. Upon the iron frame is fastened a small dynamo, a half-kilowatt hand generator, the cranks of which are grasped by four men. The generator is connected to the instrument chest and the crank men start heaving.

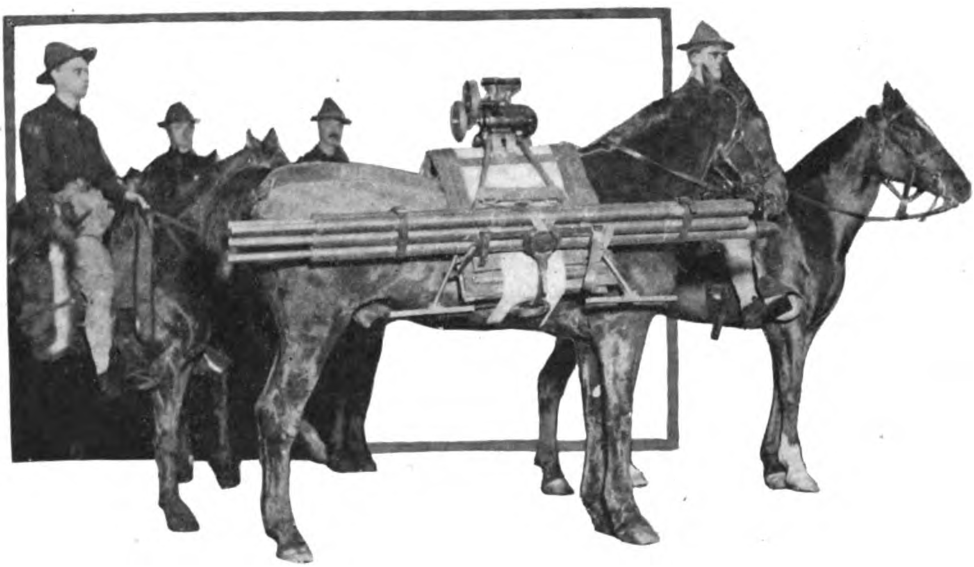
A similar piece of apparatus is set up in the headquarters of the army or in a place designated by the general. This set remains there during the day, for the army moves slowly, while from it a buzzer line extends to the actual whereabouts of the commanding officer himself.

An incident that well illustrates the usefulness of wireless telegraphy in warfare occurred when the Mexicans demanded the surrender of the detachment which was guarding the water works at El Tejar. Major Russell was in command of the American force, which was a small one and might have been easily defeated by the Mexicans. Instead of hoisting the white flag, however, the American commander sent the messenger carrying the demand to surrender back to the Mexican lines and dispatched a wireless message to General Funston at Vera Cruz.

Within a few minutes Major Russell was told by wireless that reinforcements were on the way to aid him, and about an hour afterward the little outpost contained a garrison of 1,200 men instead of only 240 marines; moreover, the entire American force at Vera Cruz was in readiness for an order to advance at any moment.

When the reinforcements, consisting of seven companies of the Fourth Infantry, as well as two battalions and three companies of marines, arrived at the water works station, Major Russell and his men were not in the least hard pressed. The Mexicans had contented themselves with a scattering fire of not more than four or five shots and only one shot was fired by the Americans.

In little more than an hour after fourteen American marines from the whaleboats of the transport Prairie landed at Pier 4, Vera Cruz harbor, under command of Captain William R. Rush of the flagship Florida, a squad of signal corps experts had erected a mast on top of the Terminal hotel. Information and requests for instructions went through the air to Rear Admiral Fletcher in the harbor, and through him to Rear Admiral Badger, fast approaching with another division of the Atlantic fleet. A few moments after the customhouse fell into American hands a large force of Mexicans was seen moving over the hills in the western outskirts of the city. Their intention, as read by Captain Rush, was to flank a battalion of our marines in the railway yards along Montesinos Street. No time was lost in getting word to the Prairie, and in short order the transport's guns had broken up any hope of Mexican interference from that quarter.



Animals accompany the detachment, bearing boxes containing the wireless equipment, and sections of poles attached to the pack saddles. The masts and apparatus may be unloaded with great rapidity, yet they are securely attached to the saddle

It is safe presumption that from day to day the work of the field companies and signal corps will figure more and more in the war news. The public will discover what the military man knows already: that there are new units of war—the field companies—whose work is as effective and as necessary, if not as conspicuous, as that of the fighting regiments and the fighting companies.

The plans of the war department are as follows:

For every division of the army there are to be two field companies, each carrying three complete sets of wireless equipment, with dynamo, transmitting apparatus, and forty or ninety foot masts. The men of the signal corps have carefully studied the field regulations sent out by Major-General Leonard Wood, chief of staff.

In these instructions it is ordered as a working rule that the wireless shall be used whenever the distance, the character of the service, and the nature of the country prevents the laying of telegraph lines. The fact that also it is to be used to intercept messages of the enemy raises the question of whether one may soon hear of the "wireless spy" in warfare. It will be of particular benefit to the mobile cavalry, and it will also be used to keep parallel columns in communication on the march.

The Marconi Wireless Telegraph Company of America recently completed at its factory at Aldene, N. J., the first of the new army cart sets designed for use by the Signal Corps. The cart set combines every essential required for the hardest kind of service and will transmit messages at least 300 miles under all weather conditions. It will receive messages sent from any distance up to 3,500 miles.

The set consists of two carts which are attached together to form a wagon when the outfit is in transit. The carts, when joined, are drawn by four horses or mules, and carry eight men. The forward section, or cart No. 1, holds a complete sending and receiving outfit; the rear cart carries an 8-horsepower Sterling motor, operated at 1,200 revolutions per minute, which is connected direct to a two-kilowatt generator. Eight lengths of bamboo, jointed to form an aerial eighty feet long, are strapped to the sides of the cart. This pole carries the antenna which intercepts the sound-waves in the air and conducts them to the receiving apparatus. The carts are painted in a shade of gray peculiar to the use of the army signal corps. They are built to withstand the severest strains incident to hard usage and passage over rough ground. The generator that supplies power for the sending apparatus of the outfit also supplies current for six incandescent lights for use at night.

Because of the whirring sound of the generator the two carts are separated a distance of about seventy-five feet while the outfit is being used for receiving messages. The receiving set consists of two pairs of telephone receivers, various forms of tuning inductances, variable condensers, a wave meter, and two detectors, three large voltage and amperage meters, rheostats, and other appliances. The transmitting apparatus consists of a sending key, condensers, transformers and generator, three large volt and ammeter rheostats and other appliances.

The Marconi company is also completing an automobile wireless telegraph outfit, combining sending and receiving stations on the same chassis, which will be equipped with a motor to serve the dual purpose of furnishing power to operate the car and also supply the power for the generator.

There has been a considerable change of opinion during the last few years concerning the wireless apparatus wanted for military purposes. The following is an example of the old specifications for portable military stations:

"The sharpness of the tuning of the stations is to be five per cent.—that is to say, a change of wave-length of five per cent in the tuning of the receiver must render readable signals inaudible, after which a corresponding change of five per cent. in the tuning of the transmitters must render the signals readable again."

The authors of these specifications apparently believed that they were guarding as much as possible against interruption of communication by hostile stations. In order to meet these requirements, however, experimenters developed very sharply tuned transmitters. The stations interfered little with the working of the enemy's stations, but provided no advantages for doing away with interference of hostile sets with the communication between their own stations. The operators at these stations discovered that their receivers were not affected by their own transmitters if their wave-length differed by more than five per cent. They discovered, however, that other stations of a commercial type, differing in wave-length by considerably more than five per cent., interfered to a great extent with their operations.

This is explained by the fact that interfering stations were using closely coupled transmitters which emitted a wave with flat tuning and comparatively high damp-

In the field regulations it is ordered that wireless shall be used whenever the distance, the character of the service and the nature of the country prevent the laying of telegraph lines

ing. The sharply tuned receivers of these receiving stations were not affected by the highly tuned transmitters of the military stations differing slightly in wave-length. In consequence the commercial stations kept up good communication between themselves and effectually interfered with marconigrams between the military stations.

The conclusions of wireless experts who have followed closely the operation of wireless stations in war are as follows:

The transmitters should not be sharply tuned; the receivers should be open to extremely sharp tuning; changes of wave-length, either in the transmitter or the receiver, should be brought about by the movements of a single handle controlling all the circuits.

The Marconi field stations adequately comply with all of these requirements. The coupling of the transmitting circuits gives flat tuning to the transmitting wave and keeps maximum efficiency. The movement of a single handle effects a change of wave-length of both transmitters; it also effects the change of wave-length of the receiving circuit. By arranging the receiver the sharpest possible tuning is given, even against interference from comparatively flat-tuned and highly damping stations. Interference can be escaped more easily if the enemy uses sharply pointed transmitters.

A new wireless station mounted on a motor truck is being constructed with all haste for use by the Signal Corps in Mexico. The machine is being built on a new design by Signal Corps engineers.

A new "rapid transmitting panel," containing the latest improved wireless apparatus has been set about midway in a big six-cylinder auto truck, which carries in boxes at each side, a jointed portable aerial reaching eighty-five feet into the air when fully extended. The electric power for the wireless is furnished by the motor of the truck in direct connection with an electric generator, supplying enough current to light the mounted wireless room and run the instruments at their full capacity. The apparatus has a range of 400 to 800 miles in sending, and of nearly 2,500 miles in receiving. The machine is for service at the army's general headquarters, giving the commander of forces easy communication with a fleet at sea, or with any of the small portable field instruments carried by sections of the Signal Corps.

In recent preliminary trials the machine was subjected to strict tests. As soon as the work reaches a satisfactory stage of completion field tests will be given and the possibilities of the equipment accurately determined. Quick shipment to Mexico will follow.

It is likely that aeroplanes will be frequently used by the American forces in Mexico. Experiments with wireless telegraph sets on flying machines have led to the conclusion that a station which will be able to transmit communications more than fifty miles under all conditions will be a reality within a short time. The Marconi aeroplane set was designed purposely to make it adaptable, as far as possible, to any type of flying machine. In constructing aeroplane sets it was found difficult to build sets which came within the weight limits and provide an effective aerial system. Designed to have the widest possible margin for the distribution of weight, the Marconi aeroplane set has been made up into several separately contained units.

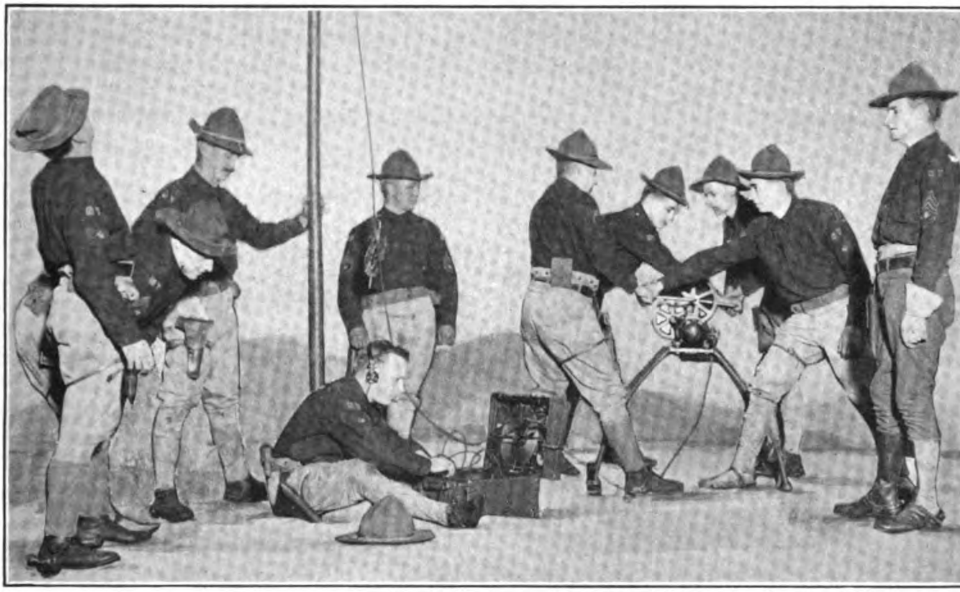
The strength of the apparatus was shown when an accident occurred in Great Britain to a Flanders monoplane on which a set had been installed. The aviator in charge of the flying machine started on a long flight. A peculiar accident occurred after the aviator had circled about the surrounding country several times. The machine was flying at no great distance from the ground, and when he suddenly descended to effect a landing, the first skid of the machine caught in the earth. The monoplane, which was flying at more than sixty miles an hour, "turned turtle" and the aviator was hurled to the ground, sustaining serious injuries.

As a result of the accident the fusilage of the machine was smashed in two places and the propeller considerably damaged. Although the wings escaped great damage it was necessary to have them stripped of their fabric and overhauled. The front skid was broken in half and the exhaust pipes, radiators and lubricating pipes on the engine were damaged. The oil tank to which the wireless apparatus was connected was demolished, and, therefore, it was expected that the installation would be found out of commission. It was discovered, however, that the set had not been damaged in the least and was in excellent condition to be operated. Even the aerial wire, which was attached to the broken fusilage, remained unbroken.

In the early experiments with wireless sets on flying machines a trailing wire was used. It is now possible to use an aerial wire contained in the machine. This is a considerable advantage over the old method because it enables the pilot to steer his aeroplane nearer to other machines and does away with the difficulties which might be experienced from a trailing wire when making a landing in a confined space.

Experimenting with wireless apparatus on aeroplanes has not been done without loss of life. During a flight at the Brooklands Aviation Grounds, made for the purpose of experimenting with wireless, Mr. Fisher, the pilot of the Flanders machine, was carrying a passenger. Fisher was circling about the grounds for the third time when he lost control of the machine and it fell to the ground. Both men were killed as a result of the accident.

In the navy wireless fills as an important place as it does in the army. Graduates of the signal school of the Newport Training Station are aboard the vessels of the United States fleet now in Mexican waters, keeping the Washington officials informed by wireless of the conditions on the coast of the enemy's country, and sending important communications.



Wireless telegraphy is playing an important part in present-day military operations, for these stations have a range of many miles, are easy to transport, and carry messages independent of wireless that might be cut by the enemy

The Engineering Measurements of Radio Telegraphy

By ALFRED N. GOLDSMITH, Ph.D.
Instructor in Radio Engineering, The College of the City of New York

ARTICLE IX

A method of measuring inductance accurately at radio frequencies and low voltage, partly due to Dr. Seibt, is considered in detail. Examples of measurements obtained by this method are given. In this connection, a general method of studying an algebraic power relation between two related quantities is described, and its application to the relation between the inductance of a coil and the length of the coil is shown.

WE pass now to measurements of inductance at radio frequencies. The first method described is a very convenient null method, which is so simple in operation and is capable of application to inductances of such widely different values that it has been found of advantage to keep the apparatus described permanently set up, in order that permanent means for rapidly determining unknown inductances shall be available. Section 25. MEASUREMENT OF INDUCTANCE AT RADIO FREQUENCIES AND LOW VOLTAGE BY THE MODIFIED SEIBT METHOD. The following method is suitable for the measurement of air-core inductances between a microhenry and several hundredths of a henry. In general, the frequency at which the measurement is made is dependent on the inductance to be determined. The method is largely due to Messrs. Lester Israel and Alfred Kuhn, and is based on the Seibt method of measuring capacity.

(a) THEORY. Let the two oscillating circuits, I (consisting of the inductance L_1 and the capacity C_1) and II (consisting of the inductance L_2 and the capacity C_2) be connected so that their capacities are joined in series as indicated in Figure 51. Furthermore, suppose that the source of electricity, S, charges the capacities C_1 and C_2, and that these capacities are then discharged through their respective inductances producing free alternating currents in circuits I and II. We assume that there is no reaction (or coupling) between circuits I and II. Let i_1 be the current that flows in circuit I, and i_2 that in circuit II. We desire to find the condition that must be fulfilled in order that $i_1 = i_2$. Let e_1 and e_2 be the potentials to which C_1 and C_2 are charged.

To begin with, we know that the total potential difference of the source S will be divided between the capacities C_1 and C_2 in inverse proportion to their capacities. That is,

$$\frac{e_1}{e_2} = \frac{C_2}{C_1} \qquad (63)$$

When the capacity C_1 is fully charged, the energy stored in it is

$$W_e = \tfrac{1}{2} C_1 e_1^2 \qquad (64)$$

When this capacity has fully discharged itself, and the current through the inductance L_1 is a maximum, the energy in the magnetic field of the inductance is

$$W_m = \tfrac{1}{2} L_1 i_1^2 \qquad (65)$$

If we take the resistance of circuit I as negligibly small (which is a condition which is fairly easily fulfilled in practice), we may take

$$W_e = W_m$$

by the law of the conservation of energy.

Consequently,

$$\tfrac{1}{2} L_1 i_1^2 = \tfrac{1}{2} C_1 e_1^2 \qquad (66)$$

and similarly for circuit II,

$$\tfrac{1}{2} L_2 i_2^2 = \tfrac{1}{2} C_2 e_2^2 \qquad (67)$$

We divide equation (66) by (67), remembering that we have assumed that $i_1 = i_2$. We obtain, after algebraic simplification,

$$\frac{L_1 C_2}{L_2 C_1} = \frac{e_1^2}{e_2^2} \qquad (68)$$

Introducing now the condition of equation (63), we find finally,

$$L_1 C_1 = L_2 C_2 \qquad (69)$$

Consequently, we reach the interesting

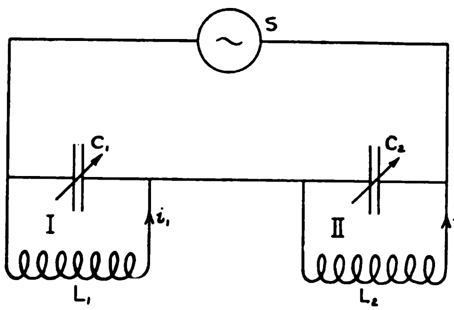


Fig. 51

conclusion, that for equality of currents in circuits I and II, we require only equality of periods (or wave-lengths) of these circuits, quite regardless of the ratio of the values of the inductance and capacity of each of these circuits. (This is true only if the dampings of the circuits in question are negligible.)

Let us consider now the arrangement shown in Figure 52. Circuits I and II are each coupled inductively with circuit III by means of the inductances L_3 and L_4. We take $L_1 = L$, and we arrange L, L_1, L_3, and L_4 so that the mutual inductance between L and L_3 is equal to the mutual inductance between L_1 and L_4. Also, we make $L_3 = L_4$. As will be seen, coils L_3 and L_4 are connected in opposition in the circuit III, so that, if equal currents flow in L and L_1, the indicator I will not be affected. That is, as we have shown above, there will be no indication in circuit III if the periods of circuits I and II are equal.

The insertion of ah extra inductance L_x in circuit II and the changing of C_1 to a new value such that the original period is retained unchanged, will therefore cause no change in the indication in circuit III. We will assume that we are provided with one standard inductance L_n, and that we desire to measure the unknown inductance L_x. In succession we arrange circuits I and II as indicated in Figure 53, parts (A), (B), and (C). In each of these cases, circuits I and II have the same period as is shown by zero indication in circuit III. As will be seen from part (B), when the standard inductance L_n is inserted in circuit II, the capacity C_1 must be changed to C_2 for equality of periods; and when the inductance L_x is inserted, C_1 must be changed to C_3.

The following relations hold:

$$LC = L_1 C_1 \qquad (70)$$
$$LC = (L_1 + L_n)\, C_2 \qquad (71)$$
$$LC = (L_1 + L_x)\, C_3 \qquad (72)$$

From equations (70) and (71), we find very readily,

$$L_1 = \frac{C_2}{C_1 - C_2} L_n \qquad (73)$$

and from all three equations, we find,

$$L_x = \frac{C_2 (C_1 - C_3)}{C_3 (C_1 - C_2)} L_n \qquad (74)$$

So that, if we have the calibration of the condenser of circuit II, and know the value of the standard inductance L_n, it is possible to measure any unknown inductance by merely inserting it in place of L_n, and noting the new setting C_3 of

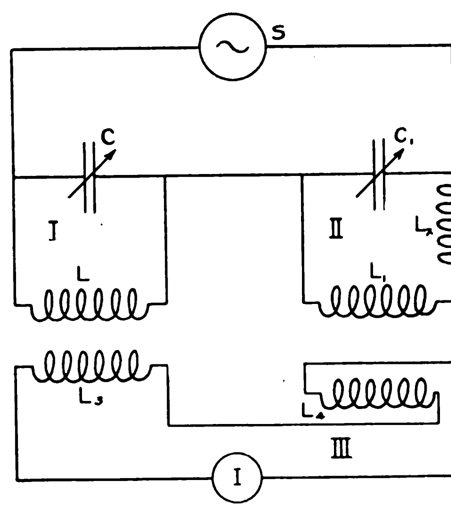


Fig. 52

the condenser corresponding to a zero indication in circuit III. Indeed, we may calculate, with a given apparatus, the values of L_x corresponding to any particular C_3, so that the operation of determining an unknown inductance can be very readily accomplished.

(b) ARRANGEMENT AND DESCRIPTION OF THE APPARATUS. A wiring diagram of the entire apparatus

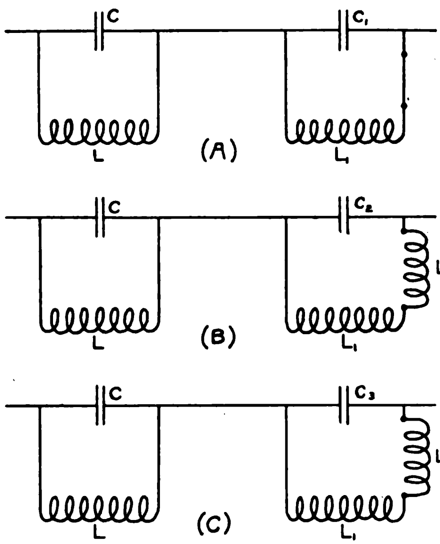


Fig. 53

is shown in Figure 54. The buzzer A is operated by the battery B, the current being controlled by the resistance R. In this way, because of the inductance of the buzzer magnet winding the condensers C and C_1 are periodically charged. It will be seen that, in the gap in circuit II, there can be inserted either a short piece of wire, a standard inductance L_n, or the unknown inductance L_x. Care must be taken to place this gap in circuit II at the proper point. A common mistake is to place the gap at one of the points indicated by crosses on the lead wires to the condenser C_1. If this mistake is made, the apparatus will not operate properly. As will be seen, L_3 and L_4, which are the secondaries corresponding to the primaries L and L_1, are connected in opposition. The indicator used was a combination of crystal detector D and telephone T. A galvanometer was substituted for the telephone receiver in one series of observations, to compare it with the telephone. The entire apparatus is shown set up in Figure 55. The buzzer A was a small "Lungen" high pitch buzzer. It is shown, together with its controlling resistance R in the center background. The two condensers C and C_1 are in the back to the right and left. They were each 0.005 microfarad variable air condensers. The two couplers, L L_3 and L_1 L_4 are in the center front. They are mounted at right angles on a common base. Situated between them, and with its axis at right angles to that of each of them, is the standard inductance L_n. All these coils were single layer coils wound with silk-covered copper wire on wooden cores. In the foreground are visible the crystal detector (which was of the "Pyron" type), the 2,000 ohm double head band telephone receivers, a throw-over switch for use in circuit II, and an unknown coil on which some measurements of inductance were made.

(c) PROCEDURE. With the gap in circuit II short-circuited, the apparatus is set in operation. If alteration of capacity C_1 does not produce a silence point in the telephones T, it is probable that either C_1 is smaller than C or that L_1 is smaller than L, or that coils L_3 and L_4 are not properly connected in opposition. The first trial should be to reverse the connection say of L_4. Condenser C should then be set to such a value that the silence point is obtained with prac-

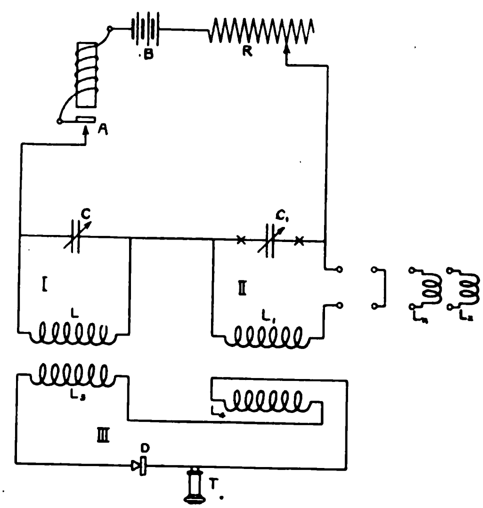


Fig. 54

tically all the capacity C_1 inserted in circuit II. That is, the reading of capacity C_1 for the silence point with no added inductance in circuit II should be at about 170° (on a condenser graduated

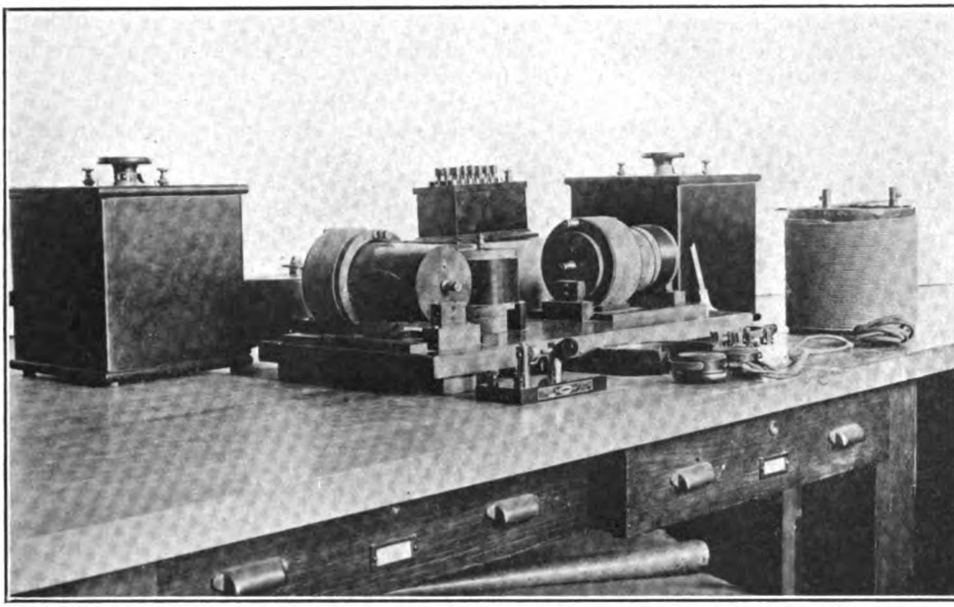


Fig. 55

from 0 to 180°). L_n should then be inserted in the gap, and the value C_2 for silence obtained. And finally L_x should be inserted in the gap, and the silence value of the capacity C_3 recorded. It is to be noted that if the apparatus is rigidly and well set up, the observations of C_1 and C_2 may be taken once and for all, and need not be repeated each time a new unknown inductance is measured. However, if there is any doubt as to whether the apparatus has been put out of adjustment between measurements, the first two observations should be repeated before each new measurement.

Since the effective damping of circuits I and II is affected by the reaction on these circuits of circuit III, it follows that, for an equality of damping in these circuits, the coupling between L and L_3 should be the same as the coupling between L_1 and L_4. The coils L_3 and L_4 should therefore be so arranged that by sliding or turning them the couplings referred to can be easily adjusted. A sharp silence point is practically always dependent on this adjustment. Furthermore, if an unknown inductance of high resistance (which therefore introduces a large damping in circuit II) be measured, the sharpness of the silence point will disappear, but can be at least partially restored by slightly readjusting the couplings. Care should be taken that the crystal detector is in a sensitive adjustment, and that the buzzer is working steadily, preferably on a small current. In adjusting the capacity C_1, the body of the observer should not be too near it. This measurement is an extraordinarily sensitive one, and the capacity of the body near C_1 is quite sufficient to make a marked change in the position of the silence point. If condensers of the usual variable air type, having movable plates mounted on a vertical spindle, are employed, care should be taken not to press downward forcibly on the knob of the condenser in adjusting it, since such condensers are generally not sufficiently rigid to hold their capacity unchanged under such treatment. The knob should be rotated by applying a tangential force of rotation to the circumference of the knob.

(d) ERRORS OF THE METHOD; THEIR ELIMINATION; AND PROBABLE ACCURACY. A single layer standard inductance of (calculated) value 0.0001897 henry was tested against an unknown inductance. The variable condenser employed in circuit II was a calibrated standard which, for the range of settings employed, had capacities which were proportional to the settings.

It was found that

$$C_1 = 171.4 \pm 0.1^\circ$$
$$C_2 = 58.6 \pm 0.1^\circ$$
$$C_3 = 84.9 \pm 0.2^\circ$$

(The diminished accuracy in the case of C_3 was due to the higher resistance and distributed capacity of the unknown inductance.)

Hence $L_x = 0.0001004$ henry
(Accurate to 0.5%)

The unknown inductance used was actually a precision 0.0001000 henry coil wound with litzendraht (multiply stranded wire) on a serpentine core. The agreement of its theoretical value with that experimentally determined is satisfactory.

Using as an indicator a galvanometer of 164 ohms resistance, and for which one degree deflection corresponds to $5.1 (10)^{-6}$ amperes, the accuracy of the measurement was 1%.

From equation (73), we find that

$L_1 = 96.7 (10)^{-6}$ henry

So that the wave-length at which the measurements were made is 1,310 meters, corresponding to a frequency of 229,000 cycles per second. Furthermore, the decrements of circuit II were of the approximate value of 0.01; and for circuit I, about 0.005.

A single layer inductance having a number of fixed sections was then measured. It was wound with heavy copper wire on a core 18.4 cm. in diameter, and the lengths of the windings of each section measured parallel to the axis of the coil were measured. They were respectively 3.8, 7.6, 11.5, 15.1 cm. The inductances of these various sections, measured in microhenrys, were 31.5, 94.6, 172, 258. It was decided to study more in detail the relation between the length of the sections and their inductance, and since the methods used are applicable in a wide variety of cases, we shall consider them quite fully.

Section 26. ON THE DETERMINATION OF THE RELATION BETWEEN TWO QUANTITIES (for the case of an algebraic power relation).

Let us suppose that we have measured two quantities, x and y. These quantities depend on each other in such a way that when one is changed, the other is changed also. Thus, one may be the *capacity* of a parallel plate condenser and the other the *distance* between the plates; or one may be the *effective resistance* of a wire and the other the *frequency* at which that resistance is measured. Or, as in the case we are considering, one may be the *inductance* of a cylindrical coil and the other the *length* of the coil. What is desired is the exact algebraic relation between them. Unfortunately, unless this relation is of a very simple form it is very difficult to determine it, and about all that can be done is to note to what extent the relation between the quantities under consideration differs from certain standard algebraic forms. This will be the case with the relation between the inductance of a coil and its length, for the relation in that case can be shown to be a very complicated one.

As is well known, the inductance of solenoids is proportional to the square of the length of the coil, provided that the length is *very great* in comparison with the diameter of the coil. If the length and diameter of the coil are not widely different, the square law is not accurate, and the smaller the length of the coil compared with the diameter, the less accurate it is. Let L be the inductance of any portion of the coil, and s its length. Then, if L varies as s^2, L/s^2 must be a constant for all values of L and corresponding values of s. We shall test this for the coil we have just measured.

s	L	L/s^2
3.8	31.5	2.18
7.6	94.6	1.64
11.5	172.0	1.30
15.1	258.0	1.13

Here s has been expressed in cm., and L in microhenrys. On examination of the columns L/s^2, it will be seen that it is not constant, so that for these short coils, the inductance does not vary as the square of the length. However, the differences between the successive values of L/s^2 are 0.54, 0.34, and 0.17. It will be seen that these differences are rapidly diminishing; that is to say, that L/s^2 is approaching a constant value as s is increased. Our original statement, that for long coils the inductance varies as the square of the length is thus verified, and the deviation from this law for short coils is also clearly indicated.

The method just shown for determining the law connecting L and s suffers from the drawback that if we do not know in advance from theoretical considerations that the inductance depends on the *square* or some other *definite* power of the length, we should be at a loss as to how to proceed. This defect is in large part remedied by the following logarithmic method, which applies broadly to every case where one quantity varies directly as some definite power of another quantity, and that power is to be determined.

Let the quantities be x and y, and suppose that

$$y = m x^n$$

where m and n are constants. From this equation we have,

$$\log y = \log m + n \log x \qquad (75)$$

or

$$\frac{\log y - \log m}{\log x} = n, \qquad (75)$$

which is a constant.

Consequently, we may determine n as a constant, if the relation between x and y is the one stated. Suppose that we take for our unit of measurement of x a quantity such that the first (and smallest) value of y corresponds to it. Then, since the first value of y corresponds to a value unity of x, we have, from equation (75),

$$\log y_1 = \log m \qquad (77)$$

where y_1 is the first value of y. This follows because the logarithm of unity is zero. Calling x_1 the first value of x, we compile the following table in any given case:

y	x	$(x/x_1) = X$	log y	log X	$\frac{\log y - \log m}{\log X}$
y_1	x_1	1	log m	O	Indeterminate
...	..	......	...	...	n
...	..	......	...	...	n
		etc.			

If we apply this to the case of the coil we have been considering, taking L for y, and s for x, we obtain the following table:

L	s	$(s/s_1) = S$	log L	log S	$\frac{\log L - \log m}{\log S} = n$
31.5	3.8	1.00	1.498	0.000	....
94.6	7.6	2.00	1.976	0.301	1.59
172.0	11.5	3.03	2.236	0.481	1.53
258.0	15.1	3.97	2.412	0.599	1.51

The conclusions to be drawn from the values of n in the last column of this table are identical with those obtained from the first table.

If the relation between the quantities under consideration is more complicated, some assistance can usually be obtained from a knowledge the standard curve forms and their corresponding function relations as studied in Analytic Geometry. In general, however, except in the simple case just considered, the task of discovering the relation involved between two sets of observations is an extremely difficult one.

This is the ninth article by Dr. Goldsmith, in a series on the engineering measurements of radio telegraphy. The tenth will appear in an early issue.

A CHAIN BETWEEN ENGLAND AND MANXLAND

An English newspaper declares that wireless telegraphy between England and Manxland is assuming tangible shape, Lord Raglan having declared that telephonic communication was practically financially prohibitive. Lifelong experienced maritime captains and globetrotters interviewed emphasized the comparative security and unique importance of insular wireless installations.

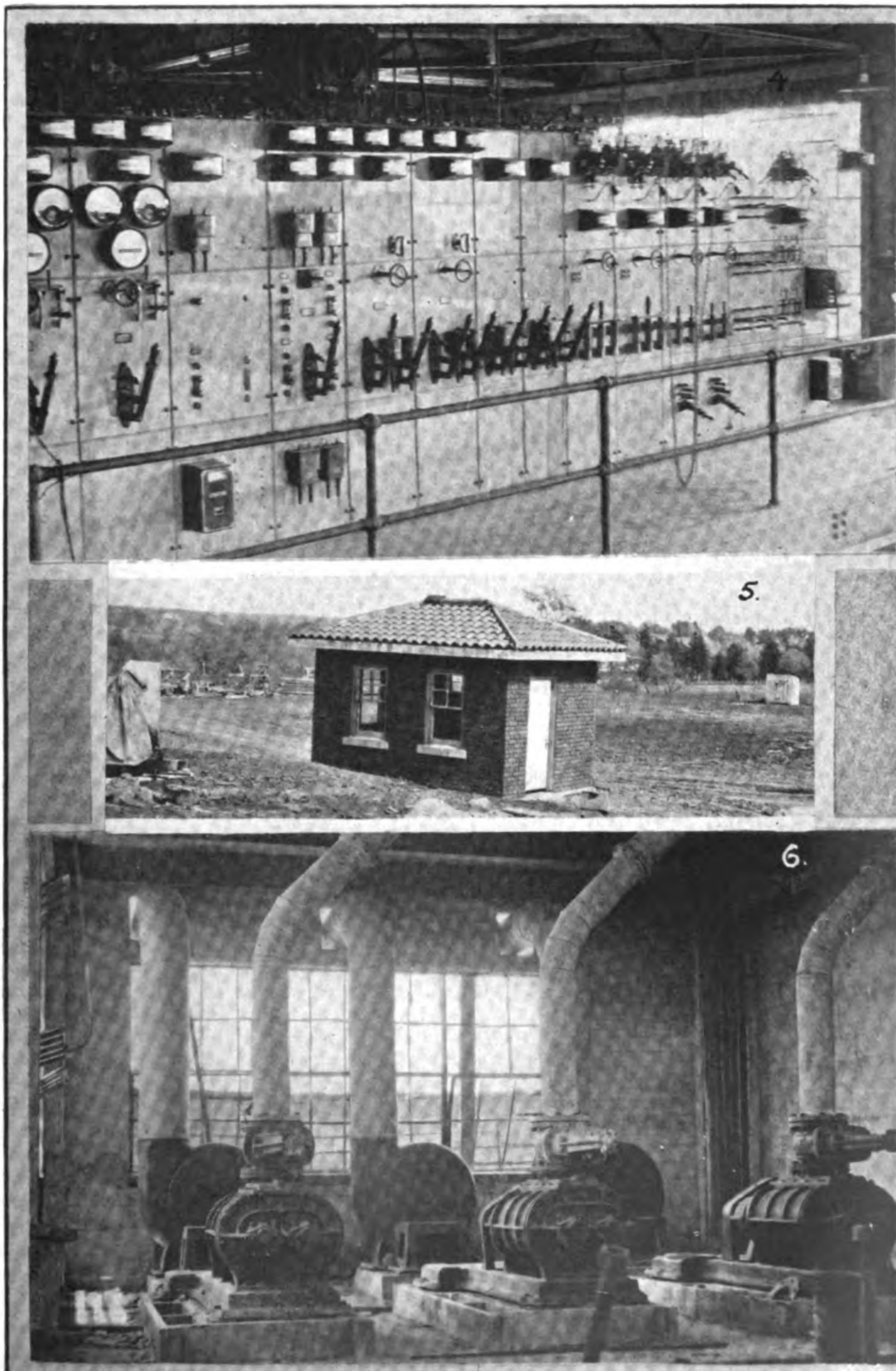
AMATEUR PENALIZED FOR VIOLATING THE LAW

A wireless amateur of Los Angeles was reported to the United States Attorney for operating his station without a license and causing interference, being a violation of section one of the Act of August 13, 1912, to regulate radio communication, for which a penalty of $500 is provided and the apparatus may be confiscated, in the discretion of the court.

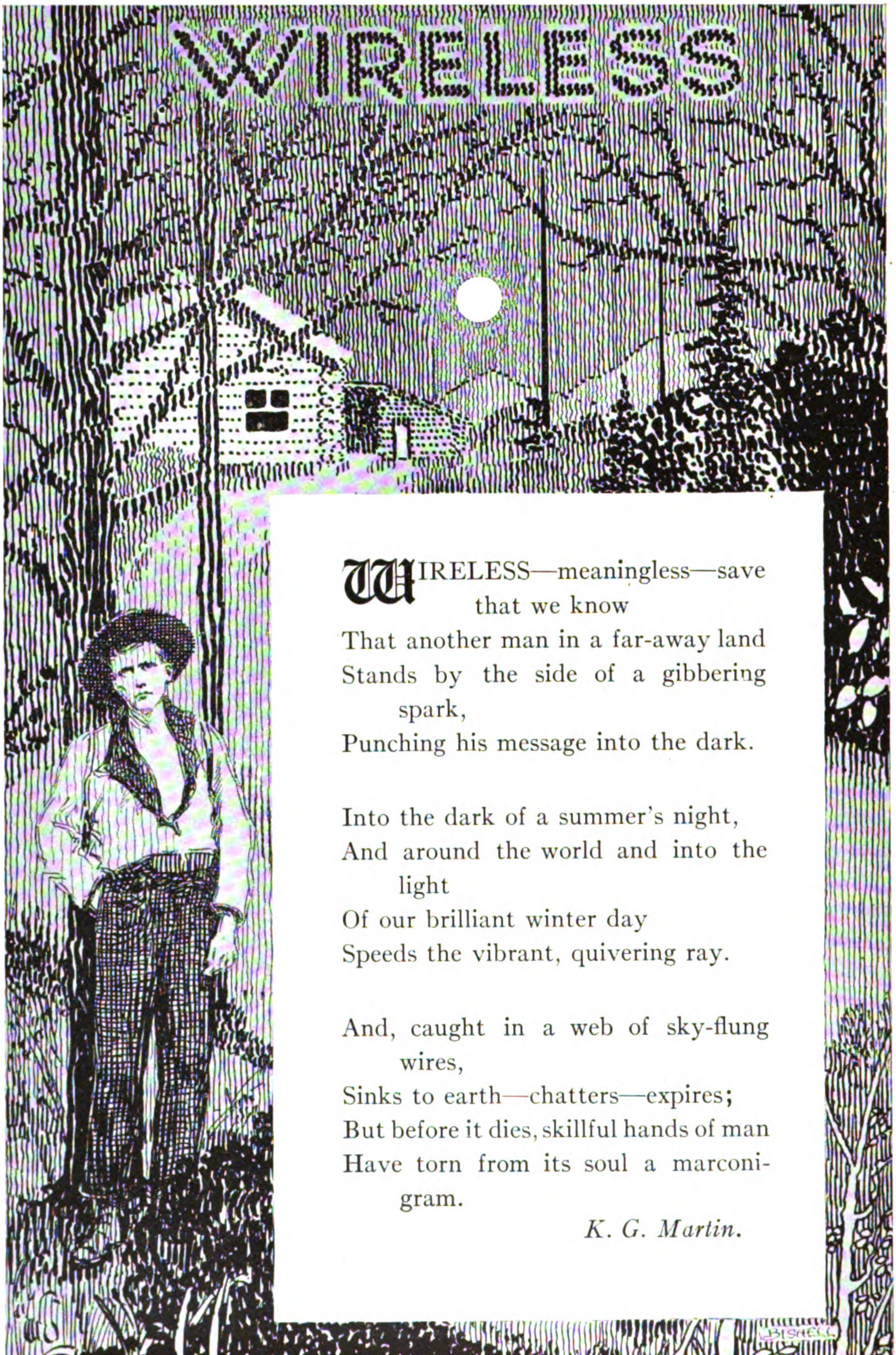
Judge Wellborn of Los Angeles, in passing sentence upon the offender, stated that as this was the first prosecution under the law in his district, he would assess only a nominal fine, with the understanding that all future prosecutions under this Act would be dealt with summarily, and the punishment materially increased. In view of the fact that the offender had disposed of his apparatus shortly before his indictment, the judgment did not include the confiscation provided by law.

(1) View of the auxiliary operating building and power house at New Brunswick. (2) Where the messages will be received at Honolulu. (3) General view of the living quarters at New Brunswick, with a view of some of the masts.

Stations near Completion



(4) An interesting view of the switchboard at the New Brunswick station. (5) A typical pu house, illustrating how carefully the architectural features of the buildings are carried through (6) Interior of the Honolulu power house, showing the blowers.



WIRELESS—meaningless—save
that we know
That another man in a far-away land
Stands by the side of a gibbering
spark,
Punching his message into the dark.

Into the dark of a summer's night,
And around the world and into the
light
Of our brilliant winter day
Speeds the vibrant, quivering ray.

And, caught in a web of sky-flung
wires,
Sinks to earth—chatters—expires;
But before it dies, skillful hands of man
Have torn from its soul a marconi-
gram.

K. G. Martin.

The British Wireless Chain—Particulars of Stations

IN the course of a paper on wireless telegraphy read before the North East Coast Institution of Engineers and Shipbuilders, England, in which the subject was covered generally and a comparison of different systems made, H. Fothergil recently gave the following details of the stations which will form the British imperial wireless chain:

Six high power Marconi stations are to be erected. One station in England for signaling in the direction of Egypt; a station in Egypt for communication in three directions—India, East Africa and England; a station in East African Protectorate for communication in two directions—Egypt and South Africa—a station in the Union of South Africa for communication in the direction of East Africa; a station in India for communication in two directions—East Africa and Singapore; and a station in Singapore for communication in two directions, namely, India and Australia, where the erection of another high power station is receiving consideration. The station will be operated on the high speed automatic system, and will be worked duplex.

The wave-lengths of all stations will be as great as possible within the limits of 15,000 and 50,000 feet (consistent with keeping the capacity, inductance and size of the aerials within reasonable limits) in order to insure reliability of reception at all times of the day and night; but the wave-lengths transmitted from any one station will be in all cases at least 25% different from those transmitted from other stations within its normal range, and with which it has to communicate. In all cases there will be a difference of five per cent between the wave-lengths emitted from any one station in order that each corresponding receiving station with which this station has to communicate may be able to tune out the waves emitted by the said station for the other station or stations with which it is also communicating. Where a station is required to communicate in more than one direction a separate transmitting aerial and a separate receiving aerial will be provided for each direction. The note of each station will be different from those of any other stations within its range, but the notes of each transmitting circuit in any one station will be identical.

The power plant at each station will be in duplicate, and will include two water-tube boilers, each capable of generating sufficient steam for the whole requirements of any one transmitting circuit. In the case of a station required to send in two directions three boilers will be provided; and in the case of the station in Egypt, which is required to transmit in three directions at the same time, four boilers will be provided. The boilers will supply steam to turbines directly coupled to alternating-current generators which in turn will be coupled to revolving-disk dischargers. The total power including spares and auxiliaries at the terminal stations will be approximately 1,300 horsepower and the power at the intermediate stations will vary from 1,900 horsepower to 25,000 horsepower. Two auxiliary sets will be provided at every station, each consisting of a turbine coupled to a direct-current generator for supplying exciting current to the alternators and current for lighting and other auxiliary purposes.

The transmitting aerials will be of the multiwire directional type and will consist of a number of horizontal parallel wires supported 300 feet high by 10 masts, each wire being composed of seven strands of No. 19 S. W. G. silicon-bronze wire and brought down at one end to the transmitting station. The masts will be of the sectional-steel tubular type, the aerial wires passing through insulators attached to triatics stretched between pairs of masts, each mast being capable of withstanding a permanent horizontal strain of not less than two tons at the head of the mast, in addition to windage calculated at the rate of 30 pounds per effective square foot. The center line through the horizontal portion of the aerial will coincide with the line of direction of the station with which it is desired to communicate, the free or elevated end of the aerial pointing directly away from the communicating station. The size of the aerials in each case will depend upon the length of wave emitted, but in no case will the length of each aerial be less than one-twelfth of the wave-length that the aerial is required to radiate.

The ground system will consist of a series of galvanized-iron plates buried in a symmetrical position relatively to the station house and connected to it by a system of radial conductors of galvanized wire leading to each plate from another set of plates buried around the station building.

Each transmitting circuit at each station will be provided with five transformers and a condenser consisting of about 500 cells. The high-frequency transformer for each circuit will comprise a multistranded primary conductor forming part of the oscillatory circuit, and a secondary winding connected to the radiating circuit and consisting of a special solenoid of similar cable to the primary winding but of smaller size. These primary and secondary windings will be entirely separate and arranged to be moved away from each other so that the coupling of the two circuits may be varied. The disk discharger in the oscillatory circuit will consist of a studded wheel, the number of studs corresponding to the number of the alternator poles, so that the condenser can be discharged at the moment of maximum amplitude in each alternation of the current. The two side electrodes, between which the moving studs pass, are of special construction and consist of slowly revolving disks so as continually to present a cool surface for the discharge.

The receiving and operating stations will be less than 10 miles distant from the transmitting stations, and will be provided with balancing aerials so as to prevent interference by the waves radiated from an adjoining transmitting station. The receiving aerials will consist of one or more silicon-bronze stranded conductors about 8,000 feet long and arranged similarly to the wires of the transmitting aerials. The operating room will be fitted with Morse hand keys and Wheatstone or other automatic transmitters of similar type. These will be connected by means of wires to the transmitting station which will be operated from the receiving station.

A NAVAL OPERATOR'S NERVE

Astride one of the huge antennæ of the big naval wireless station at Arlington, Va., this young man appears very much at ease, although he is suspended some 450 feet above the earth.

The rope on which he has chosen this lofty seat is of stranded wire, hardly over an inch thick, and the insulator upon which he sits, apparently quite comfortable, is twelve inches in diameter of porcelain.

Comfortably seated on the Arlington aerial

The extraordinary nerve required to climb down from the tower top, over the small rope and swing to a sitting position can easily be appreciated. This, after over four hundred steps had been ascended to reach the tower top.

A view of the Potomac River and the Washington monument can be seen in the background, and to the extreme left of the picture a glimpse of the Arlington National cemetery.

OPERATORS' INSTRUCTION

CHAPTER IX

MARCONI RECEIVER TYPE No. 101

THE 101 Receiver consists of an inductively coupled transformer with two solid rectifier detectors and the necessary accessory apparatus mounted on a hard rubber panel and enclosed in a mahogany case. The front elevation of this receiving set is shown in Fig. 29, the rear elevation in Fig. 30, and the circuit diagram on drawing, Fig. 31.

The aerial is connected to the binding post marked "Antenna," and the ground connection is made to binding post marked "Ground." The circuit between these two points is adjusted to resonance with the incoming signal by variation of the two transformer primary switches, the primary loading coil switch, the primary condenser, and the primary condenser switch, which is marked "Out," "Series," "Shunt." The purpose of this switch is to connect the primary condenser in series or in parallel to the aerial or to disconnect the condenser entirely. The purpose of the three other primary switches is to vary the number of turns of inductance in the circuit.

The secondary circuit contains the transformer secondary coil whose inductance is varied by the transformer secondary switch, the secondary condenser, the cerusite and the carborundum detectors, the switch for connecting either of these two in circuit, the potentiometer and the switch marked "Send," "Receive."

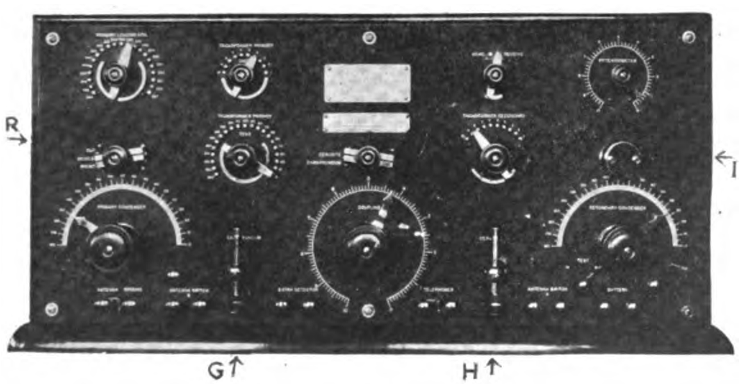


Fig. 29

The transformer secondary coil is moved in or out of the transformer primary coil by means of the handle marked "Coupling." The capacity of the secondary condenser is varied by the rotation of its handle and the potential across the carborundum detector is varied by the rotation of the potentiometer handle.

Supplied with this set is a mahogany box containing four dry cells, having three binding posts marked "1," "2," and "3." Numbers 1 and 2 connect to the two binding posts on the receiver immediately under the word "Battery," while Number 3 is connected to the post at the extreme right on the same level with "Test" switch. This post connects the battery to the test buzzer circuit.

Since the detectors work better with the battery current flowing in one direction than in the other, it is necessary to determine experimentally which binding post to connect to the carbon and which to the zinc electrode.

The head telephones are connected to binding posts marked "TELEPHONES." The binding posts marked "ANTENNA SWITCH A-Posts 1 and 2" and "ANTENNA SWITCH B & C, Posts 1, 2 & 3" are connected to points on Navy antenna switch. When the Navy switch is not used Posts A_1 & A_2; B_2 & B_3; C_1 & C_2; and B_3 & B_1 are short-circuited with pieces of thick copper wire. The posts marked "Extra Detector" are for connection with an outside detector. If outside detector requires battery, place detector switch in position marked "Carborundum," if not place it in position, marked "Cerusite." Access to the interior of the set may be had by removing the three upper screws in the panel and the screws in the case along the lower edge of the back and sides. The case can then be lifted off, exposing the coils and wiring, which permits the location and repair of any trouble. The test buzzer is mounted within the metal cap directly over the secondary condenser and can be adjusted if necessary by removing the two cap screws.

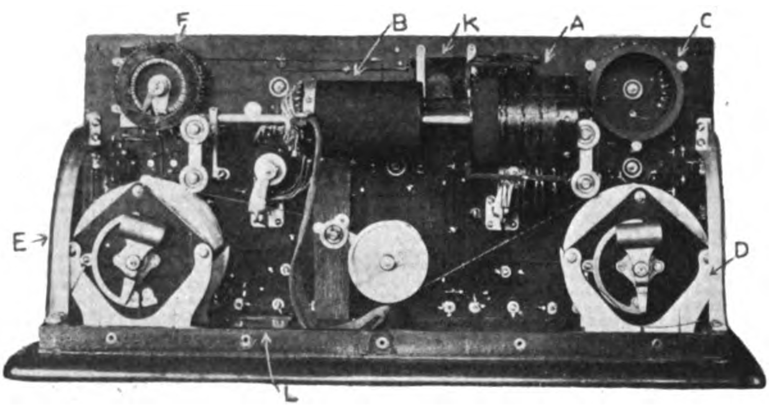
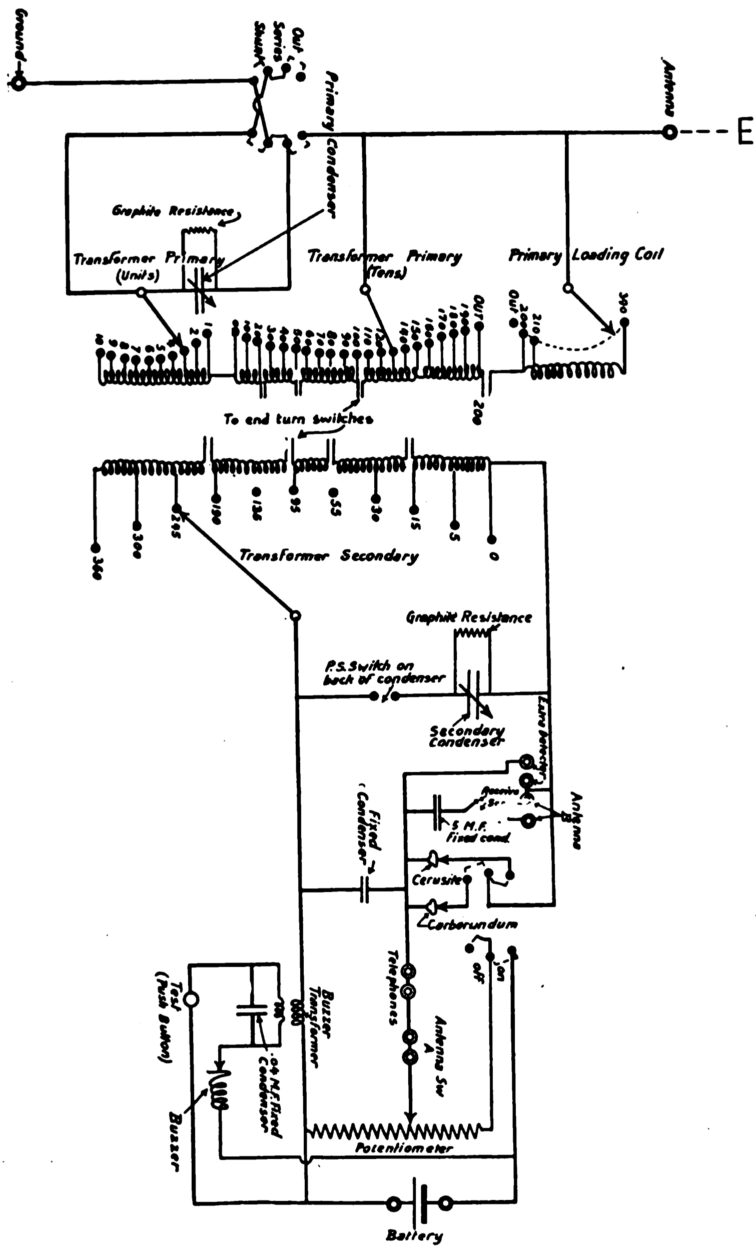


Fig. 30

Since the satisfactory operation of the set depends to a great extent on the switch blades making perfect connection with the switch studs, it is necessary to see that there is always a good, firm pressure between them. If for any reason this pressure becomes too weak, remove the screw in the handle, take off the handle and remove the two screws holding the switch blades in place. The blades can then be bent slightly so that when replaced they will make positive contact.

Having connected the receiver in accordance with the instructions and drawings, the method of adjustment and operation is as follows:

Set the Primary Condenser Switch to position "Out," place coupling pointer at about 7 on the scale, Detector Switch to "Cerusite," Secondary condenser pointer to position "Out," Potentiometer to O, "Send" and "Receive" Switch to "Receive" (if used with Navy switch or break system relay, leave in "Send" position always), turn test switch to "In" position, which starts the buzzer, adjust Cerusite Detector point on crystal surface until loudest response is heard. This crystal requires very light pressure for maximum sensitiveness and the point may be screwed up or down by turning the hard rubber knob to left or right. Having found a sensitive point on the crystal, vary the inductance of the two primary transformer switches until the desired signal is heard, then loosen the coupling by rotating coupling handle to the right until the signal is just audible, then try other points of transformer secondary



Ground
Out
Series
Shunt
Primary Condenser
Antenna
E
Graphite Resistance
Transformer Primary (Units)
Transformer Primary (Tens)
Primary Loading Coil
To end turn switches
Transformer Secondary
Graphite Resistance
P.S. Switch on back of condenser
Secondary Condenser
Fixed Condenser
S.M.F. Fixed cond.
Cerusite
Carborundum
Telephones
Antenna Sw A
Test (Push Button)
Buzzer Transformer
.04 M.F. Fixed Condenser
Buzzer
Potentiometer
Battery

Fig. 31

switch and rotate secondary condenser handle to the left until a combination is found which gives maximum response. The Primary should then be readjusted more accurately until the best setting is found and the coupling then adjusted until the maximum strength of signal is obtained. The longer the wave-length the greater the number of turns of inductance necessary in primary and secondary circuits. If more inductance is necessary for a particular signal and cannot be obtained by adjustment of transformer primary switch, place this in position marked "Out" and rotate the primary loading coil switch from its position "Out" until sufficient turns are in the circuit. If the wave-length to be received is shorter than can be reached with primary condenser switch in the Out position, place it in the series position, set the ten turn transformer primary switch at 0, the unit turn transformer primary switch at 10 and rotate primary condenser handle until maximum response is obtained. Placing the primary condenser switch in the "SHUNT" position increases the wave-length of the aerial circuit corresponding to any given setting of the inductance switches. This may be done at any time instead of increasing the inductance. Generally speaking, the method of varying inductance is preferable and gives a louder response, but in exceptional cases a reverse is true and in any particular case a trial of the two methods can be made to find out which is the better. The best secondary setting for maximum response to any particular wave-length is with the maximum inductance and minimum capacity, but the greatest selectivity will be obtained with smaller inductance and greater capacity. When using the Carborundum Detector it will be necessary to adjust the Potentiometer to a point which gives the greatest sensitiveness. This latter detector, while considerably less sensitive than the Cerusite, is very permanent in its adjustment and not easily disturbed by static, loud signals or mechanical vibrations. It should be noted that when using the Cerusite detector on very weak signals the Potentiometer should always be in zero position, but that on signals of moderate intensity it does not matter particularly what position this may happen to be in. In order that the operator may be able to measure approximately the wave-length of the incoming signals calibrations of the secondary are given with each tuner, it being understood that these are correct only when the secondary is coupled very loosely to the primary.

With the 101 receiver are supplied adjustable head telephones which are tuned to the group frequency of the transmitter. Also the electrical circuit through the telephones and the stopping condenser is tuned to the same group frequency.

It is advisable occasionally to insert a piece of paper between the spark points of the antenna and ground binding posts and telephone binding posts to make sure they are not short-circuited.

CLASSIFICATION OF SHIP STATIONS

The Bureau of Navigation has announced that the classification of vessels as given in the "Regulations for Radio Apparatus and Operators on Steamers," edition of July 1, page 8, paragraph 7, and "Regulations Governing Radio Communication," edition of July 1, page 5, "B," "Ship Stations," have been amended to read:

First Class—Vessels having a continuous service.

There shall be placed in the First Class vessels which are intended to carry 25 or more passengers—

(1) If they have an average speed in service of 15 knots or more;

(2) If they have average speed in service of more than 13 knots, but only subject to the twofold condition that they have on board 200 persons or more (passengers and crew), and that, in the course of their voyage, they go a distance of more than 500 sea miles between any two consecutive ports.

Second Class—Vessels having a service of limited duration.

There shall be placed in the Second Class all vessels which are intended to carry 25 or more passengers, if they are not, for other reasons, placed in the First Class.

Third Class—Vessels which have no fixed periods of service.

All vessels which are placed neither in the First nor in the Second Class shall be placed in the Third Class.

A glimpse of a street scene in picturesque La Paz. The difficulties of establishing communication between that city and other sections of Bolivia were taken into account when wireless telegraphy was considered as a means of linking the divided areas of the country

Portable Station Tests in Bolivia

IT seems fitting that wireless telegraphy (the realization of one man's dream) should have a place in the foreground in Bolivia—a country of dreams and romance. From La Paz, lying on the side of a lake, to the smiling confines of Riberalta or Santa Cruz; from the high wastes where the royal condor sits in solitude to the green plains where the streamlets are the arms of the sea, the whole land is one vast realm of fancy.

But it is this wealth of vegetation, holding untold riches, that is the real barrier to the development of nearly all of Bolivia. It cuts the country in two and makes communication between the north and the south well-nigh impossible. Wireless telegraphy was called into service to overcome the obstacles due to this extravagance of nature.

The adoption of some means for linking up the divided areas of Bolivia was a matter of grave concern to the government of that country. It is necessary for travelers from La Paz to Riberalta to take to the river courses, and a two months' trip down stream means one of four or five months on the return, for the term river does not properly describe the pouring waters which better deserve to be called torrents; even then their great waves and vast expanse make such a description inadequate. Imagine a large river leaping from cascades into rapids and from rapids into cascades and you will have a clear idea of one of these "streams" in Bolivia.

Trips on the torrents are made in "boats" fashioned from creepers pressed one against the other to form two huge bundles, which are joined by a little flooring of frail planks and make a primitive sort of raft. Occupants of the raft may well pray to be in the good graces of the helmsman when it leaps the sixty-mile-an-hour rapids. It goes hard with those who strike a rock; the crocodiles alone can tell the fate of these unfortunates.

Such a hazardous and necessarily slow means of communication makes the exchange of messages between the north and south extremely rare, while the impossibility of laying a single telegraph line in the forests is a foregone conclusion to all who know the country. As the most satisfactory solution of the problem, the utilization of Marconi's invention suggested itself to General Ismael Montes, the president of Bolivia. Experiments were commenced at once, but before a great deal could be accomplished, General Montes' presidential term expired, and his successor was occupied with other urgent matters.

The question was brought up again later, however, and the Marconi Company, unwilling to plunge into a venture without first submitting a proposal to the Bolivian Government, decided to send out two portable installations, the test performances of which would furnish information of material value in the construction of a general wireless network. Many tests were made with the two portable stations, some of the most interesting of which took place during the military maneuvers of 1911. The following account of the experiments were related by a man who witnessed them at close range:

"Leaving La Paz we set out. There is trouble ahead of us. For the first time in their lives, the mules are saddled with European pack saddles with all their impeding leathers. They start by rolling on the ground, and then, finding it unwise to rebel further, they accept their lot and away we go.

"After three hours' climbing on a ten per cent grade from the hollow in which lies La Paz, we reach the summit, 13,000 feet above the city, where the wind blows hurricanes. The thirty miles of the first stages of the journey are covered in seven hours; the little Bolivian soldiers, scarcely five feet high, swing along joyously, each carrying, in addition to his equipment, a tent and food for about ten days' maneuvers, for one must not reckon on a well-ordered commissariat in this great country where villages exist only every fifty miles or so.

"We halt at last, a little tired by this first journey. But we are happy and await impatiently the first experiments, just a little impatient of what this sandy and stony waste holds for us.

"The second day sees us thirty-eight miles along the white road, gloomy and dejected, relieved only by the endless chatter of the soldiers who ask countless questions about a new piece of apparatus they are escorting. They are quiet, intelligent fellows, certainly little in touch with this new development, yet so eager to be instructed that it would show a churlish disposition to be angry with them. Reaching headquarters a little behind time, we find that the second wireless station has arrived by rail. Here we join forces. The members of my little company have stood the journey well. They are dusty, but fresh and ready for the maneuvers next day.

"Wireless station A is with the state major general; station B follows the Blue army. At 5 A. M. we are up for the first experiments and both stations are erected. Station B accompanies the Blues, but, to my intense dismay, no message comes through. Mounting a horse, I gallop to station A in order to find out the reason for its failure to communicate, and to my surprise, I discover that the soldiers have forgotten to couple the dynamos to the mast. This is soon remedied; A gets into touch with us, and all goes well. An order comes to take down B and follow the Blue army. I gallop back to B station.

"I am held up by an amiable joker who remarks that my way of sending messages is very effective, but not very original. That is because he has seen me galloping from one to the other and hasn't a shadow of doubt but that it was I who had carried the telegrams.

"In the evening we arrived at Chijta, seventeen miles from Patacamaya, the headquarters of the state general. The bugle sounds for supper, and we have the first bite since morning. The mast is erected to receive orders.

"Nineteen minutes later communication is established. The night is splendid, the signals are very clear, and the orders are sent perfectly. My critic of the morning I remember with heart burnings; would that he were here so that he might be convinced that the marconigrams had not traveled by courier this time.

"On the following day we travel another twenty-five miles. At night communication is established. The battle starts and orders are received right to time. Again the mast comes down and we get on the move. Fifteen miles further on we set up the mast again; all goes well.

"'What! fresh orders?' 'Yes. You are supposed to have no more ammunition. Retire to cannonments at Sicasica!' Another fifteen miles back. Down comes the mast again and away we go. But what a journey! It is midnight. A lashing rain, and the world black as the pit. We have to put up the mast again. It is quite evident we cannot communicate forty-two miles in the tempest, and how are we to set up the station in the dark and in the middle of a town?

"We find a street a little further on and set up the mast by a sort of instinct. When all is ready along comes a courier at a gallop, collides with the stays, and down comes the mast.

"At last we are ready again. The spark is clear. Listen a moment. There! We have got into touch, and the wireless messages come, the signals being clearly distinguishable from the muttered rumbling of the storm. The rain is still pouring in torrents.

"'Hurry this 140-word wireless message to the general and we can get a little sleep at last.' It is 2 A. M. and in what state do I sleep?—in the room of a real general! Forty minutes later I have the satisfaction of seeing a courier arrive with a telegram which has come by wire; it is a copy of the one which came by wireless. What a success—forty minutes ahead of the wire! The

This photograph shows a group of llamas. These animals are used on occasions to carry messengers, and are also employed for the transportation of freight next day I make an inspection of the mast and am amazed that we have been able to receive messages. The two wires, for almost two-thirds of their length, are laid on a roof of zinc. What harmony between the antennæ and the circuit!

"And so every day for ten days, erecting and dismantling the station two or three times a day without the slightest mishap, everything going along splendidly.

"At last comes the hour of reward—the review. The Marconi Wireless Corps marches past with every eye upon them, the men smart, the motors glittering, the cases polished as if they had just come from the works instead of having traveled 350 miles on muleback through dust and mud, this way and that.

"The admiration of the officers who were called upon to give an account of the services which this apparatus would render in time of war was unbounded. There were congratulations from the president and two fine reports in the general orders from the general-in-chief, a German officer, and the general-in-chief of the Blue division, who declared that during the whole of the maneuvers the apparatus worked night and day without interruption.

"It was a triumph, for it must be borne in mind that the apparatus was worked for the first time by these soldiers, that the telegraphists borrowed from the cable office were new to it, and that the A station was directed by an engineer who had only seen a wireless apparatus for the first time a month before."

The tests were followed very closely by the Bolivian government, and there was a strong sentiment in favor of a Bolivian chain. At length the Marconi company obtained the contract for the construction of the main chain of high-power stations.

General Montes, who was chiefly responsible for bringing wireless telegraphy into Bolivia, served his country in the war with Chile, obtaining his commission after a few months' service. He was seventeen years old and a student of law at the University of La Paz when he decided to enlist. He remained in the service until he was made a captain. While he was in the army he continued his studies at the university.

BELGIAN ROYAL DECREE

A royal decree concerning wireless telegraphy has been published in the Moniteur, the Belgian government publication. It is in part as follows:

"Throughout Belgian territory and aboard all Belgian vessels, any project whatever for the installation of radio-electric apparatus suitable to serve or likely to interfere with the transmission or reception of radio-telegraphic signals, or any project whatever for the modification of the position, composition or capacity of an installation already regularly authorized must be submitted to the Department for Marine and to the Administration for Posts and Telegraphs. The application for authorization must indicate the nature of the installation, the object of the exploitation, including so far as the radio-telegraphic stations aboard ship are concerned, a statement of the taxes, if such are levied; details of the apparatus and its manner of operation, length of the waves, hours of operation, and, in general, all information allowing a close study of the project.

"The installations not regularly authorized and which may have been in service before the present decree has come into force will enjoy no privilege whatever; the exploitation must be suspended forthwith and an application for authorization must be made in conformity with the stipulation of the decree.

"When entering Belgian territorial waters foreign vessels fitted with electric radio-telegraphic apparatus suitable to serve or to interfere with the transmission or reception of radio-telegraphic or radio-telephonic signals, must cease all communications with any stations other than the nearest state shore station. Foreign vessels must signal their presence to this shore station and must wait till this latter has authorized or allowed them to communicate with either this particular or any other shore station. Foreign vessels, which prior to their arrival in Belgian territorial waters have obtained from the competent Belgian minister a special permit to be used regularly, are exempt from these regulations. Neither do these regulations apply to distress signals, nor to answers to distress signals emanating from vessels.

THE AGE OF COMMERCIAL OPERATORS

In view of the fact that following in the wake of every ocean disaster a flood of newspaper editorials score the officials of the merchant marine for having "boys" on board vessels serving as wireless operators, the recent determinations of the Bureau of Navigation are interesting.

As a basis of information the data given by the applicant at the time licenses were issued by the Secretary of Commerce was tabulated; the results show that of the first-grade operators 57 per cent were 21 years of age or older, while 83 per cent were 18 or older. Of the second-grade operators 49 per cent were 21 years of age or older, while 75 per cent were 18 or older. Of both grades 82 per cent were 18 years of age or older.

First Grade Operators

AGES	NUMBER
21 or older	1197
20	244
19	293
18	197
17	119
16	36
15 or under	13

Second Grade Operators

AGES	NUMBER
21 or older	120
20	29
19	38
18	23
17	18
16	13
15 or under	6

COUNTRY-WIDE AMATEUR CHAIN

Hiram Percy Maxim is authority for the statement that The Radio Club of Hartford, Connecticut, of which he is chairman, has organized a committee whose object is to develop a system of relay stations throughout as much of the country as seems possible. At the present time messages are being forwarded by relay from Hartford, Conn., to Buffalo, N. Y., via Northampton, Mass., and one of several intermediate stations. This plan has worked so well that there seems no reason why it should not be improved still further in detail and also extended to cover a wider range.

The club believes that the number of good amateur stations in the country is great enough to make it possible for an amateur to reach the far West and possibly the Mexican border, if the stations were organized. The only thing needed is to secure the names and addresses of the owners of stations able to transmit fifty to one hundred miles. If amateurs will write to Mr. Clarence D. Tuska, Secretary, Radio Club of Hartford, No. 136 Oakland Terrace, Hartford, Conn., blank forms will be supplied which when filled out will be used as a basis for appointing official relay stations.

This plan seems to be about the only one by which the amateur can reach distant points by wireless and without getting into difficulties with the United States Government. It is expected that messages will be received and transmitted by courtesy entirely and that no money will be involved in any way, the effort being to keep the plan strictly amateur in every sense.

* * *

At a recent meeting of the Canadian Central Wireless Club with headquarters in Winnipeg, Harold E. Mott was elected president, E. A. Dunn vice president, and H. L. Pulford, Armstrong's Point, Winnipeg, Canada, Secretary and Treasurer.

New Methods for the Production of Continuous Electric Oscillations and for their Utilization in Radio-Telegraphy*

By GUGLIELMO MARCONI

IT may be said that from its beginning up to the present time practical radiotelegraphy has depended upon the utilization of discontinuous electric oscillations; that is, of successive groups of oscillations of unequal amplitude produced by the discharge of a condenser or Leyden jar.

As is well known, electric oscillations produced by the discharge of a condenser were first investigated by Henry and Lord Kelvin, afterwards studied mathematically by Clerk Maxwell, and finally verified experimentally by Hertz.

It is now well known that if two conductors at different potential be electrically connected together by means of a spark, if the resistance of the circuit be not too high, the potentials of the conductors only reach equality after a greater or lesser number of electrical oscillations. As a consequence of this the conductors become for a short time the seat of an alternating current which may be of extremely high frequency.

If one of the conductors be the earth and the other a vertical wire, we have the essential features of the system with which, in 1895, I initiated my experiments in wireless telegraphy. Successive improvements have increased the reliability and range of the apparatus. This is well shown by the development of wireless telegraphy which resulted from the syntonic coupling of the antenna to an oscillating circuit, as first described in my English patent of April, 1900, and in the lecture which I delivered before the London Society of Arts on May 15, 1901.

The damping or decrement of the oscillations generated in the way I have referred to, and the interval of time separating the consecutive groups of oscillations (an interval necessitated by the relatively long time required to change the condensers) present certain difficulties in regard to wireless telegraphy, and still greater difficulties in the case of wireless telephony. For this reason many workers in this branch of science have been seeking a method for the production and radiation of continuous oscillations.

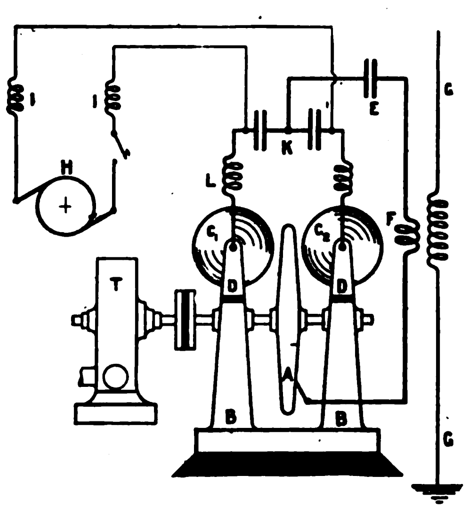


Fig. 1

There are two fairly well-known methods for the production of continuous waves. One is the so-called "Duddell Musical Arc," perfected by Poulsen; the other, the high frequency alternator typified in the Goldschmidt machine.

It is not my present intention to examine these two systems in detail, but I

* Translation of a Communication made to the R. Accademia dei Lincei in Rome, on March 1, 1914.

shall only say that certain difficulties in working which have so far been an obstacle to their practical application exist in both systems.

The first arrangement by which I succeeded in producing continuous oscillations is described in my English patent of April 11, 1907 (Fig. 1). It consists of an insulated metallic disc, A, which is rotated at a very great velocity by means of a turbine or electric motor. Adjacent to the periphery of this main disc are placed two other discs, C_1 and C_2, which are also rotated at a high rate of speed. These I will call side discs.

The two side discs are connected by means of brushes to the outside plates of two condensers, K, connected in series, and these condensers are in turn connected through resistances and inductances to the terminals of a high potential continuous current dynamo, H, or else to a high potential battery.

The main disc is connected to the inside plates of the two condensers, and forms part of an oscillating circuit consisting of the condenser, E, in series with the inductance, F, the latter being connected either directly or inductively to the aerial wire, G.

When the condensers are charged from a generator or a dynamo of sufficiently high potential, an electric discharge occurs between the side discs and the main disc (this discharge being neither a spark nor an ordinary arc), and continuous electrical oscillations are produced in the circuit, of a frequency depending upon the inductance and capacity of the circuit itself.

The working of the apparatus is probably as follows: Assuming that the generator, H, gradually charges the double condenser, K, and that the potential at the discs, C_1 and C_2, becomes, say, positive at C_1 and negative at C_2, then at a certain instant this potential causes a discharge across one of the small gaps, suppose the one between C_2 and the main disc, A. This discharge will in turn produce an oscillation through the inductance, F, and the condenser, E, and this oscillation, on reversing, will naturally pass from the main disc, A, to the disc, C_1, the latter being already charged to an opposite potential. The charge of the condenser, E, will again reverse, acquiring energy at each reversal from the condensers, K, which are kept charged by the generator, H.

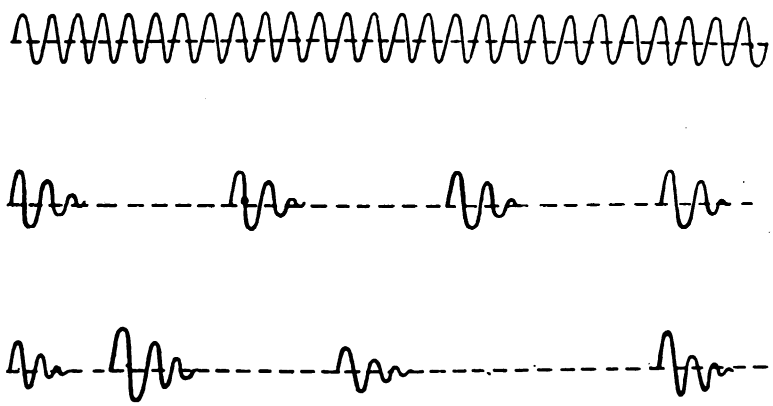


Fig. 2

This cycle can continue indefinitely; the losses which take place in the oscillating or radiating circuits being replaced by the generator, H.

If the main disc is stationary, an ordinary arc at once occurs across the gaps between the discs without any oscillations being produced.

This system has so far proved practicable for small powers, but has the disadvantage of not being quite reliable.

Another arrangement of mine for the production of continuous oscillations which is now being used for trans-Atlantic work, and with which unlimited power can be employed, is based on the principle of causing successive groups of oscillations, each generated by the discharge of a suitable oscillating circuit, to overlap each other in exact phase.

With the help of Fig. 2 I will try to explain my idea more clearly.

In the third line of this figure are shown groups of damped oscillations occurring at irregular intervals: in the second line are shown more frequent groups of oscillations occurring at equal intervals; and in the first line are shown continuous oscillations.

In the third line we have the condition which existed in the old spark systems, where the groups of oscillations followed each other at irregular intervals.

The close and regular groups of oscillations, which represent a very great step in the art of wireless telegraphy, are obtained by the employment of the apparatus illustrated in Fig. 3, which consists of an insulated metallic disc, *a*, having metallic studs fixed at regular intervals on its periphery, perpendicular to the plane of the disc. This disc is rotated at a high velocity between two other discs, *b b*, by means of a suitable motor. The studs of the central disc are of such length as almost to touch the two side discs, thus closing the circuit at regular intervals. This sudden closing of the circuit greatly diminishes the resistance of the spark, with a corresponding diminution in the damping of the wave; while the opening of the circuit, as soon as the studs of the central discs have passed the peripheries of the side discs, *b b*, stops any oscillations which may still exist in the condenser circuit. In this way, given a proper value of coupling between the condenser and radiator circuits, the energy of the condenser circuit passes entirely to the radiator without the occurrence of the usual reaction between the coupled circuits.

The advantage of this system lies in the radiation of regular groups of electric oscillations, the intervals between the groups being such as to produce in the receiver or in the telephone of the receiving apparatus a musical note which is easily distinguishable from the sounds and noises produced by the disturbances caused by atmospheric electricity.

The system of discontinuous waves to which I just now referred is that at present used in all the high-power stations erected by the Marconi company.

My idea in adopting the arrangements which I will now describe was to obtain groups of oscillations so close together and in such exact phase that their combined effect on a resonant circuit should be to induce and maintain a high-frequency alternating current.

The system of continuous waves to which I now refer is based on the cumulative effect of a series of discharges, having the same period and in phase, acting inductively on a common radiator.

In fact, if we carefully consider the system shown in the second line of Fig. 2, it is clear that, if it were possible to bring the various groups of oscillations sufficiently close together, a continuous oscillation could be obtained; in the ordinary apparatus, however, two difficulties arise. The first difficulty is caused by the time

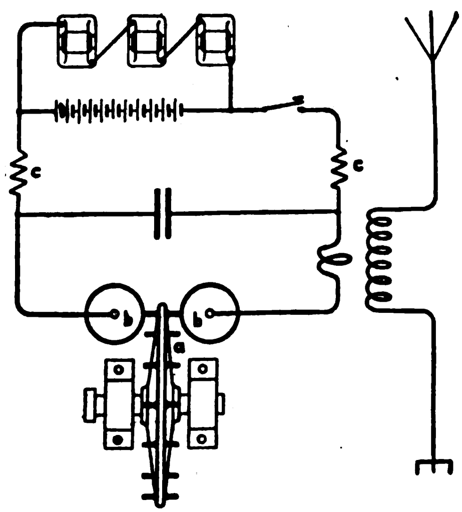


Fig. 3

required to charge the condenser, it being obvious that the condenser cannot be charged and discharged at the same time; and the second difficulty is due to the fact that the successive groups of oscillations must be in phase with each other as well as with the oscillations in the radiator.

Attempts to obtain rapidly succeeding groups, but without reference to their phase, have already been made by various workers in this field.

I believe that I have solved the problem by the use of the apparatus which I will describe with the aid of Fig. 4.

In this system are employed a number of oscillating circuits, 1, 2, 3, 4, charged from the same source of energy through respective inductances. Each discharge circuit includes a toothed metallic wheel, D_1, D_2, D_3, D_4, a condenser, and an inductance coupled to the radiator or to an intermediate circuit which in this case is inductively connected to the radiator.

The toothed wheels are insulated from each other, but rigidly mounted on the same shaft, and so fixed that the condensers discharge and recharge in succession at regular intervals one after the other; so that at a given velocity the interval between the beginning of the discharge of one condenser and the beginning of the discharge of the next condenser is equal to the period of oscillation of the aerial or intermediate circuit, or else it may be an exact multiple of the said period of oscillation.

To make certain that the beginning of each discharge occur at precisely the right moment the discharge circuit is provided with an auxiliary spark which is timed by means of another disc (omitted from the diagram); this spark is of greater potential than the main discharge, and is obtained by means of small auxiliary condensers.

The final effect of this system is shown in Fig. 5, where the oscillations produced in rotation by the 4 circuits and the resulting continuous oscillation induced in the aerial are indicated.

In regard to this system for the production of continuous waves, the Technical Committee appointed by the British Government to report on the merits of the existing systems of long-distance radio-telegraphy, and especially upon their capability for continuous communication over distances of 2,000 miles, stated in their official report, dated the 30th April, 1913, that my system—the system described above—was the only one which they had seen in successful operation over long distances.

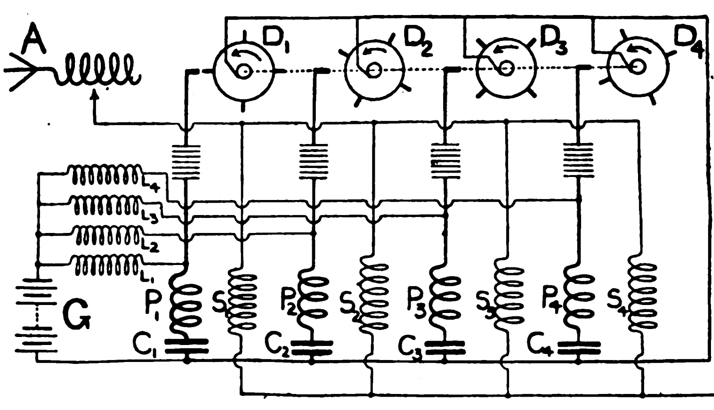


Fig. 4

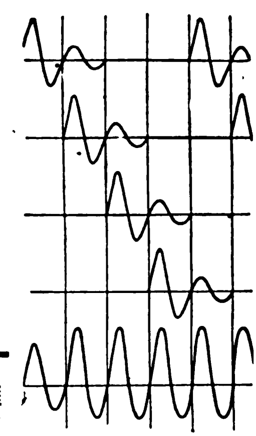


Fig. 5

It might be thought that the greatest velocity hitherto obtainable with revolving discs could not allow of a sufficiently high frequency for radio-telegraphic purposes; but this difficulty does not occur with stations working over distances of 4,000 kilometers or more, in which oscillations of a frequency higher than 50,000 periods cannot be usefully employed.

As long as it was considered necessary to employ waves of hundreds of thousands of periods such as are produced by the discharge of ordinary condensers, it seemed hopeless to attempt to construct alternators or other machines capable of producing oscillations of so high a frequency.

Ten years ago it was generally thought that frequencies at least as high as 100,000 periods per second were necessary for radio-telegraphy. The experience which I have obtained in long-distance transmission has shown me that frequencies above 40,000 periods are considerably less effective than are lower frequencies. I have also noticed that, using the same amount of energy in each case, waves ten or more kilometers in length are propagated at considerably greater distances than are waves of one kilometer or less. This discovery has greatly facilitated and encouraged the investigation and construction of high-frequency alternators, as well as the study of the other methods to which I have already referred.

In order better to illustrate the principle by which I have been able to join consecutively in phase a series of groups of oscillations so as to produce continuous oscillations, I will make a practical experiment, which I will explain with the assistance of the diagram shown in Fig. 6.

I cannot, however, show here an arrangement working in exactly the same way as that which I have already described, because no high potential continuous current is available.

Instead of the condensers charged to a high potential, I have here an inductance, L_1, charged, if I may use the word, with a current furnished by a battery, B.

When the brush, K, makes contact with one tooth of the disc, D, a current passes through L_1, and when the contact is broken by the rotation of the disc the energy of the magnetic field of L_1 is inductively transferred to the circuit, L_2C, causing the circuit, L_2C, to commence oscillating with the frequency of its own electrical period. If the velocity of the toothed disc, D, be so arranged that successive teeth make and break contact with the brush, K, in such a way that each group of oscillations be in phase with the preceding group of oscillations, then all these groups of oscillations, if sufficiently close, will act so as to add their effects together, producing continuous oscillations in the circuit, L_2C.

It is evident that the production of continuous oscillations can only occur when the velocity of the disc is such that all the oscillations produced in the circuit, L_2C, are in phase; otherwise the different groups of oscillations would tend to interfere with and neutralize each other.

We shall now see how a lamp can be lighted by means of the oscillations induced in the circuit, L_2C, when such oscillations are in phase.

From this experiment it can also be seen: (1) That maximum and minimum values of current are obtained by varying the capacity of the condenser, C, within given limits—that is, by adjusting the electric period of the circuit while the velocity of the disc is kept constant; (2) further, that maximum and minimum values of current are obtained when the period of the circuit is kept constant while the velocity of the disc is varied within given limits.

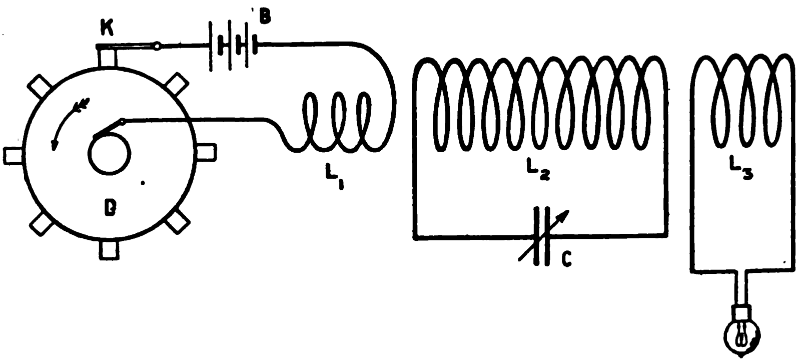


Fig. 6

[*Experiment made here.*]

The use which is now beginning to be made of continuous waves is not really owing, as some people seem to think, to special properties possessed by these waves whereby they ought to cover great distances with less expenditure of energy than that required by discontinuous waves, but is rather due to the desire to obtain in the receivers better syntonic effects which would, firstly, reduce to a minimum the disturbances caused by atmospheric electricity; and, secondly, make it possible for a greater number of neighboring stations to work without interference.

In regard to the elimination of atmospheric disturbances, I have found in practice that accurate tuning and loose coupling between the circuits of the receiver do very little toward diminishing the objectionable effects of these disturbances.

Electric waves due to nature, of which at present we have really very little knowledge, have the property of electrically impulsing the aerial systems of receivers, causing them to vibrate electrically to their own natural period, which is necessarily that of the wave which it is desired to receive.

The disturbing effect of these natural waves—commonly called X's by wireless operators—rapidly increases in intensity as the receiver is tuned to longer waves. In this may probably be found the explanation of the fact that long waves traverse great distances with smaller losses than do short waves.

The effect obtained in practice by weakening the coupling of the receivers is to cut down the signals in about the same proportion as the X's, and consequently little advantage is obtained thereby. Nevertheless, there is some difference between the waves produced by atmospheric discharges and those utilized for the transmission of radio-telegraphic signals; this difference allows the objectionable effects of the disturbing waves to be eliminated—at any rate, to some extent.

With discontinuous waves such as those produced by the disc system shown in Fig. 3, the succession of groups of waves produces in the telephone of the receiver a characteristic musical note, which is easily distinguishable from the sounds produced by atmospheric disturbances. The ability to produce a clear and characteristic sound is of extreme importance, and I have not yet found any system which will give such reliable results as those in which a musical note is used.

The so-called X's generally consist of an electric impulse or of a short irregular succession of electrical impulses producing an instantaneous inductive effect, often of considerable intensity.

The sounds produced in the telephone of the receiver of the musical spark are caused by a very large number of small impulses following each other at short and regular intervals.

Modern receivers are so constructed as to take advantage of this difference between X's and signals; thus the objectionable effects of atmospheric disturbances are to a great extent eliminated.

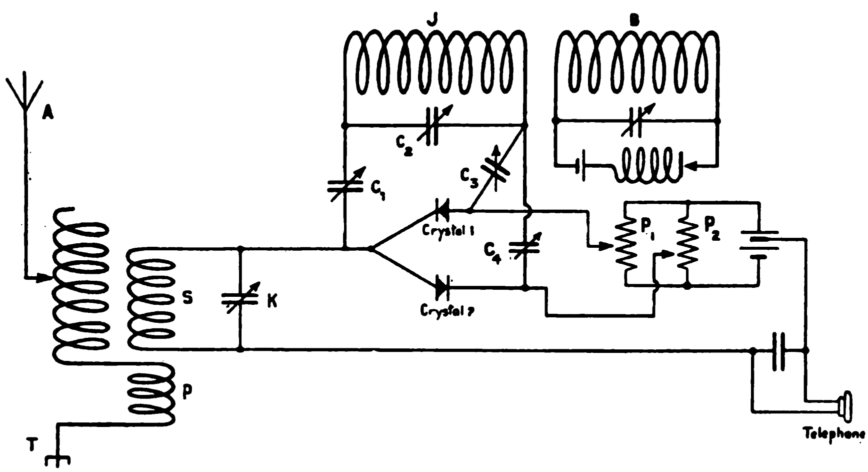


Fig. 7

In Fig. 7 is shown the receiver which has been used for more than two years in the trans-Atlantic stations. Here P is the primary of an oscillation transformer connected to the receiving aerial, and S is the secondary.

Nos. 1 and 2 are two sensitive crystals or Fleming valves, with their corresponding potentiometers, each adjusted for maximum sensitiveness, while the other is disconnected from the circuit, so that when both are connected together they produce opposite effects, and do not allow the passage of either signals or X's. It is then found that if the potentiometer, P_2, be adjusted so that the opposing E.M.F. produced by P_2 is only just sufficient to leave the crystal No. 2 in a non-conductive state while signals are being received, then the received oscillations will be efficiently detected by crystal No. 1, while the disturbances or signals of greater intensity will make the impulses of current from crystal No. 2 oppose those from crystal No. 1.

By making the resistance of No. 2 a little less than that of No. 1 even better results can be obtained.

Experience acquired in the use of continuous waves, especially when using auxiliary sparks, has suggested a new method of reception, which has been developed by Mr. H. J. Round. This method has been successfully employed for very long distances; it offers the advantage of using the principles employed for the reception of continuous waves, and of producing in the receiver a characteristic note dependent on the period of oscillation of the transmitted waves. The arrangement employed is simply a modification of my receiver which I have already described. The system of two opposing detectors which I invented is used with this arrangement.

These detectors are arranged so as to oppose their effects, but also in such manner that each can only receive signals if the latter be very strong. The crystals or detectors are then acted upon by a buzzer in a circuit, B, which emits a very short wave, with the result that for very short intervals of time the crystals become conductors.

In this way the energy stored up in the circuit, SK, is freed for very short intervals. It follows that if the groups of waves produced by the buzzer have a period slightly different from a submultiple of the period of the received waves, then the signals are received as a clear musical note.

In this manner, if the frequency of the received wave be 50,000 periods and the buzzer produce 4,900 groups per second, a discharge will take place through the telephone every ten oscillations. These discharges are stronger or weaker according as the short-wave groups coincide with the points maximum or minimum potential of the wave which is being received. The cumulative effect of these discharges produces a note of 1,000 per second.

This method of reception is somewhat analogous to my system for the production of continuous waves which I have already described.

In my view, methods for the reception of continuous waves are now at the commencement of their development, and open up a new and large experimental field which promises to play a prominent part in the progress of wireless telegraphy and wireless telephony.

GREECE PURCHASES FOURTEEN FIELD STATIONS

Arrangements have been made for the Marconi Company to supply the Greek Government with fourteen field stations. Eight will be motor-car sets of 1½ K. W. power and the remainder will be special ½ K. W. pack sets with fifty-four foot masts.

The motor-car stations will be mounted on special lorry type chassis, and so arranged as to be entirely self-contained and suitable for use in rough country. Each chassis will be made with special clearances, fitted with solid tires and a 40 horsepower motor. The maximum range for each station will be approximately 250 miles, with a guaranteed minimum of 150. Eight men will be required to take charge of each of these motor-car stations, which when erected will cover some 1,300 square yards. The masts will be seventy feet high and the average height of the aerial fifty-six feet. The total weight of a motor-car station, including an estimated average weight for the personnel, will not be more than 7,600 lbs.

The pack stations are of a special type with fifty-four-foot masts, but the apparatus is so constructed that it can be carried easily on five horses. For these stations the maximum range is approximately eighty miles, and the guaranteed minimum fifty, with a total gross weight for each station of 969 pounds.

A commission of officers has been instructed by the Greek Government to visit the works at Chelmsford, in order to supervise the manufacture and mounting of the stations.

New York to Philadelphia by Wireless Telephone

WIRELESS operators at Sandy Hook, Sea Gate and on ships leaving the harbor, together with scores of amateur wireless enthusiasts in Greater New York and along the Jersey coast, were mystified on the afternoon of May 13th by overhearing through their receivers the voice of Caruso singing. This was possible because the head piece receiver used in wireless telephony is similar in principle to that used in telegraphy.

Most of the delighted ones did not know to whom they were indebted for the canned solos of the great tenor, but it wasn't long before some of them found out that the concert was a part of a wireless telephone test made by the Marconi Wireless Telegraph Company at its station on the roof of the Wanamaker store in New York. Not only were the tenor's phonographic tones clearly heard by the operator at the wireless station at the Wanamaker store in Philadelphia but a commercial message, dealing with ordinary business of the day, was communicated by voice through the air for the first time from New York to Philadelphia.

Incidentally the Marconi people had a talk with the Southern Pacific steamship Antilles, which sailed at noon for New Orleans. At 4 o'clock a wireless was received from David Sarnoff, aboard the Antilles, saying that the telephonic operatic selections sent out from the Wanamaker station had been "received."

At twenty-five minutes to eight o'clock in the evening a cable message from Vera Cruz was telephoned by wireless to the Antilles and the ship's operator got it when the ship was about seventy-five miles off the Scotland lightship. He relayed it by wireless to the Marconi station at Cape May, from which point confirmation of its receipt was telephoned to the New York senders. The cable read as follows:

"The following cable has been received: Admiral Mayo reports that Tampico will fall by 9 o'clock to-night. The Federal gunboats Vera Cruz and Bravo are pulling out of the river and going to sea, leaving Tampico to its fate. People are now leaving the city before its fall."

The tests were made by Frank A. Hart and H. Ernest Campbell of the engineering department of the Marconi company, Roland Crane, one of the company's wireless operators, was in charge of the station. The tests started soon after the Antilles started on her journey.

It wasn't long before wireless men waiting for ordinary marconigrams began to hear through their receivers the voice of Caruso and the sound of a man talking and counting slowly and deliberately. They knew of course that they were picking up wireless telephone tests and then they started to wireless around to find out at what station the experiments were being made. When the word got around that the Wanamaker store in New York was communicating by wireless telephone to the Philadelphia store, Messrs. Hart and Campbell began to receive inquiries by old-fashioned telephone as to what was going on.

There was sending only and no receiving in the experimenting in New York. After a message had been sent out the operator in the Philadelphia store would reply by wireless telegraphy that it had been received and then he would repeat what was said.

The operatic music was sent on its way to delight the ears of operators aboard ships by placing the trumpet of a phonograph close against the sender of the telephone apparatus.

The Marconi company recently received word from London saying that Mr. Marconi had completed his wireless telephone tests and that the apparatus was an entire success. The British company will now begin construction of sets for the Italian navy. They are guaranteed to maintain communication between ships over a distance of about thirty-two miles, although in practice they have been tried successfully over a much greater distance.

The "Columbian"

Thirteen members of the Columbian's crew, driven by the flames to take refuge in a lifeboat, were picked up by the steamship Franconia fifty hours afterward

The Marine Disaster of the Month

HOW wireless telegraphy saved the lives of some of the victims of flames which destroyed a ship at sea is graphically told in a marconigram sent by the captain of one of the rescuing vessels. He says that he "sighted a boat on the starboard bow," and "being already prepared, the occupants were taken on board in a few minutes." He concluded his message by saying, "Have marconied all ships to look out for two missing boats, and received replies from Manhattan, Haverford and Marengo." That he had not used the wireless in vain was shown when, thirty-four hours after the rescue of those in the first boat, the Manhattan picked up more of the survivors.

The freighter Columbian, bound from Antwerp to New York, caught fire on May 3d, when she was about 300 miles south of Cape Race. The members of her crew were driven to take refuge in the lifeboats and fifteen perished.

Thirteen of the survivors were picked up by the steamship Franconia of the Cunard line fifty hours after they had been driven to the boats by a series of explosions of unknown origin. Among those taken aboard the Franconia was James Drohan, Marconi operator on the Columbian. It was feared that all the others had perished, for a long search by the Franconia failed to disclose any trace of the other boats. Thirty-four hours after the rescue of those in the first boat word came that the steamer Manhattan had picked up Captain McDonald of the Columbian and thirteen of his men in another boat. Four survivors out of the fifteen who escaped in a third boat were picked up by the United States revenue cutter Seneca on May 17th.

The Boston office of the Cunard Line received a report on May 6th by wireless from Captain Miller, of the Franconia, telling of the rescue of a part of the crew of the Columbian. The message follows:

"Received wireless from steamship Georgic 11:24 A.M., May 4th, 'Seydlitz passed in 41.27 N., 59.07 W., a large steamship burning all over. Hull high out of water, foremast and funnel gone, no people on board.'

"At the same time a wireless from Sable Island requesting me to endeavor to identify steamship, should I pass close, was received. At 1:15 P.M. I received from Boston: 'Great alarm over Seydlitz report of a big ocean liner afire. Rescues by Franconia. Please send brief dispatch.'

"At that time rumor of rescue was not true.

"On receipt of Georgic's message, I changed my course to cross given position of burning steamship, arriving there at 3 P.M. Could discern no trace of wreck, but decided, owing to false report, and fearing influence on other possible rescuing steamships to encircle position at six miles and at 3.30 P.M. sighted a boat on the starboard bow. Being already prepared the occupants thereof were taken on board in a few minutes. A heavy swell was running at the time, so took precautions of putting out my seaboat to cover their embarkation. The boat contained thirteen men and a corpse lying awash in the bottom of the boat.

"The survivors had used trousers-leg from corpse on end of boathook for distress signal. Survivors were in a state of extreme exhaustion and mental collapse. Some had been burned by fire.

"They state that they had been adrift forty hours. Six were put under doctor's care in hospital, and others were given brandy and soup, bathed in hot water and put to bed. They immediately fell asleep. Little information can be obtained from them.

"The carpenter says the ship was the Columbian, sailing from Antwerp, and about 12,000 tons register. He was asleep and heard the alarm of fire, and was coming along the deck and had arrived about midships when an explosion occurred under his feet, which blew him overboard. He was picked up by a small boat.

"A lamp trimmer's son states that his father was coming forward calling for him when the deck blew up and the lamp trimmer fell in the burning hold. A quartermaster says that Captain McDonald, chief engineer, chief officer, and several others were getting a third boat out when a big explosion took place. He does not know if the captain and his boat were saved. The second officer got away with about twenty-four men ten minutes before the boat that was picked up.

"All agree the fire started at midnight Sunday, from a cause unknown. It was first reported by outlook man, who saw smoke coming up the fore hatch. Half an hour later the whole ship forward and amidships was in flames, with constant violent explosions. The wireless apparatus was wrecked.

"After picking up the boat we made another detour, searching for other boats, and deeply regret could not find them, but many other steamers hastening to scene of disaster and trust if not already picked up following steamers will rescue them. Have marconied all ships to look out for two missing boats, and received replies from Manhattan, Haverford, and Marengo."

Four men were picked up in an open boat forty miles south of Sable Island on May 17th by the United States revenue cutter Seneca. They were barely alive, and were all that were left of a party of fifteen that set out from the Columbian, when she burned.

In the two weeks in which the third boat drifted through arctic ice floes, its occupants had but a scant supply of water and scarcely any food at all. Of the eleven missing from the original complement in the boat, all died at sea and their bodies were thrown overboard by the weakened survivors.

All four of the survivors were found in a state of complete collapse and were unable to tell a connected story of their horrible experience. Their boat was towed alongside of the Seneca by a small boat from the revenue cutter which went out on sighting the open boat at sea.

The wireless message from the Seneca telling the news that the boat had been picked up gave a general outline of what had occurred. Not only on account of the high winds was hope given up, but the chances that the Columbian's third boat would ever be found were discounted on account of the many ice floes through which it would have to pass to get into the steamship lane.

The Seneca was on duty as an ice patrol boat, and it was while scanning the horizon for bergs that the ship's lookout sighted the open boat through his glasses. The first report of the lookout was to the effect that the boat was empty, as not a sign of life could be observed.

The Seneca, however, put on full steam ahead and soon launched her gig to go to the boat and look it over. The gig's crew found the four emaciated men huddled in the bottom, and pressed brandy to their lips. On the deck of the Seneca, to which they were quickly removed, they received more stimulants, and then they were turned over to the ship's surgeon.

When You Stop to Consider—

There is nothing in which men more deceive themselves than in what they call zeal.

⊙ ⊙ ⊙

Manners carry the world for the moment; character for all time.

⊙ ⊙ ⊙

Work is a grand cure for all the maladies and miseries that ever beset mankind—honest work which you intend getting done.

⊙ ⊙ ⊙

Before employing a fine word, find a place for it.

⊙ ⊙ ⊙

Wit makes its own welcome and levels all distinctions.

⊙ ⊙ ⊙

Every individual has a place to fill in the world, and is important in some respect, whether he chooses to be so or not.

Variety is the mother of enjoyment.

⊙ ⊙ ⊙

The vain man is the really solitary man.

⊙ ⊙ ⊙

You have no business with consequences; you are to tell the truth.

⊙ ⊙ ⊙

He who gains time gains everything.

⊙ ⊙ ⊙

Great thoughts reduced to practice become great acts.

⊙ ⊙ ⊙

Find out what your temptations are and you will find out what largely you are yourself.

⊙ ⊙ ⊙

The talent of success is nothing more than doing what you can do well.

⊙ ⊙ ⊙

Silence is the resolve of him who distrusts himself.

⊙ ⊙ ⊙

When a man no longer is anxious to do better than well, he is done for.

⊙ ⊙ ⊙

A man without self-restraint is like a barrel without hoops, and tumbles to pieces.

⊙ ⊙ ⊙

Self-confidence is the first requisite to great undertakings.

⊙ ⊙ ⊙

Responsibility walks hand in hand with capacity and power.

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE V

SINCE the inception of wireless telegraphy, efforts have been made to imitate as much as possible the physical actions of wire telegraphy. It is only natural, then, to expect that attempts should have been made to construct wireless apparatus enabling the receiving radio operator to "break in" on or to interrupt the sending operator.

It is well understood that in wire telegraphy should the receiving operator desire to interrupt the sending operator and request, say, the repetition of a word, he need only open the line circuit by means of a switch mounted on the base of his sending key. Unfortunately, this cannot be done so readily with wireless telegraph apparatus and various means have been devised in an effort to solve the problem.

Certain "break-in" devices have been described in amateur publications from time to time, and if the directions given were closely followed fairly certain results could be obtained. It is preferable at all times to employ the "break-in" method in which the transmitting and receiving apparatus is alternately connected to and disconnected from the aerial wires by a series of electromagnetic switches which are operated by contacts mounted on the transmitting key. Thus during the periods of transmission the receiving apparatus is momentarily disconnected from the aerial, but when the transmitting key is raised the apparatus is connected into a receiving position. (See U. S. patent No. 739,287.)

This is by all means the most dependable method. The average radio club, however, has not the facilities at hand for constructing elaborate electromagnetic switches. Alternatives are therefore offered. Perhaps the simplest arrangement of all, and one with which many amateurs are familiar, is that employed by the Marconi Company. An elementary diagram is shown in Fig. 1.

The aerial wires at any station are represented at A. The aerial tuning inductance belonging to the transmitting apparatus is shown at L_2, the secondary of the transmitting oscillation transformer

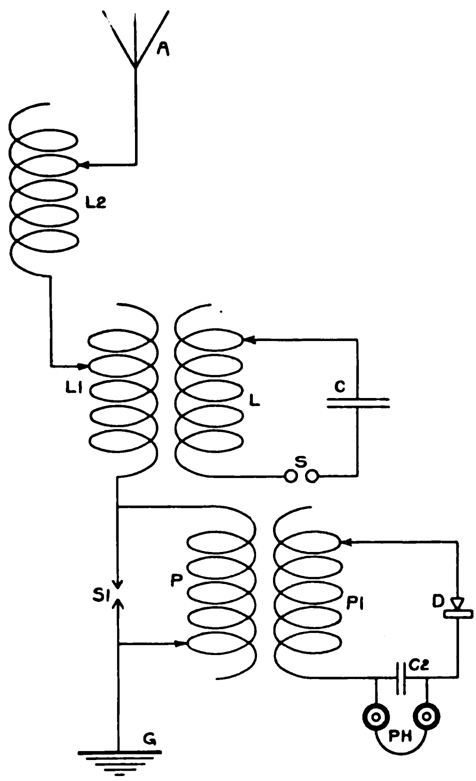


Fig. 1

at L_1. The closed oscillatory circuit of the transmitting set is indicated at LCS.

In series with the open oscillatory circuit we have the spark plate S_1, which is placed as near to the earth as possible. The terminals of the spark plate are connected to the primary winding of the receiving tuner P.

It should be understood that the connection to the winding P is not broken at all during the periods of transmission. The actual gap at S_1 is kept very short so that the difference of potential at the terminals of P will be at a minimum. Moreover, the operator wearing the head phones connected to detector D, is not apt to undergo shocks as the spark plate is placed so near to the earth that the difference of potential between the head phone circuit and the earth is practically zero.

When the operator desires to transmit he simply depresses the transmitting key, the energy in the antenna circuit being discharged to earth across the spark plate. When the transmitting key is raised, the apparatus is in a receiving position. If the receiving operator desires to "break in" on the sending operator he holds down his key, making a long dash. The receiving apparatus at the sending station is connected in just long enough to allow portions of this dash to be heard. Thus the sending operator knows that the receiving operator desires his attention and he immediately stops sending.

A disadvantage of this system is that it cannot be employed with a sensitive crystal detector. It is only applicable in connection with the valve or the magnetic detector. Both possess marvelous stability and their proximity to the sending apparatus does not destroy their sensitiveness.

Considerable racket, of course, is produced in the head phones during the operation of the transmitter, so it is sometimes necessary to mount a pair of extra contacts on the transmitting key which short-circuit the head phones just previous to the closing of the primary circuit to the transmitting transformer.

It is not advisable for amateurs or radio organizations whose equipments are located on the upper stories of apartment houses or in wooden buildings several floors from the earth, to adopt this method as, owing to the difference of potential between the receiving tuner windings and the earth (if the spark plate is placed some considerable distance from the earth), severe shocks are apt to be experienced or the head telephones may be burned out. If the framework of the building is of steel or iron, and actual connections to the steel may be obtained, it is perfectly safe to employ this method, but not otherwise.

Let it be clear, then, that the earth gaps, if necessary, may be at a distance of from 30 to 40 feet from the receiving apparatus, provided two leads are brought to the receiving apparatus.

It will be evident that the spark plug, in addition to performing the function referred to, makes quite an efficient lightning arrester and during severe lightning storms the head phones may be worn without fear.

A New "Break-in" Method

We shall now describe a new "break-in" method which not only allows the receiving operator to "break-in" on the sending operator, but also for short distances will allow the simultaneous transmission and reception of wireless messages from one and the same aerial. The method is the subject of letters patent. The device has been used commercially for a number of years. While it possessed limitations, experiments with it should be of interest to amateur organizations.

One of the principal features of the method is that it requires no moving contacts. In fact, during the periods of depression of the transmitting key, no distant control switches are used. An aerial of the loop type is, however, necessary to carry on the experiment.

Reference to the diagram (Fig. 2) shows that the loop aerial is represented at A, and the secondary of the oscillation transformer at L_1. L_1 is a doubly wound helix, that is to say, there are two coils wound in parallel on it. One terminal of each of these coils is connected to the two sides of the loop aerial.

The 3-prong gap S_1 is connected in series to the earth. The conventional closed oscillatory circuit is represented by the spark gap S, the primary of the oscillation transformer by L and the condenser by C. The receiving transformer is represented by the windings P and P_1. This transformer may be of the type found in any amateur station. It is preferably of the inductively coupled type.

What ordinarily constitutes the slider for the aerial connection on this tuner is now connected to one side of the loop at M. The other terminal of the primary winding is connected to the other leg of the loop at M_1. Lead M_1 is also connected directly to the earth E_1 near the receiving *tuner*. The closed or detector circuit is represented by the winding P_1, the carborundum crystal CAR, the fixed condenser FC and the phones PH.

It is important that the gap S_1 be placed as near as possible to the actual earth connection. The points of the gap should be closed down to the least possible length, not more than 1/100 of an inch.

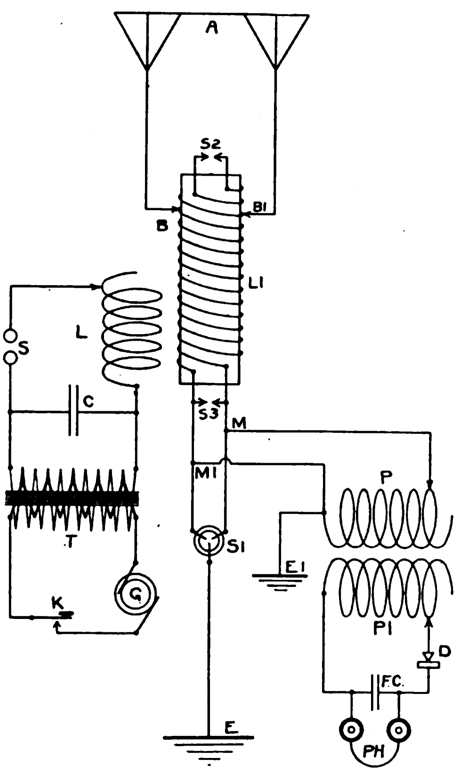


Fig. 2

A miniature spark gap S_2 is connected to the upper terminals of L_1, and another placed across the terminals at S_3.

It should be understood that the inductance L is wound about L_1 so that both windings of L_1 are excited simultaneously. The power transformer for charging the condensers is indicated at T, the transmitting key at K, and the source of energy at G.

It will be evident that in order to make up this circuit the only difference between this apparatus and that to be found in the ordinary amateur equipment is the use of the loop aerial, the doubly wound secondary of the transmitting oscillation transformer and the 3-point earth discharge gap.

Again, careful study of Fig. 2 will reveal the fact that the receiving tuner is not connected to the aerial in a freakish manner, but the circuit is that employed by the old DeForest system when using an inductively receiving tuner in connection with an aerial of the loop type.

Amateurs will find the double-wound helix easy of construction. In fact they may make use of any single coil helix at hand. If the windings of it are sufficiently spaced, they may interpose a second set of windings between its turns. Even though the first winding is made of bare wire or tubing, the second winding may be made of D. B. R. C. wire of the same size.

The Theory of Operation

Let us suppose that the two connections B and B_1 are so placed on L_1 that the aerial circuit to earth is in resonance with the closed oscillatory circuit L C S. When the transmitting key K is depressed and the spark made to act, high-frequency oscillations traverse the open oscillatory circuit which now serves as a single unit in the regular manner. That is, while the aerial possesses the characteristics of the loop when receiving, it acts as a single straightaway aerial when sending.

If, then, the inductance values at B and B_1 are suitably proportioned, no difference of potential will exist between the two sides of the loop (note this carefully), as is evidenced by the fact that no spark discharge takes place across the gaps S_2 and S_3. (Keep in mind the fact that S_2 and S_3 should not be open more than 1/100 of an inch.) S_2 and S_3 are, properly speaking, safety gaps, which in case of accidental disturbance of the circuits serve to protect the head phones and other parts of the receiving apparatus from burn-outs.

If, then, no difference of potential exists between S_2 and S_3, it is plain that no current flows in the primary winding of the receiving tuner P. The transmitting key K may then be depressed, signals transmitted without removal of the head phones from the ears or disconnections of the receiving apparatus.

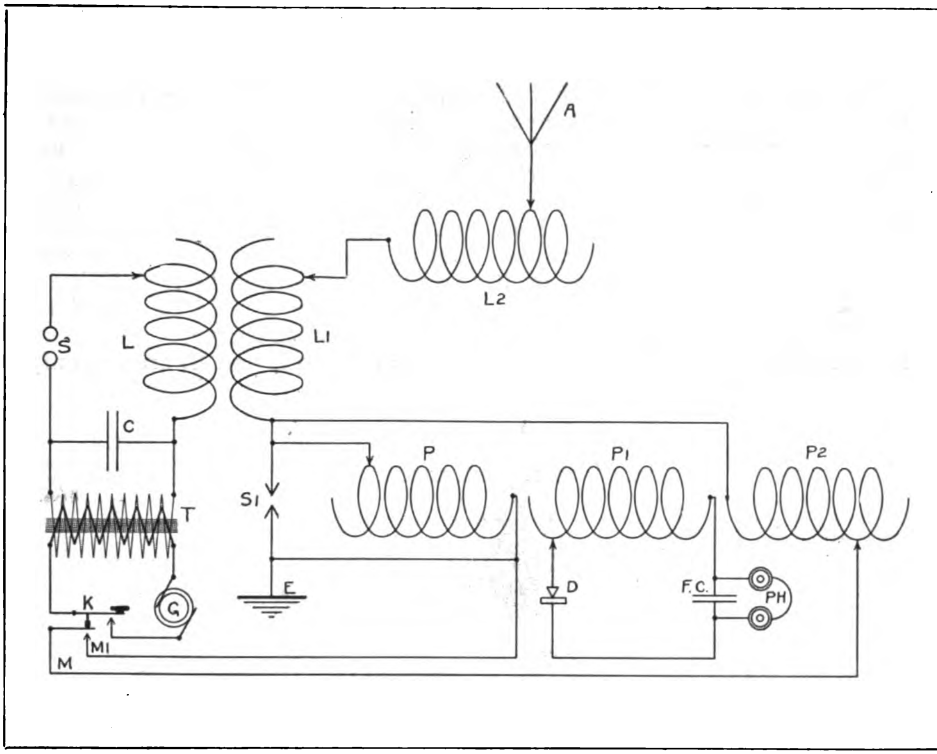


Fig. 3

As a matter of fact, a slight current does flow through the winding P. Careful examination will show that this winding is shunted by the right-hand spark discharge points at the earth gap.

It should not be forgotten that when this device is in operation the values of inductance at B and B_1 are not necessarily alike. In fact one winding invariably has more turns in use than the other. It is this very adjustment which balances the two slides of the loop and literally drives the energy out of the winding P, during the periods of transmission. Furthermore, even though this winding, as stated before, is shunted by the spark gap, which is discharging energy to earth, yet proper adjustments at B and B_1 will produce such conditions of balance that practically no energy flows through winding P. If, after several tests, there is still energy flowing in P, it should be shunted by a variable condenser which will assist in the dissipation of the unwanted energy.

There are, of course, as stated before, limitations to this device. While no energy flows in P, yet considerable energy will flow in P_1 by direct induction from the transmitter. This will cause considerable racket in the head phones and will throw sensitive crystals out of adjustment. If, however, the wave-length being transmitted is somewhat different from that being received, the circuit in which P_1 is connected will be out of resonance with the transmitter, and, therefore, little or no sound will be experienced in the phones. It is best at all times to select carborundum crystals that are rugged and possess at the same time a fair degree of sensitiveness. Crystals which possess these characteristics are generally of the dark blue or light green variety.

Duplex Wireless

With this device it is possible over very short distances to simultaneously send and receive signals from the same aerial. While the energy from the local transmitter is neutralized, that coming from the distant transmitting station flows through the aerial circuit and the receiving tuner to earth. The transmitting key may then be held down continuously and if the oscillations received are at a frequency differing from that of the transmitter, they may be read, even though the local spark gap is in operation.

While making tests at a commercial station several years ago, it was found that the transmitting key could be held down and signals read from another commercial station at a distance of 8 miles.

The full amount of energy received does not of course flow through the receiving tuner windings. Careful inspection of the circuits will show that during the periods of operation of the transmitter the receiving tuner is shunted by a gap which is discharging energy to earth and is, at the same time, sufficiently conductive to leak away considerable amount of incoming energy. This apparatus is worthy a trial by every amateur organization.

When the apparatus used in connection with the latter "break-in" method is employed, it may be adjusted to working conditions in the following manner.

If the 3-point gap is placed as near to earth as possible, the head phones need not be removed from the ears. The transmitting key K is then depressed and the inductances B and B_1 adjusted until there is no discharge across safety gaps S_2 and S_3. The earth gap, however, should be discharging, and if it is not, either the transmitting open and closed circuits are out of resonance or insufficient energy is being fed to the aerial circuit to jump the gap. This gap should be closed to the shortest possible length.

Inductances B and B_1 are not only adjusted for conditions of no sparking, but their values are slightly varied so as to produce a minimum of sound in the head telephones. Total silence in the head telephones will not be obtained as has previously been explained.

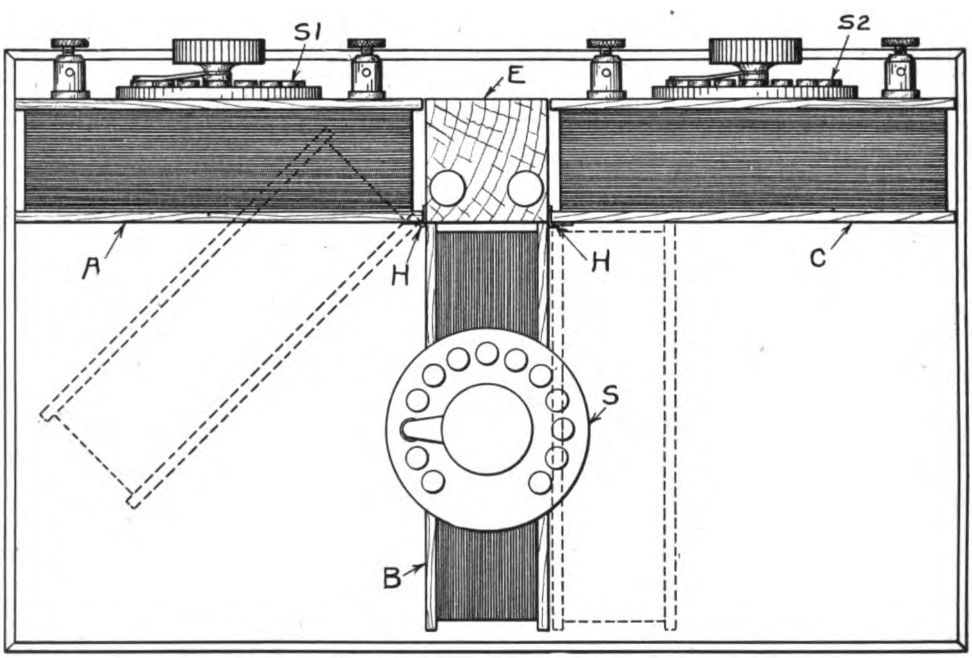


Fig. 4

Another New "Break-in" Method

While the first described "break-in" device, as previously stated, is not applicable to sensitive crystal detectors, the writer has devised auxiliary means by which this system may be employed without throwing out of adjustment even the notoriously erratic silicon detector. That is, the receiving tuner may be shunted across the regulation Marconi spark plate and employed in connection with silicon, perikon and galena detectors without loss of sensitiveness during the periods of transmission.

The apparatus may readily be applied to any amateur station requiring, as it does, only slight additions to the present receiving tuner.

The arrangement of circuits is shown in Fig. 3. An explanation follows:

Fig. 3 is similar to Fig 1, with a few additions. The power transformer for supplying energy to the spark gap circuit is represented at T, the alternating source of current supply at G, the transmitting key at K. In addition to the regular contacts, the key has special contacts M and M_1. M and M_1 are so placed and adjusted that they are placed in electrical contact just previous to the closing of the power circuit to the transformer.

The earth spark plate, in series with the open oscillatory circuit of the transmitter, is indicated at S_1 across which is shunted the primary of the receiving tuner winding P. The secondary winding of the receiving tuner and its associated apparatus are represented at P_1 and the crystal detector at D.

In inductive relation to P_1 we have the additional coil P_2, which is wound in opposition to P_1, and is also shunted around to earth gap S_1. The winding P_2 is of the same dimensions as the primary winding P and is made adjustable by a variable contact (switch or slider—preferably multiple point switch).

Theory of Operation

It is evident, from the fact of the presence of the spark gap S_1, in shunt to winding P, that during discharge considerable difference of potential will exist in P which will be transferred to P_1, by induction. Even if the winding P were wholly eliminated, considerable energy would be induced in P_1 by direct induction from the transmitting radio frequency circuits. This alone will throw a sensitive crystal out of adjustment. By the use of winding P_2, the unwanted energy in P_1 may be wholly eliminated.

Just previous to the closing of the contacts on the transmitting key, the contacts M and M_1 are closed which, when the transmitter is in operation, will tap off a certain amount of the antenna circuit energy, causing it to flow through P_2. Magnetic lines of force are set up in P_2 in opposition to those produced in P_1.

If the ampere turns of P_2 are the same as those of P, and the coupling from P_2 to P_1 is slightly greater than that from P to P_1, the energy which otherwise might flow in the detector circuit during the periods of transmission, will be wholly destroyed and complete silence in the head phones obtained. Therefore if no energy flows in the detector D, its sensitiveness will be retained and it will always be ready for the reception of signals when the transmitting key is raised.

When this method is first used a little experimenting is necessary to determine the proper values of inductance in the opposition coil.

This apparatus is adjusted in the following manner:

When the transmitting circuits are in proper resonance, and the detector D is in proper adjustment for maximum sensitiveness, the transmitting key is held down and the values of inductance and coupling at P_2 adjusted until complete silence in the head phones is obtained.

Thus the apparatus is in proper adjustment for an efficient "break-in" system and will work with great regularity. Each time the wave-length of the receiving tuner is changed it may be found necessary to readjust the values of inductance or coupling at P_2. But for any given wave-length no changes need be made. During the moments that the adjustments for silence are being made it may be necessary to make several readjustments of D, in order to maintain sensitive conditions.

The receiving tuner of ordinary construction does not allow this particular "break-in" system to be used to the best advantage. The writer prefers a receiving tuner of altered design after the drawings shown in Figs. 4 and 5.

The secondary winding of the receiving tuner is made on a rectangular frame B. B is fastened rigidly to the support E, as shown. The values of inductance in use are determined by the multiple-point switch S, mounted on the top.

The primary winding A is hinged (H) at the rear, so that it may be placed in close inductive relation to B, at right angles or at any intermediate position as desired, thus allowing variations of coupling to be obtained. The number of turns in use at A are determined by the switch S_1 mounted on the side as shown.

The opposition coil C is also mounted on hinges (H) and is of the same proportions as winding A. Coil C has a variable or multiple-point switch S_2 mounted on the side, as shown.

No actual dimensions are given as it is expected that they will be selected to suit the range of wave-lengths it is desired to receive. For amateur work coil B may be 6 inches square, 2 inches in width and wound with a single layer of No. 30 wire. Coils A and C may be 1 inch in width. Each may be wound with 2 layers of No. 22 or No. 24 wire, the turns being divided between the points of a multiple-point switch to suit the builder.

As only rough adjustments of inductance are obtained by the use of a single multiple-point switch, it is expected that variable condensers will be used in the open and closed circuits to give the fineness of adjustment desired.

The proper positions in the circuits for these condensers are readily understood by the average amateur.

Limitations

It will be observed that in all the "break-in" methods described a discharge gap is placed in series with the earth. With the loose couplings employed under the present United States regulations the insertion of this gap is detrimental to the character of the emitted wave. In fact, unless sufficient voltage is employed at the spark gap and the coupling is fairly tight, the potential at the earth arrester will be insufficient to bridge the gap.

With quenched spark transmitters the use of an earth gap is entirely out of the question. It is then necessary to employ some form of electromagnetic switch which will short-circuit the gap during the periods of transmission. This brings the device under the claims of the United States patent mentioned previously in this article.

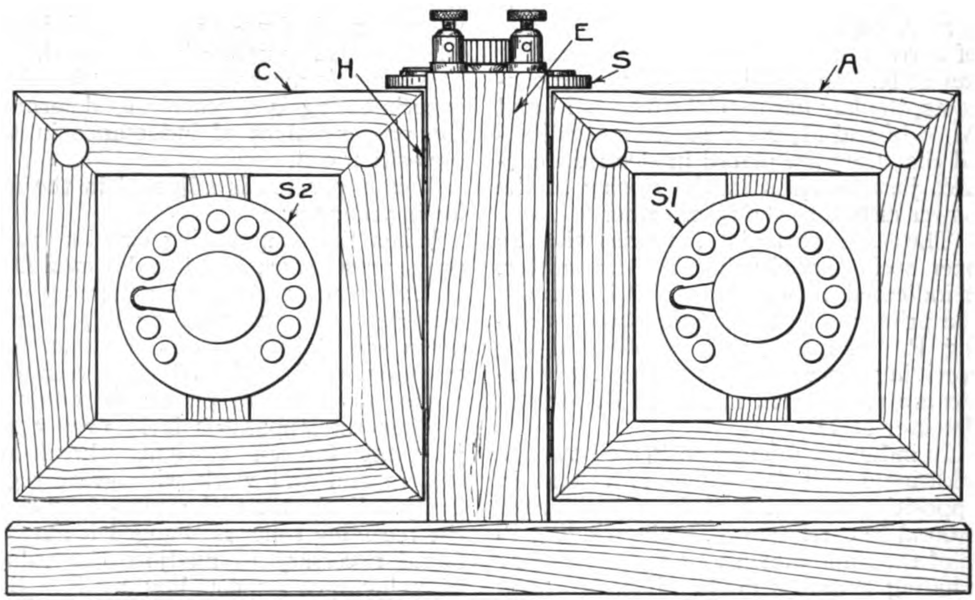
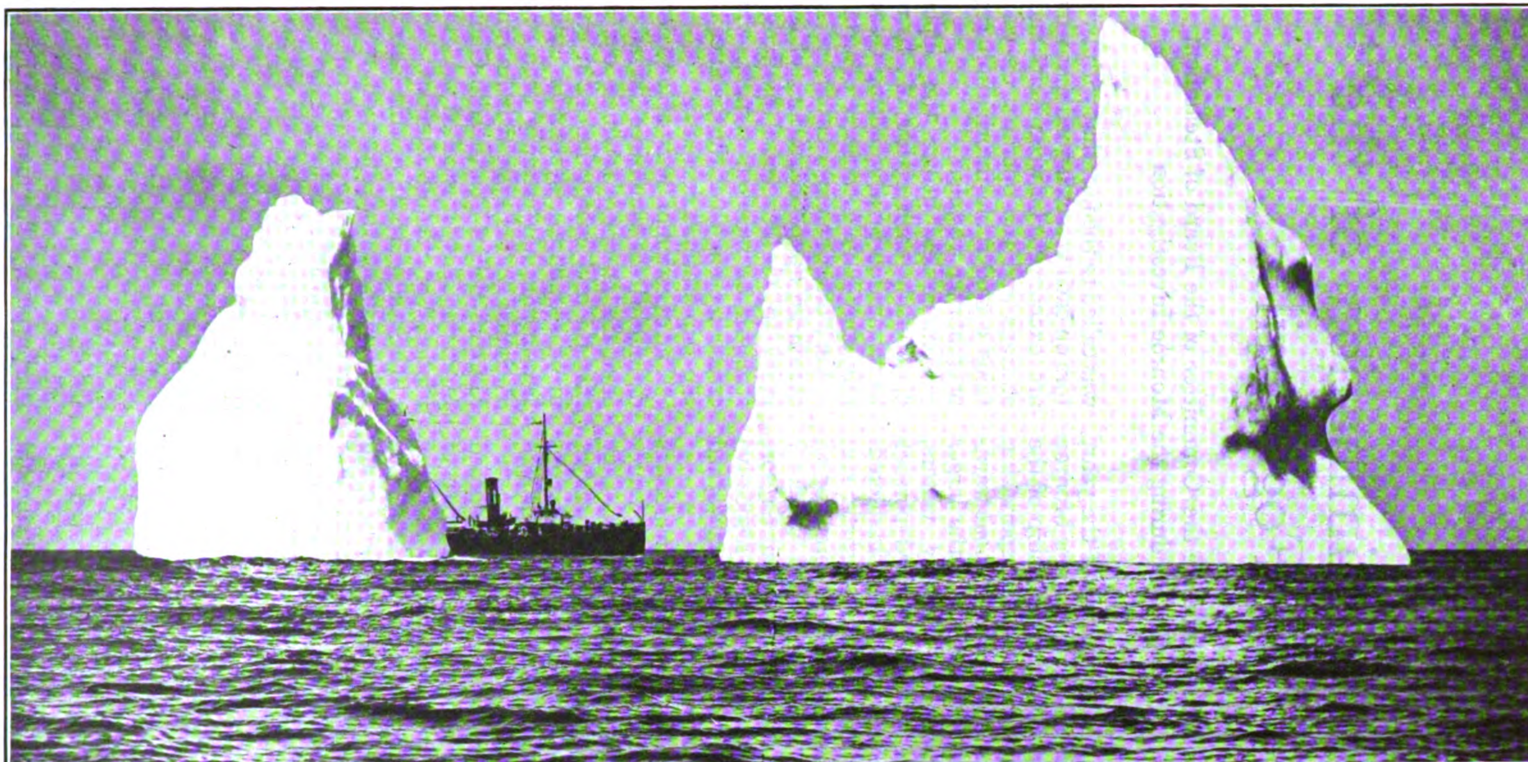


Fig. 5

(*To be Continued*)



Photographs such as this, one coming to our attention in these warm June days, make us fully appreciate what a wonderful aid is wireless to navigation. On Easter Sunday the U. S. Revenue Cutter Seneca, patroling the North Atlantic, found these two gigantic icebergs in the steamer lanes and immediately sent out wireless warnings to all nearby steamships. From water line to tip these icebergs rose to a height of over 125 feet, and the Seneca, which is seen between the two monsters, appeared nothing but a pigmy of the sea in comparison

The Elimination of the Fog Peril

Some facts laid before the Committee of the Board of Steamboat Inspectors during the Monroe Investigation

WHEN, at the beginning of the year, the Old Dominion steamer Monroe and the Nantucket, a smaller ship of the Merchants and Miners Transportation Company, crashed together without warning and twelve minutes later the larger vessel sank beneath the oily waters, carrying almost half a hundred persons with her, the American public shuddered. Then with the horror of the disaster still fresh in their minds they clamored for an investigation. Where was the wireless? Was this great human agency but a resort in time of danger; could not the respective captains of both vessels have been warned of their proximity in time?

The Board of Steamboat Inspectors thought not. After examining the junior wireless operator in Philadelphia, they reported that wireless telegraphy had yet to prove that it could prevent collisions of ships approaching each other through a blanket of fog.

This decision was given widespread publicity in the newspapers in spite of the fact that from experience the Navy Department, the revenue cutter service and several big steamship owners could not agree with the inspectors. For months they had been making tests of a new device which had shown accurately the direction from which wireless signals come and locates the sending vessels in the thickest fog. The Marconi Wireless Telegraphy Company of America then laid before the investigating Committee a few pertinent facts bearing on the subject; demonstrating that on more than one occasion wireless had proved its utility in storm or fog.

The steamboat inspectors' attention was called to the fact that with two operators on each vessel, a good many messages are exchanged between ship and shore stations and the operator on watch obtains considerable information regarding neighboring vessels.

Commanders utilize the opportunity of advising each orther of obstructions to navigation or neighboring vessels that they may have encountered en route.

Very often an experienced operator will obtain an approximate idea of the proximity to another vessel by judging the strength of received signals, which increase in strength as the distance between the ship stations decreases.

The question of being able to determine definitely from what direction radio signals emanate is one to which considerable thought and energy has been given and in consequence a system of radio direction-finding has recently been produced. Technically this system is known as the Marconi-Bellini-Tossi-Radio Goniometer. More popularly it is called the "Direction Finder," or "Radio Compass."

The sole purpose of this instrument is to determine the direction from which wireless signals are being transmitted.

The apparatus is independent and supplementary to the regular wireless outfit installed at wireless stations and requires no power for its operation. It does, however, necessitate the installation of a separate antenna or aerial wires, consisting of two triangles bisecting each other at right angles. The range of this instrument is from forty to fifty miles, the distance depending very largely upon the size of the wires that are installed for the purpose. The manipulation is simple and can be operated either by the radio operator or the navigating officer.

With a view of making this instrument adaptable to the conditions that obtain on the American coastwise steamers, initial tests were recently conducted on the steamer Northland, owned by the Eastern Steamship Corporation. During the voyage between New York and Portland, Me., a number of tests were conducted; the results of each being submitted to the captain and navigating officer of the vessel. The readings submitted were carefully compared with the ship's charts and compass, and the results obtained were pronounced correct. Captain Johnson of the steamer Northland personally checked the readings and expressed himself as being highly impressed with their accuracy.

Not long afterward the United States revenue cutter Seneca was equipped with the "Direction Finder," and this vessel put out to sea for the special purpose of conducting these tests, the results of which were also satisfactory. A report of these tests is now in the hands of Captain John Q. Walton, Naval Constructor, Washington, D. C. It was added that the U. S. Navy has been supplied with several complete outfits which they are now testing at their laboratories.

At the present time the shops of the Marconi Company are engaged in manufacturing a sufficient number of these instruments to place on the market and submit to the various steamship companies, with the privilege of thoroughly testing the apparatus before adapting it for general use.

ALASKAN MINES EQUIPPED

The Marconi Wireless Telegraph Company of America has recently closed a contract with the Jualin Alaska Mines Company for a 5 k. w. set to be installed in Jualin Juneau.

W. B. Hoggatt, former governor of Alaska and now president of the Mines Company, with headquarters in New York, stated that with this Marconi equipment the mining men confidently expected to maintain continuous communication over the mountainous Alaskan regions and relay, through the Juneau station, messages designated for San Francisco and New York.

LICENSE WARNING

The Department of Commerce has addressed letters to wireless station owners containing a warning that it is unlawful to operate a station after its license expires. Three copies of Form No. 762, "Applicant's Description of Apparatus," are enclosed, two of which are to be filled in fully and accurately and returned to the office of their local inspector.

The number of storage battery cells is to be stated, or a description of the source of power given. A diagram showing the dimensions of the antenna should also accompany the papers and the expired license must be returned.

It is added that these instructions must be promptly and carefully complied with if the owner wishes his license renewed.

SETS OF GREATER POWER FOR THE NAVY

In order that communication with Rear-Admiral Howard, commander-in-chief of the Pacific fleet, may be maintained under all conditions the wireless plants on his flagship and at San Diego, Cal., will be greatly increased in strength. Assistant Secretary of the Navy Roosevelt, who returned to Washington recently after a month inspecting yards and naval stations on the west coast, announced that the wireless outfit at San Diego is to be supplanted by one four or six times as powerful, and that the wireless set on the flagship will be changed for a more powerful one.

The California station will then have a radius of 10,000 miles, and communication with Admiral Howard and with the Panama Canal should be possible under all conditions.

A wireless set has been presented to the Massachusetts State Board of Charities for the use of Archie Thomas, a wireless operator, who has been a member of the leper colony at Penikese Island for several years.

New License Examinations

New requirements and a method for conducting examinations for operators' licenses are to be adopted at all examining offices, according to E. T. Chamberlain, Commissioner of Navigation and the Regulations published by the Department of Commerce and all instructions previously issued in conflict are thereby amended.

The Continental Morse code test (5 letters to a word) shall consist of messages with call letters and regular preambles; conventional signals and abbreviations and odd phrases; and shall in no case consist of simple, connected reading matter. The test will be conducted by means of the omnigraph or other automatic instrument wherever possible.

The test shall continue for five minutes at the speed of 20 words, 12 words and 5 words per minute, respectively, for commercial first, second, and lower grades, and to qualify, the applicant must receive correctly 20, 12, or 5 words in consecutive order.

The code test sheets written by the applicant will be forwarded to the Bureau with the other papers, and the speed attained noted in the lower left-hand corner of the first sheet.

Written Examination

The practical and theoretical examination shall consist of seven comprehensive questions under the following headings and values:

	Points Maximum Value.
1. Experience	20
2. Diagram of Receiving and Transmitting Apparatus	10
3. Knowledge of Transmitting Apparatus	20
4. Knowledge of Receiving Apparatus	20
5. Knowledge of Operation and Care of Storage Batteries	10
6. Knowledge of Motors and Generators	10
7. Knowledge of International Regulations Governing Radio Communication, and the United States Radio Laws and Regulations	10
	100

75 constitutes a passing mark for first-grade commercial.

65 constitutes a passing mark for second-grade commercial.

Question No. 1 shall determine the applicant's practical knowledge and experience in handling wireless apparatus. An applicant's experience will be determined largely from the personal question sheet and from satisfactory letters or references submitted. Experience, operating first-class amateur apparatus or the apparatus provided in good training schools, will be given a reasonable value, but applicants who have had experience as apprentices at commercial shore stations or on board vessels will receive higher marks.

Applicants who fail to attain 20 words in the code test but who attain a mark of between 65 and 75 in the written examination may be issued second-grade licenses.

Re-examination

No applicant who fails to qualify will be reëxamined at any examining office within three months from date of the previous examination. All examination papers, whether the applicant qualifies or not, will be forwarded to the Bureau of Navigation for filing as "Operator's record." When the records of the Bureau develop the fact that an applicant has failed to qualify and has applied for reexamination or been reëxamined at the same or another office within three months, his existing license or license privilege may be suspended or revoked by the Secretary of Commerce. Applicants to whom are issued second-grade licenses will not be examined for first grade within three months under the same rule.

Operator's License, Commercial Extra First Grade

The Department of Commerce will issue a special license to be known as Commercial, Extra First Grade to operators whose trustworthiness and efficient service entitle them to confidence and recognition.

These licenses will be given consideration by the Civil Service Commission in examinations for positions requiring knowledge of wireless telegraphy, when experience is rated as a part of such examinations.

Applicants for the Commercial, Extra First-grade license must pass a special examination. To be eligible for this examination they must hold commercial first-grade licenses, and their certificates of skill in radio communication, issued under the Act of June 24, 1910, or licenses under the Act of August 13, 1912, must record 12 months' satisfactory commercial service, of which at least six months have been at sea, during the two years previous to the filing of the application for examination, as shown by indorsement on the license service records, or other satisfactory evidence, and provided that the applicants have not been penalized for a violation of the radio laws and regulations.

A speed of at least 30 words per minute, Continental Morse, and 25 words per minute, American Morse (five letters to the word), must be attained. The technical questions and the questions on the radio laws and regulations will be considerably wider in scope than those for commercial first grade, and a higher percentage will be required.

All examination papers, including the code test sheets, will be marked and forwarded to the Commissioner of Navigation, with a recommendation by the inspector or examining officer. Examination papers will be marked upon the basis of 100, and licenses will be recommended only if 80 or better is attained.

Licenses of this grade will be issued by the Commissioner of Navigation, indorsed by the Secretary of Commerce, and delivered to the successful applicant through the examining officer.

Examinations for the Commercial, Extra First-grade license will be held at the following offices only by appointment: Commandants of the Navy Yards at Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa. U. S. Radio Inspectors at Customhouses of New Orleans, La.; San Francisco, Cal.; Seattle, Wash.; Cleveland, Ohio; Chicago, Ill.

In special cases, upon application to the Commissioner of Navigation, arrangements may be made for examinations at other points.

Applicants who fail to pass the examination will not be reëxamined within three months.

ADVICE FOR MARCONI OPERATORS

By JOSEPH P. MORRALL

Many operators who are using the Marconi valve tuner have difficulty in tuning to resonance with long waves as the tuner is not wound for wave-lengths much longer than 1,500 meters. Some operators tune to higher waves by placing the intermediate condenser across the aerial and ground posts, thus shunting it across the primary of the receiving transformer. This will increase the wave-length of the aerial circuit, but it does not increase the wave-length of the detector circuit which must also be brought up to resonance with the desired wave.

This difficulty can be overcome if the wave-length of the aerial circuit is increased by adding an extra inductance in series with the aerial, instead of by means of the condenser. The wave-length of the detector circuit can then be increased by placing the intermediate condenser across the secondary winding of the receiving transformer. This can be done by connecting one terminal of the condenser to the upright post to which the detector is also connected, and connecting the other terminal of the condenser to the telephone post nearest the front of the tuner.

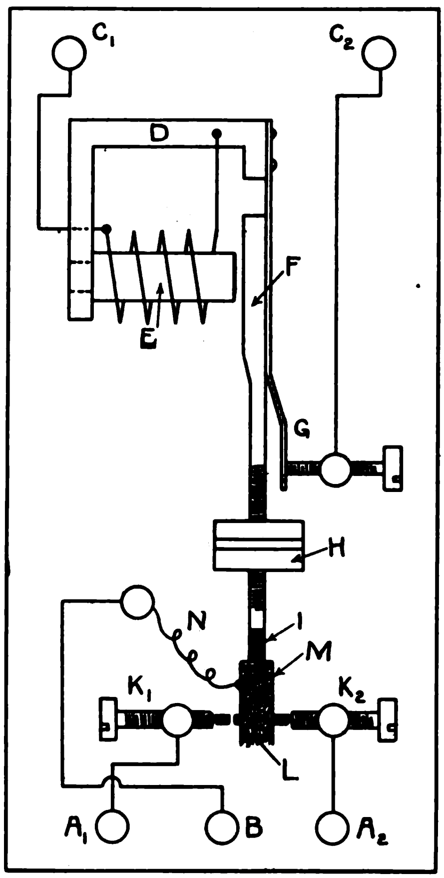
It will be found that a very long wave can then be received and the intensity of signals from Arlington will be increased nearly fifty per cent over those received with the condenser shunted across the primary of the receiving transformer.

EXPERIMENTAL SERVICE BILL

A bill appropriating $100,000 to establish an experimental wireless communication service between postoffices in the United States and offices in foreign countries has been introduced in the House by Representative Steenerson, of Minnesota. It provides that the necessary apparatus may be purchased or rented.

The Readers' Forum

Paul Schultz, of 45 Christwood Street, Springfield, Mass., sends us a description of a duplex receiving system which he says may be used to advantage in the amateur field. He says that he has observed that when using any duplex system, such as by connecting two receivers to one antenna, any adjustments made on one receiver will invariably affect the other. He therefore purposes to overcome this difficulty by the arrangement shown in the accompanying diagram. Briefly, he mounts contacts on the end of the armature of any bell buzzer. These contacts are made to play against two stationary contacts A1 and A2 which are respectively connected to two distinct receiving sets adjusted to different wave-lengths.



Diagram, Paul Schultz article

We have carefully examined the diagram and, while we agree with him to some extent in theory, we do not in practice. We see several limitations. He proposes to run the buzzer at such a speed that two receivers will be alternately connected to the circuit a sufficient number of times per second to allow the reception of the dots and dashes of the Morse code. Granted that the buzzer will make a sufficient number of makes and breaks per second to accomplish this, yet the note produced in the receiving telephones of each receiving tuner will not be that due to the spark note at a distant station, but will depend very largely upon the number of interruptions of the buzzer. Suppose then, that the antenna was so situated that it accumulated heavy static charges; then the buzzer contacts will literally "churn-up" such static charges and produce a note which may be more disagreeable than that emitted without the employment of a buzzer.

Furthermore, at the contacts G of the buzzer the sparking may be such as to set up disagreeable inductive noises in the receiving head telephones.

In his description Mr. Schultz says:

The lower part of armature F must be threaded in order to fit it with a weight H, which can be moved up or down and therefore any variations of the number of interruptions may be obtained. On the end of the armature a "U" shaped spring M is attached. This spring is about $\frac{3}{16}$ of an inch in width and is insulated from the armature F by a piece of round fiber I. It is well to fit the inside of the spring M, with a piece of felt L, in order to dampen the vibration between the contact points K1 and K2. To the spring M is soldered a flexible wire N which is connected to the binding post B.

The working of the relay is as follows:

When a battery is connected to binding posts C1 and C2 the armature F is set into rapid vibration and therefore connects the spring M alternately to contacts K1 or K2. The antenna is connected to post B while one receiving is connected to post A1 and the other to post A2. The interruptions occur many times per second and the antenna is alternately connected to either receiving set No. 1 and No. 2, through binding posts A1 and A2.

The buzzer may be adjusted for proper working conditions in the following manner:

Connect a small battery in series with the phones to post A1 and A2 and regulate the interruptions at contact screw G. Bring the screws K1 and K2 close together until a sound is produced in the receivers and then screw these contact points carefully back again until there is no sound in the receivers. This indicates the shortest interruptions possible. Then connect the battery in series with the phones first to posts A1 and B and, after noting the tone in the receivers, shift the connections to A2 and B.

Adjust the contact screw K2 until there is the same sound in the receivers as produced by the first connection. It is very important to have the same tone in the receivers in both connections in order to obtain good results.

The writer thus abruptly ends his contribution, making no statements as to whether he has actually used the apparatus or what results were actually obtained. The drawing, however, is sufficiently clear to enable any amateur to construct the apparatus. The experiment may be interesting to perform, even though the device proves to be inoperative.

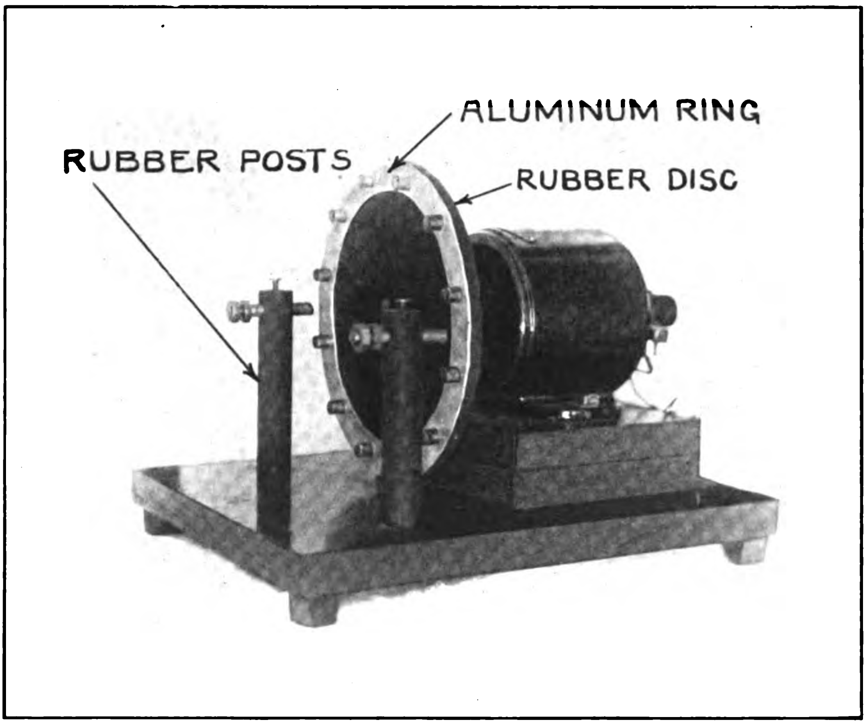
C. G. Fuss, of Little Valley, N. Y., says that he has experienced the difficulties encountered by the average amateur in the construction of a satisfactory rotary gap and that he has finally constructed one which he believes is well designed and will give better results than any other type of construction which may be employed. A photograph of the gap is shown in the accompanying diagram.

He writes:

The motor shown in the photograph is of the standard variable speed type made by the Robbins & Meyers Company and sells for about $10. This motor is strong enough for the purpose, particularly on account of the fact that I find that it is not necessary to run it at the maximum speed. The hard rubber disc shown is 7 inches in diameter and ¼ of an inch in thickness. It is attached to the pulley of the motor by 3 machine screws.

To mark off a perfect circle and produce a true wheel I find it better to first mount the disc on the shaft and then, when slowly rotated, an awl may be held against it. This is by far the better method as there is then no danger of producing a "wobbly" wheel.

It will be necessary to mount the motor upon

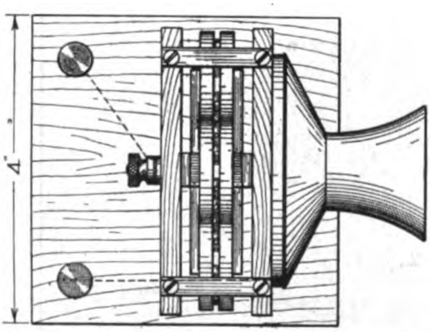


Diagram, C. G. Fuss article

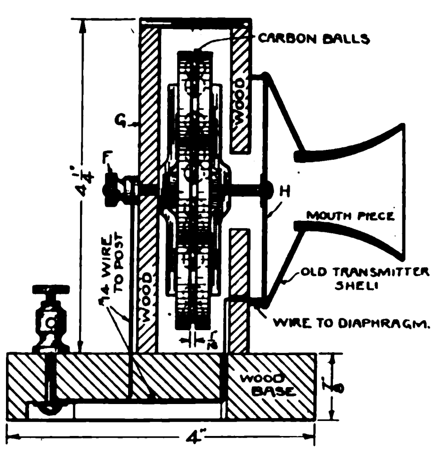
a block of wood so as to allow the rubber disc to clear the base. This can be done by passing two bolts up through the base of the instrument, the block and the base of the motor.

A circle six inches in diameter is next marked upon the wheel. Then, with the aid of a protractor, the circle is divided into twelve equal segments. At each point of division a small hole is drilled. These are to hold the spark points, which are of brass about $\frac{5}{16}$ of an inch in diameter and about the same in length. One end of each of these points is tapped and fitted with a machine screw so as to fasten it to the wheel. These points may be made or purchased. I purchased mine from the Clapp-Eastham Company at the small price of five cents each. Before fastening the points, cut out a ring of aluminum, 7 inches outside diameter and about 3/4 of an inch in width. Drill 12 holes in it to correspond with those in the wheel and place it on the wheel beneath the row of points, as shown in the photograph.

The posts that hold the stationary spark points are 3/4 of an inch hard rubber rods. They are held to the base by a screw, passed up through the base. Next the distance from the base to the center of the wheel is measured, and at this



PLAN VIEW.



SECTIONAL SIDE VIEW

Sanford G. Ryder article, Fig. 1

distance up from the bottom of each post, a $\frac{5}{16}$ of an inch hole is drilled for the stationary points. These stationary points are about $\frac{5}{16}$ of an inch in diameter and about 2 inches in length. One end of each is threaded and fitted with two nuts for connections. I purchased these points from the Clapp Eastham Company, although one might make them himself if he chose to do so. A small set screw is passed down into each post so as to hold the points.

Judging from the photograph and description accompanying it, the construction seems to be fairly rigid and we are under the impression that the gap will be found to be satisfactory in operation.

* * *

Sanford G. Ryder, of East Rockaway, L. I., sends us sketches and a description of a wireless telephone transmitter which he believes is superior to the telephone transmitter in common use.

He reminds us of the fact that the ordinary type of telephone transmitter is not suitable for wireless telephone work and cannot carry more than one ampere of current without heating. But he says that if a transmitter is designed after the manner shown in his drawing, currents in excess of this amount may be handled with ease.

So far as we are concerned, the construction is novel and the drawings may be of value to amateur experimenters in wireless telephony.

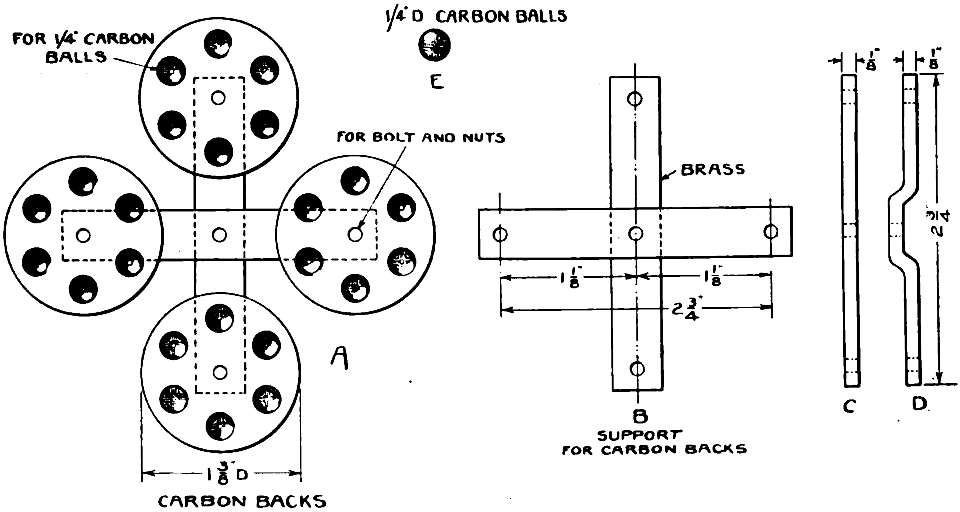
He writes:

Procure a regular telephone transmitter from any telephone company. Remove the back shell and interior parts which for our new design will not be required. The front shell, mouthpiece, and diaphragm are fastened to a wood support and base, as shown in Fig. 1.

The design of the woodwork should be as near as possible to that shown in my drawings. It will be found that telephone transmitters vary in design and therefore the construction of the wood base and support may be altered.

The carbon back support B, Fig. 2, is made of brass; 2 sets are required, one for the rear carbon back and one for the front carbon back. The latter is connected to the diaphragm H, and the rear set is held in place by the support G. The carbon back supports are made as shown at C and D. They are then placed together, forming a cross. Eight carbon backs are required, each 1 3/8 inches in diameter (four for front and rear sets). These backs may be purchased at any carbon supply dealer or at an electrical supply house. Each carbon back is arranged to carry a 1/4 of an inch carbon ball as shown at E. This apparatus should be mounted and arranged as per the drawing. Twenty-four carbon balls in all are required.

The post F is connected to the rear set of carbon backs and thence to the other binding post. The strips of brass, having dimensions of 1/8 of an inch x 1 1/4 of an inch are used to hold together the front and rear wood uprights.



Sanford G. Ryder article, Fig. 2

Oak or black walnut should be used for all woodwork and should be given two coats of shellac.

Are we to draw the conclusion that this transmitter will handle 4 to 5 ampères of undamped energy? If so, the experimenters cannot pass over our correspondent's design lightly.

We are aware that many experimenters have avoided the wireless telephone mainly on account of the fact that they were unable to design a satisfactory transmitter. Perhaps the description given may help them in the solution of the problem.

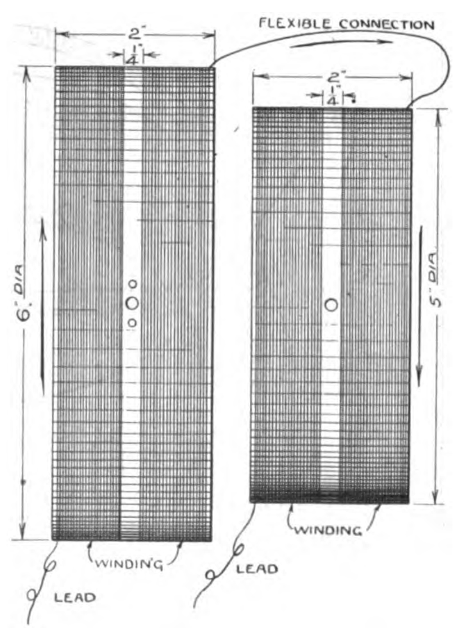
* * *

J. Lewis Munger, of 204 S. Nottawa Street, Sturgis, Mich., says that he believes that the type of variometer inductance which he describes is not generally found in an amateur equipment, but he believes the value of it is such that all amateurs would do well to construct one of similar design.

He accompanies his description by 4 sketches, 2 of which show the use of this device, first as an aerial tuning inductance and second as a coupling coil in a receiving tuner, where it simultaneously varies the wave-length of the aerial and detector circuit.

He then describes the construction of the variometer as follows:

To construct this variometer, first secure two cardboard tubes, one 6 inches in diameter, the other 5 inches in diameter. Make both tubes 2 inches in width. Each of these tubes should be wound with a single layer of No. 24 S. S. C. wire. A space should be left in the winding of these tubes in the middle for about 1/4 of an inch, as shown in Fig. 1. Care must be taken to get the same amount of wire on each tube and also



J. Lewis Munger article, Fig. 1

to wind them in the opposite direction. The wires should be thoroughly shellacked to prevent them from loosening up. The tubes are connected as shown in Fig. 1. Now drill a hole in each side of both tubes and through these holes put a piece of ¼ of an inch round brass rod, 8 inches in length, as shown in Fig. 2. When mounting the variometer fasten a small tube to the brass rod so that it will revolve with the knob. A pointer may be fastened to the knob which will work over a scale, as shown in Fig. 2.

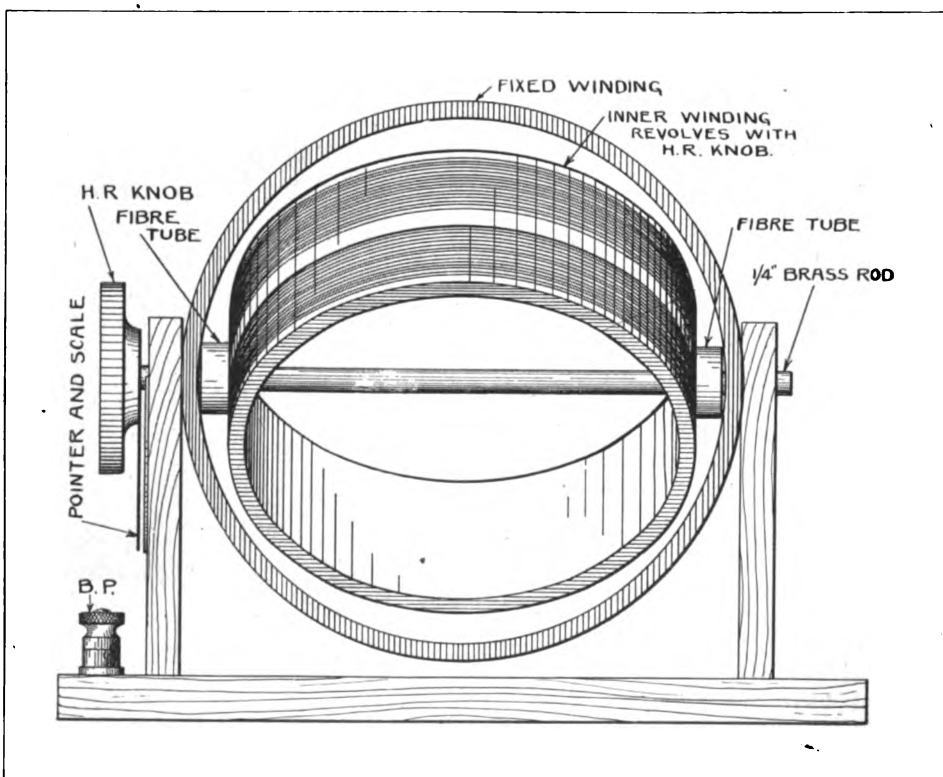
If the windings of the two tubes are identical in width, the inductance of the outer coil will be greater than that of the inner coil. Therefore, when the two coils are in concentric positions and so placed that the magnetic fields produced by each are in opposition, the value of inductance will not be zero. By a slight increase in the number of turns of the winding in the inner coil the condition may be approximated.

It makes no difference whether or not the inner or outer coils are wound in opposition, provided care is taken to connect the coils in series in such a manner that when in one position the two magnetic fields assist each other and in the opposite position, the magnetic fields oppose each other. Figure it out.

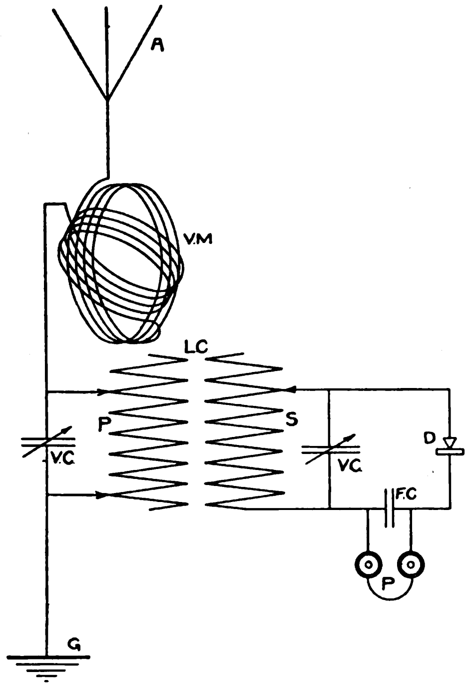
The variometer gives extremely fine adjustments of inductance, but there is always the objection that the ohmic resistance of the wire in the variometer is present after all conditions of adjustment of the relation of the two coils. Variometer coils of this type are often employed in connection with a fixed condenser, as the variable element for a wave meter.

* * *

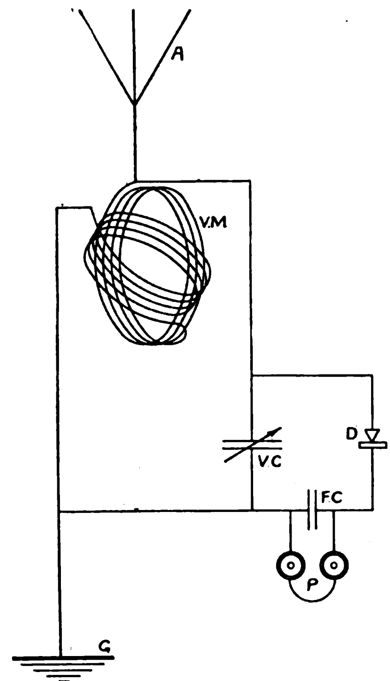
A. L. Groves, of Brooks, Va., sends us considerable data as to the wave-lengths employed by stations located all the way from Cape Cod, Mass., to Santa Marta, United States of Colombia, winding up with a description of an antenna and a tuner with which he is able to copy signals from Glace Bay, Nova Scotia, day or night, at a distance of 1,150 miles. We frequently receive inquiries from amateurs requesting data for a tuner suitable for the wave-length emitted from this station. Therefore, the results obtained



J. Lewis Munger article, Fig. 2



J. Lewis Munger article, Fig. 3



J. Lewis Munger article, Fig. 4

by our correspondent should be of interest.

He says:

In conducting experiments I find that with an aerial seventy-five feet high, total length 225 feet directional to the south, I can reach signals from Glace Bay, Nova Scotia, at a distance of 1,150 miles, day and night, continually. I use silicon as a detector. My receiving transformer primary is 8 inches in diameter and is wound with 300 turns of No. 20 S. C. C. wire. The secondary is 7½ inches in diameter and is wound with 500 turns of No. 24 S. C. C. wire.

In order to tune in Glace Bay signals I place the primary slide on the 287th turn. I use the full amount of inductance in the secondary coil. There is very little difference in the strength of the signals during the day or night, but owing to the great amount of static, as a rule the signals are easy to read during the daytime.

Our correspondent has failed to advise us as to whether a variable condenser was connected in shunt to the secondary coil. Possibly he may have used very close coupling between the primary and secondary circuit and a condenser was not therefore required.

NEW OKLAHOMA ASSOCIATION

TO THE EDITOR:—We take pleasure in announcing that on March 1st the Oklahoma State Wireless Association was reorganized, and, a week later, was incorporated under the laws of the State of Oklahoma.

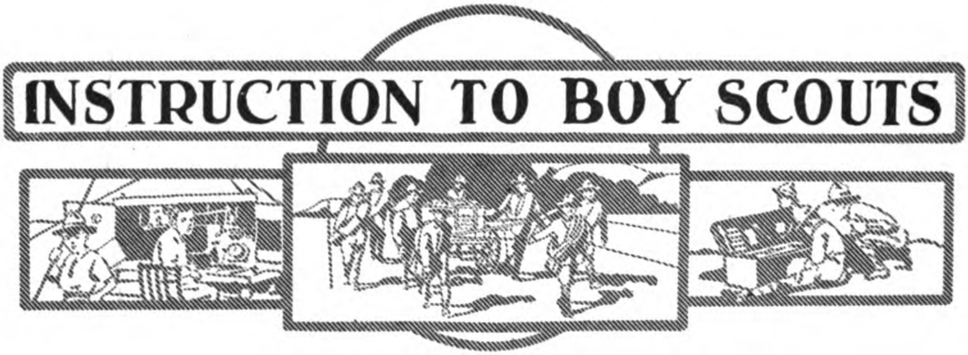
The reorganization and incorporation were effected in order that we might erect a large club station and class rooms where beginners might get instruction and assistance in the art of radio communication, and to this end we have leased a large tract of ground for a site, and plans for a large station are under way.

Application for special license is to be made soon, and until our operators take their examinations the work on the station will be mainly in the receiving.

We have found THE WIRELESS AGE a great source of help and inspiration in our previous experiments and it will be one of the most valuable additions to our library.

Very truly yours,
THE OKLAHOMA STATE WIRELESS ASSN.
J. R. Jones, *President.*

INSTRUCTION TO BOY SCOUTS



By A. B. COLE

CHAPTER XI

A Receiving Set for Station Use

THE central meeting place of each Scout Troop should be equipped with a modern outfit suitable for operating over considerable distances, not only for purposes of instruction in operating, but also to enable communication to be maintained with other troops.

Most of the instruments needed for long distance reception of messages can be built without difficulty by members of the troop, and the rest, if purchased, should be of reliable make to insure satisfactory results.

The most approved form of station apparatus is that in which the instruments are mounted on a panel, which makes the set compact, and places the apparatus within easy reach of the operator. Fig. 65 illustrates the completed receiving set mounted in this way. The panel is of wood or hard rubber and measures 12 inches wide, 20 inches high, and ¾ inch thick. It is supported in a vertical position by two brackets screwed to the back.

Receiving Transformer

The first instrument to be constructed is the receiving transformer; its windings, instead of being round, are square. The head A (Fig. 66) is of wood four inches square and ⅜ inch thick, and, as shown in Fig. 67, has its edges on one side raised ⅛ inch by the use of four wooden strips ¼ inch wide, leaving a square hole in the center into which the core projects. The head H is also four inches square and ⅜ inch thick, but has a hole 3½ inches square cut out of its center, and the core of the primary is set inside this. The

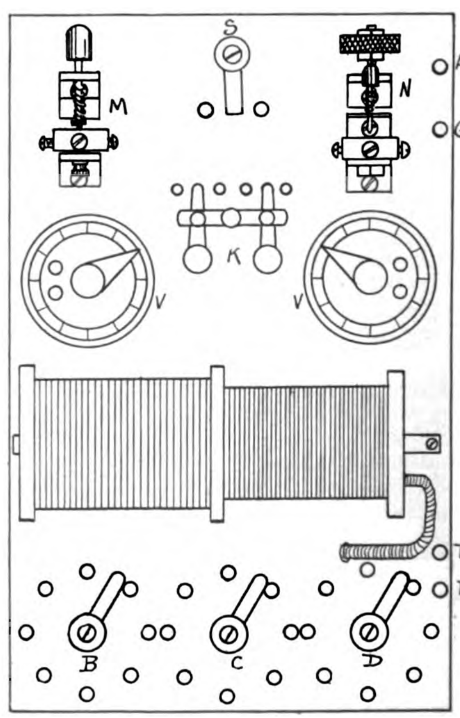


Fig. 65.—Complete receiving set

thin wood employed in parts of this receiving transformer may be taken from cigar boxes, which are made of cedar and very satisfactory for the purpose.

The small strips on the heads and also those forming the cores of the windings should be sandpapered first and then glued together, or small brass wire nails may be used, although the former method is preferable.

The core of the primary is $4\frac{1}{4}$ inches long and $3\frac{1}{2}$ inches square, outside, and is built of $\frac{1}{8}$ inch wood strips. That of the secondary is $4\frac{1}{4}$ inches long and 3 inches square outside, and is built of the same wood.

The head D of the secondary is $3\frac{3}{4}$ inches square and $\frac{3}{8}$ inch thick and has a square block C, $\frac{1}{4}$ inch thick and $2\frac{3}{4}$ inches square, set upon one side. This block fits snugly inside the core of the secondary. Another block E, $2\frac{3}{4}$ inches square and $\frac{1}{4}$ inch thick, is set inside the other end of the core of the secondary. A square hole is cut in head D, and also in block E, $\frac{7}{16}$ inch square; and another $\frac{5}{16}$ inch square in head A, by first drilling small circular holes and then cutting them out to the desired shape with a knife.

A thin square brass tube K, $4\frac{3}{8}$ inches long and $\frac{7}{16}$ inch square outside is set tightly in the holes in D and E and closely fits the brass rod F, which is $\frac{5}{16}$ inch square and $10\frac{1}{2}$ inches long. This rod is secured in head A by means of a washer and a machine screw entering it, and by a machine screw into G, which is a brass rod two inches high and $\frac{5}{16}$ inch square.

The winding of the primary, or larger coil, is one even layer of No. 19 single cotton covered copper magnet wire. Taps, made in accordance with the directions given in Chapter X for the tuning coil, are brought out and are to be connected to a 9 conductor flexible telephone cable which will pass through the panel on which the receiving transformer is supported. The taps are taken off every half inch along the winding, and including the ends of the winding, will be 9 in number.

The secondary is composed of a single even layer of No. 28 single cotton covered magnet wire, in sections brought to taps, numbering 9 in all, as in the primary winding, to a nine conductor flexible telephone cable which passes through head D for support. That conductor connected to the end of the winding nearest to the primary is a terminal of the winding, as shown in Fig. 72, and is the only one not connected to a switch point.

A flexible cable must be used to make these connections, as the secondary is moved toward or away from the primary and a cable of solid wires would resist the motion, and break before long.

The conductors of both the primary and secondary cables are led to switch points, with the exception of that mentioned before and the one connected to the end of the primary winding nearest head H, as these two are terminals of the windings, as illustrated in Fig. 72.

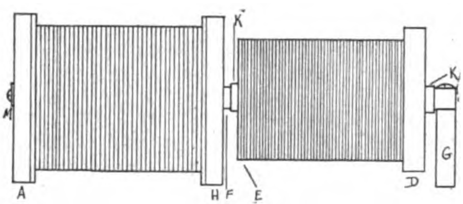


Fig. 66.—Receiving transformer

The other conductors are to be connected to switch points in two sets of 8 each, one set for the primary taps and the other for those of the secondary. The switch points are mounted on the panel as shown in Fig. 65, switch C controlling the primary and switch D the secondary. They should be connected in such a manner that the lever of either switch in revolving cuts in steps consecutively of the winding to which it is connected, starting from one end, and taking each step in proper rotation.

Loading Coil

The purpose of the loading coil is to add sufficient inductance to the primary circuit of the receiving transformer to give it a sufficiently great natural period to permit tuning to the long wave-lengths transmitted by the Government and other high-power stations. This coil consists of two even layers of No. 19 single cotton covered magnet wire wound on a cardboard or wood core $1\frac{1}{2}$ inches in diameter and ten inches long. As the wire is being wound on, four taps should be taken off each layer $2\frac{1}{2}$ inches apart, and led to the points of switch B, mounted on the panel (Fig. 65). The wire is wound in the manner of an electromagnet, starting at one end, which acts as a terminal of the coil, and winding continuously in the same direction.

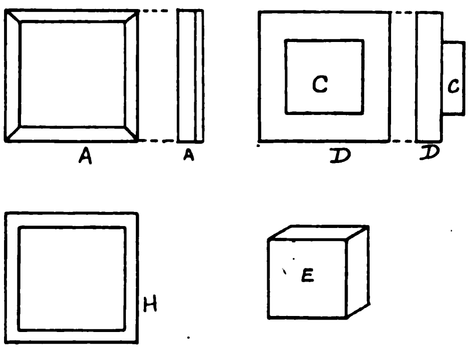


Fig. 67.—Parts of transformers

The loading coil may be supported on the back of the panel in any convenient way, but should be placed at least six inches above the receiving transformer so that the magnetic fields of these two instruments will not conflict. No iron should be used in the tuning apparatus or its supports, but brass or copper strips or screws may be employed.

Detectors

Two detectors are used in this set, and are so connected that the operator may change from one to the other quickly. As the sensitive substance one of these employs silicon and the other galena. These materials may be obtained from any large chemical house. Most crystals of silicon are of about the same sensitive qualities, but different crystals of the galena show different values for our purpose, and while a good piece of silicon will be obtained from an ounce or so, it is advisable to obtain a pound or two of galena to insure at least one extra sensitive piece. The size of the crystal seems to have no effect on the sensitiveness of the detector. Those handling the minerals should do so with care to prevent their becoming dirty or greasy.

In Fig. 65 the silicon detector is represented by M. It is shown in detail in Fig. 68, where A and F are brass strips $\frac{3}{8}$ inch wide and $\frac{1}{16}$ inch thick, bent at right angles so that they project 1$\frac{1}{4}$ inches from the front of the panel. A brass rod B, $\frac{1}{8}$ inch in diameter and 1$\frac{1}{4}$ inches long, has a shoulder upon which a light spiral spring S of brass or phosphor bronze wire exerts a pressure. The upper end of the spring is soldered to F. The upper end of B is threaded to take the small hard rubber or fiber knob K.

The cup C may be of any convenient size between $\frac{1}{2}$ and $\frac{3}{4}$ inch diameter, and is arranged with three set screws through the side to hold the mineral in place. A hole is drilled through the bottom of the cup and is threaded to take a short brass rod which is threaded at both ends. A metal washer D is placed on the rod between the cup and A, in which a hole $\frac{1}{4}$ inch in diameter is drilled as shown. A thumb nut N on the rod locks the cup in place in any desired position, so that B will touch any spot on the surface of the sensitive material.

A slot cut in A, as illustrated in the front view, permits vertical movement of this part which is locked at the best position by the screw holding it to the panel. The terminals of the detector are the two machine screws passing through the panel.

In Fig. 65, N represents the galena detector, which is shown more clearly in

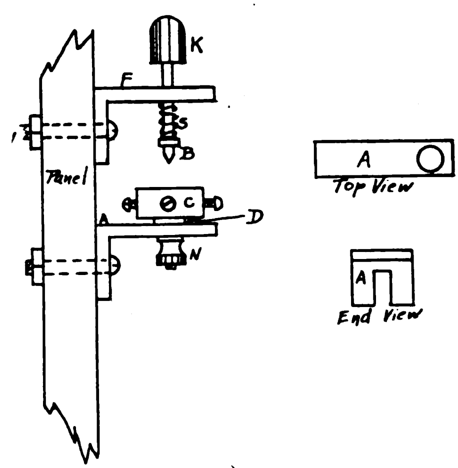


Fig. 68.—Silicon detector

Fig. 69. The hard rubber or fiber knob K is secured to the threaded brass rod B by means of two lock nuts A. K is $\frac{7}{8}$ inch in diameter and $\frac{1}{4}$ inch thick. B is $\frac{1}{8}$ inch in diameter and 1$\frac{1}{4}$ inches long. Brackets C and H are made of strip brass

3/8 inch wide and 1/16 inch thick. C projects 3/4 inch from the front of the panel, and H is 1/2 inch longer. D is a leaf spring of light brass or phosphor bronze 3/8 inch wide and of the same length as H.

T is a small hard rubber or fiber knob threaded to take the small German silver rod W which is 1/16 inch in diameter and 1 inch long. It has a needle point which rests on the galena held in the brass cup F by means of three set screws. A fine spiral spring S is soldered to D and exerts a light pressure against T.

Cup F is held to bracket H by means of a brass rod threaded into its center and locked by nut E. The terminals of the detector are the machine screws held by nuts M and P.

This form of detector gives very good results on account of the extremely close adjustment which it provides, and it is least affected of any type by vibration. The rod W presses lightly upon the surface of the galena and any vibration is taken up by the combination of spring S and spring D. The pressure of the point on the mineral is regulated by knob K, and it will be noted that this gives a compound adjustment.

Condensers

Two large variable condensers V should be used in this set to provide a wide range of wave-lengths and to insure close tuning and long distance reception of messages. These condensers should be purchased, as they are difficult to construct and their cost is low. Reliable makes of variable condensers having a capacity of .003 to .005 M. F. can be bought for $5 each, and it is suggested that no smaller size be used.

The fixed condenser, which is mounted on the back of the panel, is of the same dimensions as that described in the March, 1914, issue. This condenser should be placed in a wood case with binding post terminals, so that it may be secured properly to the panel.

Switches

The pole changing switch K (Fig. 65) may be purchased from any electrical house. It is taken apart and mounted less the base on the front of the panel as shown. This switch can be used to give the same results as a double pole double throw-knife switch and in this set is arranged to place the variable condenser at the left either in series with the primary of the receiving transformer and the ground wire, or in parallel with the primary and the loading coil. The former

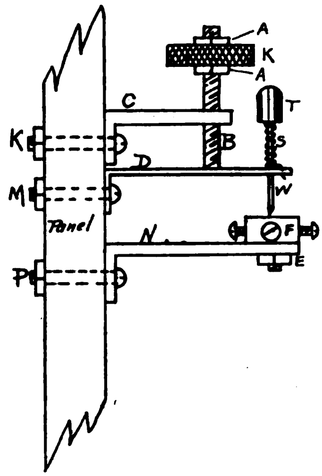


Fig. 69.—Galena detector

connection permits tuning to very short waves, such as are transmitted by amateur stations, and the latter aids in tuning to the long waves transmitted by government and other high power stations.

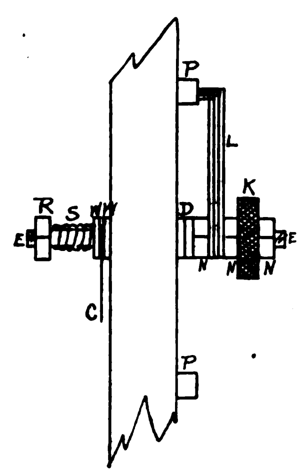


Fig. 70.—Switch lever

The contact points of all switches may be purchased, and this also applies to the switch levers, but if the builder has the necessary tools, it is advisable to make the levers after the type shown in Fig. 70, so that adjustment from the center of the switch is possible. This is neater than the regular type of switch, and gives quick action with a minimum of effort.

In Fig. 70, the hard rubber or fiber knob K is secured to the brass rod E, which is threaded at both ends, by means of three locknuts N. The rod is 1/8 inch in diameter and is held toward the back of the panel by the pressure of a spiral spring S acting against nut R and two washers W, between which the wire C is placed and acts as a connection. Nut R is soldered to the rod to prevent turning. The washers D allow the rod to turn with a minimum of friction, but spring S insures a good electrical contact at all times.

The switch lever L is made of three strips of thin phosphor bronze, bent at right angles at one end and filed off to a rounded edge where it touches the contact points. This laminated lever provides flexibility and a good contact with the points. The switch points P are the ordinary type used in bell switches, and have slightly rounded heads. It is recommended that the levers of all four switches S, B, C and D be made in this way.

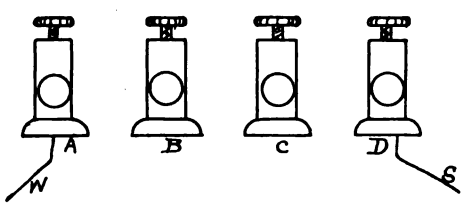


Fig. 71.—Receiver connections

Binding posts A and G are the aerial and ground terminals of the set, and the telephone receivers are to be connected to binding posts T and R. If several sets of receivers are to be used at the same time, they should all be of the same resistance and be connected in series, and to this end it would be well to arrange extra binding posts, connected as shown in Fig. 71, so that a number of head sets could be connected at once. W and S are the two wires of the set ordinarily connected to the receivers at posts T and R, and A, B, C and D are double binding posts. If one head set is to be used it is connected to posts A and D. When two sets are employed the first is connected in the upper holes in A and B and the second in the lower holes of B and D.

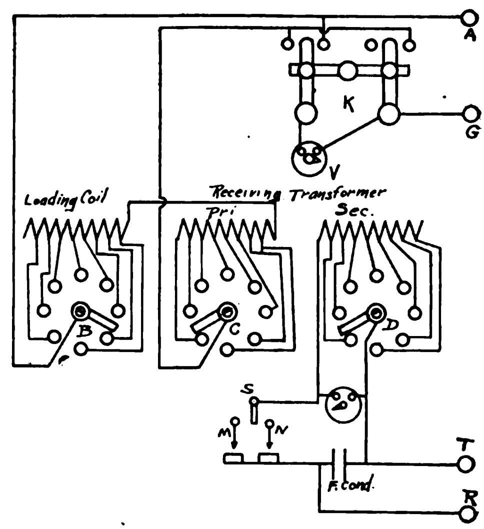


Fig. 72.—Wiring diagram

If three head sets are used, the first is connected in the upper holes of A and B, the second in the lower holes of B and C, and the third in the upper holes of C and D.

Binding posts A and D must always be in use as they are the receiver terminals of the set. In this way, any number of head sets may be provided for, but the more in use at one time, the weaker the received signals will be. When receivers are connected in series, those of the highest resistance will give louder signals with most detectors than those of lower resistance, providing they are of the same make and type.

Wiring the Set

The wiring diagram of the set is shown in Fig. 72. The letters apply to the same parts as in Fig. 65, but some of the instruments are displaced in order that the diagram may be more readily understood. The condenser V at the right in Fig. 65 is connected across the secondary of the receiving transformer, while the other variable condenser is connected to the pole changing switch K as shown. This switch when thrown to the right places the latter condenser in parallel with the loading coil and the primary of the receiving transformer, and when thrown to the left, connects it in series with the primary of the receiving transformer and the ground connection.

In connecting the flexible 9 conductor cable to the secondary of the receiving transformer, sufficient slack should be left to allow it to be moved back and forth without difficulty.

All joints of conductors in the set should be soldered and taped if best results are desired.

This is the eighth installment of Instruction to Boy Scouts. The ninth lesson by Mr. Cole will appear in an early issue.

NO DANGER FROM WIRELESS

A newspaper correspondent is alarmed by the "frequency of sparking in the rigging" which he states that he noticed on board the vessel in which he made a voyage recently, and he suggests that "here is a matter of some importance to ship owners and others, which would repay investigation."

Fire from the sparking in ships' rigging arising from the use of the wireless plant is a practically nonexistent danger. This was shown by exhaustive experiments made by the Marconi Company in April, 1912, at the instance of a firm of shipowners.

A quantity of naphtha was placed in a saucer and lodged as near as possible to a heavy spark, and a piece of waste saturated with naphtha was also placed close to the spark electrodes, but in neither case was the vapor ignited by the spark. A similar test was applied to the small sparks which obtain at minor parts of the apparatus, but it was not until a continuous spark was allowed for a very long period (which would not occur in actual practice) that the naphtha was eventually ignited.

The tests—which were all the more important as naphtha is one of the most inflammable cargoes carried—convinced the officials who carried them out—the superintending engineer of the shipping company and a representative of the Marconi Company—that fumes of naphtha would never be sufficiently dense inside the wireless cabin to permit of ignition. Outside the rigging this would be even more obvious.

Notwithstanding these tests, the Marconi Company has, at the request of some shipowners, enclosed the sparks, which are a necessary part of the transmitting apparatus, either in glass tubes or with a covering of gauze.

The sparks which may occur outside the wireless cabin in the rigging, when they do occur, are produced by induction, and have such a small heat value that they would be totally incapable of igniting gas, even if it were possible for gas to accumulate in the open air in the neighborhood of a spark. For the same reason these sparks could not ignite the driest inflammable material.

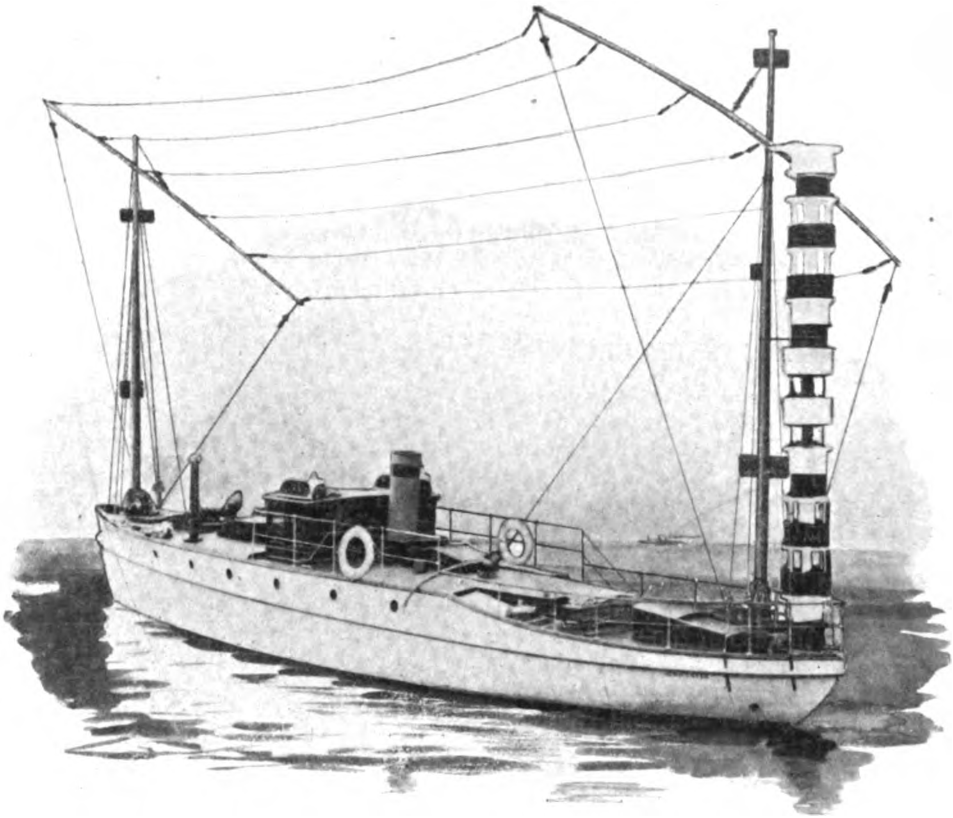
It may be suggested that sparks might occur within the ship itself, but this has never been noticed, and, in fact, with the comparatively small power which is used in the wireless installations on merchant vessels, the possibility of any spark within the ship itself is difficult to conceive, as the holds would be screened by the metal plating of the ship from any induction effect produced by the transmitting apparatus.

The foregoing statements refer to the high potential and high frequency portion of the wireless apparatus. There is also to be considered the low voltage circuit which supplies the transmitting apparatus with electric current from the ship's dynamo. All wiring, however, in connection with this is identical in every way to wiring carried out for electric lighting and motive power, so that no greater risk from fire arises, as far as the low voltage portion is concerned, than it does from the use on board of electric lamps and motors.

ENGAGING SERVANTS BY WIRELESS

The following paragraph appears in a report issued by the Dominions Royal Commission which recently met in London:

"The demand for female domestics, both in Australia and New Zealand, appears to be practically unlimited. In some cases, before a ship carrying women emigrants sights the land a large number of its passengers have been engaged by wireless telegraphy. In other cases would-be employers go out in tugs to meet it."



Hammond's Wireless Controlled Boat

JOHN HAYS HAMMOND, JR., son of the celebrated mining engineer, has for a number of years been experimenting with wireless telegraphy and adaptations of wireless to other purposes. On a wooded cliff near his father's summer home on the shore of Gloucester, Mass., Harbor, he has erected a wireless station, with two masts rising 360 feet high from a granite base. No higher wooden masts have ever been erected, and they have been insured at Lloyd's for $10,000. From his lookout station on the cliff he can, by touching a key, start or stop and steer his wireless controlled boat out and back along an 8-mile course filled with rocks, shoals and harbor craft at the speed of the swiftest cruiser.

Forty horsepower gasoline motors propel the craft, the wireless being used to start and stop her and to guide her in whatever course the operator elects. She has two masts each 40 feet high, one with alternate black and white painted cylinders on it. By these masts in the daytime he sights the craft at any distance. At night these are illuminated with clusters of electric lights.

The steering operator on the lookout platform touches a key and releases the energy emanating from the wireless antennæ of the aerials, supplied by a private power house near by. Mr. Hammond believes that only a millionth part of the power released from the aerials ever reaches the boat; the rest is dissipated into space. At night the beams of a powerful searchlight with a 5-foot parabolic mirror, more powerful than that of any battleship and the brilliancy of 186,000,000 candle power seven miles at sea, follows the boat as she zigzags about Gloucester harbor, uncanny in her avoidance of obstructions, sometimes with several experts aboard, and at others without a soul.

With a turn of his hand the operator on shore directs this immense light; a little crank lifts or lowers it; another moves it to left or right. These cranks are electrically connected with motors in the search lighthouse, and the beams do not cross the lookout platform at all. A tiny beam alone illuminates the operator's record pages.

The gentlest touch of his finger suffices to turn a vessel weighing five or six tons to any point of the compass at a distance of three to eight miles out at sea. The control is accomplished by allowing wireless waves from a shore station to act upon a system of receivers, relays and motors in the vessel, each motor exercising some control over engine or rudder. One turns the rudder to the left, another to the right; another sets the engines at half speed, another at full speed, and a third stops them. The current operating these motors comes from generators carried by the vessel itself. The wireless station ashore sends the power to start the motors or stop them. There are about five main controls, working on a dial, the wireless impulses working on these controls like invisible fingers. As the sending key is pressed in one way or another the moving hand stops at different places on the dial, actuating one motor after another, each move performing some definite piece of work.

With the help of his laboratory staff—for this young man has money enough to experiment to his heart's content with expert paid assistants—Mr. Hammond and an expert from Harvard have worked an entire year devising a reliable detector to take the place of the coherers that failed him when he had proven his ability to steer the boat for two miles, and victory was almost in sight. He guards the secret of this detector carefully.

Greater efficiency was also gained by supplying his power house with the fastest electric generators, turning at the rate of 700 miles an hour. This means that if the generators were to run on tracks, in four hours they could cross the Atlantic, or in one hour cover the distance between Boston and Chicago.

Hammond's sending station is capable of transmitting a distance of 2,000 miles and is the most powerful private equipment in the world.

Solely because of the limitations of the lookout, who can see only seven miles, is the guidance of the boat restricted to that distance. The sending station could send out efficient impulses to about fifty miles. Thus from a military point of view one sending station is sufficient to guard 100 miles of coast line, after the coast has been fully equipped with lookout and sending stations. It may be that with the powerful range finders used in coast defense works the radius may be increased, just as the effectiveness of gun fire has been increased. If necessary, the sending station can be equipped with disappearing aerials, a device which young Hammond has patented.

For the wireless boat can be substituted a wireless torpedo, equipped with the two small aerials, its hull almost sunk beneath the surface and but a very small part of its whaleback shaped deck rising above the water. If one torpedo should be struck by an enemy's shot others could be sent out as fast as required. A dozen torpedoes would not cost one-tenth the price of a battleship.

Young Hammond is but 25 years old, and as a schoolboy made a written prediction that he would some day control a moving body at a distance by the sound of his voice. He has already done this. Through a sound-amplifying device the vibrating energy of spoken words is made to do the work usually done by the pressure of the finger on the wireless key.

Mr. Hammond's new boat, now under construction, is to have a guaranteed speed of 33 miles an hour.

From and For those who help themselves

Experimenters' Experiences.

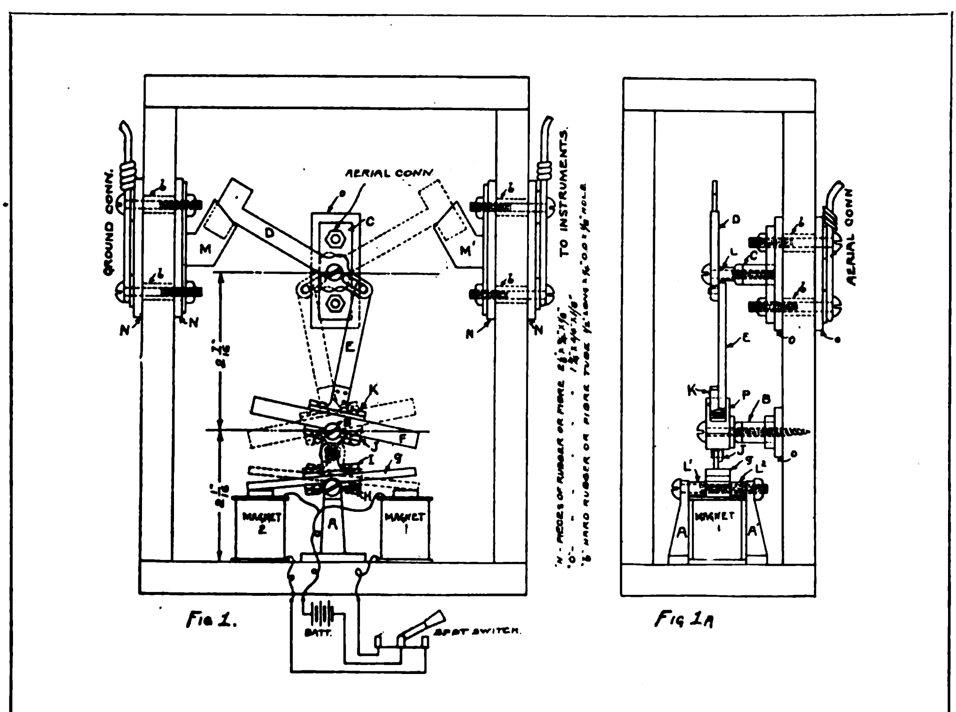
FIRST PRIZE, TEN DOLLARS

An Electro-Magnetic Aerial Switch

I have recently designed an outside aerial switch of the distant control type operated by an electro-magnet, which, I believe, will fully comply with the underwriter's regulations.

The front elevation is shown in Fig. 1, a side elevation in Fig. 1a, and details of the various parts in Fig. 2. The entire apparatus after being assembled is mounted in a box as shown. This box may be of wood or hard rubber. It is preferably lined with asbestos and coated with waterproof paint or waterproof varnish. The outside dimensions are 3 by 6 by 8 inches.

A detailed description of this device is not necessary as the construction should be plain from the drawings. It will be readily seen that a slight movement of the armature G produces a correspondingly large movement of the lever D; also, by throwing the battery switch one way or the other, the current is made to flow through either magnet No. 2 or No. 1. This throws the lever D in contact with either M or M1. Thus the aerial may be earthed or connected to the instruments as desired.



Diagram, First Prize Article

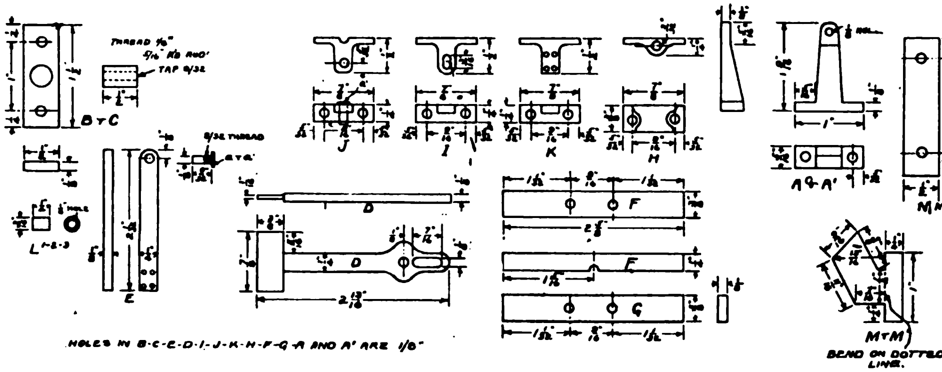


Fig. 2, First Prize Article

The magnets 1 and 2 are taken from large size electric bells; the armature G is of soft iron. The lever E is of hard rubber, and the remainder of the construction is of brass except where it is differently marked.

The bracket pieces B and C will be made stronger if a square piece, instead of the $\frac{5}{16}$ of an inch round piece, is used. The corners should be turned off in a lathe to $\frac{5}{16}$ of an inch and the rod threaded. The contact pieces M and M1 are bent along the dotted line and then riveted to N, N to form spring jaws as shown in the assembled sketch.

Three or four dry cells will give sufficient current for operation. If a larger break is desired lever D should be lengthened and E changed in proportion, shifting the jaws M and M1 to correspond.

A switch of this type possesses an advantage over the hand-operated type in that it can be operated from a distance and therefore the antenna can be effectively grounded externally to the wireless station.

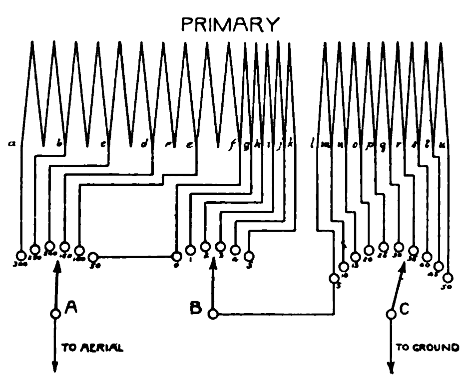
J. E. PUGSLEY, New Jersey.

SECOND PRIZE, FIVE DOLLARS

A New Method for Variation of Inductance in a Tuning Coil

I have recently employed a new method for varying the amount of inductance in use in the primary winding of an inductively coupled receiving transformer, which may also be applied to any single tuning coil. While my method is somewhat similar to that employed in the United States Navy tuners, yet I believe it possesses considerable advantage on account of the fact that the construction is not so difficult and that a smaller number of taps is required.

My sketch and article are based on an inductively coupled tuner having 300 turns of wire on the primary. My method requires but 22 taps in all, whereas in the



Diagram, Second Prize Article

Navy tuner of an equal number of turns, where the switch giving coarse adjustment of inductance contains a tap for every 15 turns, 35 taps are necessary. If a coarse adjustment switch containing a tap for every 10 turns were used 40 taps totally would be needed.

A coil of this type may be built in the following manner:

Three switches are required, two having six points and one having ten points. When the winding is begun, one end of the wire should be fastened in a small hole at the end of a tube. Fifty turns are wound as evenly as possible, and a tap taken long enough to reach the multiple point switch. The same wire is then returned to the tuning coil, making a loop. This loop should be twisted just tight enough to prevent the wire on the form from becoming loose. If twisted too tightly it may break before the coil is completely set up and cause considerable trouble.

After six such taps a tap should be taken each turn for five complete turns. Before twisting the fifth tap, mark the leg coming from the tube, either by making a knot in it, or by removing the insulation for a short distance. This precaution is taken so that this leg may be distinguished from the leg returning to the tube. Next take a tap every five turns until nine taps have been covered.

In connecting the taps to the switch point it is best to begin with tap U. Connect it to point 50 of switch C. Tap T is connected to point 45 and so on until tap K is reached. The unmarked leg is connected to point 5 on switch C. The marked leg is connected to point 5, switch B. There should be no connection between point 5 on C and point 5 on D. The 1 turn taps are connected in order through the points on switch B. Tap F is connected to point O on switch B and extended to point 50 on switch A. The remaining taps are connected in order as shown. Switches A and C are connected to the aerial and ground respectively. Switch B is connected to point 5 on switch C.

Walter Guldi, New York.

THIRD PRIZE, THREE DOLLARS

An Adjustable Condenser

A condenser of the type here described is very useful for experimental purposes, especially in connection with wireless telegraphy and telephony. The total capacity of this condenser is obtained by the employment of a variety of connections between a set of fixed condensers. The changes of capacity are quickly made by means of a set of switches.

If the true capacity of each independent condenser is known the resultant capacity of any particular combination may be readily calculated by the use of the formulæ given in previous issues of The Wireless Age. One of these units which I have constructed is shown in Fig. 1. Six single-pole double-throw switches are mounted on the top of the box which in this case were connected to 5 condensers of one microfarad capacity within the box the connections for which are shown in Fig. 2.

The constructional details are optional with the builder. For instance, a common

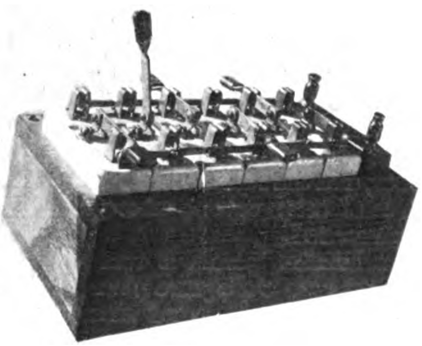


Fig. 1, Third Prize Article

2-point battery switch may be substituted for the single-pole double-throw knife-blade switch.

This condenser can be constructed for high voltages if desired, provided care is taken concerning the insulation. If it is to be used on low voltages, a dielectric composed of paraffined paper will suffice.

If the capacity of each condenser is to be 1 microfarad or over it is advisable to purchase them direct from a telephone company. The condensers used in telephone work I have found to be admirable for such purposes.

In conducting experiments with the musical arc, 20 1 M. F. condensers, consisting of four units (Fig. 1), were used.

It was connected in series with an inductance which formed an oscillatory circuit across the arc. By thus connecting the condensers in series a minimum capacity was obtained and when connected in parallel a maximum capacity was obtained.

Fig. 3 shows all the condensers connected in series, the 2 end switches only being used. Fig. 4 shows the condensers connected in parallel. In Fig. 5, two condensers are in series, and three condensers in parallel. These 2 sets are connected in parallel, the total capacity being equivalent to the sum of 3 condensers and a fraction. This combination is shown in the photograph, Fig. 1. In the same manner, many other combinations can be made.

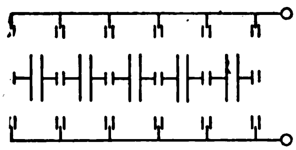


FIG 2

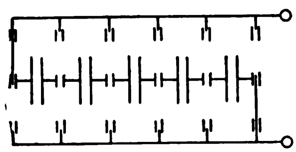


FIG 3

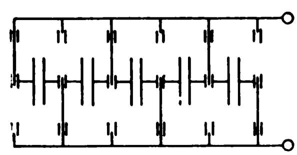


FIG 4

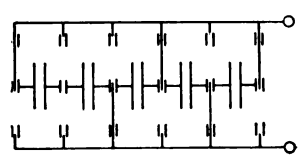


FIG 5

Diagrams, Third Prize Article

An adjustable condenser of this type may be used in any wireless receiving circuit, providing the proper capacity is used in each independent condenser.

For quick work the builder can lay out a chart showing the resultant capacity of any combination. Thus, in experimenting, a glance at the chart will give the resultant capacity of the entire condenser.

L. R. JEWETT,
Massachusetts.

FOURTH PRIZE, SUBSCRIPTION TO "THE WIRELESS AGE"

Type "D" Receiving Outfit

The following is a description of a receiving tuner suitable for amateur use which should appeal to experimenters on account of the cheapness of construction. The total cost should not exceed $2.50. If properly constructed it should prove the equal of a good many higher priced outfits.

This tuner is identical with the type used by the Marconi Company on many of the boats on inland waters with the exception that no potentiometer is employed. The set has been adapted for use with silicon, galena or other mineral detectors which do not require a battery.

Procure two wooden cylinders, 3 inches in diameter and 11 inches in length. These can be purchased at any lumber mill at a trifling cost. These cylinders are each wound with No. 24 enamel wire within ½ inch of each end. When starting the winding a small staple is driven over the end of the wire into the cylinder.

The wire should be wound tight and evenly. When the winding is completed it should be given a coating of shellac or ordinary fish glue, and then set away to dry. Of course the wire must be straight to allow contact for the slider. This may be done conveniently with a sharp-pointed knife.

After both cylinders have been wound work on the cabinet can be started. The inside dimensions of the cabinet (Fig. 2) are 11 by 9 inches, the height should be made to suit the necessary height of the slider above the coil. The top is made in 3 pieces and 1 of the sides in 2 pieces to make space for the sliders. This should be plain from the drawing. The cabinet need not necessarily be made of expensive

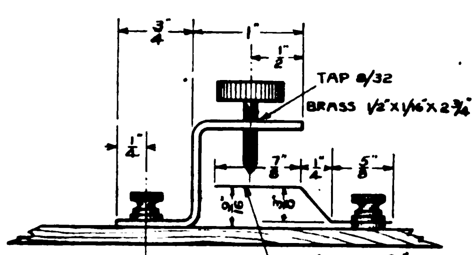


Fig. 1, Fourth Prize Article

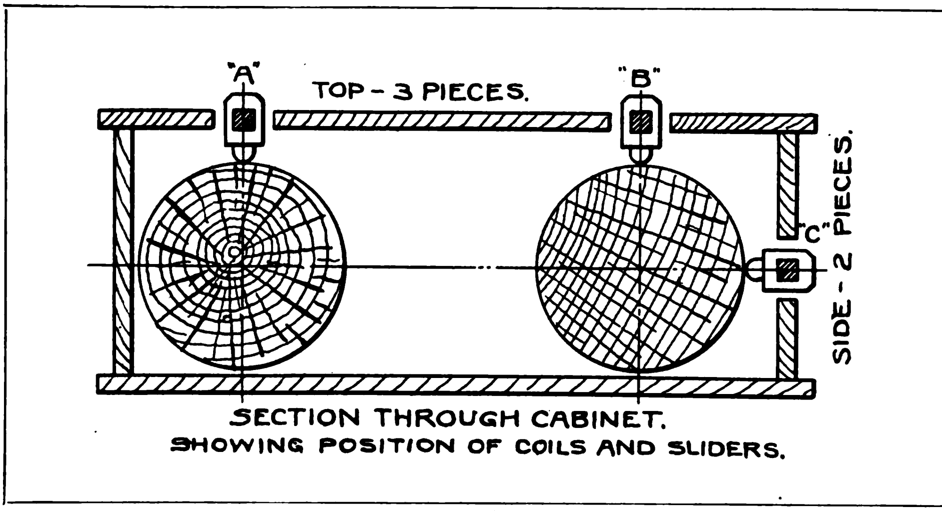


Fig. 2, Fourth Prize Article

wood as ordinary packing box lumber looks well when thoroughly sandpapered and stained.

The remaining apparatus required is: Three brass rods ¼ of an inch square and 12 inches in length; 3 sliders, a fixed condenser, a detector, and the necessary binding posts. The rolling ball sliders sold by the E. I. Company will answer the purpose admirably and at the same time lend a very distinctive appearance to the set.

Any experimenter who does not care to purchase a detector and has the use of a drill and tap may construct a very good one after drawing Fig. 1, for about 25 cents or less. Secure a brass strip $\frac{1}{27}$ of an inch in width, 2¾ inches in length, bent, drilled and tapped to suit the drawing. Cut out a piece of tin as a base for the mineral as per the drawing. The binding post should be of the hard rubber kind as furnished by the E. I. Company. Any good fixed condenser may be used in connection with this set.

The outfit is now ready for assembling. The detector is mounted on the middle board near the rear so that the arm can be rested on the cabinet while it is being adjusted.

The fixed condenser is placed beneath the board and just in front of the detector. The two cylinders are then placed in their respective positions and a screw is put through the end of a cabinet into the ends of each cylinder to hold it in position.

The three brass rods are now ready to be placed in position and, after a slider is placed on each, they are fastened to the cabinet as shown in Fig. 1, 2 being placed on the top and 1 on the right-hand side.

The wiring is done after the diagram shown in Fig. 3. The connections are made with No. 18 insulated Bell wire.

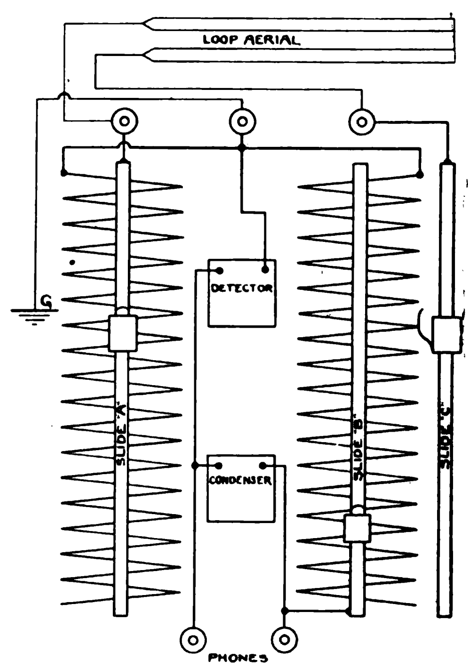


Fig. 3, Fourth Prize Article

Note that the 2 coils are connected together at one end and then to the earth post. Three binding posts are mounted on the rear end of the cabinet, the 2 outside ones being for the aerial connections, and the middle one for the earth connection. Two binding posts are then mounted on the front of the cabinet for connection to the head telephones.

The connections are made as per Fig. 3; i. e., sliders A and C are connected to the two sides of the antenna and slider B connected to one leg of the detector circuit. The fixed condenser is connected in series with the detector and the telephone shunted around the fixed condenser.

I wish to make it clear that this set is intended to be used only in connection with a loop antenna.

PHILLIP W. BOWMAN, Maryland.

HONORABLE MENTION

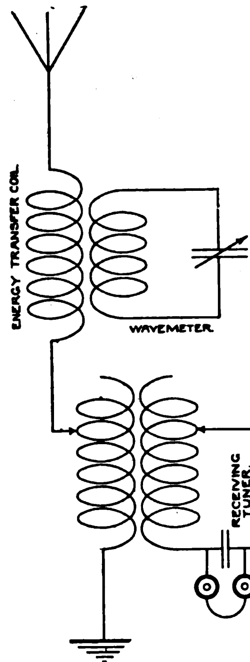
A Simple Method of Using a Wave-meter

The object of this article is to explain a simple method of using a wave-meter for determining the wave-length of a distant transmitting station at the receiving apparatus. As many experimenters are aware, the usual descriptions and diagrams of wave-meters include either a pair of head phones and a detector or buzzers employed to make the wave-meter a transmitter of predetermined wave-length.

Assuming that the experimenter possesses the usual type of loosely coupled receiving set and a wave-meter he may measure the wave-length of incoming oscillations in the following simple manner:

An energy transfer coil, consisting of 20 or 30 turns of coarse insulated wire, is connected in series with the aerial circuit as per the accompanying diagram. It is so placed that it can be set in inductive relation with the inductance coil of the wave-meter as desired. A distant station is then tuned in to the maximum strength of signals in the regular manner. The inductance coil of the wave-meter is then inductively-coupled to the energy transfer coil. The capacity of the wave-meter condenser is then altered until the signals are weakened or nearly disappear. At this adjustment the wave-meter and the incoming wave are of the same length. By reference to the wave-meter chart the wave-length of the distant station is obtained.

The explanation is very simple when it is remembered that a wave-meter will absorb the most energy when it is set at



Diagram, Honorable Mention Article, Harry V. Roome

the same wave-length as the circuit supplying the energy. It will be noted that with this method of using the wave-meter no extra detector or phones are needed, no exciting buzzer is used, the regular receiving hook-up is not disturbed in the slightest, and the station whose wave-length is to be determined can be heard all the time while the wave-length is being measured.

HARRY V. ROOME, California.

HONORABLE MENTION

An Amateur Receiving Set

I recently constructed a wireless receiving set with which I obtain excellent results. While there is nothing distinctly new or novel about the "loading coil" or "loose coupler," other than being self-constructed, considerable advantage is derived from the fact that I use telephone pin jacks and cam switches for making a

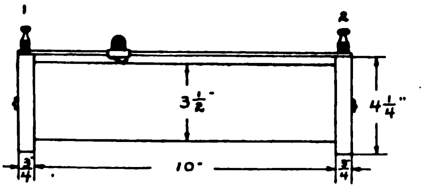


Fig. 1

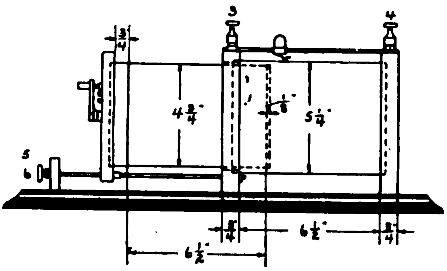


Fig. 2

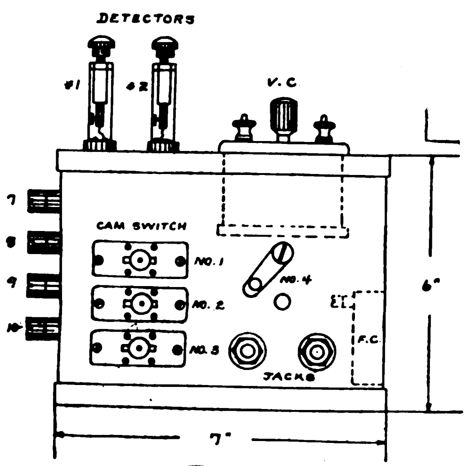


Fig. 3

Diagram, Honorable Mention Article, W. O. Powers, Jr.

variety of connections in the receiving tuner and its associated circuits, allowing complete rearrangements of the circuits to be made with considerable ease and facility.

I get such excellent results with the various combinations by simply moving the switches, that I thought the following description and sketches might be of some value to other amateurs. I had in mind particularly those desiring to construct their own sets and obtain at the same time a permanently wired set with concealed wiring that will allow various combinations to be made without completely changing the wiring. This, to say the least, is slow work.

Fig. 1 shows the dimensions, etc., of the loading coil. The ends are made of mahogany and the metal parts are of brass. The core is made from a piece of fiber conduit smoothed up on the outside and wound with No. 22 enameled wire.

Fig. 2 shows the general makeup of the loose coupler with dimensions. Both heads of the primary are made of mahogany and the secondary head is made from a piece of hard rubber one half inch thick. The base is also made of mahogany and all metal parts are of brass. Both primary and secondary cores are made of fiber conduit. The primary is wound with No. 20 enameled wire and equipped with a single slide. The secondary is wound with No. 28 enameled wire and has ten taps, equally divided and brought through the inside of the core to studs on the head where is also mounted the radial adjusting switch.

Fig. 3 shows the position of the detectors, switches, etc., mounted on the box. All connections are made on the inside, according to the wiring diagram.

As will be seen by tracing out the circuits on the wiring diagram moving switch No. 1 which controls the detectors to the right cuts in No. 1 detector and to the left cuts in No. 2. This arrangement I find to be of great value as different minerals may be compared or minerals of the same kind readjusted to give maximum signals allowing one detector to be in operation while the other is being adjusted.

Moving switch No. 2 to the right places the phones around the fixed condenser; moving it to the left places them around either detector that may be in operation. I sometimes get better results from certain stations with them when connected around the fixed condenser and at other times signals from a different station come stronger when they are connected around the detector.

Moving switch No. 3 to the right connects the instruments for inductive coupling and when tuning in this manner switch No. 4 should be opened. Moving the switch to the left makes connections for single slide tuning, using the loading coil and primary of the loose coupler; or if desired the loading coil and primary may be used separately; the one not wanted may be cut out by placing the slider at the zero value of inductance.

I use the single slide tuner to pick up stations, but, to eliminate interference, I change over to the inductively coupled tuner. When using the single slide hookup, switch No. 2 must be to the left and switch No. 4 closed.

All of these switching combinations can be made instantly by simply moving the switches to right or left.

The switches used are of the cam key type such as employed in telephone practise and can be had with various number of contacts, allowing the use of any number of "hookups" as desired. For those not familiar with this type of switch, a sketch is shown in Fig. 4.

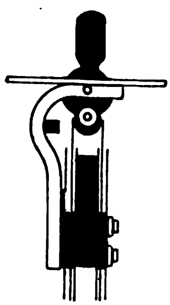


Fig. 4

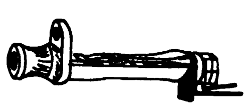


Fig. 5

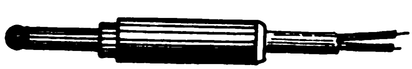
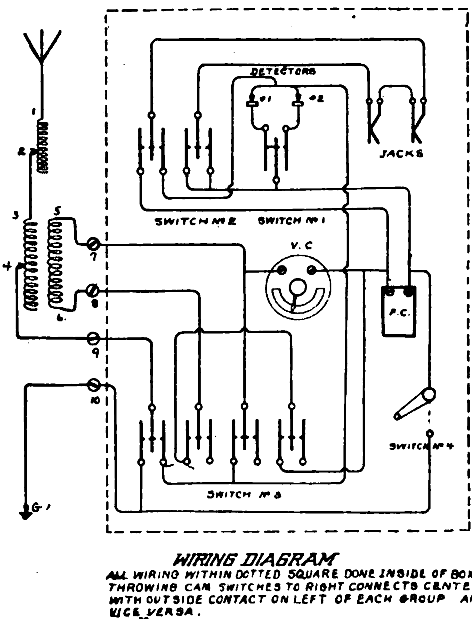


Fig. 6

Diagram, Honorable Mention Article, W. O. Powers, Jr.



Wiring Diagram, W. O. Powers, Jr.

Switch No. 4 is a single pole radial switch. The pin jacks are of the type used in telephone and telegraph practice and can be obtained in several different styles to suit the experimenter. The one shown in Fig. 5 is of the series or closed circuit type and is adapted to mounting in wood by one wood screw through the hole in the top of the shoulder.

These jacks can be used to good advantage in wireless work. In this set I have two, wired in series, as shown, which permits a second set of head phones to be plugged in if two persons wish to listen in at one time.

Fig. 6 shows the type of plug to be connected to the double conductor cords of the phones and is known as the double plug; when inserted in the jack the tip, which is insulated from the body, connects with the spring of the jack which opens the jack circuit and closes it via the body of plug and the frame of the jack.

In the wiring diagram, the straight line represents the frame of the jack and the angled line the spring.

The cam switches, pin jacks and plugs used are catalogued and can be purchased from dealers in telephone apparatus and supplies.

W. O. Powers, Jr., New York.

The men fought madly from one end of the cabin to the other

Hamilton Marron, Esquire

An exciting tale of a belated passenger, a black bag, a charming bit of femininity and the outcome of a wireless room visit

By GEORGE MABIE TODD

THE fellow who said the same spirit sent the knights of King Arthur's Round Table and wireless operators in search of adventure hit it about right. And there's just as much adventure in these days as there was in the times Tennyson wrote about. If you don't believe me just "listen in" while I pound out this story.

It was on one of my trips on the Morania, bound from New York to Liverpool. Steaming slowly down the river with flags waving and bands playing, we were feeling our way through the fleet of harbor craft blocking our way when I caught sight of a tug far astern. By the speed she was making I suspected that she was trying to catch the Morania, and it seemed more certain as I watched the way she dodged in and out among the vessels that were in her course. Once she grazed the bow of a ferryboat; again she narrowly escaped collision with a scow. She was hitting it up some, for the captain of the tug evidently knew that once we were well out of the harbor and our screws began turning it would be hopeless for him to try to overtake us.

The tug gained on us little by little and about off Beaver street she finally steamed alongside. The tardy passenger stood on her deck, a keen-featured man, carrying a small black bag. It was but the work of a few minutes to transfer him from the tug to the steamship and so frequent are these occurrences, had it not been for the unconcerned manner in which he received the congratulations of the other passengers on the successful boarding of the liner the man would probably not have attracted my attention further.

I happened to be standing near by when he introduced himself to the purser as Hamilton Marron.

"Close squeak that time, eh purser?" he remarked. "I simply had to catch this boat, too."

The man had an ingratiating manner which was not without its effect on the purser.

"Take the gentleman's bag and put it in room 92," he directed a steward as he verified the ticket. The steward stepped forward, but Marron shook his head.

"You needn't mind, I'll look out for that," he said hastily, and drew the bag toward him as if fearful of losing it.

"Must be something valuable in that," remarked a passenger. Marron's sang-froid dropped like a flash.

"What do you mean?" he snapped. Then he saw that the other man was smiling and recovered himself.

"Oh, I see, a joke," he murmured, and followed the steward to his stateroom.

Our voyage for the next three days was uneventful and Marron passed almost out of my mind. I afterward learned that he had kept closely to his stateroom during that time; so busy was I with press and message traffic that I had no opportunity to speculate upon his agitation over the custody of the bag, or conjecture his possible whereabouts.

A steamship is bound to have some gossip, though, and we operators hear many things; it wasn't long before one of the stewards told me that Marron was unusually generous with his tips. Also a man of good taste for he had formed a friendship with the prettiest girl aboard, a Miss Randall, from Detroit, and when Marron was not in his stateroom he was always with the girl. None of this information had much interest for me at the time and I turned a deaf ear to the tattling of the fellow.

I was testing my apparatus the following day when Marron appeared for the first time in the doorway of the wireless cabin accompanied by Miss Randall. The few questions he asked showed that he had some knowledge of wireless and I guess I must have looked my surprise for he laughed and said:

He drew the bag toward him as if fearful of losing it

"Oh, I'm pretty green, but once on a time I pounded a key myself. That was many years ago in a broker's office. I picked up a little smattering of wireless a while ago when one of my neighbors put up a station on his house."

Miss Randall joked with him about his proficiency as an operator and we spent an agreeable quarter-hour. He had the gift of making himself especially entertaining and I invited him to visit the wireless cabin again.

That night we had an exceptionally heavy batch of commercial business; when a lull finally came I was suffering from a severe headache and left the wireless room to get a breath of fresh air. The brisk wind was soothing and I remained away from the apparatus longer than I had intended to.

As I made my way back to the wireless room, something, I don't know what, prompted me to pause on the threshold and peek inside the cabin before I entered. I drew back startled. Seated at the table with the phones to his ears, elbows on table and intently listening, was the figure of a man. The lights had been turned off and I could not see distinctly, but I was sure it was not that of Bill Evans, the second operator.

Resolved to give the intruder a scare that he would remember, I crept softly toward him. His cap was pulled so far down over his eyes that it was impossible to distinguish his face. As I made another step forward the figure at the table suddenly sprang to its feet; a fist shot out and I sank into unconsciousness.

They found me on the floor of the cabin where I had been felled, and for a day I was pretty quiet.

The captain ordered an investigation, but nothing came of it; after a while I became tired of puzzling my brain about the identity of my assailant and laughed when the subject was brought up. But my aching jaw reminded me of the reality of the attack, nevertheless.

The news of my unpleasant experience became noised about the ship and I was bothered with visitors. I dodged the limelight by telling them my duties would not permit me to relate to each and every one the details of the occurrence. Marron and Miss Randall visited me several times and were very solicitous in their inquiries. "I suppose you'll have a guard with you after this?" Marron laughingly observed.

I replied that I didn't believe it would happen again and that I felt able to take care of myself. I don't know what made me so confident; I found out later—in fact that very night—that my statement should have been revised considerably.

Traffic was light and the hours slipped away slowly. At midnight I was so fearful of falling asleep that I rang for a cup of coffee. No one came; and deciding that the buzzer was out of commission I left the cabin to hunt up a steward. On my way back to my set I felt a touch on my arm and turned about to find myself facing Miss Randall. She explained that she had lost a ring in the earlier part of the evening and, having just discovered the loss, had returned to find it. While she was making her search she had seen a man enter the wireless cabin; his stealthy actions and the fact that he did not wear a uniform had aroused her suspicions. I told her to return to her stateroom and not to mention to the other passengers what she had seen.

Not a sound came from the wireless room when I reached the door. The place was in darkness, as I had left it, but I felt instinctively that the man whom Miss Randall had seen was still there. As quietly as possible I felt for the electric light switch. Click! went the key and the room was suddenly illuminated.

Seated at the instruments was a familiar figure—Marron!

It has been my lot to meet with many surprises and adventures during my life, for these are part of the experiences that men in my business expect. But so little had I anticipated finding in the cabin this man . . . well, I just stood still and gasped.

If Marron was concerned he did not show it. The head phones were at his ears and he was deeply absorbed.

As I approached he turned, laid the phones on the table and smiled.

"Just took the liberty of listening in," he said engagingly.

"Anything worth while?" I asked, assuming an air of nonchalance, although I was doing some rapid thinking. "Nothing much," he replied. I slipped on the phones and adjusted the tuner; at the same time I kept a watchful eye on Marron. New York had been sending, I gathered from the desultory words that buzzed in my ears. So I sent out a call for a repetition of the message. Marron started.

This is the marconigram I copied with him looking intently over my shoulder:

To Captain Johnson,
S.S. Morania, at Sea:

Arrest Thomas Jennings, alias Gentleman Tom; sometimes assumes the name of Hamilton Marron. Believed to be aboard the Morania. Wanted here for forging $125,000 draft on the Anchorage Bank. Medium height, gray hair, scar on back of right hand. Believed to have $125,000 cash in small black bag. Turn over to our operative believed to be on boat.

Martin Detective Agency,
New York.

I turned about and looked at Marron as coolly as I could. I glanced at his hand; the scar showed plainly. He had stopped smiling, and as I watched him his whole expression changed and revealed him in his true light—a criminal, forced into a corner and ready to fight for his freedom.

I had suspected what was coming and almost before he reached out to grapple with me I had slipped out of his reach. He rushed toward me. I met his charge with a shower of blows; he fell back for a minute, but quickly recovered and again sprang toward me. As we grappled with each other my hand reached his throat. Down to the floor we fell with a crash, Marron underneath. My advantage was only temporary, however, for as we struggled his knee locked mine and he threw me to one side; smash! came a staggering blow and I felt my teeth loosen. Then, quickly recovering, I grappled with him again and we fought madly from one end of the cabin to the other.

A rough-and-tumble fighter of experience, Marron proved to be more than my equal. We crashed against the door.

I felt myself growing exhausted. The thought of calling for help flashed into my mind then, but he grasped my throat with a vicious grip and forced me back against the wall of the room. Everything began to black before my eyes.

What the outcome of the struggle would have been I cannot tell, but just as consciousness began to leave me I came to a sudden realization that my antagonist's grip had relaxed.

Then I heard a girl's voice and looked up to see Marron with his hands raised above his head and the exquisite Miss Randall pointing a revolver at him.

"I'm from the Martin agency," she replied to my look of amazement. "I recognized this man from the first. Been trailing him a month."

With Marron before her she turned to go out of the cabin. At the door she paused.

"Oh, by the way, I've got the bag out of his cabin. The money's there all right. Some of it'll come to you, too."

"Me?" I exclaimed.

"Yes, half of the $1,000 reward for this man's capture. We'll share, you see."

Then she nodded, smiled easily and marched away with her prisoner.

SENT REPORT OF HIS OWN DEATH

An operator recently returned from Havana tells a story of a man who sent a wireless message that he had died.

Dionisio Rodriguez was the supposed deceased, but when the Ward Line steamer Saratoga arrived the reported corpse was found very much alive. The mourning family had the pleasure of embracing him with the spirit still intact in his body and the funeral arrangements were called off. Señor Rodriguez, who was one of the partners in a large cigar factory, had been at Liberty, N. Y., undergoing treatment for tuberculosis. He did not improve, and left for Havana in a very serious state of health. So sick was he that he was sure he was going to die before he arrived at Havana and ordered a number of wireless messages to his family stating that he was at the point of death.

Finally Señor Rodriguez had a fainting spell and was thought at first to be dead. When he came to and the ship surgeon told him of his fears, Rodriguez recalled the interest of the physicians at the sanatorium in his case, and fearing that the end was near ordered that a wireless message be sent reporting his death. The sanatorium accepted it in good faith and cabled the news to the family in Havana.

On receipt of the cable the family made all arrangements for the funeral. A burial permit was obtained and also permission from the department of sanitation to disembark the body immediately upon the arrival of the steamer. Arrangements were made to have the hearse at the wharf, and the family procession was to form there and proceed to the cemetery at once.

When all these details had been arranged it occurred to the family that it would be well to order their relative embalmed, and a marconigram to that effect was dispatched to the Saratoga. On receipt of the message Captain Miller refused counsel on the question of embalming a live man and confined his answer to the detail that there was no one aboard sufficiently dead to embalm. This gave the stricken family a momentary ray of hope, but it was quickly followed by the thought that perhaps Rodriguez was buried at sea. This thought resulted in another marconigram which brought the reassurance that he was alive although very sick.

After the rush of passengers on the ship entering port was over, a rejuvenated and smiling Rodriguez walked gaily off the gangplank into the arms of his joyful family.

He stated before leaving that the marconigrams would be kept as souvenirs.

A FLYING BOAT AND WIRELESS

The hydro-aeroplane entered a field of usefulness when a Curtiss flying boat, the Edith, was used to overtake a ship at sea to deliver important mail. The steamship Miami had left Nassau, but owing to a low tide lay-to inside the bar, three miles off Cape Florida. A high wind arose and swept the water on the bar further out to sea, leaving the ship unable to proceed. By wireless the captain communicated his position to Miami, and the aviator then set out on his mission, which he successfully accomplished.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

H. A. F., Kansas City, Mo.:

KAL is the large station of the Telefunken Company, at Nauen, Germany. CTG is the Telefunken station located at Cartagena, United States of Colombia. The call letters of the Marconi station at Glace Bay are GB. We do not know the call letters of the Eiffel Tower station in Paris. They are not listed in the International book.

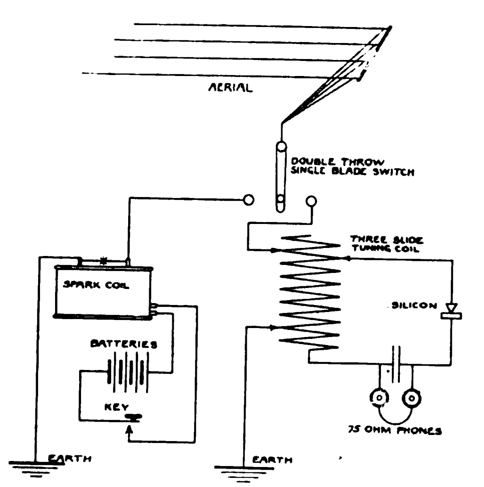
Answer to second query: If the soil surrounding your earth plate is dry, considerable advantage will be secured by surrounding the earth plate with coke.

* * *

E. T. E., Harrison, N. Y., inquires:

Will you kindly send me by mail the best hook up for the following apparatus: Receiving set Inverted L aerial, ground 2-slide tuning coil (Bunnell); fixed condenser, 75-ohm receiver and silicon detector. Sending spark coil, 3 binding posts, spark gaps, key and batteries, aerial and ground.

Ans.—(1) We do not answer queries by mail. Previous issues of THE WIRELESS AGE contain diagrams of connections that could be applied to this set. For your convenience, however, we publish the accompanying diagram containing a complete sketch which explains itself.



D. I. S., St. Johns, Kas.:

We suggest that you get in touch with the makers of your amateur apparatus and have them supply you with a full set of diagrams showing the most efficient hook-up to be used. In the Queries Answered Department of the May issue of THE WIRELESS AGE is shown a diagram of receiving connections applicable to your apparatus. Other issues of THE WIRELESS AGE contain circuit diagrams of standard transmitting sets which will help you out. You have not stated with whom you desire to communicate. Do you intend to interchange signals with local amateur stations, or are you attempting to receive from very far distant stations? Keep in mind that long distance receiving done by certain stations in the Middle West can be accomplished at night time only, the winter months being more favorable than other seasons for this kind of work. Why not get in touch with some amateur in your vicinity who is familiar with receiving and transmitting hook-ups?

* * *

J. E. F., Brooklyn, N. Y.:

Your two queries concerning a receiving transformer suitable for the audion detector are fully covered in the article entitled "How to Conduct a Radio Club," published in the January issue of THE WIRELESS AGE.

Answer to query No. 3: Pyron crystals may be obtained from The Wireless Specialty Apparatus Company, Boston, Mass. This detector gives very good results and you are quite right in believing that it is extensively used by the United States Navy. A piece of sharp pointed spring steel wire may be used for contact. It is connected in the receiving circuits in the same manner as silicon, galena, and parikon.

* * *

Mr. A. A. A., Sandy Hook, N. J., writes:

Ques.—(1) How many wireless stations on the east Atlantic Coast send free press to all ships and stations?

Ans.—(1) Press matter is sent out by the Marconi stations at Cape Cod, Mass.; Cape May, N. J.; Hatteras, N. C.; Savannah, Ga.; Virginia Beach, Va.; Tampa, Fla. and by the Telefunken station at Sayville, L. I. This matter is not sent free of charge, but is intended in some cases for the use of the steamship companies and in other cases for the use of the Marconi Company.

Ques.—(2) In the official list of radio telegraph stations, published by the International Telegraph Bureau, Berne, the statement is made that at WSL, the wireless station at Sayville, L. I., daily news bulletins are transmitted free of charge from 9:15 P.M. to 10:15 P.M. Are operators at land stations prohibited from copying this press news?

Ans.—(2) Yes. This matter is intended only for the ships to which it is directed.

* * *

B. S., Wilmington, N. C., asks:

Ques.—(1) What is the size of a condenser made of plates of glass 8 by 10 inches, covered with No. 38 brass sheeting, to be used in connection with a ¼ K. W. Blitzen Transformer and a rotary gap?

Ans.—(1) Assuming that the set is to be operated from a 60-cycle source of current supply, the condenser should consist of 18 plates of glass, 8 by 10 inches, covered with sheets of brass foil, 6 by 8 inches. The glass should be at least ⅛ of an inch in thickness. If the set is to be used in connection with the rotary gap, it will then be necessary to use a condenser of less capacity, the actual size depending upon the number of discharges at the spark gap. A little experimenting will determine the correct value.

Ques.—(2) What are some good books telling about the theory of wireless telegraphy and the use and description of the instruments?

Ans.—(2) See the article, "How to Conduct a Radio Club," in the January issue.

Ques.—(3) Is there any way to cut out interference due to electric light lines except by changing your antenna?

Ans.—(3) A complete answer to this question will be found in one of the articles on "How to Conduct a Radio Club," to appear in an early issue of this magazine.

* * *

F. R., New York:

We have no direct information concerning your first query, but we understand that Sayville at certain times does communicate directly with high power stations located in Germany.

Ques.—(2) Please show in a diagram the best way to shunt a "loose-coupler" with a variable condenser in order to receive long wave-lengths.

Ans.—(2) A diagram is not necessary. The variable condenser should be connected in shunt to the secondary winding, and a loading coil or aerial tuning inductance inserted in series with a primary winding.

* * *

K. M. W., South Framingham, Mass.:

Audions may be purchased from the Radio Telephone and Telegraph Company, 309 Broadway, New York.

The data for the construction of The Marconi Multiple Tuner is not available for publication.

There are several methods for producing quenched effects on a rotary gap, a complete description of which would require too much space. Quenched effects are sometimes produced by heavy air blasts played upon the discharge points. In other types the quenched effects are obtained by completely redesigning the entire transmitting apparatus from the generator up. Another type, such as manufactured by the Clapp-Eastham Company, is rotated simply to bring the oscillations within the limits of audibility.

In order to secure quenched effects with the amateur rotary gap, two or three plates of the ordinary quenched gap are often connected in series with the rotary gap, producing quenched effects which cannot be obtained by the rotary gap alone. The musical qualities of the rotary gap are then combined with the quenching effects of the series gap.

* * *

L. W. E., Columbus, Ohio, asks:

Ques.—(1) At what speed must one be able to receive in order to pass an examination as a first-class wireless operator, and what else must he be posted on?

Ans.—(1) To pass the examinations of The Marconi Company a speed of 25 words per minute in the Continental Morse Code is required. The Department of Commerce examinations for government license certificates require a speed of 20 words per minute for a first-grade certificate and 12 words per minute for a second-grade certificate.

To secure a commercial extra first grade government license the applicant must be able to receive 30 words per minute in the Continental Morse and 25 words per minute in American Morse. The applicant must also be thoroughly familiar with the complete commercial transmitting and receiving apparatus, including motors, generators, storage cells, etc. He is also required to have knowledge of the International Regulations governing wireless communication and the United States laws pertaining to wireless telegraphy.

Ques.—(2) Where and when are such examinations taken?

Ans.—(2) At the United States Navy Yards at Boston, Mass., Brooklyn, N. Y. and Philadelphia, Pa.; and at the customhouses at New Orleans, La., San Francisco, Cal., Seattle, Wash.; Cleveland, Ohio, and Chicago, Ill.

* * *

B. E. K., Grand Rapids, Mich., asks:

Please give me data on a ½ K. W. closed core transformer for wireless purposes to operate on 110 volts, 30 cycles, secondary voltage—20,000.

Ans.—(1) The length of the core outside measurements should be 10 inches. The width 7½ inches. Thickness of the core, 1¾ inches. The primary winding should consist of 22 layers of No. 14 D. C. C. wire. The primary should be separated from the secondary winding by several layers of empire cloth. The secondary winding should consist of 7 sections separated by paraffined cardboard insulation ⅛ of an inch in thickness. Each section of the winding should be ¼ of an inch in thickness and five inches in diameter. The winding should be of No. 34 enameled wire. The secondary should be insulated from the core by several layers of empire cloth. This transformer is intended to be used with a reactance regulator.

Ques.—(2) Using a rotary spark gap having 12 points and a speed of 3000 R.P.M., how many glass plates 10 by 14 inches, 0.15 of an inch thick, with tinfoil 8 by 12 inches on each side, will be required for a condenser for this transformer to operate on a 200-meter wave-length.

Ans.—(2) You will require 3 plates covered with foil 8 by 12 inches. The capacity of the condenser will then be .0041 MFD. If you wish to use two banks in series, you will require 6 plates in parallel in each bank.

H. V. R., Los Angeles, Cal.:

A complete answer for your first query would require more space than we could give in this department. A mathematical discussion is given in The Electrician for February, 1913, by Cohen.

Ques.—(2) Which would be the more efficient serial for sending and receiving: A long single wire or a shorter antenna having several wires in parallel, assuming that both antennæ have the same height (flat top antennæ) and the same natural wave-lengths?

Ans.—(2) For sending we prefer the multiple wire aerial on account of its comparatively small value of resistance. For a given wave-length the same statement may be made in reference to receiving, as it is always desirable to have a receiving antenna of the least possible resistance. A long single wire, however, will give good results in receiving and yet may be very inefficient for sending.

Ques.—(3) Does increasing the number of wires in parallel in an antenna increase the inductance or the capacity or both the inductance and capacity of the antenna?

Ans.—(3) Increasing the number of wires decreases the value of inductance, but increases the value of capacity.

Ques.—(4) Please give the natural wave-length of the sending antenna of the new Marconi high-power station in New Jersey.

Ans.—(4) The natural wave-length of the receiving antenna at Belmar is about 12,000 meters.

* * *

D. R. C., San Francisco, Cal.

We make the following suggestions in the design of your 1½ K. W. transformer. The core may be 36 inches in length and 3¼ inches in diameter. It should be wound with 2 layers of No. 10 D. C. wire up to within 1 inch of either end. The secondary winding should have 40 "pan cakes," each ⅛ of an inch in thickness, having 1,000 turns per "pan cake." The winding is preferably made of No. 30 S. C. C. wire.

It is preferable, as you suggest, to narrow down the winding of the secondary. It should not extend the entire length of the core.

Answer to last query: Eighty per cent of the commercial transformers in use are of the open core type. While the closed core transformer having a variable magnetic leakage gives about equal results, still, for various other reasons, the open core transformer is preferred.

* * *

E. B. H., Belleville, Ill., writes:

Ques.—(1) Will you kindly inform me where I can obtain data concerning to wireless telephony?

Ans.—(1) There is no great amount of literature on this subject. See Fleming's "Elementary Manual of Radio Telegraphy and Radio Telephony," "Operator's Wireless Telegraph Handbook," by V. H. Laughter, and "Wireless Telegraphy and Wireless Telephony," by Kennelly. In the installment of "The Engineering Measurements of Radio Telegraphy," published in the February issue of THE WIRELESS AGE, a complete description of the Poulsen arc, which is generally used in connection with wireless telephone work, is given. We know of no books devoted distinctly to a description of the wireless telephone. Such information is generally a part of all books on wireless telegraphy.

Ques.—(2) I often hear Sayville call KAL and CTG. What are these stations?

Ans.—(2) This question is answered under H. A. F.'s query in this issue.

Ques.—(3) To what stations does Sayville send when transmitting in German?

Ans.—(3) It is in communication with either Berlin, Cartagena, or Naura, a naval base near the Caroline Islands.

Ques.—(4) I have often heard Key West talk with XNT. Can you tell me what station this is?

Ans.—(4) XNT is not listed in the Berne Book. It is very likely a Mexican station.

* * *

M. F., Vineland, N. J., asks:

Ques.—(1) On occasions during evenings when I have been intensely interested in copying a distant ship or land station I have been greatly surprised to observe the signals gradually growing fainter and finally dying out altogether. A few minutes later they would gradually come back until they were fairly loud. This has happened for the most part when I have been listening to stations using rotary spark gaps, although it has occurred once in listening to Colon (NAX). Can you explain this?

Ans.—(1) This phenomenon has never been fully explained, but has been known for eight or ten years. If your station was within the daylight sending radius of the Colon (Panama), station, the effect would not be observed. It is only noticeable when receiving at night beyond the daylight radius. The effects are more likely to be observed at night during the winter months. At one time it was supposed that this effect was due to a poorly designed transmitter; this theory, however, has been disproved.

Ques.—(2) One evening at half past seven o'clock, with the weather fairly clear outside, I heard Colon (NAX) very faintly, in fact, too faint to copy. About half past ten, on the same evening, when it was snowing hard outside, I heard this station very much louder; in fact I heard it loud enough to be read with the phones 2 inches from the ears. Can you explain this phenomenon?

Ans.—(2) No. It is simply a continuance of the effect noted in your first question.

Ques.—(3) Can you give any information concerning the system, power and frequency used at the new trans-Atlantic station at Tuckerton, N. J.? Can the average amateur hear this station by the use of a tikker? Has trans-Atlantic communication been carried on and if so at what wave-length?

Ans.—(3) We have not been advised that the Tuckertown station is engaged in the transmission of signals, but to date has been employed simply for receiving purposes. The system used is the Goldschmitt high frequency alternator, giving undamped oscillations at a frequency of 50,000 cycles. The power to be used is 50 K. W.; the wave-length is 6,000 meters. You should be able to hear the signals on a properly constructed tikker in connection with a tuner that will allow adjustment to wave-lengths of this order.

THE WIRELESS AGE

JULY, 1914

THE RADIO REVIEW

THE disaster upon the lower St. Lawrence which suddenly ushered into eternity more than one thousand souls has shocked the world and brought poignant grief into the homes of many nations.

The Necessity for Fog Signaling Apparatus

In its own way, by a cunning that no art of man has yet accomplished, the hand of the sea has taken another staggering total of lives. In recent years the Titanic tragedy alone surpasses its gruesome record.

There is little instruction or wisdom to be gained by the story of the collision. The impact of the heavy collier came amidship at the weakest part of the Canadian liner and swept aft, apparently opening her whole side to the sea. Against so destructive a blow not even the most modern bulkheads can keep a ship long afloat. Wireless did its work swiftly and effectively as usual. In the narrow reaches of the St. Lawrence help was only a few miles distant and only a few minutes in arriving, but disaster was so savage and complete that few survived the maelstrom of the foundering ship.

Certainly the invention of wireless telegraphy which saved many of the passengers of the Empress of Ireland by summoning aid should also have availed to apprise these steamers each of the other's near presence. The fog was the primary cause of the collision and it may be well for the marine constructors who will readily determine the defects that led to the sinking of the vessel in such a remarkably short period of time to study the defects of a signaling system that leaves ocean travelers still largely at the mercy of the dread conspiracy of the sea and fog.

The recent inventions in wireless communication cannot be too speedily installed on all steamships; for the radio-goniometer or "direction finder" in operation over a distance of even a few miles would be sufficient to guard vessels from collision in even the densest fog.

THE need of better means for the protection of human life in case of fog at sea is just as surely indicated by the happy escape of the New York and the Pretoria from destruction, as it was by the recent terrible disaster on the St. Lawrence. It is very reassuring to know that two ocean steamers can come to collision in a fog with so little damage to either, that both may proceed on their way with most of their passengers unaware of the mishap. It is not reassuring, however, to learn that such a collision has occurred. The blow the Titanic received from the iceberg and that which the Storstad administered to the Empress

The Lesson from the Second Collision

of Ireland produced as little shock, it seems, as the Pretoria's glancing blow near the bow of the New York, but, as there was no loss of life, the incident will probably be quickly forgotten.

The Canadian disaster startled the whole world, excited a tumult of emotional comment and led to protracted investigation; but the inquiry into the harmless collision should be just as careful and as fruitful as that which has been begun at Montreal. And the principal object of both should be to officially recognize the fact that through wireless apparatus collisions in fog can be prevented.

In Appreciation of the Marconi Men

WHEN it is considered that a brief seventeen minutes elapsed from the shock of collision until the time that the Empress of Ireland sank beneath the waters, the wonder of it is that the doomed vessel was able to send out the news of her tragedy and call for aid. The men responsible for this are two clean-cut Englishmen who quietly upheld what we like to term the Marconi tradition.

Their story is very matter-of-fact; there is nothing of the heroics about it. Indeed, both of them have been exceedingly reticent about their part in the sad affair. Bamford, the junior operator, was on duty when the collision occurred. At once he called his chief, Ferguson. The latter took charge and, when the order came from Captain Kendall, as it did promptly, the S O S call was instantly flashed out. Father Point was first to catch the call and the operator on duty there called his chief, Whiteside, and the latter at once got into communication with the government boats at Rimouski wharf and dispatched them to the scene.

Ferguson continued his call until he learned that Father Point had heard and then began to give some particulars. Time was up then and both operators left the wireless room and went overboard.

The story is simple; yet it is as effective as any epic to duty ever written.

Wireless in Modern Warfare

WITH our war thoughts principally turned toward Mexico, America will not be much excited by the news that Tazza has fallen. Few of us have ever heard of Tazza and fewer still have any interest in its fate. Nevertheless there is one feature in connection with the capture of this ancient Morocco town by the French soldiers that has more than passing interest. Two columns of French troops approached Tazza from opposite directions. One marched westward from Algiers and the other eastward from the coast. Between the two columns were the hostile Moors and prompt communication between the two coöperating French columns would have been difficult and perhaps impossible except for the employment of wireless telegraphy; but by this modern aid in warfare, messages were flashed over the heads of the Moors and kept the two columns in touch and in harmony.

One of the difficulties in war heretofore has been to synchronize the movements of separated bodies of troops when a simultaneous attack was desired, or when the effort was being made to have troops advancing from different directions arrive at a given point at the same time or at times definitely related. Many battles have been lost through failure in coöperation. This is the main reason why the wireless telegraph is indispensable. Sections or divisions of an army, widely scattered, are able to keep accurately informed of what all divisions are doing. Of course if one army has such an equipment and the opposing army lacks the equipment and the knowledge of its operation, the advantage is evident.

This advantage the French troops in Morocco possess. In a campaign between two up-to-date armies, such messages might have been interrupted or captured by one to the discomfiture of the other, a few years ago, but with the close tuning now possible and special cipher codes, the interception of messages has been virtually eliminated.

The Editor.

The Phillips Memorial Unveiled

THE cloister erected at Godalming, England, to commemorate the courage of Jack Phillips, a native of the town, who was the chief wireless operator on the Titanic, was opened on April 15. The high sheriff of Surrey, J. St. Leo Strachey, who conducted the ceremony, delivered an address containing high praise for Phillips. He spoke as follows:

"I shall never forget, I do not think any Surrey man or woman will ever forget, the feeling of intense relief and of thankfulness which they experienced when during the agony of the Titanic disaster the story of Phillips' heroism blazed out like a star. It would be doing wrong to the many men and women who acted a brave part on the Titanic to speak as if Phillips' act was the only heroic deed done. There were plenty of others worthy of our admiration.

"But I think we may claim that there was something specially splendid, something specially great, in the way in which Phillips died and did his duty. No man could have called him coward, or thought of him otherwise than as a brave and a good man if, when the captain released him from his work in the wireless cabin, he had abandoned his efforts to call aid across the waters to the sinking ship. Instead Phillips stuck to his post and disdained even to say to himself: 'I have done all that is required of me, all that any man can expect me to do, and I may now fairly look out for myself.' He did not reckon like that. He kept no ledger account with Duty. He drew up no moral balance sheet with its nicely calculated less or more. He spent himself fully and without reserve in the service of his fellow men. Therefore, we are right to honor him in this haven of rest—a place as quiet as, on some halcyon day of summer, is that expanse of blue Atlantic water which is his noble tomb. Of a death such as this we can truly say:

" 'Nothing is here for tears; nothing to wail;
Or knock the breast; no weakness, no contempt;
Dispraise or blame; nothing but well and fair,
And what may quiet us in a death so noble.'

"The simplicity, the nobility that brought us this quiet, this relief in the passion, the disturbance and the discouragement of the great disaster, is reflected in the work of two Surrey artists, Mr. Thackeray Turner and Miss Jekyll. We owe to our noble dead all that is highest in the world of beauty, all that is appropriate to a deed of courage done with perfect unconsciousness of self, and perfect sincerity. These are the qualities that marked the deed. These are the qualities which are held sequestered in this gentle garden cloister. Let us hope that Phillips' example and Phillips' memory may become a part, as it were, of the building—a spell to bind the spirits of those who enter here. May no man or woman who seeks rest in the cloister leave without an inspiration toward that high courage which is in truth the liberator of souls.

"Few of us are ever likely to be called upon to face death in so appalling a form as that in which Phillips encountered it. But that need not in the least cut us off from communion from him. We can share his sacrifice on a lower plane. We are told of deeds that won the empire, and hear of great battles by sea or land, or great transactions of statecraft and politics. These are often worthy in themselves, no doubt. But, after all, the real deeds that won the empire were deeds of the spirit, deeds such as that of Phillips. In the last resort the empire was won and the empire will be sustained by the spirit of the English-speaking race, and that spirit rests on the sense of duty. As long as Englishmen feel and obey the call of duty without question and without stint, so long and no longer will the nation and the empire survive.

"Let no man be disheartened by the thought: How are we to define the word duty? None of the greatest things in the world—time, space, death, birth, love and life itself—are capable of definition. Nevertheless, we know what they are. In the same way we know what duty is. One of the early fathers of the church was asked what time was. He replied: 'I know when you do not ask me.' So we may say of duty. We know when we are not asked, when we do not try to find a definition. In the abstract we may discuss and find great difficulty in deciding what it may be our duty to do in this or that circumstance. When the moment for action comes we ought to know in an instant what we ought to do, though we may not always have the courage to do it. Duty once accepted becomes an exaltation of the spirit. Many a man has been dejected and unhappy because he realizes that he has not done his duty, or again, before he has done it. While doing his duty he

"'Is happy as a lover and attired
With sudden brightness like a man inspired.'

"The Titanic, on the tablet on which I am about to unveil, is called ill-fated. I have no quarrel with the word. It is a natural and reasonable phrase, and represents the universal thought as to that poor ship and the end that came to all her strength and her majestic beauty. But never can we think of Phillips as ill-fated. He died for his fellow men and followed the great, the divine example, which we have just commemorated in our Easter prayers. He was happy in his death. He fought a good fight. He is now God's soldier.

"On behalf of the subscribers I now unveil the memorial tablet and hand over the memorial to the mayor of Godalming on behalf of the town. May Phillips' example be an example to her citizens for all time."

H. Colpus, mayor of Godalming, responded to the address, in a short speech in which he accepted the memorial on behalf of the town.

Occupying an area of about eighty square feet, the cloister has three cloistered sides and an arcaded wall, from the arches of which can be obtained excellent views of the surrounding country. The cloister was erected by subscriptions from all parts of the British Isles, Europe and the United States. The cost of the cloister was approximately $3,500. A garden has been laid out around the memorial.

There are large tubs of agapanthus (the African lily) and a border of evergreens and flowering plants along the arcaded wall. Oak pillars support the roof. It is likely that the walls of the cloister will be used for tablets to commemorate deeds of bravery by other Godalming folk.

The Postal Telegraph Clerks' Association gave a small fountain which has been placed in the cloister. Above this is a memorial tablet, surmounted by the Godalming borough arms and bearing the following inscription:

" S O S.—This cloister is built in memory of John George Phillips, a native of this town, chief wireless telegraphist of the ill-fated SS. Titanic. He died at his post when the vessel foundered in mid Atlantic on the 15th day of April, 1912."

A portrait of Phillips in oils has been presented to the Godalming Corporation by former and present students of the Godalming Grammar School where he was educated. In Farncombe church, where he was formerly a chorister, a brass tablet has been placed.

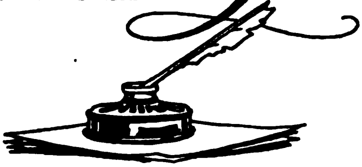
WIRELESS STUDY IN ENGLAND

Word has been received from London that a state organization to study in the public interest the science of wireless telegraphy, ordinary telegraphy and telephony is proposed by the Postmaster General and a committee of experts.

The committee, which has issued a report, suggests the establishment of a national research laboratory and a national committee of research to conduct theoretical investigations and experiments, and to coördinate and supplement the work now being done in the Government departments.

A tablet to the memory of Ferdinand J. Kuehn, the youthful wireless operator of the Old Dominion Steamship Monroe was unveiled in Public School No. 40, on May 22nd. The tablet is a gift from the Alumni Association of the school, of which young Kuehn was a member.

Confessions of a Wireless Free Lance



An anonymous sequel to "Is the Game Worth While?"

Photographs by the author

WHEN I entered the sanctum sanctorum of the Pacific Coast main office, the Man at the Desk raised a pair of sharp, searching eyes and looked me over quickly but thoroughly. I handed him the letter of introduction from the chief of the division I had just come from.

He read it quickly. He did not seem to be visibly affected, which surprised me, for I had had great faith in the job-securing qualities of that letter. It really was a crackerjack.

Out of a clear sky he shot the question: "Are you a tourist?"

'Way down in my heart I knew exactly what he meant: Was I seeking a position because it would enable me to visit foreign countries, and just how much did I have the interests of the company at heart?

So I sidestepped. "What do you mean—tourist?" I asked, innocently.

"I mean," and he tapped the desk with the edge of his hand and shot me a cold, calculating glance from a pair of steely eyes, "did you come out to the coast to work or to travel?"

Although I realized the necessity of being cautious, I hated to commit myself and run the risk of being sent out on some short-run coaster—when Japan, China, the South lay so alluringly before me. "To work, of course," I said, heroically. "Put me anywhere you need me, it doesn't make any difference." I think I must have uttered that last with the self-sacrificial air of a martyr walking into the lion's den.

"Where would you *like* to go?" he asked.

Although I was not at all aware of the fact, this was bait, cunningly concealing a lurking hook.

And I bit.

"Well," I said, luxuriously, "I had rather thought of a trip to China and Japan—"

"And after that, where?" he asked, affably.

"I thought that Australia would be a nice run."

"One of the best. And then the South Coast—to Panama?" he suggested, politely.

"Just the thing!" I exclaimed. "Fine!" I could not have ordered an itinerary more satisfactory than this was working out.

"And where next — say, Alaska?" This time I caught an ironical twinkle in the back of those 60 H.P. eyes, and I fell to earth with a crash.

"Oh! send me wherever you need an operator—it really makes no difference," I managed to say.

"China? Australia? Alaska?" he laughed; and I squirmed.

"Anywhere at all," I replied. "Put me on a fish tug in the harbor."

"That's the way to talk," he said,

Corinto, Nicaragua. We made every port from Mazatlan to Panama

parenthetically. "You drop around to the office at nine sharp to-morrow morning. I'll probably have an assignment for you."

I had come all the way from the eastern coast, paying my own expenses, just in the hope that I would be able to land a job that would enable me to see something of the world. I did not realize then that what I was doing had probably been attempted by dozens of other operators; I did not at that time consider the "Tourist" phase of it from the standpoint of The Man at the Desk. That the really "preferred runs" were on those ships which traveled to the far countries, and only the most reliable operators were placed on them.

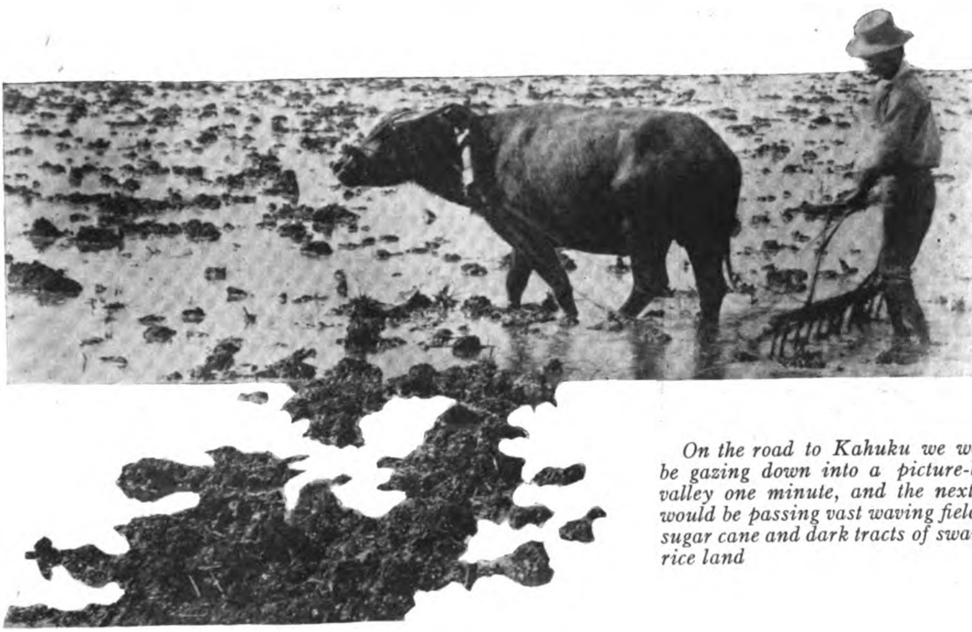
"Tourists not wanted," was the spirit as plain as words could say.

When I applied at the San Francisco office for a position I did not entertain the slightest doubt that I would be sent to China. It was quite a shock to me to learn that about four-fifths, if not five-fifths, of the new arrivals have the same sanguine expectations; also, that the majority of the operators in the western division secretly nourish that identical ambition!

But I realize my mistake. When I told the Man at the Desk I would be satisfied with a berth on a fish tug, I had a sudden change of views: I looked at the situation through the patient eyes of this executive. My attitude had certainly been wrong; and I decided to try out a steady conservation policy again, putting so much enthusiasm into whatever position was given me that a preferred run would just naturally fall into my lap.

At San Blas, Mexico, I had my first glimpse of the tropics; it was just as I expected

I have always had the interests of the company at heart, for the reason that I am a firm believer in the law of the conservation of energy. You get exactly as much out of anything as you put into it; whether it be school, business, athletics or—anything! I entered commercial wireless because it was fascinating to me. I worked diligently. I introduced new and original (at least, original to me) sales schemes for "selling" messages. In one month on an ordinary steamer on an ordinary run, by using a personal contact method of following up prospects, I turned in more paid business than any operator who had ever held the job. I do not say this in a boasting spirit but because it concretely illustrates my contention that you get out of anything just what you put into it.



On the road to Kahuku we would be gazing down into a picture-book valley one minute, and the next we would be passing vast waving fields of sugar cane and dark tracts of swampy rice land

The next season I was put on a new ship—one of the most desirable runs in the division. I have never cared for a berth at a shore station, for I like to meet people and I think I am better fitted to serve the company and myself in the capacity of a ship operator. Then, too, I will admit that I like to travel.

My first run was one which, for some reason I could never fathom, is not very popular with operators. It was a most delightful and interesting experience for me.

It was a slow boat of the Pacific Mail intermediate service to Panama, via Mexico and Central American way ports. We touched every village of consequence on the Western coast from Mazatlan to Panama. We were in a new place, usually a new country, each day. All were equally quaint and different and absolutely unspoiled by tourists.

San Blas, Mexico, a week out from San Francisco, was our first stop. It was my first glimpse of the tropics, and the best part of it was that it was just as I had expected and wanted it to be. A sweetly pervasive odor of pepper trees and tropical flowers saturated the atmosphere. The dobe houses, white or pink or blue, gleamed in an olive green setting of palms and shrubbery. The natives all wore wide sombreros. Naked babies and squealing pigs played in the houses and the streets. The señoritas were lovely. There were old monks in cassocks and armed to the teeth with knives and revolvers. Such was the conglomerate impression of my first tropical city.

One of the greatest advantages in being a wireless operator is the great clientèle of friends you may gain. I have usually found it best to meet people halfway—at least. It has always seemed to me that the people most difficult to meet are often the most desirable to know in the end. I have friends—not mere acquaintances—in nearly every state of the Union, the result of ship-board intimacy one time or another. I can claim friends in nearly every country of the world; especially the out-of-the-way places. And they are not the "How do you do! Good-by!" variety by any means; they are the sort that slap you feelingly on the back and shout, "You're coming right out and stay with us as long as you're here!" So if I have nothing else in the world I will always have the memories of these friendships of mine made in the democratic atmosphere of a wireless office. For instance, there's "Jack," who owns a sheep ranch 'way down on the Straits of Magellan; "Ikuta," the young Japanese watch inspector of the White Pass & Yukon River Railroad, at Skagway; "Eddie," of Hong Kong, who used to play me "Just a little love, a little kiss" on the grafonola all evening; "George," the young missionary located near Delhi, India, who tried to cure me of cigarettes; "Dolores," of Paris; we met in Nicaragua and—but this is not a love story; "Mel," who saved me from being stabbed at Acapulco, Mexico, and now wants me to join a cruising party to the South Seas—I really believe I could name so many that I'd have room for nothing else in the space allowed me.

So travel is broadening, if you allow it to be so. It is not easy to assimilate if you do not care to assimilate. I have met people reputed to be "globe trotters" who possessed 2 x 4 visions and insular opinions simply because they have always worn figurative blinders. Their main topic of conversation is a sort of composite grumble concerning hotel accommodations.

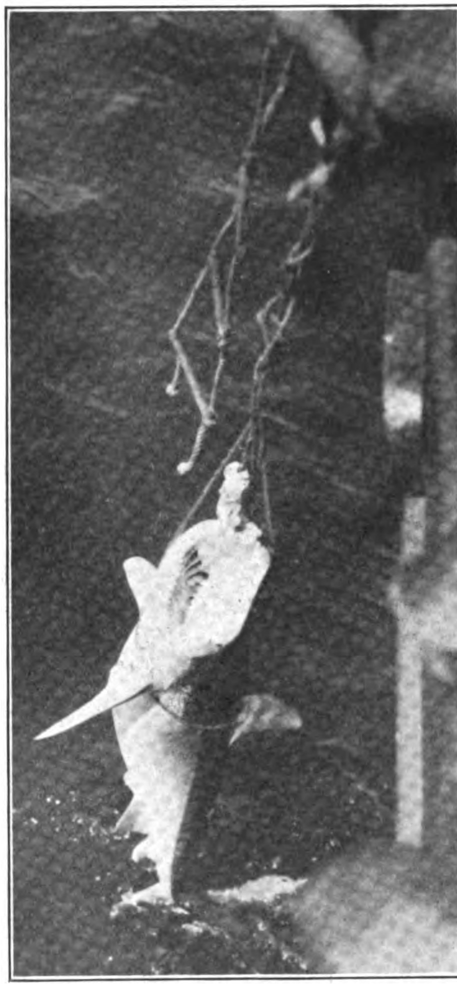
When I had returned to San Francisco, my next trip took me to Japan; fortunately this trip was made at a time when it was closed season for tourists

On the other hand, you are constantly meeting interesting people and interesting types; mining engineers, army and naval officers, politicians. These are men of the world—it is good for you to know the sort of people who do things. You meet hundreds of people, lots of them bubbling over with big ideas and with enough time on their hands to talk to you.

Is it valuable? It certainly is if you're the right sort. If you are not, you speedily degenerate; you become blasé—hopelessly bored and equally boring. But if you keep your nose to the assimilation grindstone you will be surprised to discover how broad your views are becoming, how deep your insight is growing, how keenly analytical and accurate are your judgments, how adept you are to intuitively read character in the face and attitude. Moreover, you become interested in everything that's worth while; you can talk intelligently upon practically every subject that may come up, simply because you have had contact with scores of people who individually have talked to you knowingly upon many subjects. That is not an idle theory; it is straight-from-the-shoulder logic.

But the outcome, the effect, is really the most interesting part. Perhaps, just perhaps, you find that you are not particularly fitted for life-long service in the wireless profession. If you are you soon find it out; you just naturally find the groove and rise right up through the service. But do not think for a minute that if you are not fitted for wireless,

Wash-day in Panama; two thousand miles, as the wireless waves travel, from New York



I never caught a really large shark, but the photograph shows one I landed about seven feet long and weighing between 300 and 400 pounds

wireless leaves you stranded high and dry without a profession.

All this contact with people and experience you have been having has been developing your bump of perception. The many-sided mind knows many prizes, and if you are not naturally adapted to "life on the wireless wave" you have every possible opportunity to discover just what vocation you are fitted for—a privilege that never comes to those who are plugging away in some one's office back home.

I am sure that this statement cannot be misconstrued if it is read intelligently. Even if you went into the Marconi service with the fixed determination of using your position as a tool to fashion the key with which to open the door to your destiny, you would be still giving your employers a square deal for the simple reason that you would *have* to give absolutely irreproachable service in order to gain your ends. And the Marconi Company could ask no more than that. It is another illustration of a favorite rule of energy conservation: "As ye sow, so shall ye reap."

The author of the exceedingly interesting article, "Is the Game Worth While?" did not go very far beyond the fact that wireless, directly, offers excellent opportunities for the operator. My aim is to point out, as I mentioned in the foregoing paragraph, that even if you eventually discover that you are not naturally adapted to follow the wireless game to a successful issue, even then your experience as a wireless operator will have proven invaluable.

Transportation problems as they are handled in Hawaiian waters and Chinese highways

The very least it can give you is self-confidence, breadth, resourcefulness and poise.

A great many operators who have traveled many thousand more miles than I have, may not have been quite so fortunate in the way of experiences.

One ship I was on last year performed so inopportune a feat as to pile up on the rocks. The incident was quite tragic until the receiving operator (he was rather green, I guess) who received my S O S and position report, came back with yesterday's ball scores. When he found out that "Help! Help! Assistance!" was wanted instead of Ty Cobb's latest performance he nearly tore his key off the table in order to get things straightened out. I can hear that key stutter yet!

Then, on the South Coast trip, a fireman was killed in cold blood about ten feet away from where I was standing. It was the most deliberate murder I have ever heard of—the result of a century old tribal feud 'way back in Spain. It happened on board the ship while we were anchored at the port of Acajutla, Salvador. The captain's room boy shot the fireman through the head with a dum-dum bullet. The next morning we steamed slowly to sea, and the burial services were held. There was a humorous touch to this grewsome affair, though, in the fact that the native judge who came aboard to review the case was woefully intoxicated. He looked like little Jeff, and the more serious he attempted to be, the funnier he became. I was court stenographer at the burlesque of a trial and the hardest part of my job was to keep from laughing in the face of the judge.

One of my liveliest experiences, and incidentally one I have already made passing reference to, occurred at Acapulco, Mexico. I was nearly stabbed by a gentleman who came up from behind while I was fistically engaged with one of his *comradios*. But this friend of mine, who has a fist resembling a piece of rock, intercepted the good work of the would-be surgeon with a left swipe to the jaw. The trouble concluded on the edge of the dock with, as he described it afterwards, "A loud splash, and all was quiet,"—which is an appropriate and accurate ending.

Several times, fishing for shark provided an innocent diversion when we were in port. It is keen sport when one of those sleek, tiger-striped man-eaters lunges through the water and seizes the tempting two-pound morsel of salt pork you are dangling on a hook and line, particularly when you realize at the time that he would be every bit as willing if you were substituted for the unfortunate bait. I never caught a really large shark like those to be angled for in the waters of Hawaii, so that I have not the grounds for a good fish story; but the accompanying photograph is of "my shark," about seven feet long and between 300 and 400 pounds in weight. I have seen sharks of that size pulled in along the coast of Florida and called large, but they would not be considered worth pulling out of the water in Central America and Hawaii.

You are constantly meeting interesting people and interesting types

Then there was "Dolores" — but this is not a love story

There are many varied and interesting experiences which one constantly meets in traveling in the strange countries that are not tourist-infested. Earthquakes and volcanoes have contributed to my enjoyment of life—when the excitement was over. And I was lucky enough to see some "real war" while in Mexico; it was a rebel and federal skirmish in which several score of rounds were fired. But as for actual damage done, the bullets might just as well have been caught in a basket and used for sinkers, which would not have been wasteful and eminently more charitable in spirit!

I have always gone out of my way to meet people and be courteous to them because I seemed to have been born bashful, and in the wireless service I was given an excellent opportunity to overcome the foolishness and to cultivate conversational ease.

I tried it one time in my hotel at Panama and met a man who later proved of inestimable value to me. After a brief chat he said:

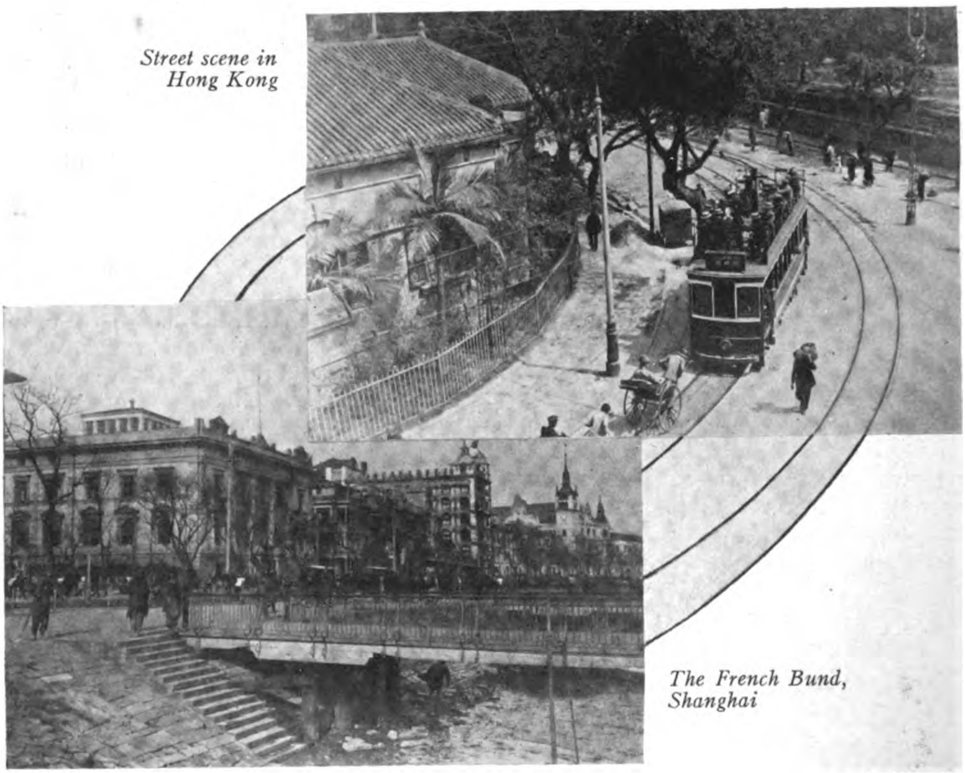
"Without asking you, I'll bet the cigars you're a newspaper man."

"You lose!" I laughed; "I'm a wireless operator."

"Anyway," he replied, "you *look* and *talk* like a newspaper man."

I made some inquiries about this gentleman of the proprietor of the hotel; he proved to be the representative of one of the biggest magazines in America. His opinion and advice were worth having; for it had suddenly dawned upon me—why not a journalistic career? I had been dabbling in it more or less, and when I acquainted my magazine friend with the idea, he plumbed me for tendencies, weaknesses and ability. He said then that I could succeed in the journalistic field. And that is how I found my groove—2,000 miles, as the wireless waves travel, from New York. Penned up in a two by four office at home, how many years would it have taken me to work out the problem? Yes—just about a thousand.

When I returned to San Francisco, my berth was changed—I *think* as a result of practicing my conservation policy—and I was assigned to one of the magnificent Hawaiian liners. It was a wonderful trip to Honolulu and a great experience. A friend, one of the J. G. White engineers directing the erection of the Oahu link of the Marconi world chain, took me in the company machine to view the work on the new stations. It was raining when we started and it drizzled on and off during the entire day. But I had become so accustomed to it from my other trip to the tropics that I was growing to consider it "liquid sunshine," quite as the Kanakas do. But the protracted rains had left the roads in a terrible condition. At the end of the hour and a half of continual bumping and jolting I felt as if I had been through an earthquake. On the grounds we were met by the construction superintendent and had lunch immediately. And such a lunch! We ate in a large mess tent, for an army of men are working there, and the meal, the best I ever tasted, was prepared by Japanese cooks, pastmasters at the gentle art of cooking food as it was intended to be cooked.



Street scene in Hong Kong

The French Bund, Shanghai

Then we went on a tour of inspection. The mile long aerials seemed unbelievable; the paradoxically complex but simple method of receiving and sending two messages at the same time seemed positively uncanny, but the two things which tickled me beyond all else were the operators' hotel and the bungalow for the engineer in charge. The hotel's billiard rooms, good old-fashioned fireplace and snug, homelike quarters certainly go to make an operator's life there highly desirable, and when you are ready to cap the climax of your career, there's a cozy little bungalow for you and "She," and a nice fat little salary check every two weeks. Our companies have been thoughtful enough to provide a sufficient number of these little bungalows to go around. All you have to do is to make good.

We took the road to Kahuku on the second morning; there the 300 k.w. transmitting stations are situated, 30 miles from the plant that I had visited the day before. There are two separate transmitting machines at Kahuku; one will shoot the 75-word-a-minute messages across 4,000 miles to Japan and the other will track off the little dots and dashes along the receiving tape at Marshalls, in California. The trip down was wonderful: Just imagine a fifty mile automobile trip along an excellent road amid the most beautiful scenery in the world! The road winds in and out, up and down, in a great valley, and on either side of you rise the sweeping hillsides of the two miniature mountain ranges of the island. We passed quaint little Japanese and Chinese settlements, vast waving fields of sugar cane, dark tracts of swampy rice land, tall sullen breaks of bamboo, and fragrant fields of pineapple, arranged with geometric neatness.

I was lucky enough to see some "real war" in Mexico; it was a rebel and federal skirmish

That travel is broadening is illustrated in this glimpse down Desveaux Road, Hong Kong

Occasionally a wonderful view of the sea, shading from a delicate emerald green to a tremendous purple would spread out before us. We crossed countless little narrow-gauge plantation railroad tracks whose engines looked like those little toy engines we used to ride behind at the fairs. Now and then through the mountains on either side beautiful alluring valleys would appear, and as suddenly disappear. They were just the kind of valleys you've dreamt of—wonderful with riotous color, invariably dissolving in the distance into a blend of vague, hazy purple.

The most striking feature of the whole trip was the ever-changing and endless variety of the views. One minute we would be gazing down into a picture-book valley of trimly arranged and brightly flowering truck gardens across to the beckoning hills when a sudden bend in the road would blot out these beauties entirely and present instead to our eyes a sweeping vista of rocky coast hundreds of feet below with the waves beating and bursting upon the pitch-black coral reefs. Or else, after a seemingly endless green dash along a sugar cane lane, all vegetation would abruptly cease, and the smooth, curving road would swing out alongside an apparently endless stretch of gleaming sandy beach with the waves, oh, so gently, lapping the shore.

And this is the paradise to which a score or more of faithful ones will duly direct their steps! "Well done, good and faithful operator!" the master executives of the Marconi Company may exclaim regarding your record. "Now pack up your carpet bag and catch the first boat out for Hawaii, earthly paradise-by-the-sea, with lucrative, interesting and instructive work and promotion if you continue to make good!" And the chances are they will surreptitiously slap you on the back and informally add, "Go to it, my boy—good luck!" For the Marconi Company, although a money making corporation, is, strange to say, occasionally quite human and always humane.

When I had returned to San Francisco, my next trip took me to Japan and China. Fortunately, this trip was made at a time when it was closed season for tourists, so I not only saw these places as they really are but I had the advantage of native prices. For example, rickshaw service was fifteen instead of fifty cents an hour and hotel accommodations for about one-half of the tourist rates.

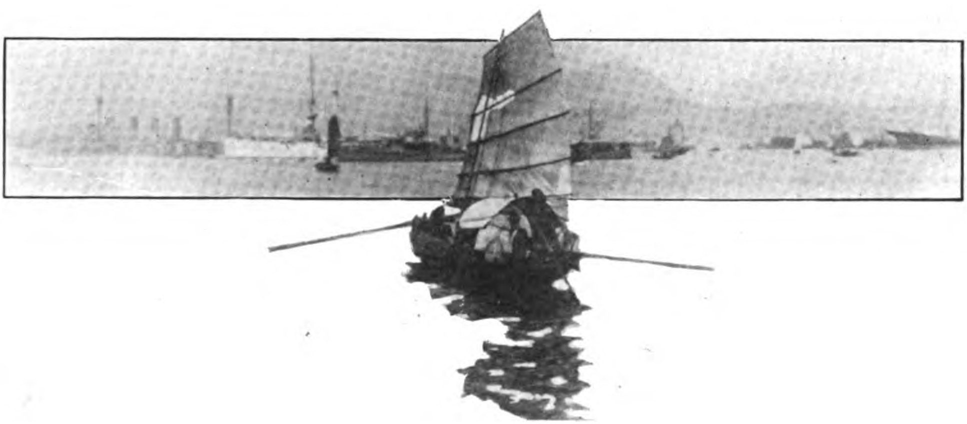
Our stops were brief but frequent, and I managed to see a great deal of both Japan and China. I learned sufficient Japanese and Pidgin-English to make myself understood the same as I had done with Spanish in Central America. Pacific Mail, the same as Ward Line Spanish, is comparatively easy and quite useful to cultivate.

In Tokyo, the old capital of Japan, I was fortunate enough to witness the famous Geisha "Cherry Dance," a yearly event. And in the Yellow Empire I made the rather doubtful acquaintance of real Chinese food. Do you imagine you would care for such tempting articles of diet as eggs that are eighty years old, black of

How Hong Kong Harbor looks from the Peak color and salt to the taste, but quite odorless? Or bird nest soup, which lives up to the name, fricaseed rat tails, broiled octopus tips? If you think it is a joke, some time when you get over to China, just obtain an invitation to a genuine Chinese banquet and see for yourself; or ask any operator who has been there. I will warn you beforehand, however, that if you should stop eating for the briefest time the Chinese gentleman on your left will promptly take it upon himself to cram food into your mouth. Which is perfectly good Chinese etiquette but rather trying at times.

Little experiences such as these, and you will meet with them all over the world, do one great thing for the receptive mind: they broaden you until you view life from more angles than you ever thought existed. You acquire the knack of meeting people favorably; you understand them and they accept you as a widely traveled but very democratic person, which means a welcome in any walk of life. Wide experience makes you appreciate the good things in life, takes the conceit from your make-up, and leaves instead, poise—*if* you will allow it!

But whatever you make out of your position as a wireless operator, or any position that you ever hold, the one limiting clause, "If you will," will form the dominating feature of your progress whether in the direction of success or failure. Quite aptly it illustrates that every action, physical, mental and moral, has an equal and opposite reaction: The law of the conservation of all energy—you get out of a thing exactly what you put into it.



BULLETIN ON THE GREAT LAKES

The announcement that the daily wireless bulletin to vessels on the Great Lakes from the station at Arlington was to become a regular service was received with expressions of approval from all the vessel owners. The passenger steamships of the Lakes are now equipped with wireless and many of the package freighters and other cargo vessels carry installations. It is expected that many more vessels will now install wireless.

The service commenced on June 1, and weather forecasts are to be sent out each night, shortly after ten o'clock, including barometric pressure, direction of the wind and the force of the wind on the Beaufort scale.

Weather Forecaster Cuthbertson, of Buffalo, stated on the opening of the service: "I regard the system of wireless transmission of weather messages to mariners on the Lakes as the greatest improvement in the Weather Bureau in the last twenty years. Mariners from Duluth to the St. Lawrence River whose vessels are equipped with wireless apparatus will be able to receive weather reports and storm warnings while far out in the Lakes, and will be able to plan accordingly. There is no doubt that the new system will prove a tremendous factor in making travel on the Great Lakes as safe as human ingenuity can make it."

Wireless Telegraphy in Railroad Service

An address read before the Convention of Railway Telegraph Superintendents New Orleans, May 19-22

By DAVID SARNOFF

Contract Manager the Marconi Wireless Telegraph Company of America

MR. L. B. FOLEY has so ably covered the subject in his paper (published in the June issue) that I feel there is little left for me to add on the subject of "Wireless Telegraphy in Railroad Service." I wish, however, to take advantage of the opportunity offered me by the Association of Railway Telegraph Superintendents to discuss the subject of wireless generally, so let me first impress upon the gentlemen present the fact that communication by wireless telegraphy over land is an established fact.

A great deal has been heard of the accomplishments and the possibilities of wireless telegraphy in connection with the maritime service; only recently have the merits of the Marconi system been thoroughly demonstrated over land as well.

The first practical use of the Marconi system for land communication was made by the Wanamaker stores in New York and Philadelphia, and from the very day the installations were completed up to the present time, the circuit has been used for many purposes. The sets installed at each end are of 5 k.w. power and the service rendered by this Marconi apparatus is, in my opinion, as well as in the opinion of the Wanamaker people, equal to that of any land line service.

Four to five thousand words are handled daily between the two points, during the business hours of the stores—9:00 a. m. to 6:00 p. m.—and as an indication of the class of service rendered, I cite an every-day example:

A customer comes into the New York store and requests a certain article which that store may not have in stock. The head of the department or the salesman immediately telephones to the wireless station on the roof of the building, requesting the operator to communicate with Philadelphia and ascertain whether or not such an article is in stock at that store. The salesman holds the wire and the customer; within a minute or two the reply is received, and very often a sale effected. This example is drawn from my personal experiences, for I served a long period in the capacity of wireless operator at the Wanamaker station.

When the advantages of the Marconi system as an auxiliary means of communication for railroad work when all other means of dispatching are made impossible through storms or other causes were perceived by Mr. Foley, the first installations were made at the Lackawanna Railroad stations at Scranton, Pa., and Binghamton, N. Y. At both places standard Marconi 2 k.w. equipments of the latest design and construction were installed. It was thought at first that difficulty might be experienced in communicating between these two points by reason of the fact that the intervening country is very mountainous. No such difficulty was experienced, however, and signals received at either end are sufficiently strong to be copied on a typewriter.

A question often asked is: What speed can be attained in the transmission and reception of wireless messages? The answer is: Given a good outfit, it depends *entirely* upon the personal skill of the wireless operator. I have handled from fifty to sixty messages an hour over a wireless circuit—messages of average length. And the only reason I can give for not handling more is that perhaps I am a "ham."

The installation on board the Lackawanna Limited train was not so simple a proposition as at the fixed stations. Several factors had to be considered—first, economy of space; second, the limited height available for the erection of the antenna; third, the low potential furnished by the train batteries.

To overcome the first difficulty, it was necessary to design special equipment which would be compact and yet efficient. Accordingly, a 1 k.w. Marconi quenched gap set was designed and installed, and a cabin specially built for the purpose. This cabin is about the same size as a standard train lavatory compartment. The booth affords ample accommodation for the installation of the apparatus and is sufficiently large to allow the operator easy manipulation of the various parts of the apparatus. The motor generator was designed especially for the purpose, the motor being wound to operate on 30 volt direct current, which is obtained from the train's lighting system. The motor generator is installed in the train's lavatory, which is directly opposite the wireless booth, and is controlled by the operator from the radio room by means of an automatic starter. Mr. Foley described in his paper the arrangement of the antenna on board the train.

Our experience with the wireless operations on the train has shown us that wave-lengths of the order of 1,500 to 2,000 meters are considerably more effective than wave-lengths below that value. We also learned that the speed at which a train is running does not seem to affect the transmission or reception of signals.

An interesting fact in connection with train work is that about three miles east of Scranton the train runs through a tunnel for about five minutes, and while in the tunnel, signals can be received on board the train from the Scranton station with perfect ease; in fact, no perceptible diminution in the intensity of the received signals is noticed. Some of the gentlemen present have been with me on the train during these experiments, and have themselves listened to the signals while going through the tunnel. This tunnel is of hard rock and dry; but I have carried on communication while in this tunnel when its surface was covered with snow. It is also worth mentioning that the noise of the train does not interfere with the reception of the signals, for the booth, being fairly soundproof, permits the operator to read the wireless signals without difficulty.

A question that is frequently asked is: How can interference be prevented when more than one or two stations are transmitting at the same time?

You have heard a great deal about tuning in wireless telegraphy; the subject is one that requires considerable explanation and I shall not take up any more of your time than I can possibly help in describing this method of interference prevention, but will simply endeavor to give you an idea of what is meant by tuning.

When an equipment is installed at a wireless station, whether it be on land or sea, the apparatus is so adjusted as to produce electrical vibrations of a definite periodicity in the ether. Such adjustment of apparatus is commonly called tuning the set to a certain wave-length. In order that wireless work may be harmonious, the government requires vessels at sea to use certain wave-lengths and reserves for naval and military use wave-lengths not used commercially. For example: all merchant vessels have their transmitting apparatus adjusted to operate on wave-lengths of 300 and 600 meters. The naval vessels and shore stations utilize wave-lengths between 600 and 1,600 meters. Wave-lengths above 1,600 meters can be used for any other purpose; and as the longer waves are more efficient for land communication, we have practically an unlimited range of variation.

Two or more stations may thus be transmitting simultaneously, and their signals will be received easily and distinctly at the separate receiving stations; provided, however, that the transmitters are adjusted to send on different wave-lengths, and the receiving apparatus adjusted to receive the different wave-lengths. In addition, the Marconi system provides a method of group tuning, which simply means that the receiving telephones and circuits are adjusted to respond to the pitch or frequency of the spark being produced at the transmitting station. Thus there are two effective means of tuning: wave-length tuning and spark frequency tuning.

As an instance of the effectiveness of these methods, I cite the recent case of the Lackawanna Railway's operation of the Marconi stations temporarily installed at Hoboken, N. J., and Dover, in conjunction with the Scranton and Binghamton stations—furnishing an absolutely reliable means of communication during a severe snow storm that crippled all land line communication on that road, and many other roads. The Hoboken station is but within a stone's throw of three or four other wireless stations situated in the city of New York. The other stations are constantly conducting business with the ships at sea. The Wanamaker station, also but a mile or two from the Hoboken station, is busy most of the day; yet it was possible for Hoboken to send and receive wireless messages without interference during all of the time that the other stations were operating.

In concluding, let me state emphatically that wireless telegraphy as an auxiliary means of communication will, in my opinion, be of inestimable value to the railroads of this country. While there is no doubt of the practicability of wireless communication aboard moving trains, I feel that its greatest utility at the present moment is perhaps in the way of fixed stations, which are ever ready to be set into operation when all other means of communication fail.

Unlike the land lines, wireless does not suffer from storms. As a matter of fact, the weather conditions during the winter months are most favorable towards the efficient working of wireless telegraphy; this means that just at the very time that land lines are most likely to be destroyed by storms or floods, wireless telegraphy is at its best.

The same operator used for land line work can take charge of the wireless, for it takes the ordinary land line operator but a short time to become familiar with the Continental Code and the Marconi system, which is simple in operation, and should the railroads of this country adopt wireless as a means of communication, it is not altogether unlikely that the government authorities may see the justice of permitting the railroads to use the American Morse code, since the railroad wireless communication is quite different from the general wireless service at sea.

The best indication of the confidence the Marconi Company has in its apparatus and its ability to accomplish all that is claimed for it, is the fact that no immediate profit is sought; that is to say, the apparatus is not sold outright to the steamship owners or railway men, leaving them to work out their own salvation and the best method of operation. Instead, the Marconi Company designs and furnishes the apparatus at its own expense, charging the users of the apparatus a rental figure, for which the lessee enjoys the advantages of all additional improvements—a considerable advantage, for the wireless art is continually being developed. Further, the Marconi Company makes regular inspections of its equipments, maintains the apparatus in good and operative condition and effects necessary repairs.

Such an organization has made possible the present entirely practicable wireless communication at sea, and the same Marconi organization will make possible reliable communication over land, regardless of the number of wireless stations erected in your vicinity.

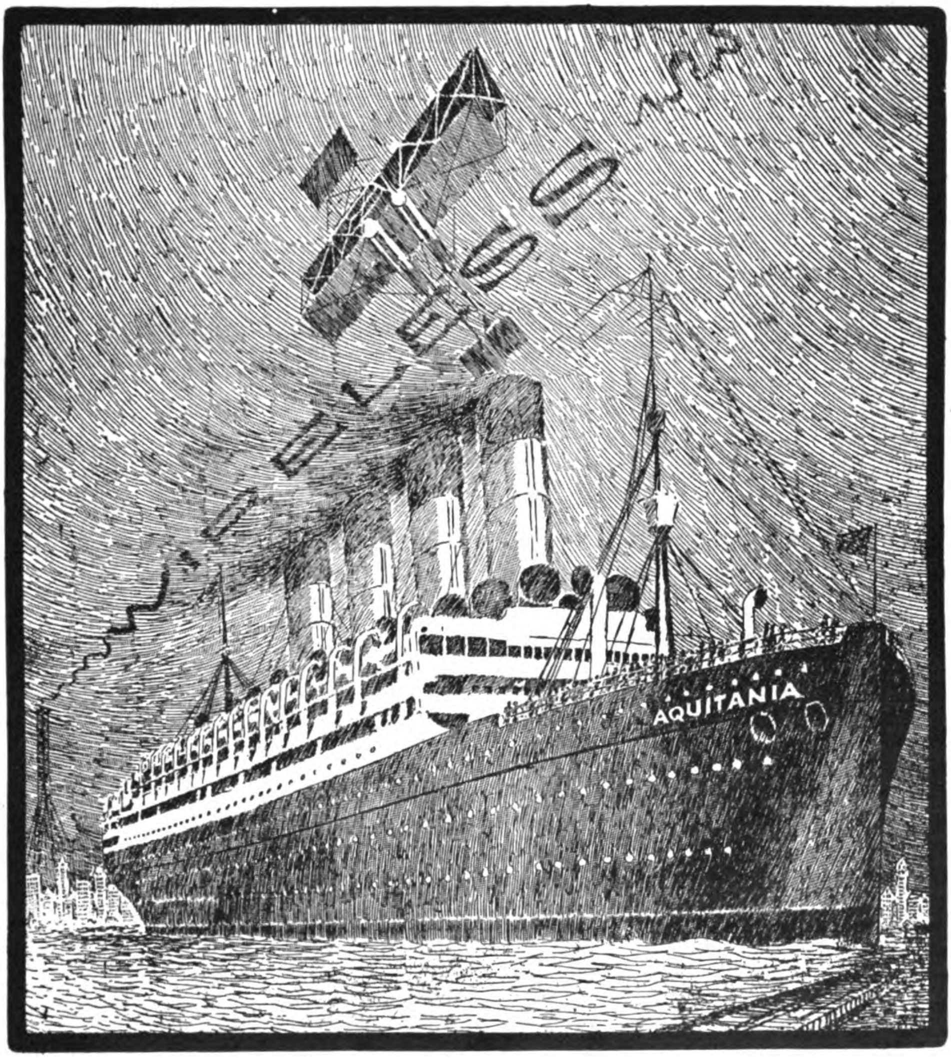
PROGRESS OF WIRELESS TELEPHONY

A cable dispatch from London says that Com. Marconi hopes to connect his office in Marconi House, London, and his country home at Fawley, Hampshire, by wireless telephone within a short time. The distance between the points is sixty-seven miles.

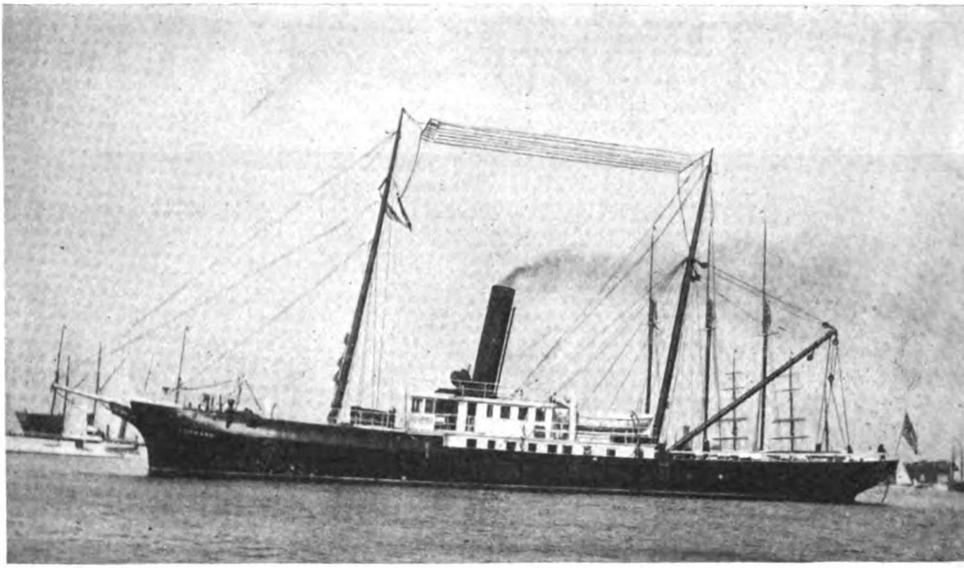
"Already we have had conversations with Berlin," he said. "We could not hear all the words, but the test was very promising, seeing that we were talking over 600 miles. Recently we had wireless telephone communication between warships forty miles apart which was entirely satisfactory. In fact we could hear conversations going on in the room. 'I want a drink' was one of the scraps we overheard."

There is almost daily communication between Marconi House and the Chelmsford works, thirty-one miles away.

The Progress of Man!



It is significant of the high place in modern commerce which wireless has attained that with the arrival of the greatest of all British liners this cartoon by the famous artist Winsor McCay should appear in the New York American. The drawing, to quote that newspaper, "shows the degree to which man has to-day conquered the forces of the air, the water and the earth. Man's inventions carry him through the heavens above, the earth beneath and the waters under the earth. The air is frequently dotted with air craft and in the clouds wireless conversation is daily held. All these are twentieth century achievements. Ours is the age of wonders."



The Yankee Salvage Association's tug "Forward," which sends ashore the press reports

Reporting the Yacht Races by Wireless

THE reporting of yacht races for newspapers is not what it used to be—and for this changed condition many newspaper men are duly grateful. The day has passed when the reporter had to stand with face upturned to the sky and entreat obstinate carrier pigeons to come to earth and yield the bulletins of the contest which they bore; no longer is it necessary for him to risk his life in a balloon high above the waters in order to serve his newspaper.

Wireless telegraphy has brought about a new and better method of getting the news. To-day while the yacht races are in progress the city editor of a newspaper does not concern himself with the problem of how the bulletins and story of the contest will reach the office. He knows that they will be flashed to land from the press boat as soon as the "copy" is handed to the operator, thereby insuring quick transmission into the proper hands.

On the eve of an international yacht race some years ago a brand new idea for reporting the contests was evolved in a Park Row newspaper office. It was proposed to obtain a flock of carrier pigeons to carry bulletins of the race from the observation boat to the office. The scheme was carefully discussed, but only one flaw could be pointed out. The carrier pigeons were obtained from Staten Island and it was feared that no matter how well they were trained in their lesson to fly directly from the observation boat off Sandy Hook to the newspaper office some of them might return to their old home. In order to guard against the failure of the plan in the event that this occurred the reporters detailed on the press boat were instructed to write duplicates of each bulletin and to liberate simultaneously several pigeons bearing the same reports. Reporters were assigned to the home of the owners of the pigeons to get the bulletins carried by the birds which might fly to their former home, and telephone their contents to the office.

As soon as the race began the reporters wrote bulletins announcing the fact, attaching them to the pigeons which were freed. Some of the birds started toward the newspaper office, while others flew for Staten Island. In a tower on the newspaper office building were men waiting to receive the pigeons and the bulletins were hurried to the editors as fast as they arrived. As the race progressed and other bulletins arrived, however, it was found that some of the later bulletins of the contest were arriving before the earlier ones.

On Staten Island the reporters were confronted by difficulties which they never before had faced, for the pigeons took refuge on the roof of a barn and could not be persuaded to come within reach of the newspaper men. The reporters tried to capture them by climbing to the roof, but as soon as the birds caught sight of them they flew away. When the reporters left the roof the pigeons returned to their roosting place. One of the men attempted to drive them to the ground by throwing stones, but this brought upon him the anger of the wife of their old owner and he was compelled to abandon this plan.

In the meantime the city editor was impatiently awaiting bulletins of the contest. But some of the important bulletins were attached to the pigeons roosting on the barn roof, while others were being carried by birds that were loitering somewhere between the race course and the newspaper office. Therefore the method of obtaining the yacht race news by carrier pigeon was declared a failure.

As the time for the next International races approached the same problem again confronted the newspapers. This time it was suggested that a reporter in a balloon be sent up over the course to observe the race. The reporter, who was also an expert telegrapher, planned to send the news of the contest by telegraph to a tug which was anchored below him. A telegraph wire extended from the balloon to the tug and the latter was in telegraphic communication with land by cable.

The balloon bearing the reporter ascended without mishap, but when the yachts started it began to turn around. Although he had made many ocean voyages the reporter was made violently ill by the motion. In fact he was so much affected that he was unable to telegraph the news of the race and was compelled to descend.

The facility with which the reports of the trial races, held recently to determine the selection of an American Cup defender, were transmitted by wireless telegraphy furnished a marked contrast to the efforts along the same lines previously described. On the tug Forward, of the Yankee Salvage Association, is a Marconi wireless telegraph set. George N. Robinson and J. F. McQuaid, operators, were assigned to the tug, which kept close enough to the yachts to enable the reporters on the Forward to observe the progress of the race. The messages were sent to the Sea Gate station from which they were transmitted by a direct wire into the offices of the Associated Press.

On one day of a race off Glen Cove, L. I., between the Vanitie and the Resolute 2,968 words were sent by wireless. On another day the story was told in 1,520 words. The following dispatch, which was sent by wireless, is an example of the service which was provided:

"Associated Press Boat, off Sandy Hook, June 10 (by wireless).—The first race of Defiance, the Tri-city cup defender, was a dismal failure, and at 12:37 P. M., an hour and twenty minutes after the start, she was so far behind Resolute and Vanitie that she withdrew. Her poor showing was due, to a large extent, to the fact that she could not hoist her club, and had to be content with a working topsail.

"In the windward work Resolute gained more than three minutes on Vanitie rounding the outer mark at 1:11:56, Vanitie turning at 1:16:11.

"Resolute finished at 2:33:07 and Vanitie at 2:37:57, Resolute having gained half a minute on the leeward run, winning by about four minutes elapsed time.

"Resolute led the way over the line to-day in the first of the series of three races of the America's cup defenders over the regular course off Sandy Hook, crossing at 11:16:27. Vanite and Defiance were timed by the two-minute rule at 11:17, Vanite being handicapped three seconds and Defiance twenty-nine seconds for late crossing.

"At the end of the first hour of sailing the windward course of eleven miles, Resolute still held the original lead over Vanitie, but Defiance was fully three miles astern and losing minutes to the mile in the eight-knot breeze.

"Defiance's skipper made no effort to mix with his rivals. He had hard work holding the nose of his sloop up into the wind, and started a hunt for conditions favoring his crippled rig. Defiance chose a course very close to the Jersey shore, where she picked up a strong wind, which came more from the west than that which the other two boats were encountering. This enabled her to cut down some of the long lead, because she was able to make a long fetch down the shore without tacking. In this maneuver, Captain Zelah Howell, whose home is at Highland Beach, showed his intimate acquaintance with local airs.

"Meanwhile, Resolute and Vanitie were making a thrilling contest. Both pointed high in the wind, with their baby jib-topsails, and negotiated the swelling sea with little difficulty. Resolute seemed the quicker in stays. An hour after the start she led her rival by a quarter of a mile. The breeze picked up a bit as the leaders approached the first mark off North Long Branch, and headed out to sea on the starboard tack. Resolute was then more than holding her own.

"After rounding the mark, spinnakers were set, and as the wind still held strong in the south-southwest, and the boats ran down toward the home mark with such speed that some of the excursion fleet were hard put to it to keep up with them. Resolute gybed as she rounded so that her mainsail went to port. She then set her spinnaker. While Vanitie moved very fast on this point of sailing, she was making what appeared to be a hopeless race of it, as she not only had to overcome the lead of her rival, but also had to give her a time allowance of three minutes."

A conference concerning the races for the America's cup to be held off Sandy Hook on September 10, 12 and 15 was held recently between Secretary Redfield of the Department of Commerce and Secretary Cormack of the New York Yacht Club. It has been decided that, as the success of the races depends upon a clear course, only one press boat, as within previous years, be allowed within the lines. The vessel for the purpose must be approved by the Secretary of Commerce and the New York Yacht Club.

Special arrangements will be necessary to insure the successful transmission of wireless bulletins from the course during the progress of the race. The indiscriminate use of wireless will interfere with these messages and deprive those waiting before bulletin boards the world round of instant news of the progress of the races. Such indiscriminate use will also interfere with the necessary daily communication by wireless between ships at sea and the port of New York, which must not be disturbed. Accordingly, Secretary Redfield will make use of the law to prevent wireless interference and will restrict wireless messages relating to the races during their progress to the wireless apparatus on the press boat.

Special arrangements will be made to prevent or detect violations of the law punishing wireless interference. The press and wireless boat will in all respects be under the control of an officer of the Government, and Secretary Redfield will ask Secretary Daniels to detail Captain W. H. G. Bullard, U. S. N., superintendent of the Naval Radio Service, for this purpose.

The international yacht races held off Sandy Hook in September and October, 1899, were reported by wireless telegraphy. Com. Marconi came to this country especially for the purpose of making the arrangements for the transmission of the messages.

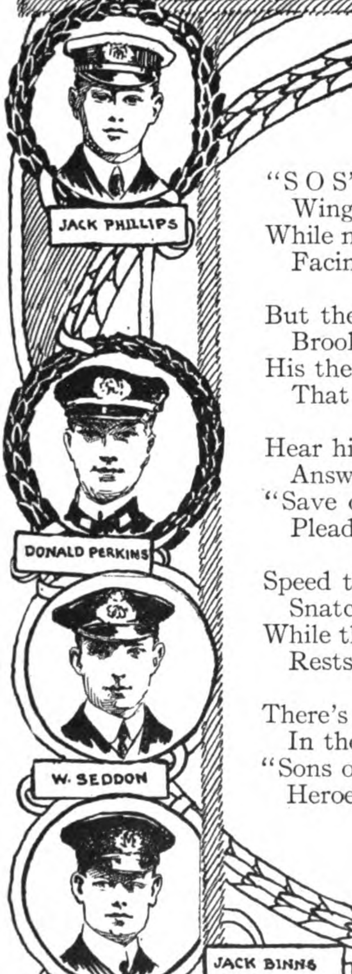
THE NORTHLAND ASHORE

In times of peril the first thought of those concerned is of the wireless. This was shown when the Northland of the Main Steamship line ran hard aground on the rocks of Bartlett's Reef in Long Island Sound in a fog early in the morning of June 5. The wireless set, in charge of H. Bondeaux, and Carl Krech, first and second Marconi operators respectively, was used to send out calls for help and the passengers were taken off by the Tasco, an ocean-going tug of the Scott Wrecking Company, which responded to the summons from New London, Conn.

The Northland was three or four miles out of her course when she struck. Captain Johnson, her commander, was on the bridge at the time.

Officers were quick to assure the passengers that there was no danger.

The wireless was picked up by several Sound vessels and on the New London shore. Captain Johnson, in his call for help, asked that a revenue cutter be sent. Thirty minutes afterward he sent out another message to the effect that assistance was not needed.



"S O S"—Unspoken anguish
Wings the message o'er the waves!
While men's spirits droop and languish
Facing death in watery graves!

But the hero's soul, afire,
Brooks no thought of death or fear;
His the one, the sole desire
That the sister ship shall hear.

Hear him call! and swiftly heeding,
Answer his persistent calls—
"Save our people," he keeps pleading—
Pleading!—Then the silence falls.

Speed the rescuers; and tireless
Snatch their brethren from the deep!
While the hero at the wireless
Rests now in immortal sleep.

There's another meaning dwelling
In those letters "S O S";
"Sons of succor," they are spelling
Heroes of the wireless.

CHARLES J. MASON.

DEDICATED TO THE MEMORY OF ALL THE WIRELESS HEROES

The Brigantine

A Wireless Detective Story

by Roland Trevor

Illustrations by F. E. Bisbell

AT first the proposition didn't appeal to me and I told the Superintendent so. "You're a funny fellow, Harper," he said to me; "I don't believe any other wireless operator in the service would pass up the chance of exchanging a coastwise vessel for a nice trim steam yacht—particularly when her owner happens to be Vincent Dalyer."

"Vincent Dalyer, eh? . . . Why the deuce do you hold that interesting detail till the last?" I demanded with a familiarity which I always assumed but never felt in this man's presence. A twinkle in his eyes and a slow smile was the only answer. He turned to some papers on his desk and, while running through them, observed over his shoulder:

"Of course, Harper, if you've changed your mind about this berth, I'll arrange things accordingly. You know, just because the Avencia is the biggest steamship afloat that is no reason why I should put the best operator in the service in charge of her wireless room. Besides, after one trip, you'd want to change again, I know. Aboard the Dalyer yacht things'll be a lot more interesting and it will mean, most likely, a long and comfortable cruise in pleasant waters. Then suppose Vincent D. takes a fancy to you. Likes the way you comb your hair or some little thing like that, and decides he needs a new secretary—you never can tell."

"Me for the prospective, rosy little secretaryship," said I. "Put me down for the yacht; that is, if she don't sail within ten minutes. There is a certain little party up town, and—"

"Sails day after t'morrow; go aboard at Erie Basin," growled the Superintendent as he scratched off the necessary memorandum.

And that was all I really knew about my assignment when, two days later, I located the Athor, the most widely photographed of yachts, for the simple reason that her owner was many times richer than the next richest young man in the universe. She was a trim little vessel, staunchly built for ocean-cruising and magnificently equipped and furnished. Besides the captain, two mates, steward, cook and the owner's personal servant, she carried a crew of seventeen men. From innumerable newspaper reports I knew that Dalyer was himself an able seaman and, for some months now, had made his yacht his home. After I had presented my credentials to the captain and signed ship's articles, I inquired what manner of man was the owner. I learned that he was very democratic, a remarkably good sailor and displayed a pretty wit at the table. In place of the society circus set with which the average yacht owner burdened himself, Dalyer preferred to surround himself with the vessel's officers at meal times and, while a strict disciplinarian, his relations with the men were always very friendly.

This sounded enticing and I ventured to remark to the captain, "Well, I'll have to think up some merry quips to pass out over the soup."

"You?" sneered the captain.

"Yes, me," I replied. "I rank as a ship's officer—"

"Ship's cabin-boy, you—"

"Not on your life. Haven't I just signed on as a petty officer?" I waxed indignant. "And as such I am entitled to—"

"That's right, Captain Thomas," a voice interrupted. "Dead right."

There in the doorway stood the owner, readily recognizable through my having seen his pictures in the illustrated papers some thousands of times. He was smiling easily, and as he came forward he extended his hand to me. I recall now how distinctly I was impressed with its strength and slimness as I grasped it and mumbled some inane conventionality. "The new wireless man, I suppose," he remarked, "and being put over the jumps by our excellent skipper, I presume, from what I overheard as I came along. We'll have to save you from further initiation," he grinned, "thus cheating Captain Thomas out of a portion of his greatest diversion." He nodded and smiled at the captain, and I noted the grim visage of that old seadog relax into a suggestion of amiability in return.

"Your name?" Dalyer was saying, as my amazement subsided over this phenomenon.

"Harper . . . er . . . Frank Harper," I stammered.

"I am Mr. Dalyer."

Thus was my introduction to the richest young man in the world made, and it seemed even then that I would find him very interesting and the trip eventful.

I was not disappointed in either respect. Long before we reached the Azores he had singled me out for his almost constant companion. Just how this happened, I do not know; but there were two contributing causes: I had more time on my hands than any other man in the ship's company—in fact, I had little or no wireless business to transact—and then the dog, Bob, almost as famous as his master, as you well know, had conceived a great liking for me. And, by the way, that strapping big mastiff quite won my heart. Stately, high-bred, intelligent and lovable, he was a thoroughbred from the jet of his handsome muzzle to the tip of his tawny tail. I had never appreciated before how much of a companion a dog could be. Meeting on the common ground of fondness for Bob, and, owing to the fact that I had little or nothing to occupy my time, Dalyer and I became so well acquainted that I expected by the time we arrived at Lisbon to be calling him by his first name. We were to run down the Mediterranean to Naples, stop there for a while, then double back to New York over the route we had come.

Scarcely had Sao Miguel been lost to sight, when Aeolus became capricious and stirred up about the roughest sea I had seen in many a day. For three days we tossed madly and uneventfully in the trough of the heavy sea. On the morning of the fifth of April, however, the sun shone beautifully, the waves had gone down and the surface of the sea was all aglitter with little ripples. The owner's spirits rose as, soon after nine o'clock, we sighted a sail about three points off the port bow—the only thing in sight on the broad expanse of blue, shining ocean.

Within the hour we had approached the stranger near enough to see that she was a brigantine, under short sail, and in a little while we were within hailing distance. Through the glass I made her out to be a smart looking and beautifully modeled craft and after a few minutes I read the name in gilt letters on her quarter as Ionia. Except her jib and a staysail, she had not a stitch of canvas set. Dalyer lowered his glass and I saw in his eyes what I knew he must have read in mine. Somehow she impressed us with a sense of deathlike stillness and mystery. I could see that her wheel was loose and that there was no one on her deck. The slight breeze that still prevailed was from the north and the brigantine was on the starboard tack while our yacht lay to leeward.

After another short survey Dalyer lowered his glass and told Captain Thomas to hail. The captain, as we neared her, called repeatedly in stentorian tones, but no answer came and no kind of life appeared on board the strange vessel. When we were within three hundred yards of her we slowed up, a boat was lowered away and Dalyer and I, the first mate of the Athor and two seamen rowed alongside. Slowly drifting to leeward, she was barely moving and Stevens, the mate, clambered aboard by the bowsprit stays. He threw out the line, and making the boat fast we quickly followed him. He and the two men went forward and I followed Dalyer across the deck to the companionway, which we found open, and entered the cabin. It was empty.

The men forward found no one; so all five joined in and searched the vessel fore and aft and high and low. There was not a living being besides ourselves on board.

She had evidently been deserted. But why? As far as we could see, she was perfectly sound and we failed to discover the least apparent cause for her abandonment. Her hold was exceptionally dry, with not enough bilge in it to fill a hogshead. Her cargo consisted of casks marked as containing alcohol, all of which were still in good order and condition, except one, which had been started. The exterior of the hull above the waterline did not exhibit the slightest trace of damage, nor was there the least evidence, on the interior, that the vessel had been repaired in any way or was at that time in need of any repairs.

We also discovered that the vessel was amply provisioned and that she had plenty of good water in her casks. A number of articles found among the seamen's effects bore witness to the fact that the men were comparatively well to do, which was sufficiently unusual in men of their class to arouse speculation.

Her cabin was nothing short of luxurious. I must say that I had no idea there was a merchantman afloat so comfortably and attractively equipped in this respect. The apartment was large, high and well lighted, with four staterooms opening from it, two forward and two aft. Along the bunks on either side were broad thick cushions, covered with crimson velour. The center table was stationary and in the space between the staterooms forward was a reed organ, open, and in the corresponding space aft stood a sewing machine, also uncovered. Several music books and loose sheets of music lay on a stand beside the organ, and on the sewing machine we found a pattern in muslin, evidently a child's garment in process of making, also a small phial of machine oil, spool of cotton and a thimble; all three were in a perpendicular position, attesting that the vessel could not have encountered any stress of weather, else these lightly balanced articles would have been upset.

Under the berth in the forward port stateroom we found an open box, containing panes of glass packed in hay and unbroken. Hanging on the partition, opposite the berth in the corresponding room forward we found a cutlass of somewhat ancient pattern, which, on extracting it from its scabbard, I discovered to be stained with what seemed to me to be blood. I called Dalyer's attention to this and, after a careful examination, he agreed with me and concluded that we had perhaps found a clue to the mystery. Later we discovered marks on the main rail, apparently of blood, but by that time we had been forced to give up the idea that there had been any violence on board the vessel; everything was in well-nigh perfect order. We returned to the cabin and inspected the remaining articles of furniture. There were two large easy chairs upholstered in leather and several smaller lighter chairs. The carpet was a heavy Brussels and the woodwork was painted a pale soft gray, with bluish trimmings. All the brass mountings of the lights were bright and shining; in fact the whole apartment was pervaded by an air of quiet order which only heightened the mystery. It was clear that it had been occupied in part by a woman and child, and these we naturally supposed to be the wife and child of the captain.

Dalyer proved that he could be practical when occasion required and at once set about making arrangements to work our prize to Gibraltar. He left the mate aboard the vessel, and with the two men and myself returned to the yacht. It was then nearly noon and after he had issued some orders to the captain he invited me to join him in a snack of lunch, which had been ordered from the cook. This cook, by the way, was an Indian of truly remarkable appearance; tall, with black hair and clear complexion, he reminded one of nothing short of an Indian prince in disguise. He took an inordinate amount of pride in his culinary achievements and never failed to flush to the roots of his hair with pleasure whenever the rich young owner complimented him upon some special delicacy. These compliments were given frequently, for the man was certainly remarkably adept in his chosen vocation and was ever and anon preparing new surprises.

This afternoon he insisted upon personally serving Dalyer and myself with what he termed, "Le triump' av meeny year devoshun to cook art. A morsel, O masters, as cud not be have less if in India palace."

Dalyer smiled at this elaborate introduction and replied, "I am quite sure it will be especially nice. Mr. Harper and

I distinctly saw a man step from the rail at the port quarter; he was dripping wet and hatless

myself feel greatly honored. We both thank you for your consideration, Archie." This little by-play concluded, the Indian withdrew smilingly, and we began an assault on what could be best described as a confection so skillfully blended that not a single one of the various ingredients could be recognized by sight or taste. The dish was so distinctive and appetizing that I suggested to Dalyer he inquire its name and the recipe. He said that this would be useless; no one had ever been known to extract any of his culinary secrets from Archie. He then volunteered the information that the cook's name was not Archie; that he fixed that designation upon him because his real name was positively unpronounceable, being spelled something like K-h-d-r-a-c-d-o-x-t-h.

I recall this incident because of Dalyer's concluding remark: that he kept both Archie and the dog Bob on board because both were highly ornamental, useful and, in their respective ways, thoroughbreds.

Luncheon over, Dalyer told Captain Thomas to collect five men from the crew, one to be in authority as sailing master, and send them aboard the brigantine prepared to take up their quarters. After sending off a wireless report of our prize to C N W, I accompanied the owner, at his request, and returned to the cabin of the brigantine. He engaged himself in looking over the log-book and some papers he had found in the captain's room and I went forward to poke about in the seamen's quarters which were to be occupied by the Athor's men.

About fifteen minutes later, as I was standing by the foremast facing aft, I struck a match to light my cigar. As I raised my eyes I distinctly saw a man step from the rail at the port quarter, move quickly across the deck and disappear in the companionway. I caught but the briefest glimpse of his face and figure; but they were not to be forgotten. He seemed to have clambered aboard from the sea, for he was dripping wet and hatless, and his light hair was matted or glued about his head and face by the water, while his clothes clung to his body and limbs and glistened and dripped in the sunlight. His figure was gigantic. His face and trunk were bloated or distended like those of a man who has been drowned; there was not a vestige of color in his face, which was ghastly horrible and expressionless, even to the eyes. I was considerably startled and received a distinct shock by the suddenness of his appearance and his extraordinary condition, yet I managed to shout "Hey, there!" as I caught sight of him.

He neither answered nor hesitated. He did not even look toward me. Before my voice had died away he had disappeared, as I have said, down the companionway.

I hurried aft and entered the cabin. There alone, with his feet on a chair before him and the log-book on his knee, sat Dalyer quite unconcerned and half facing the companionway. All the stateroom doors were wide open and, as I looked around and saw no one else, I exclaimed in amazement, "Where is he?"

"Where is who?" drawled Dalyer.

"That man," I shouted, excitedly. "That man who just came in here! Here, right here! I saw the man come in here this moment. He's here somewhere," I added as I dashed from room to room, in vain. I tried to open a door in the foreward starboard stateroom, leading, as I supposed, into the between decks space. The door was fast and bolted on my side of it. No one had gone through there. I tugged and wrenched at this door and finally it came open. It led into the between decks space and the ship's storeroom, which we had entered and examined during our original search of the vessel. The casks of alcohol composing the cargo were undisturbed. There was nothing else to be found and no possible corner where anyone could have been concealed.

I turned back to the cabin, where my rich young employer stood gazing at me curiously. He stood close to me and, after a careful scrutiny, he said rather sharply:

"What's the matter with you, old man? What is all this about? How could anyone come in here without me seeing him?"

I described the man I had seen, adding that I could swear I had seen him enter the cabin three seconds before me.

Somewhat impressed by my positiveness, Dalyer preceded me to the deck, where hailing the yacht, he called out: "Take the dinghy and have a man bring the dog over here." And then to me: "If there is anyone on board here, Bob will find him."

As we turned back to the cabin, I noted the part of the deck over which I had seen the stranger pass, dripping with water, five minutes before, was perfectly dry; and so were the brass plates on the companion ladder, down which I had seen him disappear. This discovery bothered me not a little, but I still remained firm in my conviction that I had actually seen the man and had not, as Dalyer evidently believed, simply suffered an optical delusion.

I paced the deck until the yacht's boat arrived with the men and Bob. When they had boarded the brigantine, Dalyer came on deck again and we made another thorough search of her, with the dog running on ahead and with the aid of two bull's-eye lanterns that the men had brought over. This second search was as barren of results as the first. It was after five o'clock when we finished and we were on the point of returning to the yacht to prepare for dinner when it was decided it would be best to lock the cabin. After having secured the doors of the staterooms and closed the port we turned to leave, Dalyer preceding me toward the deck. Halfway up the companionway I remembered that I had left my cigarette case on the table and I returned to get it.

Hardly had I again stepped into the apartment when I saw, clearly defined, at the upper end of the bunk, on the starboard side of the partition close by the stateroom door, the shadow, in profile, of the face and figure of a man. The shadow appeared to be cast by some very tall person sitting on the bunk to my right; but there was no one there. I began to doubt the evidence of my senses and stood, for a moment, looking about me in bewilderment. Then I approached the corner convinced that the dark gray shadow was a stain upon the paint. Then I saw it was not. To verify this conviction, I took a loose sheet of music from the chair near the reed organ and, holding it between the shadow and the light, I looked behind it and there a portion of the shadow—part of the head—had been obliterated. Turning to the surface of the paper in my hand, I saw the missing portion of the shadow clearly silhouetted thereon.

Certain then, that it was a shadow, and one cast by some invisible and impalpable thing or substance, I became somewhat excited. I shouted to Dalyer, who immediately ran back into the cabin, followed by the dog. I gave him the details and told him of my test; which he repeated with exactly the same result! Then we turned to speak to Bob and found, to our surprise, that he had left us; and, although we put forth our best efforts, in turn persuading and commanding him to enter the cabin, we could not move him.

Dalyer and I looked at each other for a long period in silence. Mingled with my feeling of triumph at having thus convinced him that there were others besides ourselves aboard the mysterious derelict was an uncomfortable consciousness that the wierd annoyance was beginning to strain on my nerves and excite my imagination disagreeably. I wondered what was to come next.

"Well," said Dalyer, as he lighted a cigarette, "this is a queer proceeding and it is really a very interesting one, in spite of the fact that I have not the least doubt that we are the victims of some vulgar jugglery, practiced upon us for some unexplained reason by some one about."

I nodded an affirmative, for I was morally certain that this was the case. Of course I had not time to reason with myself as to the logic of the conclusion; it was the only natural one, and certainly no other explanation for what I had seen occurred to me. Consideration of possible supernatural causes as a solution was out of the question with both of us. Vincent Dalyer was as free from all superstitious fancies as he was incapable of fear, and I trust I will be allowed to claim to have been his counterpart, in at least the former respect.

As we looked, the strange shadow slowly faded out. Then followed a vain search for half an hour and fruitless experiments with the lights and shadows of the cabin, after which we locked the companionway and returned to the yacht to dine.

It was easily seen that Dalyer was annoyed; not so much over the fact that it appeared some one was playing a joke on us, but as to the identity of the one behind it all. During the course of the dinner he was for the most part silent and it was evident he was figuring out something in his mind. With the arrival of the salad he announced that he had formulated a plan to turn the tables. He asked me if I could get a wireless message over to C R F, at Lisbon; and when I told him that was a cinch he left the table, returning in a minute with a code book. He inquired if I had ever seen one like it before. Naturally I had not, as there were only half a dozen copies of this private code in existence. In a few minutes he had prepared a message, which, to my amazement, was addressed to the chief of the police detective bureau at Lisbon. "A very clever fellow and a personal friend of mine," he volunteered. "He is really in the government service, but I am quite sure he will be more than pleased to unravel this little problem for me. We will have some fun. Should he be able to come right away, how long do you suppose it would take him to get here?"

I replied that in a good fast boat four to five hours would be sufficient.

I dispatched the message straightway and within ten minutes had a reply that the detective would start immediately. Dalyer cautioned me to silence and warned me that I must be sure to treat this man as a guest when he arrived.

By eight o'clock our arrangements were complete and we went back to the brigantine to pass the night in her cabin. Bob remained on deck and we tried again, but in vain, to induce him to enter the apartment with us. His refusal annoyed us both, but cataloging it as incomprehensible, we prepared ourselves for the night. Dalyer established himself in the forward starboard corner on the bunk looking aft; the shadowed corner. I made myself comfortable in the port corner aft, diagonally opposite and facing him. Thus, between us, we commanded a full view of the cabin and the four staterooms, the doors of which we had reopened. The dog roamed restlessly about the deck until a little before midnight, when I heard him lie down across the entrance of the companionway.

I was dozing lightly, when a slight sound caused me to start up. I looked at my watch. It was a quarter to one. Just at that instant the three cabin lamps suddenly became dim. This was surprising, as we had carefully trimmed and filled them all before lighting them. I got up to examine that nearest me, turning my back to Dalyer. As I did so, I heard the unmistakable double click of the hammer of a pistol. Turning again, I saw my companion, with his cocked revolver in hand, step to the floor. His face was pale and rigid and his eyes fierce and fixed. He moved the table and raised the weapon. With an indescribable and fearsome sensation, I looked in the direction of his aim and, there, not five feet from where I stood on the inside edge of one of the ports, I saw a large coarse bloated hand clinging, and behind it outside, the ghastly brutal face of the man I had seen cross the deck in the afternoon. The dull lead-colored eyes seemed peering into the cabin. No words can convey an idea of the loathsomeness of this man's appearance, except that I was almost overcome by mingled horror and disgust. Then the clear cold tones of Dalyer's voice broke in:

"Now, my man, I have you in range. I'm a passable shot and if you move I shall fire. Who are you and why are we honored with this visit?"

There was no reply. After a pause, Dalyer spoke again:

"I intend to have an answer. If you don't speak up before I say 'three,' I shall fire anyway! I mean this; and intend to prove that we are not to be trifled with."

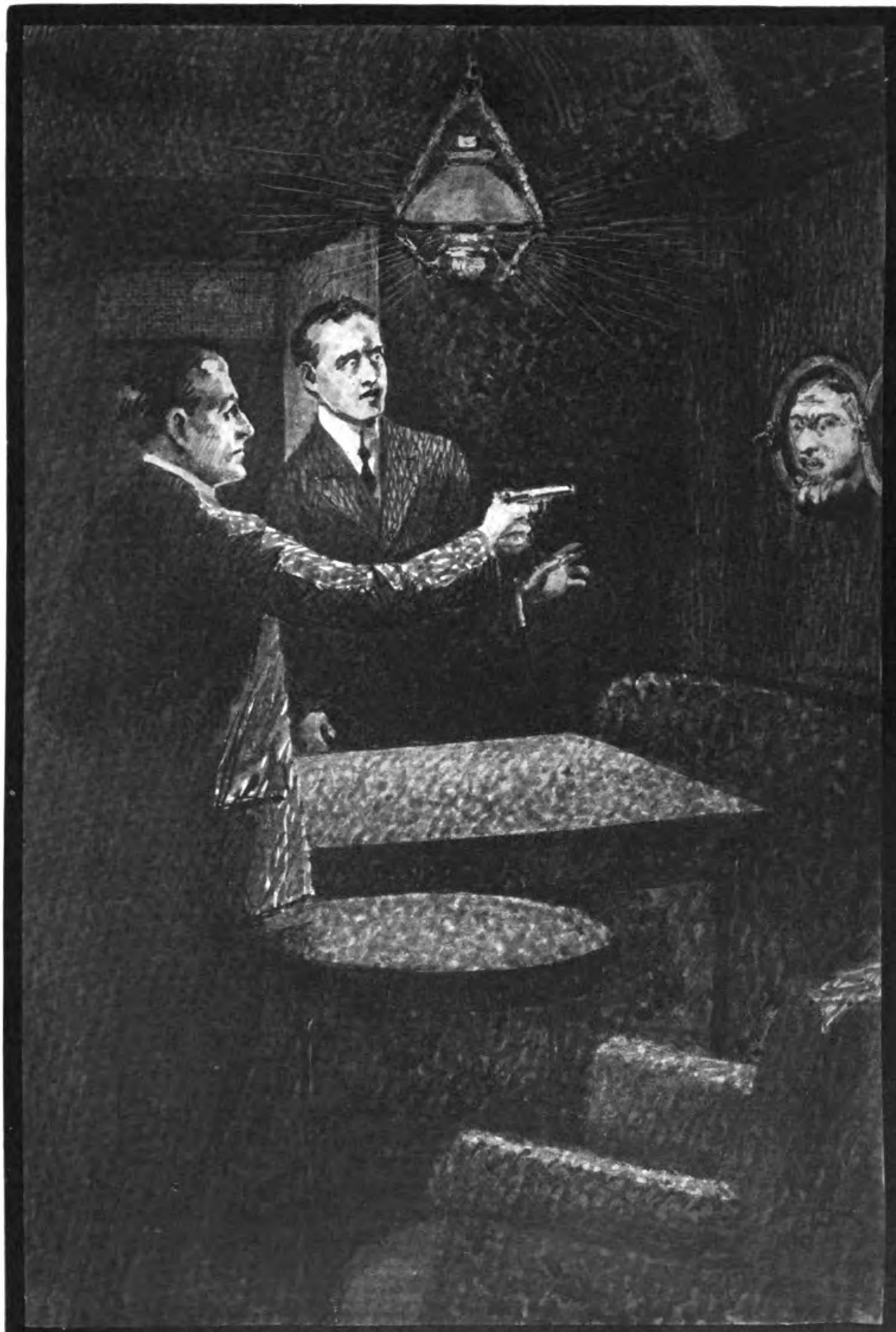
Still there was no reply and, after a pause of about ten seconds, Dalyer counted very slowly, "One—two—three," and then followed the flash and report of the pistol.

The man at the porthole did not move. Dalyer, with wonderful nerve, raised the weapon again; but, even as he did so, the face and hand disappeared; not instantly, but as if drawn slowly back, they seemed to be swallowed up in the darkness without. As they faded away, the lights in the cabin waned again; and crying to me, as the dog bounded into the cabin, "Stay where you are and keep Bob with you," Dalyer dashed up the companionway to the deck.

As I seized Bob's collar the doors of all four staterooms slowly but steadily swung and silently closed, although there was not the slightest lurch of the vessel; the same happened with the skylight supports and the sliding hasps in the doors of the companionway, shutting me in alone with the dog.

My recollection of what followed is perfectly clear. Without any attempt at description, I will relate what occurred as I actually saw and felt it. Appreciation of my horror of my position I must leave to the imagination of the reader.

Finding myself thus closed in, my first undefined idea, naturally, was to reach the deck and call Dalyer. I was startled, but I do not think I was afraid, at first. Some new trick was about to be played upon us and I wanted him to see what it was with me. It did not occur to me that the companion hatch could have been made fast, so I turned to the steps, the dog accompanying me closely—too closely, in fact. As I raised my foot I felt that I was unable to place it on the first step. It was as though the exit from the cabin had been walled up. A second attempt was equally in vain. I endeavored to precipitate myself into the companionway. I might as well have tried to walk through a wall of solid rock and, still, in extending my hands and looking before me, I felt nothing but a soft though forbidding pressure, and saw nothing but the open stairway. I cannot say whether my sensation was one of terror or bewilderment—perhaps it was a mingling of the two. I called aloud with the full strength of my



After a pause, Dalyer spoke again: " I intend to have an answer. If you don't speak up before I say 'three,' I shall fire anyway!"

ungs. The sound of my voice was strangely muffled, even while I was perfectly conscious that I had full possession of my senses.

During all this time the dog had been pressing close against me, trembling like a leaf and shuddering. I laid my hand on his head. It was hot to the touch. I looked down at him. His ears laid back, his eyes protruding and his tongue hanging out, he was the picture of terror . . . such a picture as I hope never to see again. A great, fearless, noble mastiff, utterly abject and cowering like any little cur.

And now the cabin lamps were suddenly extinguished and only a small lamp was left burning on the table. The atmosphere became oppressively hot and a musty, moldy odor pervaded the apartment. In the deepened darkness, I turned to look behind me with an added foreboding. Beneath the door of the stateroom forward I saw a brilliant line of light and, in the same place as before, the wierd shadow of the afternoon, now bent over as though he who cast it there were listening at the door. With my hand still on the mastiff's head, and impelled by some power not my own, I moved toward the shade. My third step placed me directly in front of one of the large leather lounging chairs, so situated as to squarely face the dreadful corner. In this chair I sank, not only involuntarily, but seemingly by compulsion. The dog stood against it, beside me. I laid my hand upon him and felt that he was rigid and strained in every muscle. As I gazed at the shadow it slowly became upright and huge and cast itself clearly upon the door, which immediately swung open without sound. A sensation of almost intolerable pressure came upon me. I felt as though bound with iron or incased in lead. The chair seemed to hold me in a viselike embrace. All power of motion left me. I tried to speak. I was dumb. The silence was awful; my sense of loneliness appalling. My mind, however, was most active and acute. After a moment, every faculty seemed to be concentrated upon what was going on before me.

Under a hanging lamp which shed a brilliant light over the stateroom, I saw within, a short thick-set man, seated on a camp stool beside the berth. His face was in his hands and his head leaned against the partition before him; he seemed asleep, but I could not see that he breathed. Behind him and half turned toward me, I saw one standing who seemed to be the original of the shadow, and who as I looked raised his right arm in the air and dealt the sleeping man a terrible blow at the back of the head with a heavy marlin-spike, crushing his skull like tissue paper. The victim had evidently been killed instantly. Yet no blood followed the stroke and, although the room was brilliantly illuminated, I saw no shadow. The murderer seized the corpse before it fell to the floor, and opening the forward door leading into the between decks space passed out, dragging the body with him, and disappeared in the darkness. In an instant he had returned and as he came toward me into the cabin I again recognized the horrible face of the giant I had seen cross the deck above in the afternoon—the face of the man at whose hand, Dalyer, with unerring aim, had fired in the open porthole a little while before! I sat transfixed, but followed him with my eyes. He entered the apartment and I saw him extend his hand and take from the bunk, where he might have been sitting a few minutes earlier, what appeared to me a carpenter's chisel or a screw driver. With this he again vanished into the darkness between decks.

Simultaneously the forward door of the stateroom closed behind him, the light within went out and the lamps in the cabin were restored to brilliancy, while the doors in the porthole, skylight and companion hatch were, I felt, reopened. My hand being still upon the dog I perceived a tremor or shudder pass through his entire frame, and, with a deep sigh, he instantly dashed from the cabin to the deck. I heard Dalyer's voice call loudly, "Bob! Bob!" and then a splash in the silent sea.

Freed from the terrible pressure, I then arose blindly to make my own way to the deck from the pressing atmosphere of the cabin; the walls and furniture seemed to whirl and spin around and around me—and I remembered no more. . . .

When I recovered consciousness I was again seated in the heavy chair. The cabin was cool and there was an odor of brandy about. Dalyer was standing over me, with his hand on my forehead. I heard the tramp of feet on the deck above. I looked at my watch, which I had laid open on the table a couple of hours earlier, and it told me that I had been in the cabin alone with the dog ten minutes at the most.

From my companion I learned that after leaving me he had called the forward watch and one of the men from the deck house and searched fruitlessly for trace of the man of the porthole. As he had approached the companionway the dog had dashed from it, foaming at the mouth and, in his madness, leaped into the sea. Every effort was made to save him, but we never saw the poor animal again.

During the next hour I related to Dalyer what I had seen in the cabin and we agreed that whatever the power that was exhibiting itself aboard the brigantine—whether human or superhuman, natural or supernatural, it was one that we certainly could not account for, try as we might.

We discussed the pros and cons of the situation, Dalyer finally remarking, "It must have been something in the nature of an intuition that made me send for my friend at the Lisbon police headquarters. In view of what has happened, no doubt he will find his visit very interesting."

Hardly had the words left his mouth when I discerned the light of an approaching vessel, scarcely a quarter-mile away. She was making toward us under full head, throwing spray high into the air. It proved to be the expected detective and in a few minutes later he was seated comfortably at my right, asking for full particulars of everything that had transpired. I gave them to him approximately as I have set them down here. When I had concluded and he had offered no comment, Dalyer asked him if he didn't want to immediately visit the brigantine. He replied that he would rather postpone his visit until daylight; he preferred just then to turn in for a few hours' needed rest.

Breakfast was served early the next morning and Archie, who had been informed of the arrival of a guest during the night, must have made a special effort to please, for the victuals were exceptionally fine. Mr. Hawkes, which was the name the detective had announced as his official designation for the present, remarked in the most casual manner imaginable toward the end of the meal, that he would like to see the cook who had prepared that meal. Dalyer sent for Archie, who entered the cabin solemnly and stood motionless in the doorway.

"My good friend, Mr. Hawkes," the owner said, "has been so pleased with our breakfast, Archie, that he wished to especially compliment you."

"Which I now do; and heartily," interposed the detective; "it's many a long day since my palate has known the taste of distinctive and delightful flavorings such as these; yes, half a dozen years have elapsed—fully that; for it must have been when I was in Rajputana, in the Arvalli Range——"

"Das where me come from," offered Archie, with a pleased gleam in his eye.

"Yes, I thought so," returned the detective significantly, yet with scarcely any perceptible change in his voice or manner.

Archie was dismissed a few moments later, following the exchange of a few banal compliments. When he had gone Hawkes arose from the table saying, "If I am not mistaken, right there is the key to the mystery. I will have a longer and private talk with him later." And totally disregarding the curiosity which was plainly written on our faces he announced that he was now prepared to make his inspection of the brigantine. Examination was first made of the room in which had occurred my hair-raising experience of the night before. Then the between decks space forward was inspected, but nothing was revealed so far as Dalyer and myself were concerned. At the edge of the porthole, however, at the spot where the hand had been, we found a bullet from a revolver buried in the wood.

By this time the seamen had got an inkling of the character of the ship, but as none of them had actually seen anything or, strange to say, had not heard the shot, Dalyer's good sense and firmness of manner triumphed over their superstition.

The stains on the old cutlass and on the vessel's rail were next examined by the detective. He studied them carefully through a glass for many minutes, looking at them from various angles; then he suddenly whipped out a little phial, sprinkled a few drops, and an instant later announced, "They are *not* blood stains."

Then I accompanied the detective below, for the purpose of pointing out the movement of what he termed the "phantom" murderer, although I repeatedly insisted that he seemed no less real flesh and blood than myself. Hawkes subjected me to an ingenious cross-examination concerning the chisel or screw driver for which the assassin had returned after the murder. On my remaining firm in my conviction as to what the tool appeared to be, he announced that he would confine further examination to the fatal stateroom and the between decks space forward, his object being to discover some evidence of the use for such tool, to the appearance of which he attached the greatest importance. I will not attempt to describe how infinitely carefully and patiently this search was pursued, but some idea of it may be had when I say that at least ten minutes was spent over each lineal inch. Hours had passed when, at a point but a few feet distant from the stateroom, he found a narrow strip of oak about an inch in thickness and five feet in length, projecting by its thickness beyond the smooth surface of the vessel's inner shell, less than the proverbial hair's breadth. The same careful scrutiny revealed that it had been fixed in its place by means of five screws, apparently of brass, as the heads were incrusted with bright green rust or mold. Hawkes immediately dispatched me for a screw driver and when I returned he removed the strip. We discovered that the strip had been affixed over the perpendicular succession of the joints of the narrow points of the vessel's interior hull, which sprung out as they were released far enough for the detective to insert his fingers behind them. We tugged and wrenched together until they came off. Then, to my horror, we found wedged in the inner space a grinning skeleton of a man, upon which hung shreds of clothing. As this skeleton was lifted out, something dropped to the deck with a metallic sound and rolled to my feet. I stooped and picked it up. It was a plain band of gold—a ring. On the inside was engraved "From B. A. to H. T." The clothing of the unfortunate man appeared to have been partially eaten by rats. At the time it flashed on me that it was a fortunate thing this had not been entirely destroyed, as the ring, which had been retained in one of the folds, would long before have slipped from the bony finger to the bottom of the hold and, perhaps, have rendered positive identification impossible. The skeleton was clean, dry and white, and on further examination we found that the back of the skull had been fractured; apparently by a blow from a club!

Hawkes closed and bolted the door leading into the between decks section and ordering that a guard be placed in the stateroom leading to it and permit no one to pass until he returned. Then he disappeared.

I learned later that he had gone over to the yacht and had a long talk with Archie, the Indian cook.

Some time later I returned to the cabin of the brigantine; there I found Hawkes absorbed in the log book and covering some sheets of paper at his side with unintelligible memoranda. I stood there quietly for quite a time, and so absorbed was he in his task that I figured he did not know of my presence; but suddenly and without as much as a flicker of an eyebrow he said: "Mr. Harper, please send out this message broadcast—a C Q, you know," and as I turned to leave: "Stay by your instruments, please, and when you get a reply such as I am looking for send the yacht's dinghy over for me immediately, please. I think I have our nice little mystery cleared up."

He dismissed me with a nod.

Arrived aboard the yacht, I told Dalyer of my instructions and so interested was he that he came and sat beside me in the wireless cabin. The message given to me by the detective was but a brief and universal inquiry as to whether any ships within range had picked up survivors of the crew of the Ionia. I sent this out broadcast, and one by one the replies came that no such crew had been found; then finally the word for which I was waiting came from a tramp steamer. From the deck of the yacht I megaphoned of my success and, a few minutes later, the great police detective was at my side.

"Where are they?" he inquired. And when I informed him that the vessel was then nearing Gibraltar, he grunted: "Never mind them then, just now; get this message off, please." He sat down and scribbled off a twenty-word marconigram. "It is to the Special Police Agent at Lisbon," he volunteered, as he handed the message to me. "If the cables are in working order to-day we should have a reply in less than half an hour. Then I may have something interesting to tell you."

In less than the time prescribed I heard C R F calling me. I took down a message in cipher. There were only three words

I could distinguish; "Portland" and "Henry Tait," although there were several hundred words in all. Hawkes excused himself for a few minutes when I gave him the message, presumably to decipher it. Then he called us into the cabin and, with a slow smile, announced: "Gentlemen, allow me to relate the strange story of the mystery aboard the Ionia."

"First of all, although I have unearthed a murder, the rest of the crew was not made way with by wholesale butchery. The corpse, I have every reason to believe, is that of the brigantine's captain, Henry Tait—corresponding to the H. T. initials in the ring. This, my agent informs me, was the name of the captain of the Ionia. The man was murdered by a powerful Swede or Norwegian—my advisers tell me there were several such in the crew—and the murderer was undoubtedly insane. Somehow he must have later taken posession of the ship; which I think will account for the desertion of the crew. Unfortunately, I expect to find that this was not accomplished before other fatalities had taken place. . . . And, gentlemen, I think that will be about all for the present. I presume, Mr. Dalyer, you will hold to your purpose of taking the brigantine to Gibraltar, there to turn her over to the Vice Admiralty Court; and if you feel that you can leave things in charge of your captain and accompany me on my boat, I shall be more than pleased to arrange for you and Mr. Harper to be present when I interview the surviving members of the Ionia's crew, who will arrive in port about the same time we will."

This proposition appealed to my employer and he very graciously included me, as suggested by the detective.

Nothing further could be learned from Hawkes, although we both tried every artifice at our command to make him talk. Once aboard his own rakish craft, he turned in for what he termed: "A well earned snooze, after a fairly strenuous day."

The next day proved even more interesting than we expected, for, from the mouth of Mr. Riggs, recent mate of the Ionia, we heard this verification and amplification of the detective's theory:

"The brigantine was built for Horn & Weeks, about two years ago, at Portland, Me. Including her present voyage, she had made four in all. The first ones were long and on neither of them did anything out of the ordinary run occur. Captain Henry Tait had been in the Company's employ for many years and had commanded the same vessel on her three preceding voyages.

"Among her crew was a Swede or Norwegian by the name of Stefan, a gigantic, ill-favored fellow, who had been injured in our service some time before by a fall from the rigging, in which he sustained a severe concussion of the brain. For several months he lay in the hospital in what was believed to be a hopeless condition of imbecility; but finally, having recovered or apparently recovered, he applied for and secured a berth on the Ionia.

"About the eighth day out from New York, Stefan developed symptoms of a relapse of his disease, which seemed, however to affect his mind only with a sort of intermittent stupor. He exhibited no signs of mania or violence and was capable of performing his light duties about half of the time. Consequently he was not confined and the master did what he could for him, treating him with the utmost kindness and advising him to lay off from his work. This he did for several days, but apparently without beneficial effect.

"On the night of April 5, Captain Tait turned in at eight bells (12 o'clock). The weather was clear, the wind over the port quarter and the moon lighted up the deck. The vessel was then about latitude 38 degrees north; longitude 17 degrees west; near the point at which you gentlemen picked her up. Just before two bells (one o'clock) the man at the wheel saw Stefan, whom he recognized by his great size, cross the deck amidship to the starboard rail, and throw something into the sea. On being hailed by this man, Stefan went aft and said that he had thrown a pair of old shoes overboard. He was in his stocking feet.

"In the morning, the master failed to appear and, after waiting a reasonable time, the steward knocked at his door. Receiving no response, he called me and I entered the stateroom and found it empty; the berth had not been occupied. When, after a search, it became evident that the captain could not be found, Miller, the man who had taken the wheel at midnight, told the mate of Stefan's appearance and his conversation with him.

The Swede was sent for and found in his bunk, apparently sleeping. He was aroused and brought on deck in a very excited condition and, when I questioned him, he became incoherent and violent. I ordered two of the men to seize him and, as they approached to do so, he eluded them and scrambled up the ratlines. It seemed clear that in a fit of insanity, he had murdered the captain and thrown his body into the sea, during the night. How this was accomplished, no one knew, for no noise was heard nor were there any traces of violence found about the vessel. Just at this time a sharp blow came up and we had all we could do to manage the vessel. The Swede was forgotten in the excitement and it was only after the wind had subsided, perhaps an hour later, when we were forcibly reminded of his presence. It seems that while we were engrossed in handling the vessel, the maniac had searched her from stem to stern and gathered up every single firearm on board. Our first intimation of our perilous situation came with the crack of a pistol aft. The man at the wheel dropped. Stefan, with a howl of joy, grasped the wheel and swung her over to the opposite tack. As a man, the whole crew rushed aft to take away the wheel from him. Three shots rang out in quick succession and three men dropped.

"Then we resorted to strategy. All through a horrible night we tried, time and time again, to steal upon him unawares. When morning came two more lives had been sacrificed and nothing accomplished. As the day advanced, the seaman's wild cries became wilder and he joyously shot two or three holes through the topsail. We were helpless. I had my wife and my little six-year-old girl aboard, and after several hours of deliberation, it was decided that the only safe course would be to take to the small boats, leaving the big Swede in full possession.

"This was done, as you know and—well, here we are."

"While your man Stefan, the cause of all the trouble, lies at the bottom of the sea," added Hawkes, quietly.

"How do you know that?" asked Riggs.

"Oh, it's very simple. There are certain marks . . . but there now, that is a professional secret."

* * *

We three, the detective, Dalyer and myself, dined together again that evening. Both my rich young employer and myself had not recovered from our astonishment that the mate's story should tally in every respect with the theoretical outline of the strange occurrences given by Mr. Hawkes aboard the yacht the preceding night. And, as you can well imagine, we were consumed with curiosity to learn how these able deductions had been made.

Dalyer finally said:

"Mr. Hawkes, it is no doubt quite evident to you that Mr. Harper and myself are only too willing to play Dr. Watson, if you will kindly assume the rôle of Sherlock Holmes and, true to character, reveal the interesting processes by which you solved the mystery of the Ionia."

The detective smiled. "That, my dear Dr. Watson-Dalyer, is only done in story books. It is really not ethical and, as I am in the Government Service, I fear you will have to bespeak permission from my superiors to read the official report, when I have delivered it."

"That, I presume, is next to impossible?" drawled Dalyer.

The detective did not answer. A slight elevation of one eyebrow and the almost imperceptible shrug vouchsafed might have meant any of a dozen things.

"But can't you give us some inkling?" Dalyer persisted. "For instance, how did you know that this madman had sailed the boat after the murder? I imagine, of course, that there was some indication of the identity of the murderer, but I'm blessed if I see how you learned of his possession of the vessel."

"I see you gentlemen are not to be set aside," said the detective, "but if you will give me immunity from further questioning, I will satisfy you on this one point." We nodded assent and he continued: "One of the first things I examined when I arrived aboard the yacht were her charts, which showed that you had boarded the derelict at latitude 38° 20′ north, longitude 17 15′ west. Then, aboard the brigantine, I found her log book in its proper place, but her chronometer, manifest and bills of lading were missing. The log showed the last day's work of the vessel had been on the twenty-fourth of March, sea time, when the weather allowed an observation to be taken that placed her in latitude 36° 56′

north; longitude 27° 20′ west. The entries on her slate log were, however, carried down to eight o'clock on the morning of the twenty-fifth, at which hour she had passed from west to east to the north of the island of St. Mary's, in the Azores, the eastern point of which then bore S-S. W., six miles distant. Now, the distance in longitude from the island of St. Mary's to the point at which you fell in with the Ionia is 7° 54′; the corrected distance of latitude from the position last indicated in the log is 1° 18′ north; and the brigantine had apparently held on her course for ten days after the twenty-fifth of March, the wheel being loose all the time. But during the period from the twenty-fifth of March to the fifth of April the wind had been more or less from the north continuously, and it appeared to me impossible that the derelict could have covered within that time a distance of 7° 54′ east; at any rate on the starboard tack. The obvious inference was, therefore, that she had not been abandoned until several days after the last entry made in the log."

This, to us, was astonishing in its simplicity. Still, it was readily seen that here was but one of a thousand details that must have entered into the solution of the problem, and it merely whetted our appetites for further revelations. Perhaps we would have learned more had it not been for a chance remark I dropped. This was to the effect that the solution quite remarkably dovetailed with what I had seen in my vision, dream, or whatever it could be termed.

"That, my dear Mr. Harper," said the detective, "gave me the key to the situation. The rest was simple."

Now, while my experience had been very real to me, I was amazed at hearing that the detective had taken my story so seriously at first. It was evident that he had, for the discovery of the skeleton hinged directly upon the cross-examination he had subjected me to in the cabin of the brigantine. I felt that, under the same conditions, I personally would not have taken the unsupported word of a stranger, should one have related to me what would ordinarily be termed a ghost story. I said so.

"I didn't take the account of your experience so seriously at the very beginning, Mr. Harper," explained the detective, "although I tried not to show any skepticism. My conviction that it would prove the key to the whole situation was born at the breakfast table. The presence of the Indian servant you call Archie made many things clear."

"What in the world has Archie to do with this?" I exclaimed.

"You have Archie to thank for your vision, or whatever you care to term it—*that* I learned at the breakfast table. You see the business of being a detective makes one observant of trivial things; for instance, the unique flavoring of the very delightful meals served aboard Mr. Dalyer's yacht. You had already related an experience which bordered on the supernatural, and therefore it was plain to me I must look for a reason for this mental disturbance or brain excitation. Once given the effect, we must search for the cause; and had you any knowledge of Indian drugs, the mere presence of Archie fairly shouted a clue."

I started from my seat. "Well, of all the—er—dirty——"

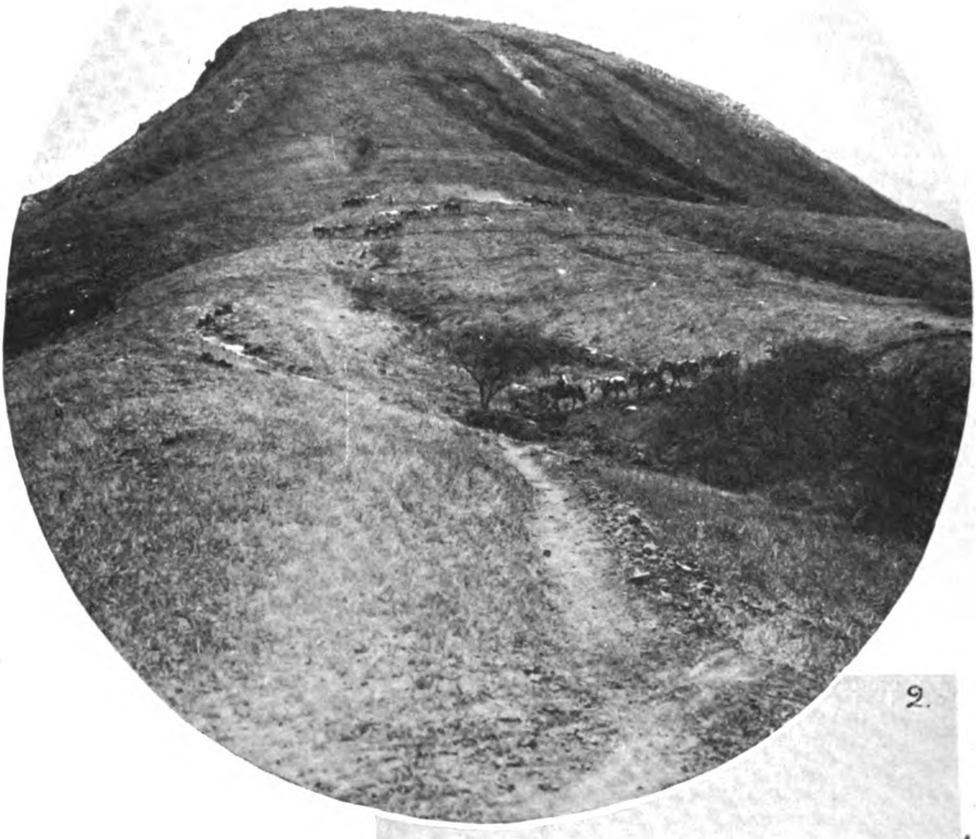
"Whoa! Nothing to get excited about, Mr. Harper," the detective broke in. "It was a perfectly harmless drug that Archie administered to both you and Mr. Dalyer and you really have something to thank him for. It isn't often, in these days, that two young men like yourselves undergo such an unusual experience. Rather savors of the times of the buccaneers, eh? But it was unfortunate, wasn't it, that Mr. Dalyer lost such a fine animal as I understood the dog Bob to be? . . . But then, no matter how great the pet, one should make it a rule not to feed animals at the table."

That was the last word that came from the lips of the detective on the subject.

I have set down all I know about the strange occurrences aboard the Ionia and detailed my part faithfully and without exaggeration. To this day I cannot account for many things, and have not here attempted to. My sole intention has been to report without flourishes an unusual experience, solely for your entertainment. My success or failure rests solely upon how seriously you consider what I have written here and your knowledge of the innocuous effects of the resinous matter exuding from the tender sprouts of *Cannais indica*, and other Indian plants.

The Marconi Trans-Oceanic

1.



2.

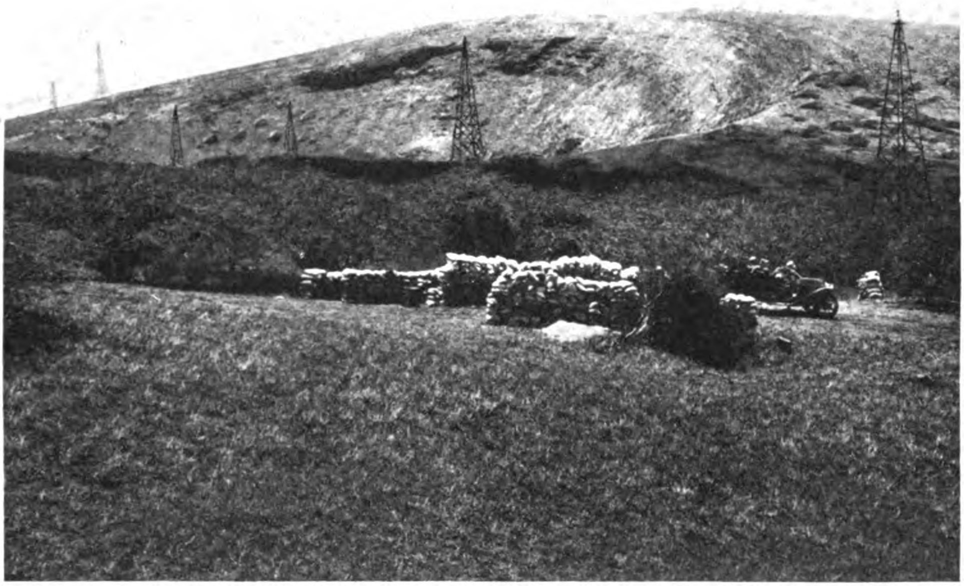
(1) *Looking up Koko Crater with a view of the trail and pack animals descending*

(2) *The line of masts, balancing line towers, water tower, lighting plant and hotel, seen from the foot of the trail*

(3) *Six of the balancing line towers and the rock and sand stores at the base of the crater*

Station at Koko Head, Hawaii

3.



2.

The Year Book for 1914

WHAT you don't know about wireless will be found in "The Year Book of Wireless Telegraphy and Telephony" for 1914, published by the Marconi Publishing Corporation. This volume is a veritable wonder book, for it contains knowledge which even the best informed wireless men will be glad to avail themselves of.

It is safe to say that you, for instance, do not know the locations of all the principal wireless telegraph stations of the world. In the Year Book you will find a complete list of installations. You may be interested in the International Convention on Safety of Life at Sea. If you are you will be gratified to find the proceedings of this important assemblage published in detail. And there are a thousand and one matters—some big and some small—but all of vital interest to the wireless man which he can find out about and study by means of this volume.

As wireless grows the Year Book develops correspondingly. This is attested by the fact that there are 745 pages in the Year Book for 1914—approximately 200 more than there were in the volume for 1913. The object of the Year Book is to place at the disposal of the reader all of the information available concerning wireless in such a way that he will be able to obtain it without difficulty or the expenditure of useless effort. This information covers a multitude of subjects, including the wireless stations of the world, the rates for all messages, the laws and regulations concerning wireless telegraphy and the progress of experimental work.

One of the first features that strikes the eye is the "Record of the Development of Wireless Telegraphy." This epitomizes the history of wireless telegraphy from the time in 1831 when Michael Faraday discovered electromagnetic induction between two entirely separate circuits to 1913 when Marconi portable sets were used in the second Balkan war.

This part of the record appears under the heading 1913:

"The Roumanian Army during the second Balkan war was equipped with seven Marconi portable sets which ensured regular radio telegraphic communications between the headquarters and various Roumanian commanders in the field."

The record covers eighteen pages.

Every person interested in wireless telegraphy will be eager to know all about the laws and regulations governing the art. The articles of the International Radio Telegraphic Convention held in London, July 5th, 1913, are published in full, covering thirty-four pages. They are accompanied by an appendix containing abbreviations.

The following quotation is from the text of the law governing the transmission of messages:

"Ships in distress shall make use of the following signal, . . . — — — . . . repeated at short intervals, followed by the necessary particulars.

"As soon as a station hears the signal of distress it must suspend all correspondence and must not resume the same until after it has made sure that the communication consequent upon the call for help is finished.

"The stations which hear a call of distress must act according to indications given by the ship which makes the call with regard to the order of messages or their cessation.

"When at the end of a series of distress calls there is added the call signal of the particular station, the reply to the call is proper to that station only, unless that station does not reply. Failing the indication of a particular station in the call for help every station that hears the call shall be bound to reply thereto."

Twenty-five pages are devoted to the proceedings of the International Convention on Safety of Life at Sea held in London on January 20, 1914. The results of the convention are published in detail. The Convention contains seventy-four articles, all of which cannot fail to interest the followers of wireless.

Take Article 8 on page 77:

"The master of every ship which meets with dangerous ice or a dangerous derelict is bound to communicate the information by all the means of communication at his disposal to the ships in the vicinity, and also to the competent authorities at the first point of the coast with which he can communicate.

"Every Administration which receives intelligence of dangerous ice or a dangerous derelict shall take all steps which it thinks necessary for bringing the information to the knowledge of those concerned and for communicating it to the other Administrations.

"The transmission of messages respecting ice and derelicts is free of cost to the ships concerned."

Article 37 prescribes:

"Every master of a ship who receives a call for assistance from a vessel in distress is bound to proceed to the assistance of the persons in distress.

"Every master of a vessel in distress has the right to requisition from among the ships which answer his call for assistance the ship or ships which he considers best able to render him assistance, but he must exercise this right only after consultation, so far as may be possible with the masters of those ships. Such ships are then bound to comply immediately with the requisition by proceeding with all speed to the assistance of the persons in distress.

"The masters of the ships which are required to render assistance are released from this obligation as soon as the master or masters requisitioned have made known that they will comply with the requisition, or as soon as the master of one of the ships which has reached the scene of the casualty has made known to them that their assistance is no longer necessary.

"If the master of a ship is unable, or considers it unreasonable or unnecessary, in the special circumstances of the case, to go to the assistance of the vessel in distress, he must immediately inform the master of the vessel in distress accordingly. Moreover, he must enter in his log book the reason justifying his action.

"The above provisions do not prejudice the International Convention for the unification of certain rules with respect to Assistance and Salvage at Sea, signed at Brussels on September 23rd, 1910, and, in particular, the obligation to render assistance laid down in Article II of that Convention."

The Convention is divided into chapters covering navigation, radio telegraphy, life-saving appliances and fire protection, ice and derelicts, and meteorological information. Codes and examples of messages are given.

Following the London Convention are found the wireless regulations and laws of all countries, from the Argentine Republic to Uruguay, arranged in alphabetical order. The text of these laws occupies 177 pages.

What is probably the most useful feature of the book is the list of wireless telegraph stations of the world to be used in connection with the map issued with the volume. The stations have been arranged under the names of the countries in which they are located and the latter have been placed in alphabetical order. This serves to obviate any difficulties in finding the location of stations. Private stations, or those which were constructed for experimental purposes are not generally included in the list.

Virginia Beach, for example, is given in the list of land stations in the United States. A reference note shows that the station transmits weather reports daily at 8 A. M. Its geographical position is given as Virginia, entrance of Chesapeake Bay, 75° 58′ 58″ W. and 36° 50′ 36″ N. Its call signal is WSY and its range 150 nautical miles. The station is controlled by the Marconi Company and has a wave-length ranging from 300 to 600 metres. It is used for general public correspondence and has continuous service.

The Arlington (Va.) station, as shown in the list, has a geographical position near Washington, D. C., 77° 04′ 47^{20}″ W., 38° 52′ 05^{20}″ N. Its call signal is NNA. It has a range of 1,000 nautical miles, is controlled by the United States Navy and has a wave-length of 2,500 meters. The nature of its service, which is continuous, is official correspondence.

A reference note declares that "The station sends time-signals for five minutes on wave-length of 2,500 meters commencing at 11.55 A. M. and 9.55 P. M. every day, Sundays and holidays included. Final signals at 12 noon and 10 P. M. (time of the meridian 75° west of Greenwich). Every tick of the standard clock of the Naval Observatory, Washington, is transmitted as a dot, omitting the 29th second of each minute, the last five seconds of each of the four minutes, and finally the last ten seconds of the last minute. The 12 noon and 10 P. M. signal is a dash."

Sixty-five pages are devoted to this list. The compilers of the volume have worked to good purpose in giving the combination of letters belonging to the various countries. Great Britain, it is shown, has all combinations commencing with B, G and M. The United States has all combinations of letters commencing with N and W, as well as the combinations KIA to KZZ.

Another valuable feature of the book is the list of the ship stations of the various countries, giving their call signals, range in nautical miles, the steamship lines to which they belong, the wave-lengths, the nature of the service performed, the hours of service and the charge for sending messages. One hundred and forty-five pages are given up to this subject.

A list of call letters of the land and ship stations, alphabetically arranged, will undoubtedly meet with the favor of readers. It occupies thirty-four pages.

Other noteworthy features of the book include "Waves and Wave Motion," by J. A. Fleming, M. A., D. Sc., F. R. S.; "The Function of the Atmosphere in Transmission," by J. Erskine-Murray, D. Sc.; "The Measurements of the Strength of Wireless Signals," by E. W. Marchant, D. Sc., M. I., E. E.; David Jardine, Professor of Electrical Engineering in the University of Liverpool; "Problems of Wireless Telephony," by C. E. Prince; "Wireless Telegraphy in the Merchant Service," by G. E. Turnbull; "Wireless and Life-Saving," "The Application of Wireless Telegraphy to Meteorology," by R. G. K. Lempfert, M. A., Superintendent of the Forecast Division of the Meteorological Office; "Wireless Time Signals and Longitudes," by Arthur R. Hinks, M. A., F. R. S., assistant Secretary of the Royal Geographical Society; "International Time and Weather Signals;" "Radio-Telegraphic Investigations" and work of the British Association Committee, by W. Eccles, D. Sc., Secretary to the Committee.

Included in the book also are useful formulae and equations, a glossary of terms, a dictionary of technical terms, useful data, comprising tables showing the length of a degree in latitude and longitude and other valuable information; a list of wireless patents, a list of the companies engaged in the commercial development of wireless, biographical notices, literature of wireless telegraphy and telephony and a directory of wireless societies.

The features mentioned in this review do not include by any means all of those in the book. There are handsome illustrations—thirty-two in all—some of which are photographs of stations and apparatus and others of men identified with wireless. The volume is tastefully bound in buckram. The price is one dollar.

In conclusion it may be said that the wireless man who once looks between the covers of the Year Book will always have one at hand, for he will depend upon it for information concerning all phases of the art.

EXPANSION OF WIRELESS IN THE BRITISH EMPIRE

Apart from the Imperial Wireless Chain, there are many schemes of wireless communication now being carried out in various parts of the British Empire.

The most important relates to radio communication, between London and the Eastern Colonies, Australia, New Zealand and the Pacific. The Australian Government has decided to offer greater inducements to the public to utilize the stations by reducing the charge for messages for coastal vessels from 20c to 12c per word, and by inaugurating a scheme for furnishing persons at sea with a daily record of current news items.

In regard to the Pacific, it has been decided, in addition to the high power stations in Australia and New Zealand, that medium power stations shall be erected in Fiji, Ocean Island, Solomons and New Hebrides. The total cost of these is estimated at $210,000, of which the British Government bears more than half.

Substantial progress has been made in India and stations will be erected in British Borneo and British Guiana, in addition to those already sanctioned for Ceylon, the Straits Settlements, the Federated Malay States and Hong Kong.

INSTRUCTION TO BOY SCOUTS

By A. B. COLE

CHAPTER XII

A Transmitting Set for Station Use

THIS transmitting set is designed to operate on an electric lighting circuit of from 100 to 125 volts, 60 cycles. Alternating current circuits of 60 cycles frequency are the ones most generally available.

The set is mounted on a panel, in the same manner as the receiving set described in Chapter XI, and for the same reasons.

The Transformer

The transformer used to generate the high voltage currents for transmission is that described in the November, 1913, issue of THE WIRELESS AGE. It is rated at ¼ k. w., and in connection with the rest of the set and a good aerial will enable communication to be maintained over a sufficient distance to meet all requirements of any Scout troop. The radius of operation of a set depends on so many factors, of which the size and construction of the aerial is one of the most important, that any attempt to state a definite transmitting distance is always only an estimate, but a ¼ k. w. set, properly tuned, is generally found in practice to be capable of covering from 25 to 50 miles over level land or water under ordinary weather conditions.

The Spark Gap

The use of a rotary spark gap improves the efficiency and radius so much over that of a plain gap that no modern station is considered complete without one. A rotary gap consists of a disk with a number of spark electrodes, driven by an electric motor, and revolving between two stationary electrodes, so that where a single spark might pass with a plain gap, a

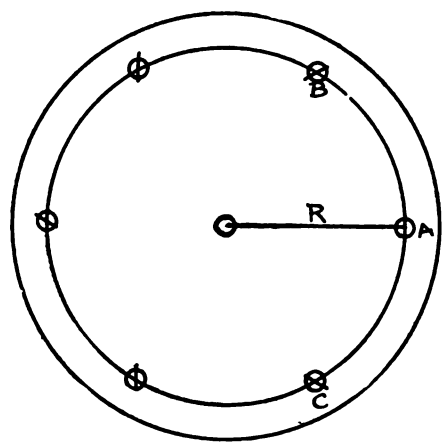


Fig. 73.—Spacing the electrodes

large number occur on account of the high speed of rotation of the rotary gap disk and electrodes.

Two types of motor may be used in the construction of the gap. One to operate on the electric light circuit, and the other to be driven by battery power. The motor need be only a small one, but should be able to carry the disk at a speed of from 3,500 to 5,000 revolutions per minute. When a small 110-volt motor is used to drive the gap, however, there is always

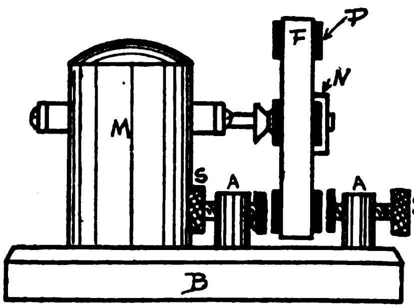


Fig. 74.—Rotary spark gap

danger of burning out the windings on account of the high voltage currents which are induced in the lighting circuit by the transmitting apparatus, and these are liable to cause much trouble in the motor, even if a line protector is employed to prevent it.

It is therefore suggested that a battery type motor, wound for 4 or 6 volts, be chosen, as this will eliminate all chance of trouble. Such a motor consumes little current, and since it is used only while the operator is transmitting, a set of dry cells or a storage battery will give long service at low expense while operating it.

The disk of the gap is of hard rubber, ¼ of an inch thick and four inches in diameter. Six holes are drilled ⅜ of an inch from the edge at equal distances apart for the spark electrodes, as shown in Fig. 73. In order to do this accurately, a circle having a radius R of 1⅝ inches is drawn on the disk, and starting at any point on the circumference of the circle, such as A, with a compass set at the distance R, arcs are described, cutting the circumference at points B and C. Then taking these two points as centers, the same procedure is followed until the six points are found, at which holes ⅛ of an inch in diameter are drilled for the electrodes.

The electrodes are made from the machine screws used in the carbon posts of dry cells, filed off to the proper length, and held in place by the nuts drawn up tightly against the hard rubber disk. On account of the high speed of rotation, these nuts must be as tight as possible.

The motor shaft is threaded next and to accommodate it a hole is drilled exactly in the center of the disk. In case the motor has no pulley, a nut must be put on each side of the disk. It is essential that the motor revolve anti-clockwise, that is, opposite to the direction of movement of the hands of a clock, looking at it from the end on which the disk is placed, as otherwise the nuts would come loose and the disk would fly off. If the motor does not revolve in this direction it will only be necessary to reverse the armature connections, so that the current will flow in the opposite direction in the armature, but in the same direction in the field winding.

Since the set is mounted on a panel, no base is required for the spark gap. The stationary electrodes are the same as those of a plain gap, ⅜ of an inch in diameter, on brass rods passing through binding posts, arranged with hard rubber or fiber knobs for adjusting the length of the spark. They are mounted as shown in Fig. 74, so that when an electrode on the disk passes between them, the spark passes from one to the moving electrode,

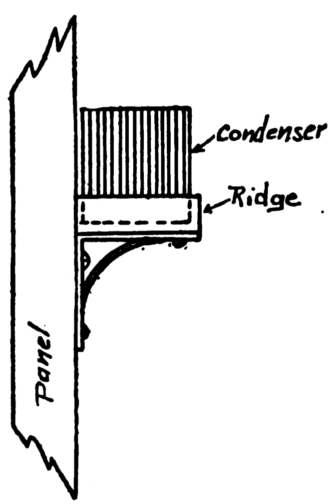


Fig. 75.—Shelf for condenser

and back to the other stationary electrode, giving a double spark. The terminals of the stationary electrodes should be preferably of zinc.

The transmitting condenser is made of glass plates and tinfoil sheets in the manner described in the May issue. The glass plates are 21 in number, and measure 9 by 7 inches. The foil sheets are 7 by 5 inches, and have a connection lug at one end, as in that previously mentioned.

The condenser is made into a solid unit by means of two strips of tape, wound several times around the plates. When finished it is supported from the back of the panel by means of a bracket holding a small wooden shelf, around the edge of which is a ridge 2 inches high, as in Fig. 75, into which the condenser fits closely. The purpose of the ridge is to hold the condenser in place.

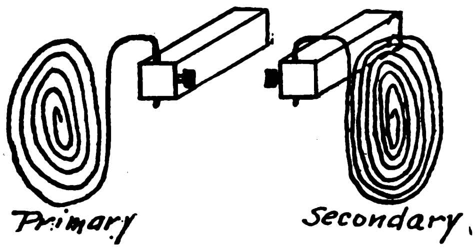


Fig. 76.—Oscillation transformer

The Key

A good wireless key should be purchased, as the cost is low, and a well balanced key cannot be built easily with ordinary tools. It should be capable of breaking at least 5 amperes at 110 volts.

The Oscillation Transformer

A very simple and easily constructed oscillation transformer is used with this set. It consists of two spirals of No. 6 copper or aluminum wire which are readily shaped by hand. The primary spiral has six turns, the smallest being 4 inches in diameter and the largest 9 inches. The secondary has 9 turns, the smallest 3 inches and the largest 11 inches in diameter. The outer ends of the spirals are bent, as shown in Fig. 76, and pass through two large binding posts, A B, for support. They may be turned from one side to the other quickly, so that this arrangement provides ready means of changing the "coupling" between them.

Two clips are needed, one for the primary and one for the secondary. A good form of construction is illustrated in Fig. 77, where a hard rubber or fiber rod, H, 3/8 of an inch in diameter and 3/4 of an inch long is slotted to take 2 brass strips, T, bent at one end to accommodate the wire of the windings. These strips are held in place by a binding post, N, with washers, M and L, and this also provides a means of connection for a flexible conductor which passes through the panel.

The binding posts supporting the two windings are set 2½ inches apart on the panel, so that when the spirals are parallel considerable energy will be transferred from the primary to the secondary, but when they are turned apart, the magnetic coupling between them will be "loosened." This arrangement is required by the regulations governing wireless stations. When the proper relative position of the two windings is once found, there will be no need of changing them, and the thumb screws of the binding posts may be set to hold them in place.

The Aerial Switch

Any one of several types of aerial switches now on the market may be used to connect the aerial and ground to the transmitting or to the receiving set, but one built like that illustrated in Fig. 78 is recommended. With this type of switch, the throw is only about 30 degrees, enabling the operator to change quickly from sending to the receiving position or vice versa. The third blade in the center is a short one, and is used to break the primary circuit of the transformer when the blades are in the "up" or receiving position, so that if the key were accidentally depressed the transformer could not be set in operation. The blades of the standard switch are 8 inches long, 3/8 of an

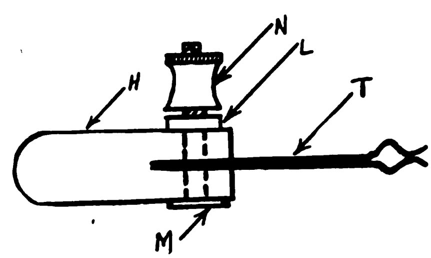


Fig. 77.—Connecting clip

inch wide and 1/16 of an inch thick. The switch jaws and other parts may be taken from a standard switch. The cross bars between the blades are of fiber, and the base is of wood. The vertical block supporting the upper jaws may be of wood or

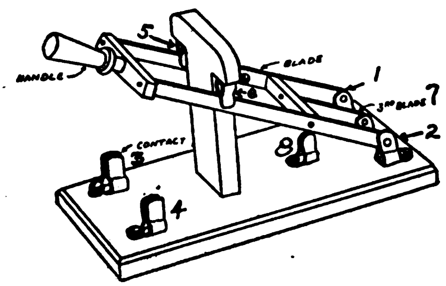


Fig. 78.—Aerial switch

fiber, but the latter is suggested for purposes of better insulation.

The aerial and ground are connected to the hinges, 1 and 2, of the two long blades, and jaws, 3 and 4, are connected to the secondary winding of the oscillation transformer. Jaws 5 and 6 connect with the aerial and ground terminals of the receiving set. These connections are shown in Fig. 82, by these numbers, as possibly some other type of aerial switch may be used by those who build the set.

The Radiation Indicator

It is always desirable to have some indicating device in the station to show comparatively how much energy is being transmitted at any time. In many outfits a hot wire ammeter is used for this purpose and while this is a very satisfactory instrument, a good one is rather expensive; then, too, if left in circuit when the set is being used for transmitting it will reduce the radius of the station to some extent on account of its resistance.

A good and inexpensive type of indicator consists of 40 turns of No. 14 insulated magnet wire wound in a single layer on a cardboard tube 3 inches in diameter. The insulation is scraped off along a line to permit a sliding contact to touch any turn of the wire, so that more or less may be placed in circuit as desired. The ends of the coil are connected across from 6 to 10 feet of the ground wire of the station and a small battery lamp is connected between one end of the coil and the sliding contact, as illustrated in Fig. 79.

When the transmitting set is in operation the lamp will light if the sliding contact is in a position to cut in a sufficient number of the turns of the wire on the coil. To tune the set to greatest radiation, it is simply necessary to adjust the number of turns in use in the primary and secondary windings of the oscillation transformer and change the coupling between them by moving these windings until the lamp of the indicator attains maximum brilliancy. When it becomes too bright for the safety of its filament its intensity is reduced by moving the sliding contact.

This indicator may be left in circuit at all times and will always show whether or not the set is radiating; for if a connection in the set should become broken, the lamp will not light if the outfit is set in operation. The indicator assists materially also in adjusting the spark gap to the best efficiency, since when the spark is "ragged" or of poor quality the lamp of the indicator will flicker.

The Line Protector

In a set of this size it is necessary to employ a line protector on account of the

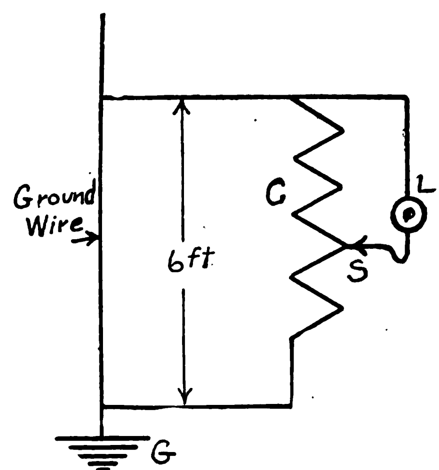


Fig. 79.—Radiation indicator

high voltage currents mentioned. These are set up in the electric light wires due to induction between them and the aerial system. These currents are liable to pass through weak places in the insulation of the wires, carrying with them the lighting current, which may cause much damage. This generally occurs in the fixtures.

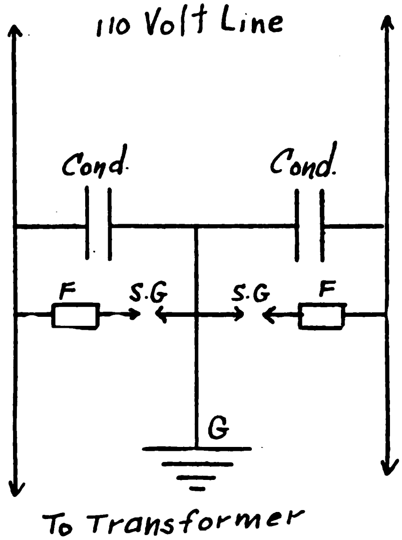


Fig. 80.—*Line protector*

The purpose of the line protector is to offer a shorter path for the high voltage induced currents. It consists of two condensers each of ½ or 1 M. F. capacity, connected in series across the lighting circuit with their common terminal grounded; across these condensers two small spark gaps are connected, in series with 3 ampere fuses, as shown in Fig. 80. The spark gaps are made of pointed brass rods supported in binding posts, and set $\frac{1}{16}$ of an inch apart.

Unless the condensers can permit the high voltage currents to pass through, a spark will appear at one or both of the gaps, and if these are insufficient the fuses will burn out. This happens very seldom, however, and would indicate possibly a path somewhere between the high voltage circuits of the sending set to the lighting line or primary circuit. Of course this should be corrected at once.

It will be noticed that the two small spark gaps are directly across the 110-volt line, and if short-circuited, they would short-circuit this line. If properly adjusted, there will be no difficulty from this source.

In Fig. 81 the set is shown on the panel, and Fig. 82 illustrates the wiring system. All secondary or high tension wires should be of the quality known as "high tension" cable, such as is used in connecting the coils and spark plugs of automobiles or motor boats.

The panel itself may be of wood, but either fiber or hard rubber is recommended. Slate must not be employed, as it is a poor insulator at the high voltages used in this work.

The transformer and condenser are placed in back of the panel, which should be supported from the rear by brackets of large size on account of the weight of the condenser and other apparatus.

The aerial switch may be mounted on the panel if desired, but a better place for it is on the table between the sending and receiving sets, quite close to the key. In Fig. 81, A and G are the aerial and ground terminals of the set, and are connected to jaws 3 and 4 of the aerial switch. The wires for the primary circuit of the transformer are run under the table in loom.

In Figs. 81 and 82 the letters apply to the same instruments and binding posts,

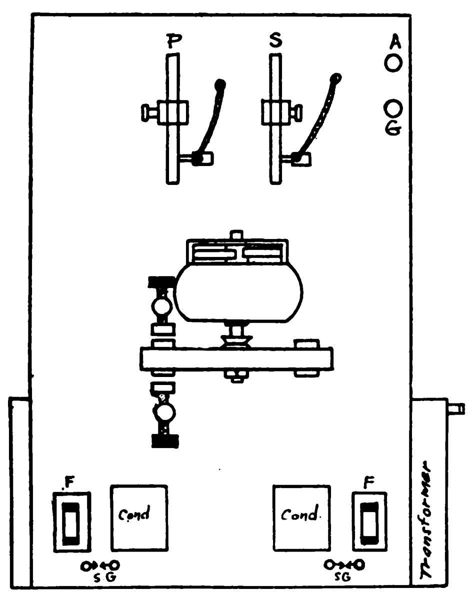


Fig. 81.—*Instruments on panel*

and the numbers apply to those of the same parts of the aerial switch shown in Fig. 78, if this type is used.

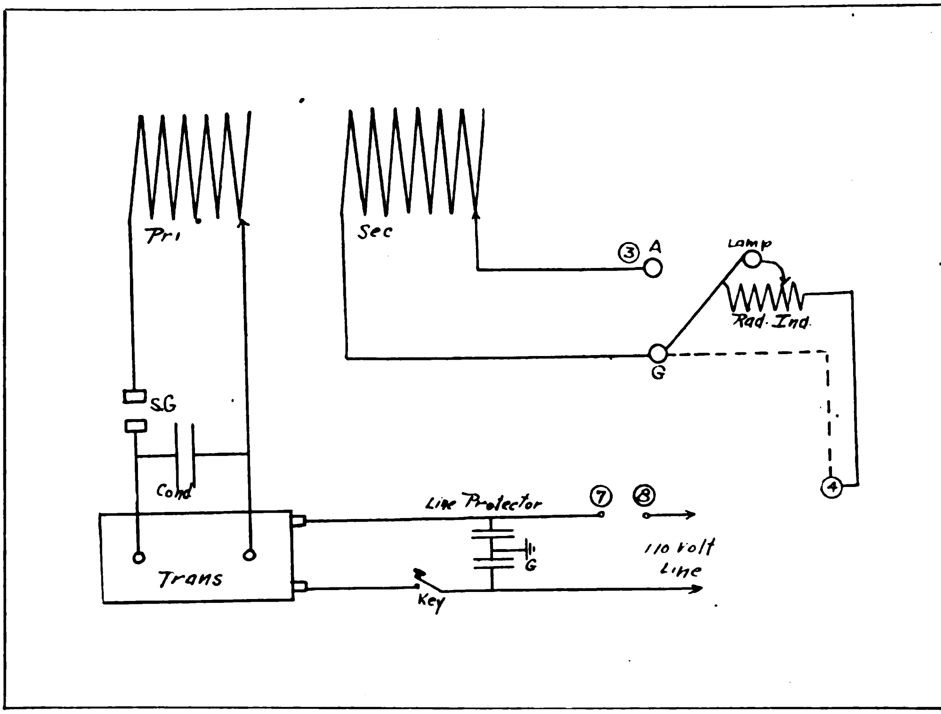


Fig. 82.—Wiring diagram of set

Licenses

The government requires no license to operate a receiving station only, nor for a sending station, except where the range of transmission is beyond the border of the state in which the station is located. In this case a license is required for the station and also one for the operator, for which there is no charge. In this case the station must comply with certain regulations, and must be tuned so that its transmitted wave-length is 200 meters or less. The use of a wave-meter is needed for this purpose, and this can be purchased for $6 or $8, together with full directions for using it, so that little difficulty will be met in tuning the set to the proper wave-length.

Complete information can be obtained concerning licenses by writing to the radio inspector (Dept. of Commerce), governing the district in which the station is located. The various district headquarters are as follows: First district, Boston, Mass.; second district, New York, N. Y.; third district, Baltimore, Md.; fourth district, Savannah, Ga.; fifth district, New Orleans, La.; sixth district, San Francisco, Cal.; seventh district, Seattle, Wash.; eighth district, Cleveland, Ohio; ninth district, Chicago, Ill.

THE END

CAUGHT IN AN ICE FLOE

Malcolm Brainard, of Hartford, Conn., who is chief electrician and wireless operator on the naval tug Potomac, is credited with having walked 150 miles on the ice when the ship was caught in an ice floe off the Banks of Newfoundland and had to be abandoned about six months ago. As soon as the ice broke up he joined the ship, which had not been injured, and is expected to arrive in New York soon.

Comment and Criticism

ONE of our correspondents has found that the Blitzen tuner can be made receptive to the signals from the Arlington station in a simple manner. He has made note of the inquiry in the March issue from C. K. of St. Louis in which the statement is made that with a similar outfit he is unable to receive the time signals from Arlington. We advised that we had studied C. K.'s diagram carefully and found that the connections were correct with the exception that he had the fixed condenser connected in series with the local circuit instead of in shunt to the head telephones. A typographical error was made in our answer. It should have read, "with the exception that the fixed condenser should be connected in shunt to the head telephones not in series."

Now it is plainly evident that if the fixed condenser is connected in series with the head telephones the local battery current cannot flow, and therefore no signals will be received. We are of the opinion that C. K. will have no difficulty in reading Arlington signals in St. Louis, Mo., if he will make this correction in his circuits. Our correspondent describes the results he obtains in the following manner:

I have taken notice of the question asked by C. K. of St. Louis, in the March issue of THE WIRELESS AGE, in which he asks why he does not get the time signals from Arlington, with his Blitzen tuner. I wish to state that I am using a Blitzen tuner and get the time signals almost every night and seldom fail to hear it at 10.55 to 11.00 A.M. Central time.

My aerial is but 80 feet long and 70 feet high. I have been experimenting with loading coils of every kind before using the instruments that I am using at present, but on no occasion did I get the time signals. I then bought two rotary variable condensers from the Clapp Eastham Company. I filled one with castor oil, making the capacity .004 and the other has a capacity of .0008 mf. The oil-filled condenser is connected across the primary of the tuner while the other is connected across the secondary. I use a galena detector connected in series with phones and tuner. A small fixed condenser is shunted across phones. This, however, is not essential. With this arrangement I can receive from stations using waves as high as 3,500 meters. Sayville (WSL), which I think uses a wave between 2,500 and 3,000 meters, can easily be read during severe static. C. B. H.

Generally, better signals are received with the use of a loading coil in the aerial circuit rather than with a variable condenser in shunt to the primary of the receiving tuner. However, the construction of the apparatus may make either one of the methods desirable.

* * *

The use of single wire aerials is still the subject of considerable discussion among our amateur readers, as is evidenced by the following communication, dated from Los Angeles, Calif.:

I note with considerable interest the controversy in regard to the advantages of a long one-wire aerial over a short aerial having several wires, for long distance receiving. The criticism in the March WIRELESS AGE, by "L. M.," "W. W.," and the President of the Talo Wireless Club, of Mr. Dreher's article in the January, 1914, issue of THE WIRELESS AGE surprises me greatly.

I have tried out several short aerials, 100 feet and under, and am now using a one-wire aerial 450 feet long, averaging height 55 feet, having a natural wave-length of 600 meters. I find that I am able to get much greater distances with this long single-wire antenna.

Following are some of the results I have obtained:

NAR (Key West, Fla.), distance from Los Angeles 2,200 miles.

NVP (Unalga, Alaska), distance from Los Angeles 2,500 miles.

KHK (Kahuku, T. H.), distance from Los Angeles 2,000 miles.

NPW (Eureka, Cal.), *daytime*, 650 miles.

Pacific mail liners bound for Japan as far as 3,000 miles.

The above results were obtained using an ordinary loose coupled receiving set and a crystal detector. H. V. R.

The figures speak for themselves. No special comment is required with the exception that it is a well-known fact that better distance work can be done both in transmitting and receiving on the Pacific than on the Atlantic coast.

Another of our readers who formerly criticised C. Dreher, writes. "I give in, and now agree with Mr. Dreher on the desirability of single wire aerials." He then goes on to describe some unusual long distance work he has accomplished which we have not published on account of the lack of verification. He says, "I think the foregoing statements point to the desirability of the single wire aerial," and incidentally makes the statement that he has found the galena detector more sensitive than the audion.

Having no data as to the design of his receiving tuner we can offer no comment. A receiving tuner for the audion should be so proportioned as to allow a given wave-length to be attained with the use of a small amount of capacity in shunt to the inductance.

* * *

A subscriber after commenting favorably upon our magazine in general writes as follows:

I notice a discussion on aerials running in your magazine. Permit me to relate an experience I have had using IRON wire for the aerial. About a year ago I had in use an aluminum wire aerial strung from a tree to a pole. The height was 60 feet at the tree end and 30 feet at the pole, length of wires 160 feet. With this aerial I had heard NPE (North Head, Wash.), distant about 950 miles, and several ships about the same distance at sea. One night a heavy wind storm came up and carried it away. Although I used a weight on the end of the rope running through a pulley to take up the slack as the tree swayed in the wind, the strain was too great and the wires broke. I decided to put up an iron wire aerial. I was of the opinion that good results were out of the question with such an aerial, but as copper or aluminum would not hold up in a wind storm, I decided to make a trial. I erected a four-strand aerial of GALVANIZED iron wire No. 14, the same length and height as the former aluminum aerial and the same number of strands and same size wire. With this aerial I obtained good results. I heard NPE a number of times and the signals seemed to come in just as loud as with the aluminum wire aerial. All stations that were heard on the aluminum aerial could be heard on the iron wire aerial with equal strength. Longer distances could probably have been covered under better conditions but my station is located on low ground surrounded by hills. The explanation of this phenomenon is that all high-frequency currents travel on the extreme outside of the conductors, and as the galvanization on iron wire is of zinc it works similar to a zinc wire aerial. The difference is that the iron would probably have a magnetic effect. Can you explain what the magnetic effect would amount to? Although I obtained excellent results with the iron wire aerial, I do not wish to say that it should be used if it is possible to use copper or aluminum, but in places where the wire is subjected to great strain, galvanized iron wire will give highly satisfactory results. It is also very cheap.

It is preferable at all times to construct an aerial of wire having the highest possible degree of conductivity, but as the writer states, it is the surface of the wire which principally needs to be considered. Assuming that an annealed copper wire has a percentage of conductivity equal to 100, then as a basis for comparison we may tabulate the specific resistance, of these elements as follows:

Annealed Copper	100%
Commercial Aluminum	59.8%
Zinc	27.7%
Iron Wire	16.2%

This tabulation is based on the specific ohmic resistance of the wire and does not take into account the mere surface conductivity. The high frequency resistance of a conductor varies with the frequency of the oscillation passing through it and is therefore not a constant at all wave-lengths. While the table indicates the resistance of zinc a little more than twice that of aluminum when a steady current is flowing, this same ratio does not hold good in terms of high frequency resistance.

Calculations based on the well-known Rayleigh formulæ indicate that at frequencies of a million corresponding to a wave-length of 300 meters, the high frequency resistance of zinc (ignoring the magnetic effect due to the iron core) is 4.1 times the steady current resistance, whereas for aluminum it is 6.1 times the steady current resistance. The magnetic permeability of the iron core of our correspondent's aerial will have the effect of increasing the high frequency resistance which would make the ratio of high frequency resistance to the steady resistance about the same or slightly greater than that of aluminum. Therefore, about equal results are obtained, but the total resistance is greater in the case of the zinc-coated wire.

When a high frequency current flows through a conductor it tends to remain on the surface of that conductor because of the fact that a counter-electromotive force is set up in the center of the wire which opposes the variation of current. It will be readily understood then that in the case of a large wire having a low value of steady current resistance the counter-electromotive force in the center will be correspondingly large and therefore the increase of the high frequency resistance, size for size of wire will be greater than with the conductor having increased value of steady current resistance.

In plain words, the increase in the *ratio* of the high frequency resistance to the specific resistance of any wire varies with the size, and the smaller the diameter the less the resultant value. For diameters below one-tenth of a millimeter the high frequency of a wire does not differ from its resistance to direct current, but with larger wires having a diameter of, say, 2 centimeters, the high frequency resistance may be eighty times the value of specific resistance. It should be understood that our statements are made in the sense of ratios. We do not mean to infer that the poorer conductors such as zinc, iron and aluminum as an aerial will give results equal to that of copper wire, we simply desire to make plain that in a case of these poorer conductors, the difference between the steady current resistance, and the high frequency resistance is not so great as with the better conductors.

The difference in the value of high frequency resistance between our correspondents' zinc and aluminum aerials is therefore not so great as might be supposed.

* * *

The motive that animates our monthly prize contests is best expressed by the great Scotch essayist Carlyle, who said: "The merit of *originality* is not novelty; it is sincerity."

And knowing this, it does seem unfortunate that the material sort of encouragement should be vitiated by individuals, who, lacking the sincerity of originality, attempt to advance themselves by appropriating the ideas of others.

Our attention has been recently called to the honorable mention article in the May issue in which is described a method for the operation of a quenched or rotary gap in connection with an ordinary coil. Its critic says the context of this article was plagiarized from his contribution to the January, 1913, issue of Modern Electrics. He sends a copy and requests that we draw our own conclusions.

The two contributions in question are so obviously alike that there can be no doubt that the honorable mention article is a direct copy of C. Ballantine's contribution to Modern Electrics.

To the sincere workers in the amateur field we offer an apology for having allowed this contribution to receive an honorary award; to our critic we offer our sincere thanks for calling our attention to the matter.

We trust that the offending contributor will come to the front and acknowledge that the idea upon which the article is based is not original with him, and at the same time will publicly apologize to Mr. Ballantine for appropriating the latter's ideas to his own benefit.

Had the contribution described an improvement on Mr. Ballantine's idea and acknowledged prior use, the article would have been welcome for its sincerity of purpose; but under the conditions we cannot let the matter pass without comment, and in defense of Mr. Ballantine quote as follows:

"This method as far as I know was first applied by myself back in 1911 and a description of it appeared in Modern Electrics, in January, 1913. I am enclosing a copy of the original article. Read it over and draw your own conclusions. I am not claiming credit for myself," etc., etc.

Further on he says:

"It seems to be a fad lately for contributors to draw on old numbers of magazines for their 'original' ideas."

Thanks for the warning. We shall take special precautions from now on and we expect to bring this fad to an untimely end; we hope that "faddists" will take note accordingly. We do not propose to censure the rehearsal of an old idea for the benefit of new readers, if the originator is given full credit or some improvement of note has been made, but in the language of the street, when a contributor tries "to get away with it" in this manner, he will certainly be exposed and we may, if the case is particularly flagrant, let the law take its course.

* * *

A still more flagrant instance is the awarding of a prize to an amateur for a contribution which appears to be based on the research work of a western correspondent. In this case reference is made to the second prize article in the May issue, wherein the writer shows how the sensitiveness of an audion may sometimes be increased by the application of an external magnetic field.

In commenting on the article, we remarked that the method described was not new, but was well known in 1907. We deemed the article of sufficient interest to amateurs to award a prize to the writer, but we had no knowledge of a similar article written by Ellery Stone in a previous issue of a contemporary publication.

It seems that Mr. Stone has done considerable research work on the effect of magnetic fields on the audion and in a complete exposition of the results published in March he advances some original theories for which he is justly entitled to credit. He writes that A. A. Skene's article in the May issue is obviously based on the results of his (Stone's) research.

A careful comparison of the two articles reveals that some of the words in Skene's article are identical with those in Stone's contribution and we therefore believe that an apology is due the latter. The curves, however, are slightly dissimilar.

We quote Mr. Stone as follows:

> Inasmuch as my article set forth the results of considerable research on my part and advanced some original theories, I think you can understand the natural feeling of resentment I have upon seeing it presented as another man's work. Even the curve accompanying the article in your magazine is almost an exact replica of one of the curves I published.
>
> I would not write this letter to you if I did not feel confident that the publication of plagiarized material and the awarding of prizes for the same was not in accordance with the policy of your magazine. I feel sure that you did so wholly unconscious of the fact that the article in question was a clear case of plagiarism.
>
> It is only by an exposé of such methods that irresponsible young writers can be brought to a realization of the gravity of such an offense.
>
> I trust you will take some steps to set forth to your readers the true facts with regard to the source of the material presented concerning the magnetic effects on an audion detector.

We assure Mr. Stone that the awarding of this prize, under such conditions, was not in accordance with the policy of this magazine and we thank him for calling our attention to the matter.

It is now in order for the author of the second prize article to state the conditions under which the data for the curves accompanying his article was obtained; also the apparatus used and the exact date at which such tests were made.

A correspondent refers to the "How to Conduct a Radio Club" articles appearing from time to time in the following manner:

"Offer you profound congratulations for being the first to offer the amateur any real solidly interesting matter on the new things in wireless. Does a fellow good to get hold of something original once in a while and your articles make the magazine for me."

We are pleased to note that these articles are meeting amateur requirements, and we can assure wireless organizations that future issues of this series will contain new matter of no little interest.

* * *

Another subscriber wonders what range of wave-lengths may be expected from the hinged-back receiving tuner described on page 735 of the June issue in the Radio Club series.

We reply that, under test, when the secondary winding was shunted by a variable condenser of .001 mfds., it had a wave-length of 4,000 meters.

This will allow reception of signals from the Arlington station at its longest wave-length.

With the average amateur aerial, an aerial tuning inductance should be connected in series, with the primary winding per adjustments to this wave-length.

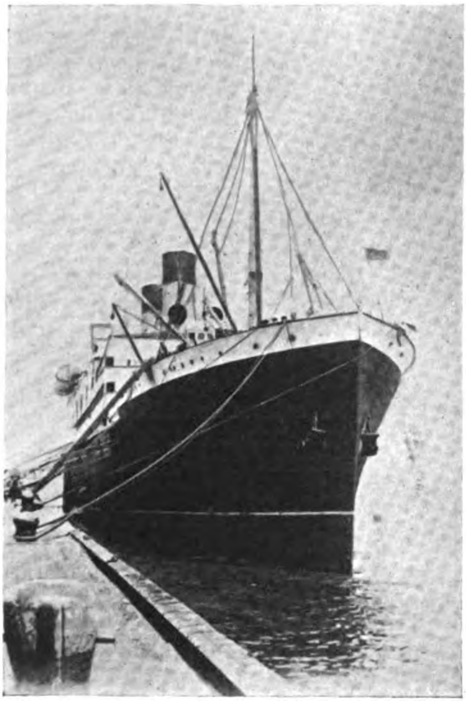
* * *

The following advice is offered to amateurs from a fellow worker in Buffalo, N. Y., who has done considerable experimenting with audion bulbs. He says:

"I might . . . advise the fellows that if they find their valve works best on the highest point of the high voltage battery, it would be well to add a few more cells. I have had the air specially extracted from some bulbs and found them to work twice as well as an extra grade bulb but the vacuum was so high that they required 55 to 60 volts for satisfactory operation; furthermore an air dielectric variable condenser of reliable make always bettered my results when used in the circuit in place of the fixed condenser."

The higher degree of vacuum with a corresponding increase of voltage "steepens" the volt ampere curve of the audion and hence the increased sensitiveness.

Air condensers are free from dielectric losses and therefore may give increased strength of signal.



The Empress of Ireland leaving Liverpool. Her side was torn open for half her length when she and the Storstad crashed

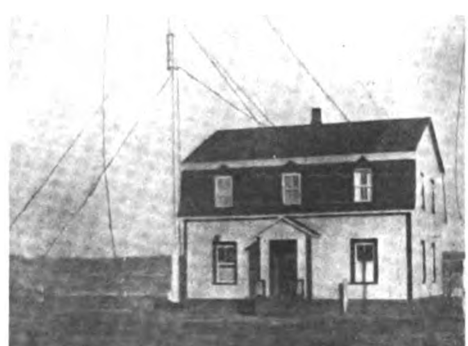
The Collision on the St. Lawrence

Illustrating the Importance of Wireless on Land-locked Waters

ANOTHER disaster of the waters has furnished an impressive story of how lives were snatched from a grave made by the fog—one of the terrors with which mariners are compelled to contend—by means of wireless telegraphy. The efficacy of the art during a time when speed and potency were most essential brought timely assistance, resulting in the rescue of almost half a thousand persons. The saving of these lives, despite the loss of more than a thousand others, is the only gleam of brightness in an awful accident and should bring a thrill of gratitude throughout the world for the genius which placed this means at the disposal of those in peril.

The wireless operators have come in for praise, and justly, too. None of the masters of fiction have drawn figures which are more heroic than these men of the key. One of them, saved from death after he had remained at his post sending out the S O S even as the ship was being drawn down as if by unseen hands, thus tersely sums up what wireless did in depriving the waters of their prey:

"I do not think it has been realized what a part wireless played in the affair. Only eight minutes was I able to work, but without that the only boats that



In the wireless station at Father Point the operator was aroused from a doze by the S O S. He ran from the station in his night clothes and hurried rescuers to the spot where the Empress sank would have been available for the passengers would have been those on the starboard side . . . and it is not likely that more than forty or fifty would have been saved."

The Empress of Ireland, bound for Liverpool, with a number of distinguished passengers aboard, left Montreal on the afternoon of May 27, in command of Captain Kendall. She stopped at Quebec, steaming away from that port at half past four o'clock in the afternoon of the following day. Several hours afterward a thick fog enveloped the waters and all of the craft upon them. As the night wore on the mist still prevailed and the Empress, in order to insure safety, reduced her speed.

This was about two o'clock in the morning when the liner was in the St. Lawrence river, not far from the shores of Father Point, 150 miles from Quebec and about ten miles from Rimouski. Feeling her way through the fog, inward bound, was the Danish collier Storstad, with Captain Andersen in command. She had fifty men aboard.

After a while the collier approached close enough to the passenger steamship for those on the latter to distinguish her lights. The proximity of the Storstad was then called to the attention of Captain Kendall, who was on the bridge. He, according to reports of the disaster, signaled with three blasts of the whistle, "I am continuing my course."

The collier continued to approach the Empress and Captain Kendall, realizing the peril of his ship, signaled for full speed astern. The order came too late to avoid a collision, however, and the collier steamed ahead on her course, crashing bow-on into the side of the liner. She struck her about midway of her length and tore her side open to the stern.

Edward Bamford, the second Marconi operator, was on duty when the crash came. He sent a summons for the first operator, Ronald Ferguson, who was in his cabin, off duty. The latter ran to the wireless room and sent a message to Father Point, telling the operator there to "stand by" as the Empress had "struck something." Then First Officer Steade ran up and directed that the S O S call be flashed.

Far and wide the summons for aid reached out into the darkness. In the station at Father Point the operator was following his custom of taking the opportunity offered during a slack period in the early morning hours to doze on his cot. The buzzing in his head phones aroused him, however, and in an instant he had the tuner adjusted and his hand on the key. At the second call he answered:

"Where and who?"

"Empress of Ireland, off Father Point," was the response.

The land operator responded to the message and then called his chief, Whiteside; without stopping to change his night clothes for other apparel, he hurried from the station to the pier where he found the Canadian government boat Eureka tied up and every one aboard sleeping. The operator aroused the Captain, J. B. Belanger.

"For God's sake, get up steam," cried the former, "the Empress of Ireland has gone under."

The captain awakened his crew and gave orders to prepare the Eureka for a rush trip. The Lady Evelyn, also a government boat, was notified of the disaster and both craft steamed at high speed to the spot where it was believed the Empress had gone down.

While these preparations for rescuing were being made the water was pouring like a mill stream through the great gap in the Empress' side. The disaster came so suddenly that there was no time for many of those on the vessel to even attempt to save themselves. They were trapped in their cabin by the waters and drowned before they could reach the deck. The majority of those whose lives were saved leaped from the starboard side of the ship when the deck was almost perpendicular.

When the Empress listed her lights went out and the confusion in the darkness which resulted added to the horror of the situation. This was alleviated to some extent by the fact that most of those on board knew that the ship carried a wireless equipment which was in itself a guarantee that there was a possibility at least of obtaining aid.

As the vessel was being swallowed up by the waters those who slid off the deck on the low side were either killed by the fall of deck structures or boat tackle, or were carried down by the suction as the

The bodies of the victims were taken to Quebec for identification. In the building shown in the photograph many heartrending scenes were witnessed as relatives and friends came in search of their loved ones

craft careened and sank. There was no lowering of boats. They broke away and floated off. The life belts were of little use except to the members of the crew, because only a few persons among the passengers had an opportunity to adjust them.

On arriving at the point where the Empress sank the rescuing boats, the Eureka and Lady Evelyn, found a scene which was not unlike that presented to the rescuers of the Titanic's victims. There was no sign of the Empress, for she sank seventeen minutes after the collision; but in the vicinity were to be seen many life boats and much wreckage. The occupants of the boats were transferred to the rescuing craft as quickly as possible and taken to Rimouski.

Both of the Marconi operators on the Empress were saved. Bamford fell into a life-boat and was picked up by a rescuing ship. Ferguson, however, was carried down with the wrecked vessel and was compelled to swim about for a considerable time before he was picked up.

"I had left the apparatus to my junior just five minutes before the collision came," he said, "and I turned into my bunk on the port side. My cabin was on the top deck, and though I could not see the Storstad, immediately after the shock I saw lights passing.

"I ran to the wireless room, took over the telephones from my junior and called all stations: 'Stand by for distress signal, have struck something.' In a minute, the chief officer, Mr. Steade, ran into the room and told me to call S O S, so I sent out the message 'S O S—Have struck something, sinking fast, send help.'

"The station at Father Point replied right away, asking where we were. I replied that we were twenty miles past Rimouski, and was trying to confirm this in answer to a request from Father Point when the power was cut off. The water had got into the stokehold, cut off the steam and put the dynamos out of commission.

"Before I was forced to sit before apparatus that was useless, I got the message from Father Point: 'O.K. Am sending out Lady Evelyn and Eureka to your assistance.' Eight minutes had elapsed between the first and last calls.

"Knowing this I rushed out of the cabin and shouted to the passengers that there was plenty of assistance coming and that the two boats would be on the spot in an hour. Then I went back to the cabin and tried to put the emergency gear in operation. But it was too late. The ship was sinking fast and listing so much that all the emergency apparatus fell over.

"I went out and picked up a deck chair as I ran, with the idea of getting something to keep me up, if necessary. I kept to the port side, for had I gone to the starboard, I should undoubtedly have been killed like many others by the boats that were rolling down the decks with a noise like thunder.

Ronald Ferguson, the first Marconi operator on the Empress. He stuck to his post, even while the ship was sinking

"Just as I was getting on the rail, the ship gave a final plunge and I was thrown clear into the water. I went down, and the suction took me to a great depth, and when I came to the top, no boat was in sight. I swam about for three-quarters of an hour, and then was picked up by one of the Empress' boats in charge of the boatswain.

"I was taken on board the Storstad, and was so weak that I had to be dragged aboard. I stripped myself, and helped to strip others, then went below to warm myself and dry some clothes. While I was there, some of the survivors came down shouting for Marconi.

"When I got on deck, I found the Lady Evelyn alongside. Although she had wireless, there was no operator. I was so eager to get aboard that I did not notice I was nearly naked. As I climbed over the rail one of the survivors gave me an overcoat, and then I jumped on to the Lady Evelyn.

"The wireless room was locked and the key was not there, so I broke a window and two men pushed me through. I geared up the apparatus, called Father Point and gave all the information I had, asking for clothes, supplies and a train to be sent to Rimouski wharf. I remained at the apparatus until the Lady Evelyn came alongside the wharf at Rimouski.

"I do not think it has been realized what a part wireless played in the affair. Only eight minutes was I able to work, but without that the only boats that would have been available for the passengers would have been those on the starboard side of the Empress, and it is not likely that more than 40 or 50 would have been saved.

"Had the Empress kept afloat a little while, the two boats coming to the rescue could have taken on all her passengers and crew. As it was, when the Lady Evelyn did arrive boats on each side were out, ready for the water, and those in the river were picked up very quickly."

Ferguson's home is in Liverpool. He is not unused to marine perils, for he was on the Ambrose when she rammed the Beta and sent her to the bottom in the River Mersey, England, on January 9, 1913. Bamford lives in Manchester, England. At one time he was an operator on the Warren liner Michigan and made his hime in Boston. Bamford studied at the Manchester Wireless School, afterward going to London where he obtained employment with the Marconi Company. He made three voyages on the Michigan and, being ambitious for an assignment on a larger vessel, succeeded in obtaining a detail on the Empress of Ireland. He is twenty-three years old. It was his first trip on the Empress.

Accounts of the wreck show that Captain Kendall maintained the traditions of bravery among seafaring men that have been handed down since craft began to sail the seas. He stood on the bridge as the Empress foundered and was picked up by one of the small boats. He directed the work of saving others until the boat was filled to its capacity.

Dr. James F. Grant, ship's surgeon, won praise for his coolness and the services he rendered to the survivors as a physician. He was pulled from a porthole by those who stood on the side of the ship after she had canted over. As the great hull dropped from under him he slid into the water and swam toward the Storstad. He was picked up by one of the collier's boats and aided in the rescue work. His story of the disaster is as follows:

"We left Quebec on May 27 and had an uneventful trip during the evening. During the early morning a fog dropped around us and we proceeded slowly. At 1:30 A.M. we put the pilot off at Father's Point. At 1:52 the collier Storstad rammed the Empress of Ireland. The vessel's lights had been sighted by the watch, who reported to Captain Kendall, who was on the bridge.

"The captain signaled with three blasts of the whistle, 'I am continuing my course.' The collier answered but what the reply was I have not learned. Captain Kendall sounded the whistle twice, saying, 'I am stopping.'

"The light of the collier could be seen approaching. The captain of the Empress signaled to reverse and steam full astern. But the big liner could not avoid the small ship. She was rammed amidships in the engine room on the starboard side. The plates were ripped open to an enormous length. Then the collier backed off about a mile.

"In a few moments the Empress began to list to one side. She made an attempt to right herself, and then canted still further to starboard. As the water forced its way in through the gaping break in her side she lurched further and was doomed.

"An attempt was made to lower the boats on the starboard side. The first one was thrown clear and the sailors in it were thrown out. That boat was overturned. Then some of the port boats were flung across the deck by her list and several persons were killed.

"They were crushed to death against the rail. I believed that the chief officer, Mr. Steade, lost his life when these boats catapulted their way through the crowd.

"There was no disorder among the crew. The captain and other officers remained on the bridge until the vessel sank. It was just seventeen minutes from the time she was rammed until she sank below the surface. Comparatively only a few were able to obtain life belts, and practically all were forced out in their night clothes into the water.

"Several hundred clung to the ship until she sank, holding to the rail until the vessel canted over so far that it was necessary to climb the rail and stand on the plates of the side. Then as she keeled over further they slid down and into the water as though they were walking down a sandy beach into the water to bathe.

"The lifeboats in the Storstad were launched, and came rapidly to the rescue. Not one went back that was not well loaded. About five of the Empress' boats also got away. The entire catastrophe was so sudden that scores never left their bunks.

Edward Bamford, the second operator on the ill-destined craft, who was on duty when the collison occurred

"The passengers had been on the ship only a day, and were not yet familiar with their surroundings. In the confusion and the semi-panic, many could not find their way to the decks, and only a few knew how to reach the boat deck. This was largely responsible for the terrible toll of death."

Figures said to be official place the death list at 1,024 and the number of saved at 452. J. McWilliams, wireless operator at Father Point, said: "The prompt Marconi service doubtless saved many lives, as one of the rescue steamers, the Eureka, was on the spot about twenty minutes after the disaster, and the Lady Evelyn was close on her heels. The prompt arrival of these vessels enabled the lifeboats to be overfilled without danger."

It is gratifying to be able to record another triumph for wireless telegraphy and one naturally asks, What would have happened without it? The fact that the accident occurred within a short distance of the shore and was a disaster of the river and not of the sea makes the Marconi achievement a noteworthy example of the value of wireless. It drives home the fact that wireless telegraphy is as much of a necessity on inland waters as it is on the ocean.

But when all is said and done the thought occurs that one of the recent developments of wireless—the Marconi-Bellini-Tosi direction finder—might have been employed to advantage in averting the disaster. This instrument, which is also known as the radiogoniometer, is designed particularly to defeat circumstances such as those which arose when the Empress of Ireland and the Storstad came into collision.

If the Empress and the Storstad had been equipped with direction finders the instruments would doubtless have indicated by an increased strength of signaling that the vessels were nearing each other. There is a possibility that there might have been doubt as to whether one ship was approaching the other on the port or starboard side. A wireless message from one craft to the other, asking as to her course, would have done away with the difficulties of this problem, however.

Captain Kendall's story is to the effect that while the weather was still clear he sighted the Storstad which at that time was about two miles away from the liner. Then a fog bank came between the vessels and each lost sight of the other. Signals were exchanged by whistling, but notwithstanding this precaution, the ships crashed together.

In view of the fact that the whistling signals did not prevent the disaster, the warning issued by the Buoy List of the Coast of Massachusetts, published by the Federal Lighthouse Service, has a pertinent interest. This cautions seafaring men concerning relying on sound in a fog because in the "silent areas" created by special conditions the signals may not be heard even when the vessels are a short distance apart. An explanation of the collision between the Empress and Storstad may lie in the fact that it was impossible to distinguish the sirens of the two vessels.

The steamship Lady Grey which conveyed the bodies of the victims to Quebec after the collision which cost more than a thousand lives

This possibility again draws attention to the advantages of the direction finder. It is already in use in the American Navy, having been thoroughly tested and found to operate successfully. Facts concerning the instrument were placed before the Board of Steamboat Inspectors investigating the collision between the Old Dominion liner Monroe and the Nantucket of the Merchants and Miners Transportation Company which came together in a fog.

It was pointed out that the device shows accurately the direction from which wireless signals come and locates the vessels from which the signals come in a fog. It was also pointed out that with two operators on duty many messages are exchanged between ship and shore station, resulting in the distribution of considerable information concerning vessels in the harbor.

The instrument, the sole object of which is to determine the direction from which wireless signals are being sent, has a range of from forty to fifty miles. It can be operated either by the wireless operator or the navigating officer.

The Empress of Ireland was a steel twin-screw steamship of 14,191 tons, 518.9 feet long, with a beam of 65.7 and a draft of 36.7 feet. Her passenger capacity was 350 first cabin, 350 second cabin and 1,000 steerage.

She was built in 1906 for the Canadian Pacific Railway Company, and has plied between Quebec and Liverpool since she went into commission. Captain Kendall, the commander of the Empress, was on his first trip on the sunken vessel.

Book Reviews

WIRELESS TELEGRAPH CONSTRUCTION FOR AMATEURS

By ALFRED P. MORGAN

D. Van Nostrand Co., N. Y. Price $1.50

The author of this volume evidently anticipated the needs of amateurs who desire to construct their own equipment, but lack the necessary instruction and data; and by avoiding the cut-and-dried "how to make" style has delivered his message entertainingly.

No attempt has been made to cover the entire field of elementary electrical engineering, which is the evident purpose of most writers to the amateur. Instead, the first chapter deals directly with the principles of wireless telegraphy, giving simple explanations of the fundamental phenomena, and commendably leaves the discussion of the elementary principles of electricity to other volumes. The description of actual amateur apparatus logically follows the order in which the amateur experimenter takes up wireless work—receiving apparatus first. The construction of the transmitting apparatus follows in due course, and the author, recognizing that there has been a deplorable lack of published data on the actual construction of induction coils, transformers and other parts of the complete transmitting apparatus, supplies this material. Not only are the fundamentals of a complete transmitting and receiving apparatus covered; working drawings of all auxiliary devices used accompany the description.

A new chapter has been added in this edition in which the recently enacted U. S. amateur regulations are referred to and amateur equipment to comply fully with the regulations is described. This chapter includes the description of oscillation transformers, quenched and rotary spark gaps, a variometer for receiving purposes, "kick-back" preventers or protective devices, crystal and audion detectors.

Your reviewer takes exception to the explanation of Fig. 9 on page 12. Upon investigation, the path of the open circuit is found to be from the aerial contact B, through the closed circuit contact A, across the spark gap to the earth connection G; or, more plainly, when the earth connection is placed as shown in the diagram the path of the open circuit energy is invariably across the spark gap to earth rather than through the condenser C to earth.

And in the wiring diagram Fig. 15, page 19, we believe that more consistent and better results would be obtained if the fixed stopping condenser were connected in shunt to the head telephones.

On page 24, the statement is made that the loop aerial formerly used by the United Wireless Company is well adapted to long waves and close tuning, whereas experience covering a number of years disclosed the fact that unfortunately the loop aerial was found to be more suited to the reception of short wave-lengths.

To bring the volume more up to date, the statement on page 24, that the pyramid aerial is debarred from extensive installation on account of the large cost of erection but is a type used by Marconi in long distance ultra powerful stations, should be amended. The inverted "L" type of aerial is now invariably used by the Marconi Company in the ultra powerful stations.

On page 29 it is stated that the standard wave-length of the United States Navy ship installations is 425 meters. The Navy has been allotted wave-lengths between 600 and 1,600 meters. For long distance communication at the higher power stations, wave-lengths in excess of 3,000 meters are employed.

The statement on page 25 "an increase in the capacity (of an aerial) enables more energy to be accumulated in the antenna, and consequently greater radiation results," is open to criticism in the latter half. If the antenna is kept at the same height and its capacity increased, and all other conditions increased proportionately, we agree that greater radiation will result; but suppose an antenna of given construction should gradually be lowered nearer to the earth. An increase of capacity would result, and even though conditions of resonance in the transmitting circuits were maintained the radiation from this aerial would be decreased as the earth was approached.

Taking the volume on the whole, however, it should be an excellent guide for the beginner and is worthy of recommendation to the amateur field.

Miss Reynolds

Christening the North Sixth Mast

By EVA H. REYNOLDS

Miss Eva H. Reynolds recently rode through the air in a bo'sun's chair to the top of one of the 425-foot steel masts that support the aerial of the new Marconi Wireless station at New Brunswick, N. J. Standing in the workmen's box, at the top of the mast, Miss Reynolds named the station "Scio," breaking a champagne bottle over the point of the mast. The account of her adventures which follows was written at the request of the New Brunswick Home News. In the May issue of The Wireless Age *appeared an illustration of Miss Reynolds making the ascent.*

TO the recreation seekers strolling along the towpath to the upper lock on half holidays and Sundays, the scene of varying beauty environing the wireless plant is so satisfying and entrancing that I would hesitate to change the reel to mid-winter, to a tempest and disaster, were it not for the patience, heroism and final success which crowned the work of the engineering corps.

For more than half a century, the property where the "tall thirteen" stake out the Marconi boundary has been called and known as Scio Estate; and this fact is the pivot around which centers the incident which follows. N. Covas, a Greek, the former owner of the estate, named it Scio, after a beautiful and fertile island in the Ægean. The inhabitants were aristocrats, and felt themselves upon a higher plane than their countrymen; yet they were unwarlike, cultured and refined, the result of mild government.

The name Scio admirably fitted the conditions. The people felt they knew how, and so, when the masts of the Trans-oceanic Aerial Message system began to climb higher and higher toward completion, I, too, felt that some one knew how, and poetic justice suggested that the name be ceremoniously given to the last completed of the thirteen shining steel beauties.

A shade of seriousness crept over the face of the official to whom I first applied for permission to use the tower swing.

He explained that the men who used the ropes were veritable steeplejacks; that they had been trained from boyhood for the work. Many were sailor mast climbers, and all were as much at home swinging from a crass-bars four or five hundred feet above the ground as in a porch rocker.

Three months later, as the sun was measuring off the second half of the day, word was passed me by a younger member of the office force to bestir myself as the last opportunity to go up was at hand. I had been waiting for weeks for a possible chance, and my fixings were all ready. Men were working overtime and with feverish haste fastening stay wires and making all secure against a possible storm.

Superintendent Rossi was to personally inspect the north sixth mast and to make the ascent. It appeared that in some way I had "qualified" to the satisfaction of the Superintendent and others for the trip, and my plea to make it was granted.

La Fayette Stone house was the starting point, and here in the large council room, where strategic plans for independence had been whispered over crude maps in the French general's soldier days, two documents were handed me to sign.

"Your death release," it was explained. For the first time the gravity of the situation impressed me, and my hand was "infirm of purpose," but it was only momentary. The J. G. White Engineering Co. and the Marconi Wireless Telegraph Co. of America were both freed by my signature from any responsibility whatever.

The great blizzard had not yet set in, but previous snows had made the walking laborious. When the principals in the little drama reached the mast, we found my father and our faithful collie waiting for us. The former tried to look pleased, the latter whined as I swung out beyond his reach in the open. Two swings were provided; in one sat the Superintendent. Simple board swings they were, without even the mast for company, raised by an engine. Not knowing what to do with the christening outfit, as both hands were needed to grasp the ropes, the Superintendent kindly packed the articles in the tops of his rubber boots. So absorbed was I with the details of the christening, and the object for which I had set out, that fear never once found a foothold.

A weather-beaten steeplejack stood in a box at the mast-head to receive us. I recall with keen pleasure his honest greeting as I stepped out to praise his crowning work. Crash goes the bottle. "I name thee Scio." Then hands full of confetti were swiftly thrown out, described by those below us as a light cloud of shining atoms gilded by the sun. Next, there seemed to fly out from the tower a flock of pigeons. Slow and undulating in movement, they were not winged messengers of feather and flesh, but were copies of the Home News and the New Brunswick Times, cut in squares and flung into space that there might ever be a bond of friendship between our local printing press and its distinguished neighbor the wireless dispatch bearer.

A half hour amid aerial trappings impressed one with the difference of temperature, and becoming uncomfortably cold, the swings were adjusted for the descent. The pushing out from the mast as the swing leaves the box, is to my thinking the most perilous act of all, and no one, be it man or woman, who is subject to vertigo or heart trouble or of doubtful courage, should ever entertain the thought of a rope trip.

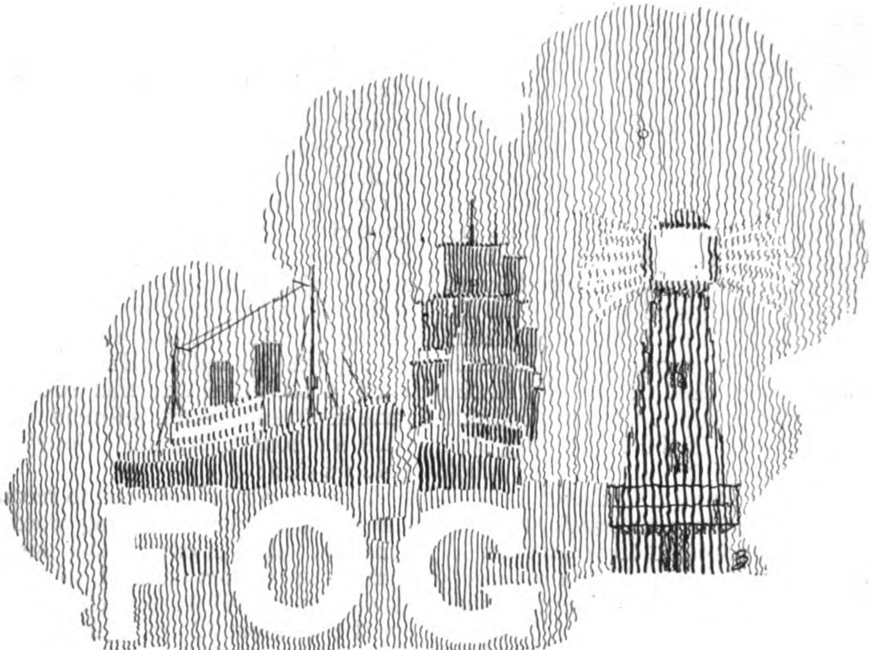
The sun which had burst through the clouds long enough to cheer the occasion, now drew back, and the twilight, as the little party started for home, seemed touched with atmospheric caution-whispers. The Superintendent looked grave and stopped at the north fifth mast to encourage the men who were still working like mad on the anchorage cables—far past union hours they tugged and struggled regardless of self.

There had been unforeseen obstacles to delay the completion of the station, due to waiting for machinery and supplies.

Twenty-four hours later the blizzard rushed upon all with incredible speed, strength and fury. The intricate yet geometric arrangement of the wires, resembling on a fair day the riggings of stately ships in repose, now hissed and whistled and boomed in the blackness of the night. Anyone bold enough to open a door quickly closed it. Had not the laboriously constructed Hatteras wireless tower gone down a few years before in a hundred mile an hour hurricane! Could "Scio" hold its own?

A messenger volunteered to reconnoiter the wireless tract and bring word of the tempest. As he passed the north fifth mast, two figures muffled to their eyes stood like snow statues, with looks riveted on the tortuous black supine steel giant that a moment before writhed in its fall before them. They were Superintendent Rossi and his head surveyor. The former, turning with a half hopeless gesture toward the next mast, the lately christened Scio, whose tip in alternate spasms quivered and bent and straightened, said: "Nothing but a miracle and the grace of God can save it." They walked slowly away, while the messenger, choosing another route, was lost in the woods, returning later in the night, panting, exhausted and wet to the skin.

Referring to the north sixth he said, "She can't stand another hour of this." Hour succeeded hour with no abatement of fury through the long stretch till daybreak. If there could only have been a short interval of rest from the storm current, so that the neck of the giant could hold its poise for a space! But it was not vouchsafed. Meanwhile, weird sounds and wind moans chanted dirges while the snow drifted and flung itself. At daybreak I crept to an attic window. The storm had spent itself, leaving destruction in its wake—great trees were snapped off like saplings, but towering above all, like a knotted giant, with its spine made of the steel of Damascus, and its tip glorified by its supreme struggles, stood "Scio." It knew how! The Storm King!



An automatic warning gun for isolated beacons

Some unique applications

A NEW application of wireless has been found by the English Marconi Company in the invention of a device for the distant control of fog signals at sea. The system is designed to prevent marine disasters which occur because of a lack of proper fog signals. The apparatus will also control safety signals in mines, on railroad trains, for blasting purposes, alarm signals between vessels and call signals for wireless telephones.

The Technical Committee of the Marconi Company had this to say in its report concerning the device:

"Now that the dots and dashes of the Morse code can be transmitted with regularity over thousands of miles, it would seem only reasonable to suppose that with the help of suitable relays, valves could be turned on and off, helms moved to port or starboard, machinery checked and started, alarms run—in fact, a whole number of useful operations could be controlled by the electric waves used in wireless telegraphy. Hitherto of the many inventions along these lines not one has come to any good result.

"Now, however, the Marconi Company has an apparatus for distant control which has been tested under the most adverse conditions possible: for from the very start it has been combined with an automatic fog gun erected on an isolated beacon in mid-sea, and has not only been left unattended for weeks on end, but has all this time been exposed to all weathers and to the interference from strong signals from ships passing close by."

A long time ago it was decided that for the safety of ships at sea passing near to the English coast it was desirable to install fog signals or isolated beacons. The Clyde Lighthouse Trust felt particularly the need of signals of this kind and the automatic gas gun provided the Trust with exactly what was needed. These signals, unlike the wave-worked whistling buoy, would operate equally well in rough or calm seas.

Six of these guns have already been installed in Scotland and one has been sent to America. These signals not only give vessels the information that they are in the neighborhood of one of these beacons, but also (each particular beacon having its own particular signal rate of so many per minute) aid them to locate their exact position.

Once this gun is started it will continue to feed and fire itself until its fuel is exhausted. But to leave it in continual action in all weathers would obviously be wasteful and extravagant. It might be arranged to adjust the gun for firing when fog prevailed by means of a submarine cable. This would mean considerable expense, however, and besides, a cable laid on such a bottom would be liable to break at a critical time. Therefore it was decided that wireless control of the guns would be a feasible plan, and the Marconi Company undertook the solution of the problem.

In a comparatively short time the company's Research Department had patented and prepared for demonstration an apparatus which fulfilled all requirements. A trial was then arranged and the test was successfully made.

Two sets of the apparatus are now working on the Clyde. Roseneath Patch, located almost in the middle of the Firth of Clyde, has one which is erected on an isolated beacon and operated from the Coastguard station at Gourock; Fort Matilda has the other. Other sets will be put into service shortly and the Marconi Company is designing apparatus suitable for greater distances.

The fog guns, when once started, will continue to fire at intervals of about twenty seconds until the supply of acetylene gas is exhausted, which would take two or three weeks. The function of the wireless control is to enable the coast guard station to turn "on" and "off" the gun as desired, by this means prolonging the time for which the gun may be left without attention from three to four months, according to the period of foggy weather experienced.

The Marconi apparatus is applied to a Stevenson-Moyes acetylene gun. It contains a gas-admission valve introduced between the gas generator and the gun itself. This needle valve is controlled by two electro-magnets, so arranged that when the first magnet is energized the valve opens wide and allows the gas to pass freely. When the second magnet is energized the valve shuts firmly against a pressure of twenty pounds a square inch—a pressure considerably in excess of the maximum used in the acetylene gun.

Next to the valve is a water-tight metal box containing the wireless receiving gear. Connection to the receiving aerial is made through an insulator; the received signals pass through the receiving apparatus to earth. A special form of detector is used which actuates a special relay which is so constructed that, although very sensitive, it has a large movement and is therefore capable of keeping in adjustment under all kinds of temperature conditions. This end is further assured by the provision of counterbalancing springs.

Two synchronizers are an essential part of the apparatus, and make it immune from the two great troubles of wireless—atmospherics and interference from powerful signals from passing ships. It enables the same apparatus to perform two distinct functions—to turn "on" and "off" the gun. One of these synchronizers is connected to one of the two electro-magnets of the gas valve, so that when one synchronizer is actuated by the relay, it energizes one magnet and opens the valve, which remains fully open until the second synchronizer, actuated by the same relay, energizes the second magnet and closes the valve.

The second synchronizer is also in an air-tight case containing a clockwork mechanism which runs for four months with one winding. This clockwork performs a useful function every ten minutes; it strikes a sharp blow with a hammer, which gives the relay contacts a shake, gets rid of any stickiness, either in the pivots or at the contacts themselves, which might develop after several months, and at the same time causes a momentary current to flow through the detector.

A battery of dry cells provides the driving power for the whole receiving apparatus. A small fourfold aerial supported from a short mast about 14 feet high, completes the receiving apparatus.

The transmitting apparatus, installed on shore and in charge of the coastguards, is very simple. For short distances, such as four-mile communication, it consists of a small transformer, a transmitting jigger and condenser, and the transmitting synchronizers corresponding to those of the receiving set. For greater distances the same apparatus will serve if a greater aerial height is available; failing this, a dynamo is used to provide the additional power.

The wireless control of fog signals, however, is only one application of the Marconi distant control apparatus. On all sides can be seen the opportunities for the great utility of such an apparatus. These present only a small part of the difficulties which have already been overcome.

Operations in blasting on a large scale would be rendered much safer and more certain if controlled by this apparatus instead of by time fuses, with their element of risk and uncertainty, and alarm signals for ships in a fog, worked on a separate small aerial and in no way affecting the ordinary wireless would without fail call the attention of the captain of a ship to another ship within a distance of say, four miles, in a fog which might deaden the carrying power of the siren and which might be accompanied by sufficient breeze to cause any audible alarm signal to miscarry. There are other numerous applications of the distant control apparatus.

THE USE OF WIRELESS BY THE BLIND

Following King George's appeal on behalf of the National Institute of the Blind in London, which was sent out to ships at sea by wireless on March 28, the possibilities of the service of the art to those without the power of seeing have been considerably discussed. This is what a blind man in England who is much interested in wireless telegraphy had to say concerning the matter:

"The sense of hearing is extremely keen in the case of a blind person, and this is a valuable asset to anyone taking up 'wireless.' To learn a system of signalling like the Morse code is comparatively child's play, and many blind men would have no difficulty in putting it into practice.

"The sense of tone is often very acute in the blind man, and among my acquaintances is a man who has a note for everything which will produce a sound when struck, and with the more resonant materials, such as china and glass, he will state what the note is.

"Wireless receiving outfits would undoubtedly keep the more progressive type of blind man in touch with the daily events of life. The daily news service which is sent by 'wireless' to ships at sea would be a blessing to those who are unable to get some one to read the newspapers to them every day, and it must be remembered that the blind person is entirely dependent upon others for his news of common events. Imagine with what eagerness a blind man would put on the 'phones and listen for the Poldhu daily news, and in the morning at breakfast tell of the happenings of the day before!"

He said that wireless is regarded as a coming essential in the life of the educated blind. The simplicity of the receiving apparatus, the delicacy of touch which will enable the blind man to handle an ordinary crystal detector, and the fact that batteries and other accessories are not required, makes the outfit ideal for the individual in question.

From a scientific point of view it has yet to be shown that the blind are incapable of advancing theoretical knowledge and practical applications of wireless. The educated blind men have extraordinary intuition and introspection. Many of them are firm believers in the possibilities of telepathy, and in wireless they perceive a valuable stepping-stone to that end.

TELEPHONE WIRES FOR ANTENNA

It is reported from London that the demonstration of the new style of radio telegraphic and telephonic receiver invented by Lieutenant Colonel George O. Squyer, Military Attaché of the American Embassy, created great interest at a recent meeting of the Royal Society. The invention embodies the use of ordinary street telephone wires as antenna requiring no mast.

Messages were received over long distances during the demonstration and were heard distinctly. The apparatus is inexpensive and simple and can easily be adjusted to receive a number of messages simultaneously, without interference or interruption.

New Honors for Marconi

IT has already been announced that the Council of the Royal Society of Arts, with the approval of its president, the Duke of Connaught, has awarded the Albert Medal for the current year to Guglielmo Marconi, "For services in the development and practical application of wireless telegraphy." The medal was instituted in 1862. The first was given to Sir Rowland Hill. The King received it last year.

And right behind this comes the announcement of a still greater honor to be conferred by the King of Italy. It is reported that Com. Marconi, having reached the requisite age of forty, the King of Italy will soon appoint him a Senator.

The office carries no stipend and appointment is for life. In the Senate sit all the princes of the blood who have reached their majority. A seat in the Senate is coveted by every Italian who has been of distinctive service to the world.

The royal princes are the only members of the Senate who enter automatically. All the others are appointed by the King. The number of members is unlimited, but ordinarily it does not much exceed three hundred. To be eligible, candidates must have held high office under the government or must come within certain specified categories, which keeps the standard, for the most part, high. Though the Senators receive no salaries, they are given passes over all the railroads of Italy and passes on certain steamship lines.

Com. Marconi will not be required to attend every session of the Senate, but will be summoned by the president of that body when matters of importance are pending and his presence is needed.

Besides exercising its legislative functions the Senate is the highest court in the kingdom when political offense or the impeachment of any of the Ministers of the Cabinet is involved.

While the world gratefully receives announcements of honors bestowed on this great benefactor of the human race, very little is known of Com. Marconi as a man. This is due, mainly, to his aversion to personal publicity. Thus the question is often heard, "How does he look and act?"

He has best been described as follows: "Marconi is a human dynamo. He is happiest when he is busiest."

He stands about 5 feet 10 inches, has a slim but well-knit figure, evidences energy and great capacity for work, and in face, form or characteristics shows little trace of his Italian paternity. His head is large and well shaped, with a high forehead and sloping crown. His manner is reserved, his carriage erect and his bearing confident.

While his relations with his assistants are pleasant and comrade-like, he never permits to be forgotten who is the master spirit. He impresses one as a man possessed of a great idea, an all absorbing thought, from the contemplation of which he detaches himself with difficulty.

In social life it is different, but in business he displays neither the volatility of the Italian nor the cheery cordiality of the Irishman. He most resembles the cold, deliberate, almost stolid Englishman—a strange fact, in view of his parentage. In only one respect does he show evidence of Irish blood—in the genial, winning smile which sometimes flickers on his face for a moment or two, giving way again to his ordinary aspect of extreme gravity.

A REVIEW OF NAVAL WIRELESS

The progress of wireless telegraphy in the Navy is interestingly told in a report presented to the Naval Institute by Captain W. H. G. Bullard, U. S. N., who is in charge of the naval radio service. He has his headquarters under the shadow of the three great steel masts which form the center of the naval wireless system at Arlington, Va.

It was during 1899, the year after the Spanish-American conflict, that the British Navy became the first of all of the naval powers to try the new means of communication upon the three warships —Alexandria, Europea and Juno. These ships succeeded in communicating up to a distance of 74 miles.

The first trial of wireless on American warships was made late in 1899, directly after the British ships had proved its possibilities, and to-day practically every vessel in the United States Navy is equipped with radio apparatus. The armored cruiser New York (now the Saratoga), the battleship Massachusetts and the torpedo-boat Porter were the first to be equipped. At about the same time the Highlands Light Station in New York Harbor was established as the first shore station of the naval wireless system.

In 1907-8 the development of the wireless seemed to warrant the erection of high-powered stations at Washington, on the Pacific coast, at Hawaii, Guam, Samoa and the Philippines, so that wherever it might be the United States fleet would be at all times in communication with Washington. The success of long distance communication was established during 1908, when the Hawaiian Islands exchanged messages with Farallon Islands, Cal., and later during the cruise of the Atlantic fleet around the world, when messages were received across Central America by Pensacola and Washington. By a system of relays the fleet was in touch with Washington practically every minute during the trip across the Pacific until after New Zealand was reached.

Congress for the first time took notice of wireless in the act of June 24, 1910, which was amended by the act of July 23, 1912. The Titanic disaster of April, 1912, riveted the attention of lawmakers anew to the necessity of government control over wireless apparatus and its operation. Further laws were passed, and the president proclaimed the Berlin wireless convention, since succeeded by the London wireless convention, establishing general rules for wireless as to ships throughout the world.

The Mexican trouble led to further extension to take the place of interrupted land lines and for exchanges with the ships. Isabel, Texas, near the mouth of the Rio Grande, was chosen as the central point of operation on the Atlantic side and San Diego on the Pacific side.

The chief work of the naval stations is to keep the Navy Department in connection with its ships at sea, either by direct or relayed messages. This service extends to all bureaus, offices and divisions of the Navy Department, those in command of navy yards and stations, and to officers of fleets, divisions and ships.

The daily weather reports and storm warnings are sent from Arlington and Key West a few minutes after the 10 o'clock time signal at night, but important storm warnings are sent whenever necessary. Incoming ships are compelled, under the London safety convention, to report information concerning ice and derelict; this goes through the hydrographic offices to the Arlington station and then eastward and to other stations.

This information being of an urgent character—icebergs, derelicts, cyclones and typhoons—is sent under a special signal, called the safety signal, repeated at short intervals, ten times at full power (T T T). On receiving this all wireless stations are required to keep silent, in order to let the danger warnings go broadcast.

More recent developments of the naval wireless work are the fog signals and direction finders, by which the dangers attending fog are overcome, and the location and direction of ships in reference to shore stations are established; also, a rapid development of commercial work by which the general public and the press are allowed to use the wireless equipment aboard warships and at shore stations, on payment of land and sea charges. These charges are regulated under the London convention, and the amounts collected by naval coast or ship stations are turned into the Treasury as miscellaneous receipts.

How to Conduct a Radio Club

By E. E. BUTCHER

ARTICLE VI

IN the June issue of this series the writer described an opposition method used in connection with a break-in system in which the receiving detector is completely protected from the transmitter by the simple use of a coil shunted across an anchor gap in series with the earth. The same results may be obtained if the opposition coil is used after the manner shown in Fig. 1. In this method the connection is somewhat simplified, as no extra contacts are employed to break the circuit of the opposition coil during the periods of reception. This is explained further on in the article.

In the drawing, Fig. 1, the aerial at any station is represented at A, the aerial tuning inductance at L2, the secondary of the transmitting oscillation transformer at L1, the primary of the latter at L.

The receiving tuner has the primary winding L5 shunted across the earth gap S, and the secondary winding L6. As explained in the previous article, the receiving tuner is connected to the aerial at all times and during the periods of transmission the energy in the open circuit discharges to earth across the gap, S.

In place of the connection shown in the June article, the energy for the opposition coil, L4, is taken by inductive coupling from the closed circuit of the transmitter through the coil, L3. The entire opposition circuit, L3, C, L4, is so proportioned as to have about the same wave-frequency as the incoming signals. Of course the wave-length of this circuit may be varied over a considerable range by the variable contact on each coil, as indicated in the drawing.

For actual working these elements may be proportioned as follows:

The condenser, C, should have capacity of the order of .002 or .003 mfd. The coil, L3, should be made similar to winding L—that is, it may consist of 6 to 8 turns of, say, No. 8 wire spaced about ½ inch. L3 should move freely and be so arranged that a reasonable degree of coupling between it and L may be obtained. In operation, however, it will be found, in the majority of experiments, that the value of coupling between the two coils is very small indeed. The winding, L4, is made similar to the primary winding of the tuner, L5. It is placed in inductive relation to L6, as shown in the drawing.

It is of course apparent that the values of the elements composing the opposition circuit must be varied according to the wave-lengths it is desired to receive. A little experimenting will determine the correct values of inductance and capacity to be used.

The operation of this circuit is as follows:

When the transmitting key (not shown) is depressed, if it were not for the opposition circuit, considerable energy would flow in the receiving tuner circuits, destroying the sensitive adjustment of the crystal; but owing to the presence of the opposition coil, L4, and the fact that the energy absorbed from the closed circuit by L3 flows through it (L4), the current which otherwise might flow through the detector circuit is opposed and annulled. Thus, each time the transmitting key is raised the receiving apparatus is in working condition and an efficient "break in" system is effected.

Without much forethought it may appear highly desirable to break the circuit of the opposition coil while signals are being received, but it has been found by experiment that the opposition circuit need not necessarily be in resonance with the local detector circuit, for owing to the amount of energy available from the closed circuit, oscillations of a given frequency or wave-length may be forced

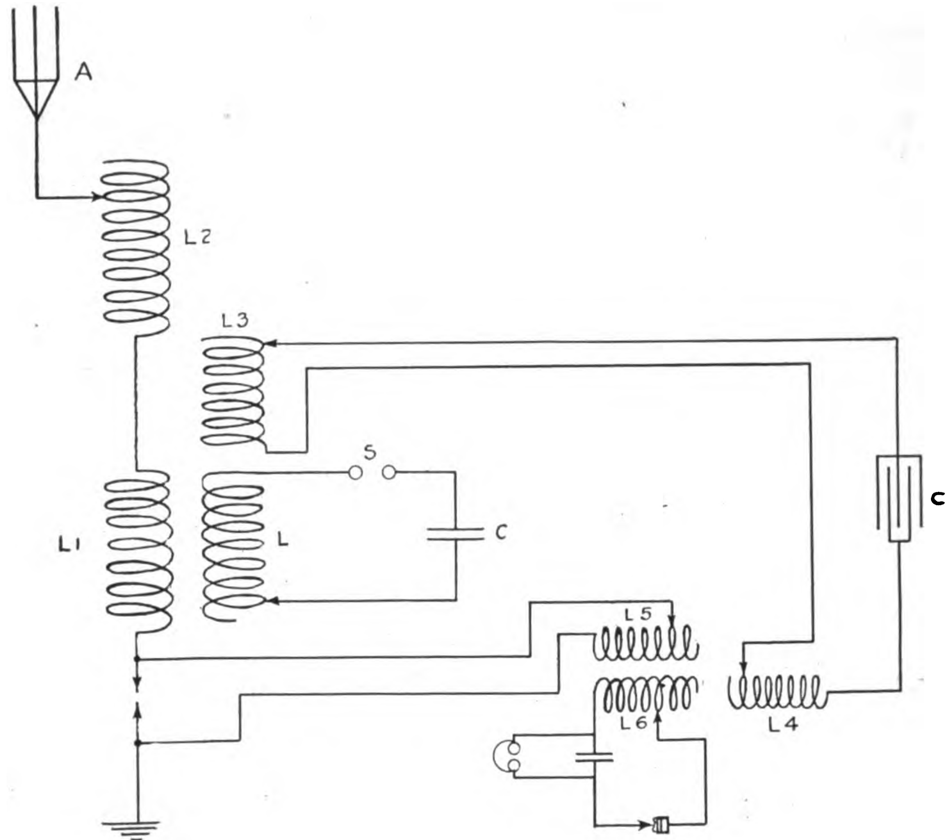


Fig. 1

into the opposition circuit whether it is in resonance or not; therefore a very small amount of the energy of the *received* signals will be absorbed from the local detector circuit on account of the difference in wave-length of the two circuits. However, if desired, the opposition circuit may be broken by an extra pair of contacts mounted on the transmitting key as shown in the previous article.

To bring this apparatus into efficient working condition, several trials are necessary. For instance: the coupling at L and L3 must be of a certain value and the same statement applies to the relation of the windings, L4 and L6. The number of turns at L6 must be varied until complete silence in the head telephones is attained.

When making the preliminary tests, it is preferable to use a carborundum crystal as the detector; when the proper adjustments have been made, crystals of the less rugged type may be substituted.

In connection with the various "break-in" methods described, it may be added that members of a radio club cannot overestimate the benefit to be derived in the adoption of one of these systems at the club station.

As a preventive of unnecessary interference it has no equal, for without effort on the part of the operator, he is able to hear while sending when other transmitting stations in his vicinity are interfering with the station receiving. Thus he is able to give slight pauses during his sending and literally pick his way through the atmosphere. Equal advantage is derived at the receiving station because the receiving operator is enabled to interrupt or stop the sending operator as he desires, notifying the sending operator when he (the receiving operator) is encountering hostile interference from stations in his vicinity.

Very frequently the writer has received requests from amateurs for a description of some method for the elimination of humming noises due to induction from nearby trolley, telephone or telegraph wires. It is a well-known fact that when a wireless telegraph aerial is placed near the alternating current power lines of high or low potential, particularly when in a parallel position, very objectionable noises are produced in the receiving head telephones. A number of experiments have revealed that such effects can be reduced to a minimum in a remarkably simple manner. With the aid of the diagram shown in Fig. 2, we shall explain how this may be accomplished.

P and S represent respectively the primary and secondary windings of an ordinary receiving tuner at a certain station. In this particular station, the aerial A is practically parallel and about 400 feet distant from a 2,200-volt A.C. power line. In addition, the house wiring was not placed in a metallic conduit, which amplified the effects. Very loud inductive noises were produced which seriously interfered with any except extremely strong signals, making long distance work entirely out of the question.

In an effort to eliminate the trouble, the wires, B, leading to a lamp socket in the radio room were interrupted at C and two leads connected to the winding, S1. S1 was of the same dimensions as P and readily moved in or out of S. S1 was also in magnetic opposition to S. By proper variation of the coupling between S and S1, the humming noises were almost entirely eliminated. Of course the presence of the winding, S1, had the effect of reducing the strength of the received signals, but it allowed the reception of messages which otherwise could not be heard.

Elimination of Arc Light Induction

Another flagrant case of induction trouble may be solved in the manner shown in the diagram in Fig. 3. Here the aerial wires, A, lay parallel to an arc light circuit of considerable potential, B. The inductive noises generally produced under such conditions are terrific and defy all attempts at elimination. Of course the arc light wires cannot be tapped and the opposition coil method adopted as described. But the effects may be reduced if a single aerial wire, B, is strong underneath or near the two power wires, C. This wire is then connected to a coil, S, which is inductively coupled to the secondary winding of the

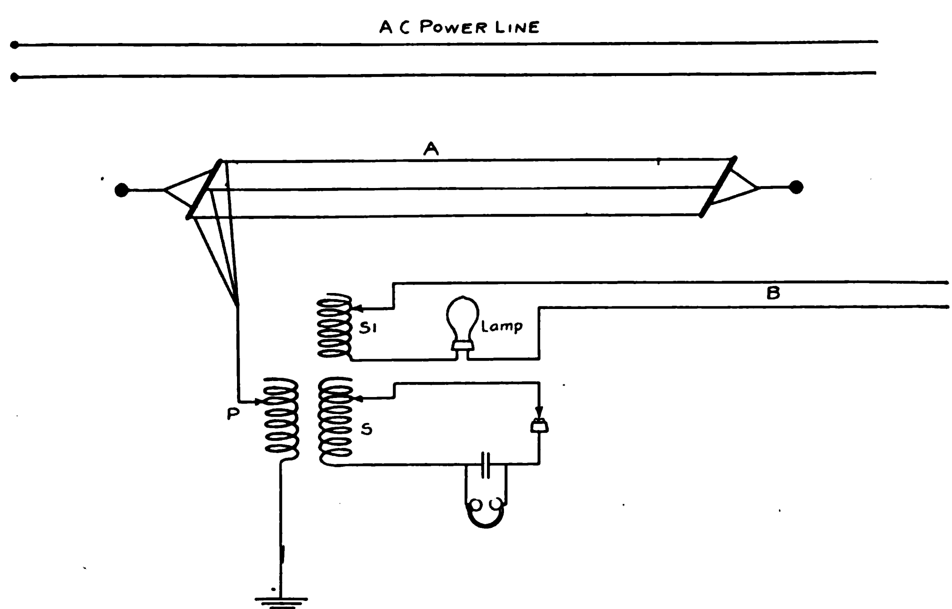


Fig. 2

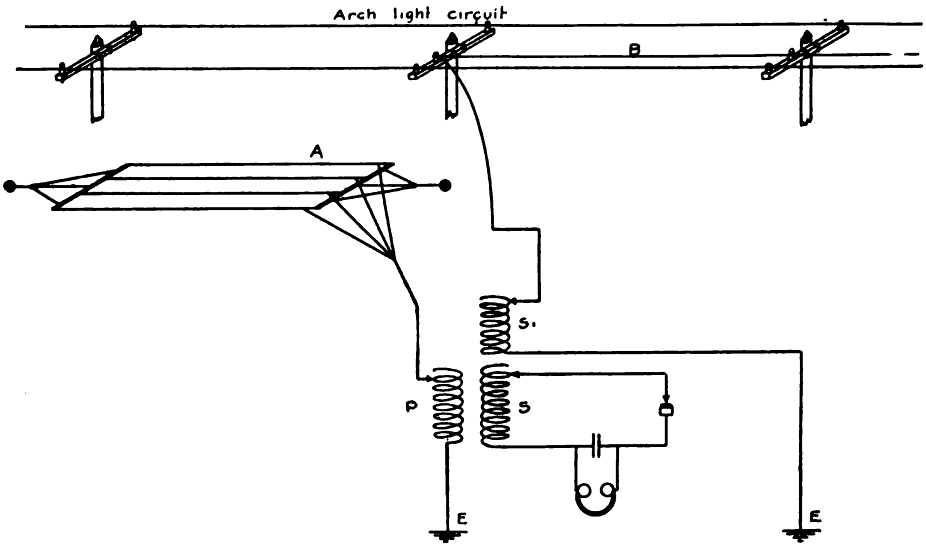


Fig. 3

receiving tuner, S. The energy set to by the power lines in A will be opposed by that flowing in the special aerial, B, and if proper coupling adjustments are made at S and S1, complete silence in the head telephones will be obtained. Care must be taken to see that these coils (S and S1) are in opposition; otherwise the induced noises will be increased.

It is best that the single aerial wire, B, be placed at a considerable distance from the receiving aerial A, and if possible B should be placed in the opposite direction to A.

(*To be continued*)

Wireless to Replace Cable

From all indications it would appear that the new Marconi station at Miami, Fla., will remain the only means of communication with Nassau, Bahamas, and the United States. Several months ago cable communication was interrupted and the new wireless station was called upon; according to P. H. Burns, superintendent telegraph department of the Nassau Government, the wireless service rendered since May 1 has been entirely satisfactory and the Nassau officials have decided to give the wireless service one year's trial. If it proves as satisfactory it is planned to adopt it exclusively in place of the cables.

It is understood that all negotiations for repairs to the present submarine cable or the installation of a new one have been called off, because, to quote Mr. Burns on Miami: "We are getting prompt attention and very satisfactory service."

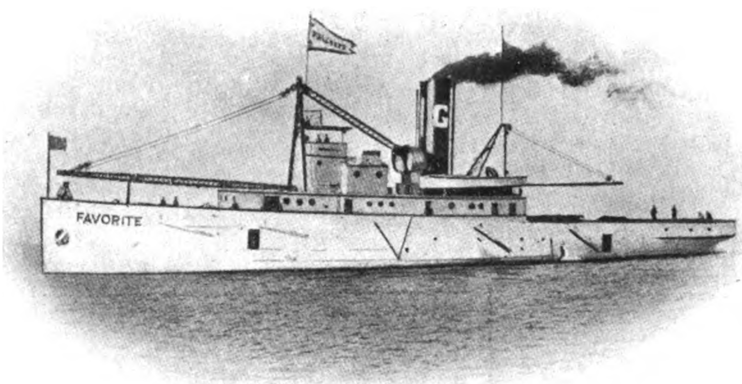
While the message traffic with Nassau during the summer months is light, it is correspondingly heavy in winter, and the Miami station will become one of the most important on the East Coast.

Although Great Britain has hitherto taken no very prominent part in the organization of an international wireless time service, there are indications that the subject is beginning to arouse public attention in that country. With the object of obtaining information concerning the matter a number of questions were asked in the House of Commons.

Interesting Equipments

THE Str. Favorite engaged in towing and wrecking on the Great Lakes for the past seven years, and owned by The Great Lakes Towing Company, has been recently equipped with a 2 k.w. Marconi set at Houghton, Mich.

The Favorite is a wrecking tug of 1,233 gross tons, 196 feet long, 43 feet beam and a depth of 19 feet, 6 inches. She has two Scotch Marine boilers 11 feet 6 inches long and 15 feet in diameter, each allowed a working pressure of 180 pounds; and has a triple expansion engine with 22 inch, 36 inch and 60 inch cylinders with a 30 inch stroke.



Great Lakes Towing Company's wrecking tug "Favorite"

The tug is constructed of steel throughout and carries the following equipment: A steam windlass and steam capstan; an A. frame derrick forward, with powerful hoisting engine, operating a 3 ton grab bucket; a patent sectional collision mat to cover fracture 20 feet by 30 feet, a derrick with steam hoist aft, for handling equipment; a special towing machine with 1,800 feet, 2 inch steel towing cable; a complete machine shop and iron working tools to handle plate up to one inch in thickness. A stationary air compressor that will furnish 500 feet of free air per minute at 100 pounds pressure is installed as well as three portable compressors with portable boilers. Also ten large wrecking pumps and boilers, 30 100-ton hydraulic jacks and steel hutchicks; a power sawmill for handling lumber and blocking; a full equipment of submarine and portable electric lights and a powerful searchlight. The steamer has a full complement of supplies, ship chandlers stores and other materials for wrecking purposes, and a gasoline power launch.

The Favorite carries a crew of 26 men, is commanded by Capt. Cunning of Port Huron, Mich., and is said to be the best equipped wrecking tug in the world.

Contract News

A contract has been closed for the equipment of Cornelius Vanderbilt's yacht North Star with a standard 2 k.w. Marconi set and an independent emergency plant. The apparatus has been shipped abroad and will be installed before the yacht leaves the English shipyard where is being built a special cabin for the apparatus and operator.

An interesting contract closed by the

American Marconi Company provides for the installation of standard Marconi sets and emergency plants on the Mallory Line freighters, Ossabaw, Satilla and Colorado. These three vessels have been chartered by the U. S. Government and will be used as transports for the troops in Mexico. The ships, which are being equipped in Galveston, will each carry two operators.

A 2 k.w. Marconi set is to be installed on the SS. Char Knudsen, under charter by the Inter-Ocean Transport Company.

The SS. Energie, owned by the National Railways of Mexico, is to have installed a standard Marconi equipment and emergency plant. This vessel is engaged in the oil trade between Mexico and American ports.

Engaged in the same trade, the SS. La Hesbaye, of the Freeport Tampico Fuel Oil Corporation of Houston, Tex., will carry a 2 k.w. Marconi set and independent power plant.

The Texas Company has contracted for installations of standard Marconi sets on the freighters Florida and Brabant.

VESSELS EQUIPPED WITH MARCONI APPARATUS SINCE THE JUNE ISSUE

Name	Owners	Call Letters
El Mundo	Southern Pacific Company	KKU
Paraiso	Craig Shipbuilding Company	WRI
North Star (tug)	Libby McNeill & Libby Co.	WHR
Brabant	Texas Company	OOB
Bessie Dollar	Dollar Steamship Company	VGZ
Florida	Texas Company	KUS

THE SHARE MARKET

NEW YORK, June 19.

In spite of the reorts of bumper crops and a healthier tone to business, persistent liquidation for many months seemed to have so weakened the market that favorable reaction is short-lived.

It is evident that confidence has not yet been restored, but with the quotations on standard industrials on a bed-rock basis, the future recovery to normal levels rests entirely with the general buying public. The professional speculators are inactive now and the stocks which have withstood their attacks should respond to any movement or influence based on the common sense view that securities are now selling below their intrinsic value.

Bid and asked prices to-day: American, 3¼—3½; Canadian, 1½—1⅞; English, common, 13—15; English, preferred, 10—12½.

It is reported that John Hays Hammond, Jr. has perfected at Gloucester, Mass., a wireless telegraph apparatus for aeroplanes which he intends to sell to the government.

SERVICE ITEMS

Announcement has been made of the marriage, on May 2, of Bertha Elizabeth Sanda to Edward Cole Newton, Superintendent Great Lakes Division, Marconi Wireless Telegraph Company of America. Mr. and Mrs. Newton will make their home in Cleveland, O. Mr. Newton has been associated with commercial wireless telegraphy for eight years, first as marine and land station operator, and has for the past five years served in his present capacity.

John R. Binns, the noted "Jack" Binns, of Republic fame, and Miss Alice A. Macnif were married on June 3, at the home of the bride, 1722 Caton Ave., Flatbush. The ceremony was performed by the Rev. Charles W. Flint, pastor of the New York Avenue Methodist Church, of Flatbush. The best man was E. T. Edwards, Superintendent of the Eastern Division of the Marconi Company, who has been a friend of Mr. Binns for twelve years. Mr. and Mrs. Binns spent a two weeks' honeymoon at Atlantic City, Washington and Old Point Comfort.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

A Receiving Transformer of the Rotary Type

I have recently constructed a receiving tuner of the rotary type. An explanation of the figures accompanying my article follows:

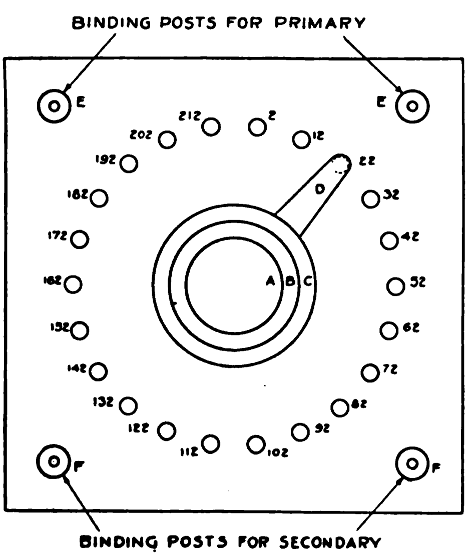


Fig. 1, First Prize Article

Fig. 1 is an elevation of the front of the tuner, showing the knobs for the adjustments of inductance in the primary and secondary circuits and for variations of the degree of coupling. Fig. 2 is a detail sketch of the mounting of the knobs to the various rods. Fig. 3 is a side elevation, showing the relation of the primary and secondary coils to one another. To construct this tuner, first make a box of quarter-inch wood, such as pine, 7 x 7 x 9 inches in size. If a variable condenser detector or other instrument is to be included in the set, the box should have dimensions 7 x 7 x 14 inches.

On the front side of this box mount a 22-point switch made of bright brass-headed tacks. This switch is for the purpose of varying the amount of wire in use on the primary winding. Next cut a ¼-inch wooden disc 2½ inches in diameter and mount on it an 11-point switch made of brass tacks which is connected to the secondary winding. The latter switch is fastened to the rear of the brass tube (to which reference is made further on) and soldered thereto as suggested. (Fig. 2, G).

Obtain a brass tube ¼ of an inch in diameter, about 7 inches in length and a brass rod a trifle longer to fit inside it, as shown at RT, Fig. 3. (I used a curtain rod.) Two pieces of glass tubing, ½ inch and 1½ inches long respectively, are fitted over the tube so that the latter fits tightly, but moves freely through the primary coil, as per Fig. 3.

Make three ¼-inch wooden discs, A, B and C. Disc A is 1½ inches, B is 2 inches and C is 2½ inches in diameter. On the back of A and at the center tack a small piece of tin. Then bore a hole the size of the brass rod through the tin and extend it halfway through the disc. Insert the rod and solder it to the tin. Bore a hole the size of the brass tube entirely through the center of B, soldering to this tube a piece of tin as with A. Next bore a hole in

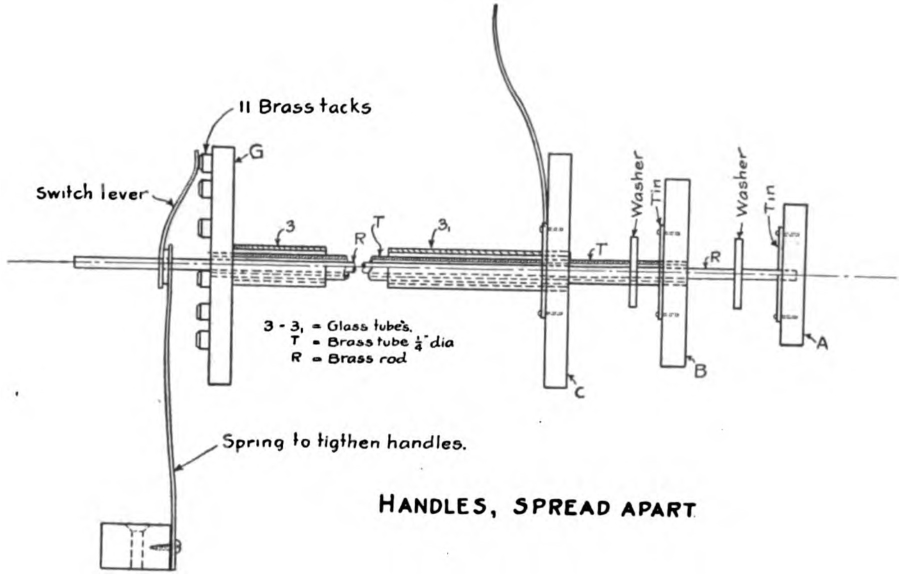


Fig. 2, First Prize Article

the center of C, and insert the longer glass tube, which acts as a hub for this disc as per Fig. 3 (3 and 3). C turns around readily on the glass tube.

The frame of the primary is made of two pieces of ⅛-inch wood taken from the back of a picture frame, reversing the grain of each piece to strengthen it and gluing it securely.

By means of a compass, draw a circle 6½ inches in diameter, and inside it, another of 5⅞ inches in diameter. These are then sawed out, making a strong grain. The other side of the frame of the coil is of course made in the same manner. A strip of strong cardboard 1½ inches in width is then made into a tube to fit the inside of the two circular pieces of wood, forming a barrel upon which to wind the wire. The cardboard is then glued in place firmly. This barrel is then wound with No. 22 wire and connected to the contact points of a 22-point switch.

The frame for the secondary is made from wood and cardboard in the same manner as the primary, but the circles are reduced to 5⅛ inches in diameter.

This barrel is fastened firmly to the brass tube by gluing it (after it has been wound) to the rod (Fig. 3). It is wound with No. 28 wire, taking the taps to the 11-point switch. As the secondary has an axis of a quarter a revolution, care should be taken to give enough slack wire to allow for this movement.

After the apparatus has been assembled, solder the brass switch lever to the back end of a brass rod as indicated in Fig. 2. A tension spring to hold the primary switch lever tight on the contacts is indicated at 4, Fig. 3.

The operation of the instrument is as follows: To vary the amount of wire on

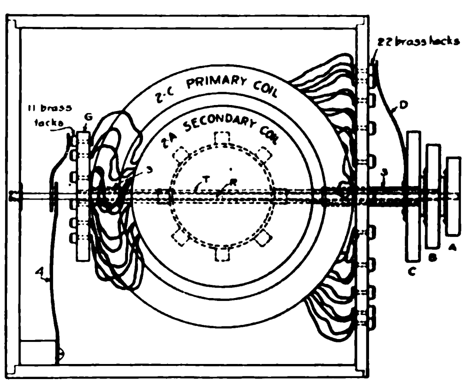


Fig. 3, First Prize Article

the primary, simply turn the switch handle C, Fig. 1, which swings the lever D, Fig. 1, over the contact points. To vary the amount of inductance in the secondary, turn the smallest handle to the right or left which moves the switch lever, Fig. 2,

over the contacts on the disc G, Fig. 2. In order to vary the coupling between the primary and secondary windings, turn the middle handle. This turns the secondary in or out of the primary coil, and also the disc G, Fig. 2. Of course this moves the small handle right with it, but the coupling is varied without changing the position of the switch lever, Fig. 2, on the disc G. CHARLES WALTER CUSHING,
North Dakota.

NOTE.—For best results from a tuner of this type, arrangements should be made for the use of a variable condenser in shunt with the secondary winding, and another in series, or in shunt with the primary winding. These will give a fineness of adjustment that cannot be obtained by the use of the multiple point switches alone.—*Contest Editor.*

SECOND PRIZE, FIVE DOLLARS

An Efficient Home-made Transmitting Condenser

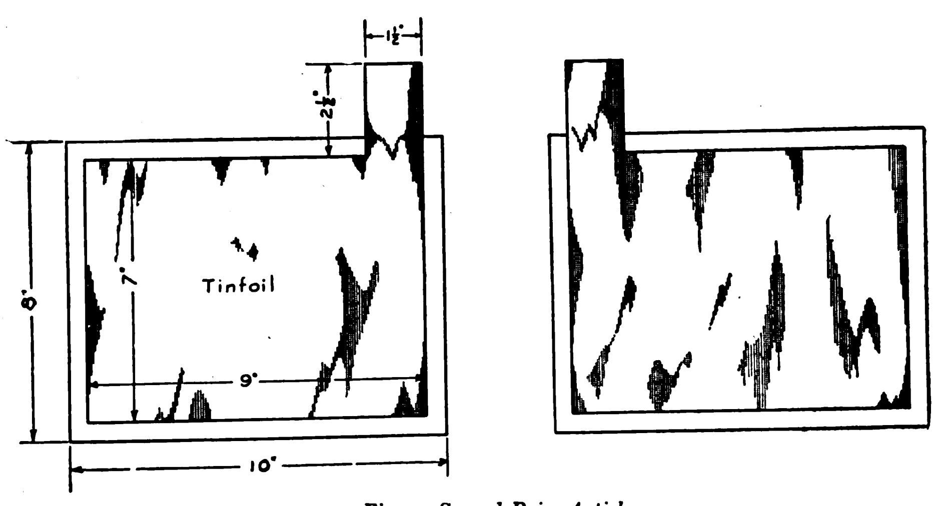
Many amateurs who own transmitting sets of ¼-k.w. capacity or over, experience trouble with the condenser. Home-made condensers are often a failure and those of good manufacture are generally too high-priced for the pocketbook. The condenser I am about to describe is cheap, easy to make and efficient.

First procure seventeen 8 x 10-inch glass plates from a local photographer. From an electrical store purchase ½ pound of heavy tin foil 7 inches in width, a small can of shellac and a gallon of transformer oil. If transformer oil cannot be secured, use linseed oil.

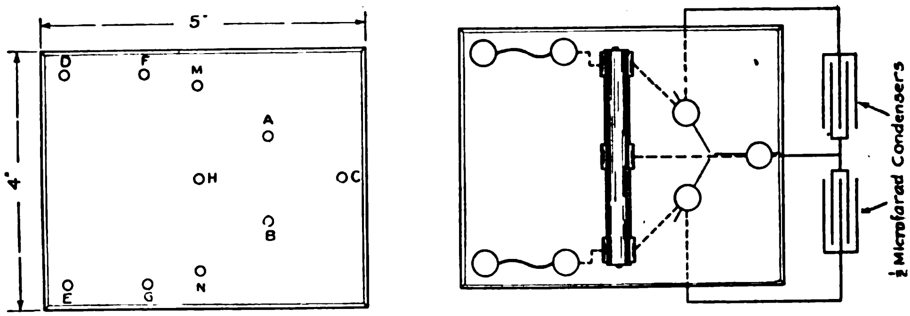
Give the tin foil to the washerwoman with instructions to iron to smoothness. Cut it into 16 sheets, each 7 x 9 inches, leaving on the right hand corner, in a lengthwise position, a tab about 2½ inches long and 1½ inch wide, as at A, in the accompanying figure. Round off all corners, as in the diagram. The plates are prepared for use in the following manner:

Set one plate down and cover it with a light coating of shellac on one side around the middle portions. Next place the tin foil exactly 1 inch from each edge of the plate, having the tab come out on the right as in the figure. Place another tab on top of the first one, laying the tin foil in the same position as in the first place. The tab of the second plate issues from the upper left hand corner. After the plates are completed, they are bound together with friction tape which is also wound over the tabs as a matter of protection.

When completed, allow the condenser to stand for two days until the shellac is thoroughly dry. Next secure a tin tray or pan of sufficient size to accommodate the condenser. It should have a depth of about 2½ inches. Place the condenser in the tray and pour in transformer oil until the plates are completely covered. Care should be taken to see that the tabs or foil do not touch or come within sparking distance of the pan. I have used the foregoing condenser on my 1-k.w. set and it



Figure, Second Prize Article



Figs. 1 and 2, Third Prize Article

has given excellent satisfaction. It has a capacity of .01 microfarad.

William H. Lyon,
Massachusetts.

THIRD PRIZE, THREE DOLLARS

An Absolute "Kick-back" Preventer

Many amateurs suffer much annoyance from the "kick-back" of high tension currents from the wireless aerial into the power line, the results being blown out fuses, burned out wiring meters and lamp sockets. In my case, the result was a grounded line which made the meters spin around at an enormous rate and at the same time burned out the wiring in a neighboring house. All this happened from the "kick-back" of a small ½-inch induction coil. The following is a positive and sure method for the prevention of potentials induced in this manner.

A base 4 x 5 inches is made of any suitable material, but preferably of slate. It is drilled for 8/32 bolts as shown in Fig. 1. Now put a 2-wire binding post in each hole; also insert three ordinary needles in the three binding posts, A, B and C, Fig. 1, and adjust them so as they form a gap of about 1/32 of an inch in length. At D and E, and F and G, place fuse clips and insert fuses at the amperage needed for protection. At M and N also put 2-fuse clips to hold a resistance rod of 3,000 or 5,000 ohms. These rods are of graphite and may be purchased from the Electro-Importing Company for fifty cents. At the center of this rod make a connection, fastening it to H. The wiring diagram is shown in Fig. 2, binding post H being connected to C underneath. Next connect two ½ microfarads condensers in series and shunt them across A and B and between the two condensers make a metallic connection, extending it to binding post C, and the preventer is finished.

It can be seen readily that an exceedingly small amount of line current will flow through 5,000-ohm resistance, and therefore the consumption of energy on this account is, practically speaking, nothing; but a high frequency discharge will travel through this rod quite easily and flow to the earth. Binding post C is connected to the ground and therefore induced potentials may take the choice of three ways to the ground: through the rod, the condenser, or the needle gap. Binding posts D and E are shunted right across the source of current. Fig. 3 shows the completed instrument.

Hayden P. Roberts, Ohio.

Note.—Apparently our correspondent has combined all the known methods for the prevention of the ill effects of electro-static induction into one piece of apparatus, and we agree with him, with the choice of paths afforded the high potential surges need not suffer from indecision as to which is preferable.—*Contest Editor*

FOURTH PRIZE, SUB CRIPTION TO THE WIRELESS AGE

A "Variable Fixed" Condenser for Amateur Use

The following is a description of an instrument comprising several fixed condensers of different capacities, so arranged that any or all may be connected in the circuit, making it variable to a considerable degree. A list of the materials required follows:

Seventy-four square inches of tin foil; 144 square inches of wax paper 0.001 of an inch in thickness; 25 square inches of brass 1/16 of an inch in thickness; 3 feet of ⅛ of an inch round brass rod, 3 feet of cable composed of from 6 to 12 strands small copper wire (about 32 B and S); 8 6-inch cables (those of the cord type are preferable); 5 binding posts, and a case about 10 x 4 x 3 inches.

Cut the tin foil into sheets 1 x 1¾ inches and the paper into sheets 2 x 1½ inches. The dielectric of the first condenser should be composed of three thicknesses of paper and the next of two thicknesses. Each of these condensers have 2 sheets of tin foil. The dielectric of the remaining 5 should be a single thickness of paper and the number of sheets should be 2, 3, 5, 9 and 17 respectively.

If the dimensions given here are used, the approximate capacity of these condensers in their respective order will be 0.000018 mfd., 0.000042 mfd., 0.00016 mfd., 0.00033 mfd., 0.00066 mfd., 0.00133 mfd., and 0.00266 mfd.

Two rolls of brass plates, each plate having dimensions of 1 inch by 1½ inches, should be screwed into the top of the case as shown in the accompanying drawings. There are 13 plates in each row; short lengths of cable are used to connect these plates with the condensers after the manner shown in Fig. 1.

Next cut a number of plugs ¾ of an inch in length from the brass rod of the size to fit the hole. These should be tapered almost to a point; solder one of these to each end of 4 of the 6-inch cords and to one end of each of the other 4 cords. The remaining plugs are for use in establishing contact between the plates. Drill a 3/32 of an inch hole in each of the three brass plates and fasten these on the end of the case.

They are to be connected to the aerial inductance and the earth, and allow a quick change from a shunt to a series condenser if the condenser is used on the aerial circuit of the tuner. Having a maximum capacity of 0.005 mfd., and a minimum capacity of less than 0.00001 mfd., this condenser may be used across the phones or the secondary winding of a "loose coupler." By proper arrangement of the plates, the operator may connect several condensers in series, multiple, or series multiple. The 4 cords with plugs on both ends are used to bridge over the condensers not wanted in the circuit.

The plates in the top of the case should not be placed closer than 1/32 of an inch or a relative large capacity between them will result. Also, a thick dielectric with a small surface of tin foil is to be avoided or the capacity will be next to nothing.

The formula for condensers in series is,

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

and for condensers in parallel,

$$C = C_1 + C_2 + C_3, \text{ etc.}$$

Thus it may be seen that almost any desired capacity may be obtained.

AUGUST SCHMIDT, JR., New York.

HONORABLE MENTION

An Efficient Pocket Wireless Set

The accompanying photograph shows a pocket receiving set which I constructed some time ago and with which I have ob-

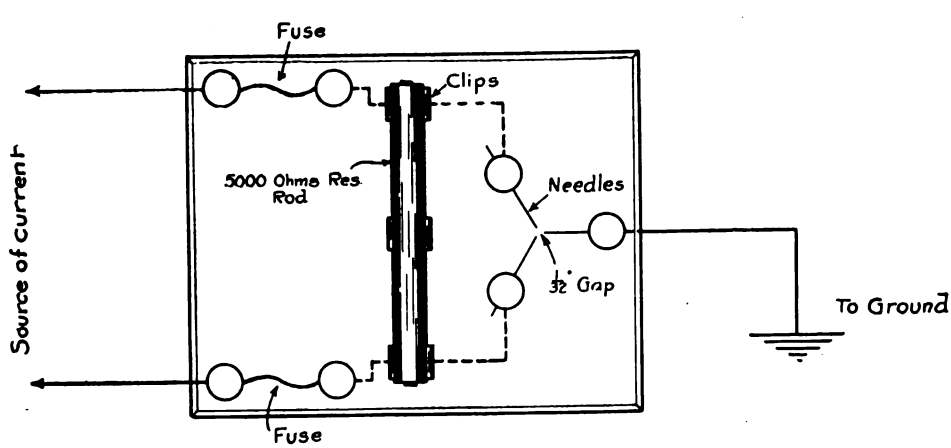
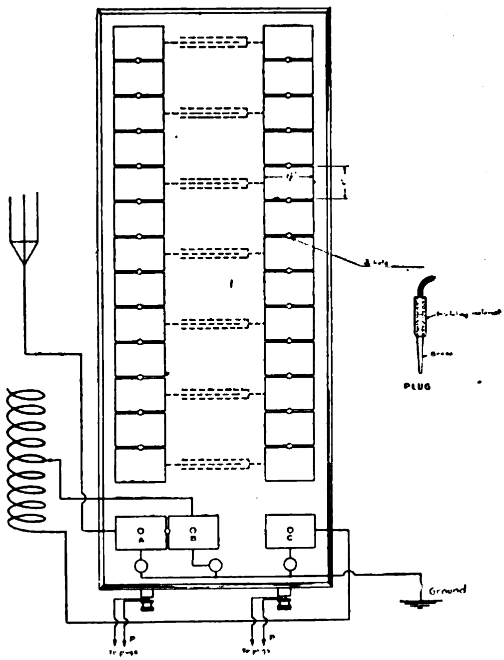


Fig. 3, Third Prize Article

tained excellent results. An Ingersoll "Yankee" watch is shown beside the set for comparison. With this outfit in connection with an aerial 60 feet high and 100 feet long, I have been able to hear NAM, NAI, NAA, WSL, WCC and many other



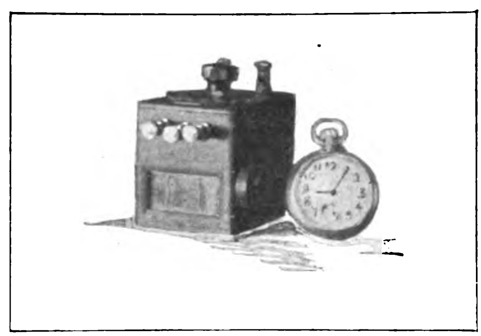
Figure, Fourth Prize Article

government and commercial stations along the Atlantic coast. Without using a loading coil, I have heard WCC fifteen feet away from the receiver. NAA and WSL come in equally as loud with this set, using a loading coil and the antenna referred to.

For construction, a box is made of 1/8-inch mahogany, the outside dimensions 3½ inches long by 2⅜ inches wide by 2¾ inches high. A window is cut through one end of the box which measures 1¾ inches by ⅞ inch. It is cut ⅜ of an inch up from the bottom and ⅜ of an inch from either side. A piece of glass or mica is glued over the window on the inside of the box.

The loose-coupled receiving tuning coils are made as follows:

Primary tube 2⅝ inches long by 2 inches outside diameter, wound with one

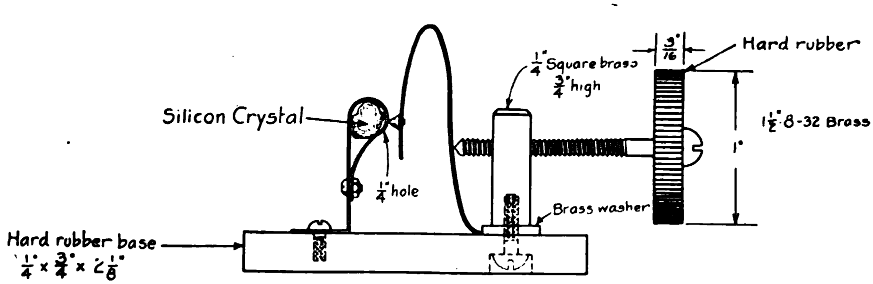


Photograph, Honorable Mention Article, James B. Armstrong

layer No. 30 enameled wire, tapped every 1/8 of an inch. Secondary tube 2⅝ inches long by 1⅝ inches outside diameter, wound with No. 30 enameled wire, no taps necessary.

The primary taps are connected to the points on a 20-point rotary switch on the box cover. An electrose knob is used to rotate the switch arm.

Detector Construction



Figure, Honorable Mention Article, James B. Armstrong

Two medium sized binding-posts are fastened to the cover near the back. One of these posts is connected to the switch arm while the other is connected to the remaining end of the primary winding.

A silicon detector is made as per sketch, of springy brass ribbon about 3/8 of an inch wide. The detector knob is of hard rubber.

Without any loading inductance, the set will tune up to 1,800 meters in connection with an aerial 100 feet long, or more. A loading coil made of 200 turns of No. 30 enameled wire 1½ inches in diameter will bring the wave-length up to 2,500 meters. A loading coil like this may be

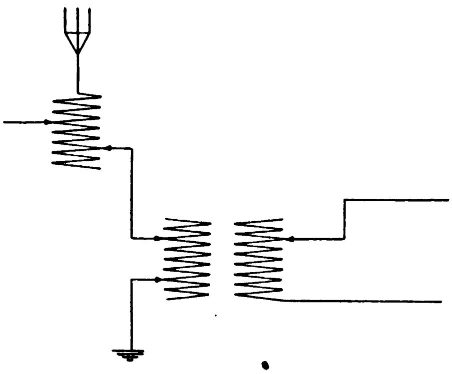


Fig. 1, Honorable Mention Article, Thomas W. Benson

placed in the box and connected to a suitable shorting switch on the rear end.

A fixed condenser is shunted across the binding-posts on the front end of the case, which is intended for the receiver connections. The detector is glued to the bottom of the box just behind the window, the knob projecting through a hole on one side, as in the photograph. The middle binding-post shown is to be used to connect in an extra detector from outside. I often use galena.

In conclusion I would say that I have had considerable success with a receiving set inside of an old Ingersoll watch case, the instruments consisting of inductive tuner and detector.

JAMES B. ARMSTRONG,
Massachusetts.

NOTE.—With a non-adjustable secondary of this type, the oscillations are necessarily forced, but if very tight coupling is used, the set will be responsive over a wide range of wave-lengths. Tests made on a secondary coil of similar dimensions, when shunted by a condenser of .001 mfd. maximum capacity, indicated a range of wave-

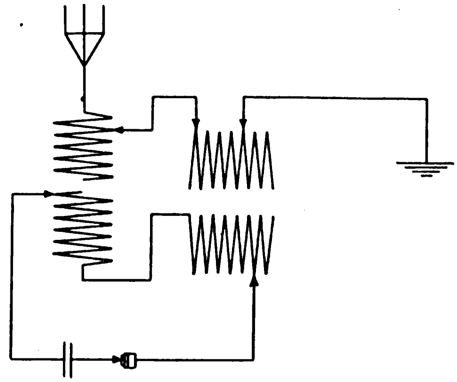


Fig. 2, Honorable Mention Article, Thomas W. Benson

lengths of from 200 to 1,600 meters. With tight coupling this secondary should respond to 2,500 meters.—*Contest Editor.*

HONORABLE MENTION

Loading Coils

As far as amateur sets are concerned, this is the day of loading coils. This is because the large commercial and government stations use waves far in excess of the range of the regular tuning apparatus in the amateur stations. I intend to describe a few methods of proven value that will enable the amateur to receive

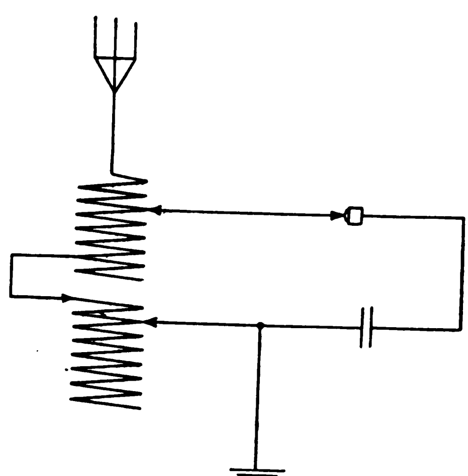


Fig. 3, Honorable Mention Article, Thomas W. Benson

signals from high power stations and therefore increase the value of his set.

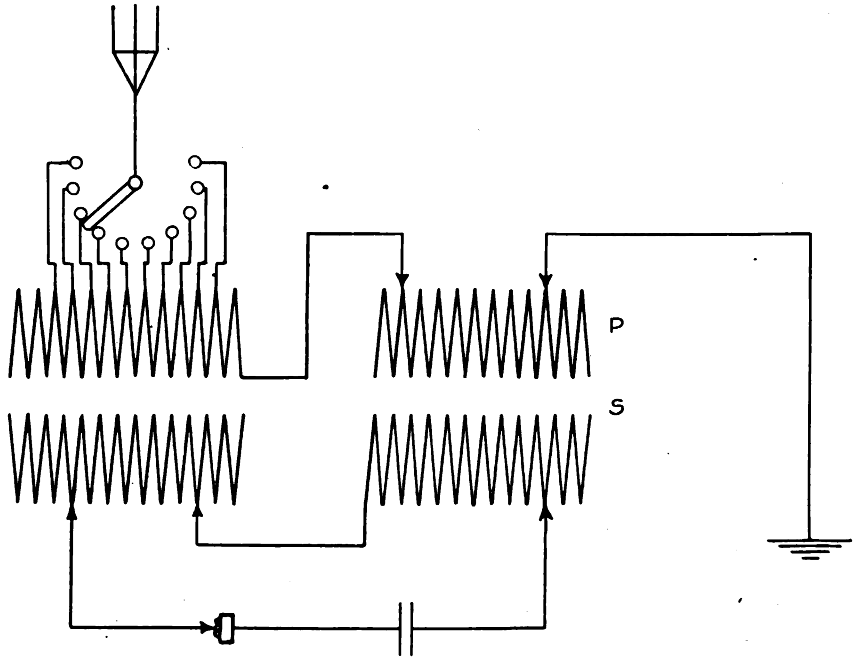


Fig. 4, Honorable Mention Article

Two methods can be used, one in which inductance is added in the circuit and the other in which capacities are placed in parallel with the regular inductances, thereby increasing the wave-length of the circuit.

I shall deal with the first method only. Many are "loading" with a tuner connected as shown in Fig. 1. This will work, but a better way to use a double slide tuner is shown in Fig. 2. Here the wire on the tuner is divided into 2 coils by cutting out 1 or 2 turns. This change will greatly increase the intensity of the signals as the secondary can be balanced up by adding inductance, which is also inductively coupled to the primary circuit.

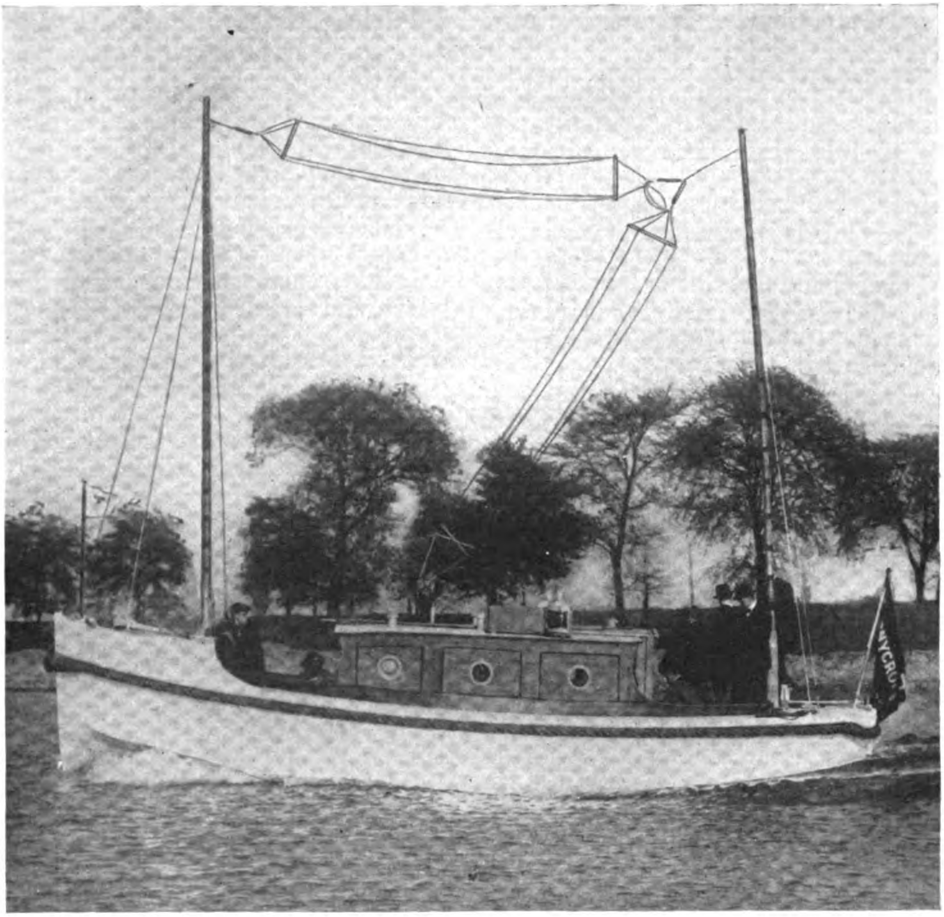
If a double slide tuner is used in connection with a single slide tuner as a loading coil use the hook-up shown in Fig. 3 for the best results.

The three methods described are really nothing more than new hook-ups, so I shall now describe a good loading coil that is worthy of a place on any amateur's table. A core 3 inches in diameter and 10 inches long, of wood or cardboard, is wound with one layer of No. 26 SCC wire. Cotton covered wire is used to get the full inductive effect and diminish the condenser action that would be present if enameled wire were used. This layer is tapped at 9 equidistant places and leads are connected. Over this two or three layers of paper are wrapped and then another layer of No. 26 SCC wire is wound neatly over it; no taps are taken from this layer. This coil is now mounted between two heads and two slide rods and sliders are mounted on it similar to a regular 2-slide tuner; a switch for the secondary turns is placed on one end.

For use connect as per Fig. 4. This will give a sliding adjustment in both circuits, allowing close tuning. Taps may be taken from the outer coil if so desired, but with the 2 sliders a change of coupling is possible by sliding them simultaneously away from the active section of the interior coil. In fact this coil will make a good loose-coupler if used as directed and it is easy to construct.

This article, I am sure, will be of some assistance to the experimenter in his efforts to increase the range, usefulness and efficiency of his set.

Thomas W. Benson,
Pennsylvania.



Wireless Equipment of Motor Lifeboats

WHEN measures are taken to make more secure the lives of those on board ships at sea, wireless telegraphy is almost sure to be used as one of the main factors in the plan. This was shown by the fact that the motor lifeboats with which the British Board of Trade Departmental Committee on Ships' Boats and Davits recommended that vessels be supplied, have been equipped with Marconi sets.

The Aquitania of the Cunard line and the Alsatian and Calgarran of the Allan line have been provided with motor boats equipped with Marconi sets.

The Aquitania, which has been added recently to the Cunard fleet, has been supplied with two motor boats. Their dimensions are as follows: length, thirty feet; breadth, nine feet and six inches· depth, four feet and six inches. Each boat is equipped with a motor arranged to start on petrol until the vaporizer is sufficiently heated, and then turned over to paraffin, thereby insuring an immediate start. The motor boats are designed to tow away the ordinary rowing lifeboats from the scene of a disaster. Each of the Aquitania's boats would be able to tow a considerable number of lifeboats. They make excellent sea boats because of their wide beam and specially designed lines.

The motor is housed in a cabin amidships, the forward end being divided off by a sound-proof bulkhead, forming a room for the Marconi apparatus. These compartments are lighted by eight portholes and ventilated from the roof. Provision has been made for the comfort of passengers in emergencies, each boat being fitted with space for medical chests and food supplies.

The wireless sets on the boats of the Aquitania transmit on a wave-length of 300 meters and receive on a wave-length of 600 meters. The aerial is of the L type, twenty-five feet in length, and twenty-five feet in height, made up of four wires supported on wood spreaders. Single ebonite rod insulators insulate the horizontal portion of the aerial from the mast halyards. Earth connection is obtained from some part of the engine near the propeller shaft. An aluminum water-tight box contains all of the transmitting and receiving apparatus. This box has a driving handle from the magnetic detector, and, where the alternator is hand driven, another handle is provided for the purpose. Current for the wireless telegraph apparatus is supplied by a small alternator driven by the engine. In the event that the engine power is not available an arrangement is provided for driving the dynamo by hand.

The magnetic detector has an aerial tuning inductance coil, which, with the jigger secondary and aerial, tune to 600 meters. A tapping is made on the inductance if 300 meters are required. An earth gap is provided and one change over is therefore necessary from transmitting to receiving.

The exhaustive tests to which the wireless apparatus on the motor boats has been subjected leave no doubt as to its efficiency. The box which contains the set occupies only a small space. One of the advantages of the box is that it is water-tight. This is important, for when a liner's lifeboats are compelled to do rescue work the weather conditions are apt to be such that the strength of the wireless equipment will be severely tested.

The necessity for motor boats equipped with wireless apparatus has been felt for a long time. When disasters occur at sea the lifeboats are generally widely separated. The wireless-equipped motor boats will enable the craft to be gathered together and held until the S O S brings rescuing vessels.

WIRELESS SUPPLEMENTS WIRE TELEGRAPH

High-speed wireless is to supplement the existing telegraphic system between England and the north of Scotland. The decision to employ wireless as a means of overcoming the havoc caused by Highland storms was made some time ago, but the employment of high-speed wireless was only agreed upon after a demonstration which was recently given by the Marconi Company. On that occasion messages were successfully transmitted between Chelmsford and Letterfrack in Galway, at the speed of 100 words a minute. Two systems of high-speed transmission have been standardized for wireless telegraphy, said a Marconi official. For messages sent at a speed not exceeding 60 words a minute an electrically operated switch is used, working in conjunction with a relay. For messages sent at speeds up to 150 words a minute a compressed air engine is used to operate the switch. In each case, however, the machines are primarily operated by Wheatstone's automatic transmitters, using a Wheatstone perforated tape. For high-speed recording a recording phonograph is used, in which the signals are magnified by valves and relays. The record is taken on a wax cylinder with the phonograph running fast. It is then transferred to another machine and reproduced to an operator at such a speed as gives the dot and dash effects in a distinguishable form. The Marconi Company claim for this high-speed. telegraphy, which shows at least four times the sending rapidity of the hand-transmitted wireless, several advantages in time of war. By high-speed work a very long message can be gotten through in a very short interval. The same high speed also prevents an enemy from tapping a message, unless, of course, the enemy obtains a high-speed receiver and runs it continuously.

The verses which accompanied the article on "War and Wireless" in the June issue of The Wireless Age were by Ernest Dupuy; the photographs were by F. M. B. de Stefano. Through an oversight the writer and photographer did not receive credit when the article was published.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

C. B., Brockport, N. Y., asks:

Ques.—(1) What is a good method of eliminating static when receiving?

Ans.—(1) This problem has never been solved. The effects of static may be reduced by the employment of an inductively coupled receiving tuner, using the least possible degree of coupling between the primary and secondary windings, consistent with the strength of signals.

The interference preventer circuits of Fessenden are of some value in this respect. This circuit is described in article 198, Naval Manual of Wireless Telegraphy for 1913.

A receiving aerial placed near to the earth is influenced by atmosphere electricity to a less degree than one erected at a great height.

Ques.—(2) Which would be better for general work, a straightaway type aerial or a loop type when 2 wires 300 feet long and about 60 feet high are to be used?

Ans.—(2) As far as transmission is concerned, it makes no difference because aerials arranged in the "looped" form for receiving generally act as a plain straight-way aerial when sending.

Are you sure that you thoroughly understand the points of difference between the loop and the straightaway types? If you are a beginner we suggest that the straight-way aerial be adopted.

* * *

S. C., Brooklyn, N. Y., writes:

Ques.—(1) Can you tell me the trouble with my receivers? They are 2,000 ohms resistance. When I use my navy phones, signals come in quite loud, but when I use the other pair even NAH comes in faint. The magnets seem to be all right.

Ans.—(1) It is rather hard to say without closer investigation. The diaphragms may be bent or too close to the magnets. The windings of the magnets may be partially short-circuited. There may be considerable difference of resistance between the two telephones, which may account for the difference in sensitiveness.

Ques.—(2) My aerial is 85 feet long; 2 strands, 4 feet apart; lead-in, 30 feet; ground lead-in, 15 feet; using loose coupler, silicon detector, fixed condenser and navy phones. Why can't I tune in amateur stations?

Ans.—(2) You require a short wave condenser placed in series with the antenna circuit in order to hear amateur stations. Any of the small variable condensers to be found in the open market may be used.

Ques.—(3) Please show in a diagram how to take taps off the secondary of a loose coupler.

Ans.—(3) The turns in use in the secondary winding of a receiving tuner are ordinarily varied by means of a multiple point switch, as shown in

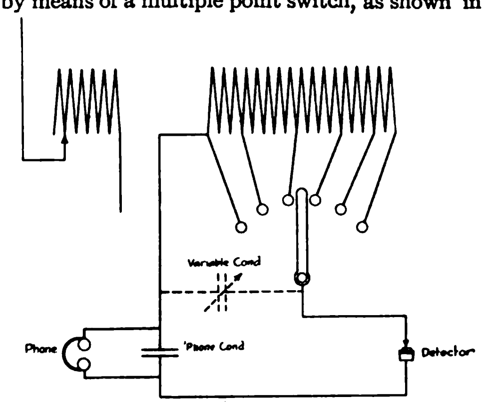


Fig. 1

Fig. 1. The turns are usually divided equally between the taps on the switch. For the average secondary, not more than 10 taps are necessary; this is particularly the case when a variable condenser is connected across the terminals of the secondary winding.

* * *

C. M. W., Jr., Hampton, Va., asks:

Ques.—(1) Will you kindly explain why I hear wireless signals clearly and distinctly when the detector is not making contact? This has happened twice and I am anxious to know what causes it. The Norfolk Naval Station is heard by me in this manner. This station is 20 miles from mine.

Ans.—(1) We have carefully noted the hook-up accompanying your query, but do not understand it thoroughly. If your aerial was very near to the Norfolk station it could be accounted for in the phenomena of electro-static induction. A detector is unnecessary to read signals when the head telephones or its associated circuits are in the static field of the aerial, but since you are at some distance, we cannot account for it.

Ques.—(2) Give the number of watts at which the average 1½-inch spark coil is rated.

Ans.—(2) Thirty watts.

Ques.—(3) Give the approximate wave-length of the following instruments: 1½-inch coil; 1

pint Leyden jar; oscillation transformer, primary 18 feet of brass ribbon, 1¼ inches in width, secondary 30 feet of ribbon; aerial 50 feet by 55 feet high, 90 feet long; 10 dry cells as power.

Ans.—(3) The approximate wave-length of the aerial is 280 meters; it will be increased to about 340 meters by the use of an oscillation transformer.

Ques.—(4) What is your opinion on the distance that I may send and receive with an aerial 36 by 30 by 90 feet?

Ans.—(4) You will be able to send 15 to 20 miles under best conditions, and receive 200 miles.

* * *

T. E. M., Stanislaus, Cal., writes:

Ques.—(1) Please tell me the natural wave-length of an inverted L aerial consisting of 2 wires 300 feet long and spaced 10 feet apart; the horizontal part 200 feet long and the vertical part 100 feet. The average height from the ground is about 150 feet. The aerial consists of No. 12 B. & S. gauge stranded (7 strands of No. 20 B. & S. gauge copper-clad wire). The aerial is suspended across a canyon with considerable vegetation growing on its sides.

Ans.—(1) The natural wave-length of this aerial is about 460 meters.

Ques.—(2) What is the natural wave-length of an aerial of the same dimensions as that referred to in question No. 1, except that it consists of 3 wires spaced 8 feet apart?

Ans.—(2) About 500 meters.

Ques.—(3) How many amperes should a hot wire meter read, placed in the "grounded" side of the secondary of the oscillation transformer of a well tuned 1½-k.w. transmitting set? (60 cycles).

Ans.—(3) With the plain type of spark gap, 5 amperes should flow.

* * *

T. D., Columbus, O., inquires:

Ques.—(1) The wave-length of my aerial is 260 meters and with an oscillation transformer I have about 600 meters' wave-length. What size series condenser would bring it down from 600 to 190 meters?

Ans.—(1) This query cannot be answered, for we do not know the capacity (in microfarads) of the present aerial. It is a very inefficient method to attempt transmission on a 600 meter circuit reduced to 160 meters by a series condenser. You will find that there will be practically no radiation from the aerial. Your queries Nos. 2, 3 and 4 may be placed in the same category and cannot be answered unless the capacity of the aerial is known. Query No. 5 cannot be definitely answered as we do not know the order of the capacity of the condenser used in the spark gap circuit.

* * *

J. F., Tampa, Fla., sends us a number of queries. He asks:

Will you please tell me how much wire should be put on the primary and secondary of an oscillation transformer for use with a 550-watt transformer? The secondary will be similar to the ones used by the Marconi Company and I intend to use a loading coil to vary the wave-length of the open circuit.

About what length should my aerial be from the lead-in to secure 200 meters' wave-length? It will be about 54 feet to 58 feet high and of the inverted L type.

I have some 8-inch by 10-inch glass photograph plates to use for a condenser. Will you please tell me how many should be used for the transformer mentioned? The voltage is about 9,600.

Also, please give a diagram for connections of set including transformer, rotary gap, glass plate condenser and oscillation transformer.

Ans.—We shall first begin with the rotary gap. You have given us no data whatsoever concerning it. We should know the speed and the number of points on the disc. Assuming that your disc gave 400 sparks per second, the maximum power your transformer would absorb at the secondary voltage of 9,600 would not be more than 200 watts.

This is based on a condenser capacity in the spark gap circuit of .01 mfds., which is the maximum allowable at a wave-length of 200 meters. Using 8 by 10-inch glass plates covered with foil 6 inches by 8 inches, 18 are required to obtain a capacity of .01 mfds.

For the data as to an oscillation transformer suitable for a 200-meter amateur set, see the article entitled, "A 200-meter Amateur Set," in the November, 1913, Wireless Age. You may increase the size of the wire suggested in that article.

Note past issues of The Wireless Age for proper connections of your apparatus. It seems that a wave-meter would be a desirable asset at the stations of the majority of our correspondents. If the flat top portion of the aerial you describe consisted of 4 wires spaced 2 feet apart it should be 40 feet in length for a natural period of 200 meters.

* * *

L. W. B., Waterford, Conn., asks:

Ques.—(1) Please tell me if a register such as the Electro Importing Co. puts out can be hooked up with the following instruments to register wireless messages: A relay 50-ohm coherer and decoherer and a 175-foot 2-wire aerial and ground. If so, will you send me a hook-up for it?

Ans.—(1) The relay may be used for short distance work, but is preferably of higher resistance —150 to 500 ohms. Relays formerly used by the Marconi Company in connection with the commercial coherer sets had resistance of from 8,000 to 10,000 ohms.

If you have not had experience with the coherer type of receiver you will find you have much to learn. It is a delicate arrangement, requiring considerable skill in adjustment for working results.

We have never witnessed the small register you refer to, in operation, but if it will respond on a wire line circuit, it should give results in connection with the coherer.

Please bear in mind that the average amateur signaling in the United States is too rapid for the ordinary coherer, and further, that the sending must be done more carefully to give intelligible signals at the receiver; again the armature of the Morse register must be adjusted to act sluggishly, because a dash otherwise will be recorded as a succession of dots. This is due to the action of the decoherer.

The following hook-up may be used (Fig. 2):

R and R1 are non-inductive resistances to eliminate sparking at the contacts of the relay and decoherer. R2, R3 and R4 eliminate the counter-electromotive force in the magnet windings. The resistance winding placed across the contacts of the decoherer is not shown, but should be readily understood.

The actual value of resistance employed will depend upon the resistance of the coils of the various magnets. For instance, R should be of sufficiently high value not to close the battery circuit of the register and decoherer. C and C1 are choking coils, consisting of two or three layers of No. 36 wire wound over an iron core 2 inches in length and ¼ of an inch in diameter.

* * *

A. L. G., New York City, asks:

Will you kindly explain the use of cerusite as a detector? I have tried to use it in the same way as silicon and galena but without results.

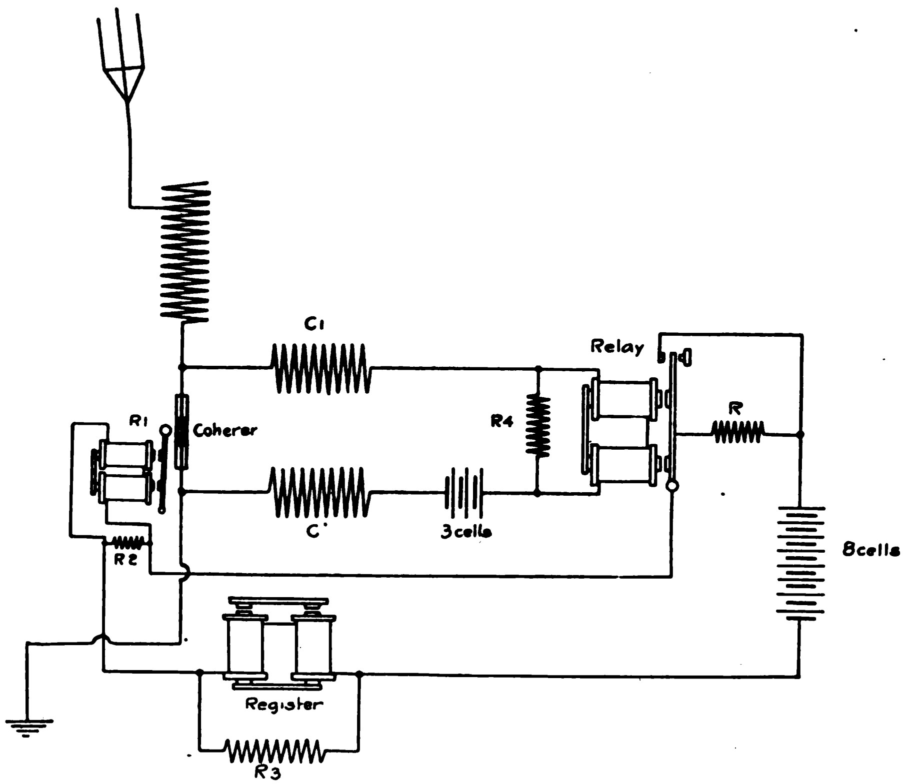


Fig. 2

Ans.—Cerusite crystals other than those furnished by the Marconi Company are apt to be insensitive. It is used in the same manner as silicon or perikon. The contact point is generally steel. Cerusite detectors may be purchased from the Marconi Company for $50 each.

* * *

J. E. C., Waterbury, Conn., writes:

Ques.—(1) I have constructed a condenser of the type shown in the November, 1913, issue of THE WIRELESS AGE, in the article entitled "A 200-meter Amateur Set." The remainder of my set is of the standard Marconi 1-k.w. boat type. (60 cycles A. C.) I use a Thordarson transformer (20,000 volt secondary). The oscillation transformer primary consists of 10 turns of ¼-inch wire on a 14½-inch frame spaced 1 inch apart. The secondary winding has a fixed value of inductance consisting of about 4 turns of Packard combination high tension cable, wound on a drum 20½ inches in diameter. My aerial tuning inductance is wound on a frame 30 inches in length and 13 inches in diameter. The winding is of 7-strand copper wire spaced 1½ inches apart. For the rotary gap, I intend to use a Barnes variable speed motor and a 12-point disc turning at a speed of 3,000 R. P. M. My aerial consists of 4 No. 12 wires spaced 30 inches apart, 165 feet in length by 55 feet in height.

Will you please give me the correct number of plates of this size for best efficiency and the method of connection?

Ans.—(1) With the disc traveling at this speed, the condenser should have capacity of 0.0083 mfds. You therefore require 16 plates in parallel. This calculation is based on a 20,000 volt secondary.

Ques.—(2) What is the natural wave-length of my aerial?

Ans.—(2) About 410 meters. This value will be boosted considerably by the oscillation transformer and aerial inductance.

* * *

M. C. C., New York:

The information you request concerning the magnetic detector is not available for publication.

THE WIRELESS AGE

AUGUST, 1914

THE RADIO REVIEW

GODFREY ISAACS, Managing Director of the English Marconi Company, is quoted in London dispatches as saying that Mr. Marconi expects to be able to telephone from Carnarvon, Wales, to New York, before the end of the present year. This statement was made while testifying before the Dominions Royal Commission on Imperial Communications, and was followed by a query from Sir Rider Haggard as to whether it could be expected that the time would come when a subscriber could have a telephone in his house by which he could telephone all over the world. Mr. Isaacs answered that he would not like to go as far as this, for many difficulties would first have to be overcome; but it might be possible to go to a particular station in London and telephone to New York.

Telephony Predictions near Realization

Thus it is not only possible but probable that the feat of telephoning from Wales to New York will be accomplished before many months have passed. For some little time tests have been conducted between London and Chelmsford, twenty-nine miles apart, and, according to the dispatches, Mr. Marconi is authority for the statement that the telephone apparatus to be used in trans-Atlantic communication will soon be ready. Mr. Marconi does not make statements haphazardly, so it looks as if we shall soon see the fulfillment of the long-expected wireless telephoning between two countries, the wonder of which baffles ordinary intelligence.

WITH experiments so far advanced and unusual confidence in success expressed, one's thoughts naturally turn to the commercial possibilities of the wireless telephone, and first—in these days when we all stand in the shadow of the bugaboo of the high cost of living—is what will it cost to talk from New York to London? If it is to be compared to present-day cable telephone, it will be somewhat expensive. It now costs nearly one dollar a minute to telephone between London and Paris. The wireless telephone may have competition there. But it is rather well understood that a cable telephone between London and New York is an impossibility. There are now sixteen cables across the Atlantic, but not one spoken word can be heard. In attempting to telephone by cable

Cost and Type of Service

the sounds are distorted as the distance increases; with wireless the sounds of course become weaker, but the voice is not distorted.

The forthcoming wireless telephone service is not expected to be a public one, but full confidence is expressed that it will be possible for privileged persons. Nor is it likely that apparatus will be installed in private homes, although there could hardly be any physical objection to a millionaire having a private installation between his home and his office. The logical arrangement, and the one which will eventually be adopted no doubt, will consist of wire connections from offices direct into instruments located at the stations in London and New York.

The Globe Girdling Aerial Flight

WITH his ever-increasing activities Mr. Marconi has not neglected aviation, according to the reports of his recent conference with the Commissioner of Aeronautics of the Panama-Pacific Exposition.

The Commissioner, Mr. Arnold Kruckman, had a long conference with Mr. Marconi, who is enthusiastic over the prospects of the around-the-world flight. The inventor not only promised to help with wireless on the seas, but offered to place the entire world's wireless system at the disposal of competitors in the race. He has studied carefully the question of wireless assistance to overseas flyers with Hamel, when the distinguished English aviator was planning a cross-Atlantic flight. Hamel's disappearance while flying the English Channel put an untimely end to those plans. But the result of these calculations will be placed at the disposal of the commission.

Wireless Employment for Unfortunates

A LEPER in a colony on an island near New Bedford, Mass., has applied for a wireless license, and it is said he will have no difficulty in securing it. He has pursued his wireless studies with poor equipment during the five years he has been a member of the colony. Why does not this open the way to a possible use for the leper, now an outcast and a drone? There are government activities which require no communication with the outside world of a nature which threatens infection and yet do not leave the sufferer out of the processes of society. For example, many wireless stations on bleak coasts where settlements are impossible would be well cared for in the hands of those afflicted with the dread disease. A leper settlement with a physician in charge and telephone equipment to relay messages could give splendid service, several inmates serving at the receiving and sending stations for a short period during the day or night.

Then there is that cable station in the Pacific where a dozen persons are on an island far from every inhabited region. Christmas Island's phosphate industry might offer similar opportunities. It would seem worthy of strenuous effort to find means of making happy the lives of these unfortunates; and no way promises greater possibilities in the discovery of some means of employment under government supervision which assures productivity without the chance of infection and without the absolute isolation which is so fatal to human kind.

THE EDITOR.

Lawrence Prudhont

An Appreciation

Monument Erected in California to the Memory of an Unsung Hero of the Wireless Key

ON the first anniversary of the Rosecrans sea disaster, a monument to the memory of Marconi operator Lawrence A. Prudhont was unveiled at Venice, Cal. The granite shaft stands in the Rosedale Cemetery, but there is no grave. The body has never been recovered.

Behind this brief news item lies a story of noble self-sacrifice that others might live, and wonderful devotion to duty in the face of certain death. A blue-eyed boy of eighteen years had stood alone by his crackling wireless key and with the hungry waves clutching at his feet sent forth the plaintive appeal that brought succor to the vessel's storm-stricken crew. When the rescuers arrived, hours later and after a heartbreaking battle with the sea, Lawrence Prudhont could not be found.

According to the survivors this hero of heroes, duty done, had been pinned between the wrecked pilot house and the vessel's rail, and when the ill-starred Rosecrans broke up, he was washed away and drowned. An immortal hero sleeps; unsung, almost unknown, but leaving behind a glorious memory of supreme devotion and undaunted courage. All men must feel an expansion of soul in the presence of calm courage such as this; and his example will ever prove a source of inspiration to his fellow wireless workers.

Little is known of the Rosecrans disaster. It was not a national tragedy with thousands of hearts pulsating and enormous crowds gathering about bulletin boards, searching through blinding tears for the names of loved ones, lost or saved. Thirty-three lives were lost. Thirty-three good seamen, snatched into oblivion on the morning of January 7, 1913, and a pitiful remainder of three brought safely ashore. None of them were well known; many left no family; so the ocean tragedy was soon forgotten. A few public spirited citizens of California cherished the memory of Lawrence Prudhont, though, and a movement was started to secure funds for a memorial by popular subscription. It was also arranged to have his name inscribed on the wireless operators' memorial fountain to be erected in New York; and this will be done.

Far too little is known of this boy; not much about him can be told. But the one thing that invariably stands out when each new hero is made upholding the Marconi tradition, is particularly noticeable in the case of young Prudhont. That is, a perfect record. This is best shown by extracts from the reports of his superiors. One says: "The young man was single and of exceptional ability as a wireless operator; he was studious, honest, and in the very best of standing in the community." Another says: "Lawrence was a fine boy, a good, conscientious worker. I had a very high regard for Lawrence." The general superintendent of his division reported that "Operator Prudhont was a young, industrious and ambition operator; a credit to his profession."

Young Prudhont was a wireless operator from choice, and secured his position through determination and conscientious effort. A glimpse of his boyhood days will throw some light on how inevitable was his following of the sea and reveal interesting indications of strength of character manifested unusually early.

His father was a merchant on the ocean front at Venice, Cal., and the limitless spaces and mysterious tides of the sea drew Lawrence to the beach from childhood. The strength and restfulness which the great solitudes habitually impart to those who commune with them had taught him life's true perspective when, at seventeen, he combined another elemental love, electricity. Thus it was that his experiments with wireless quickly fostered a definite aim and purpose—to become a man-of-warsman in the United States Navy.

He had learned something of that branch of the service from embracing every opportunity to go on short voyages and while aboard permitted nothing of an electrical nature to escape his keen observation. He tried several times to enter the navy, but failed for lack of parental consent. Finally this was given, his father and mother deciding there was no other way to relieve him of his constant longing to enter the marine wireless field.

Passing his examination at Los Angeles, he left for San Francisco expecting to be stationed on a training ship at that port and to be later assigned to a warship. To his great surprise the exacting medicos at the Golden Gate turned him down. Rear Admiral Moore later advised his father that the boy had been rejected on account of valvular heart disease. Greatly disappointed, but not discouraged, Prudhont started back home. He stopped off at San Pedro en route, however, embraced the opportunity there given him to ship on the merchant steamer Yosemite and commenced the wireless career that was brought to such an untimely end.

Aside from the instruction gathered by questioning the mechanics of Venice, young Prudhont attended the Belden School in Los Angeles and the Marconi School in San Francisco. In January, 1913, he had gained the position of chief operator on the steamship Yale, running from San Diego to San Francisco. The vessel was put in dry dock for twelve days and the boy planned to go home on a vacation. He gave up this project when he was asked to make one trip on the Rosecrans as an accommodation to the company. When the Rosecrans went ashore only three of the thirty-six members of the crew were saved, and the boy who loved the sea was the last to leave the doomed vessel.

One of the most touching incidents connected with the preservation of the memory of Lawrence Prudhont's noble performance of duty occurred on the Memorial Day following his death. Five torpedo boats were stationed outside the breakwater at Venice and ushered in the day with a cannon salute. Services were held in the auditorium and at their conclusion the civic bodies and the school children formed in line and marched to the ocean front. A salute was fired from the naval militia and the torpedo boats and the children and adults tossed thousands of white carnations on the ocean in memory of Lawrence Prudhont, whose name will remain emblazoned throughout eternity among those who have gone to death in the sanctified cause of manliness and self-sacrifice.

SERVICE ITEMS

Henry F. Litaud, who has been employed in the traffic department of the Marconi Wireless Telegraph Company of America for the last fourteen months, has accepted a position in the traffic department of the English Marconi Company. He left New York for England on July 21 on the SS. Aquitania.

H. E. Jensen, an apprentice wireless operator of the Marconi Company, died at sea on the SS. United States on May 23. He had been in the service only twelve days.

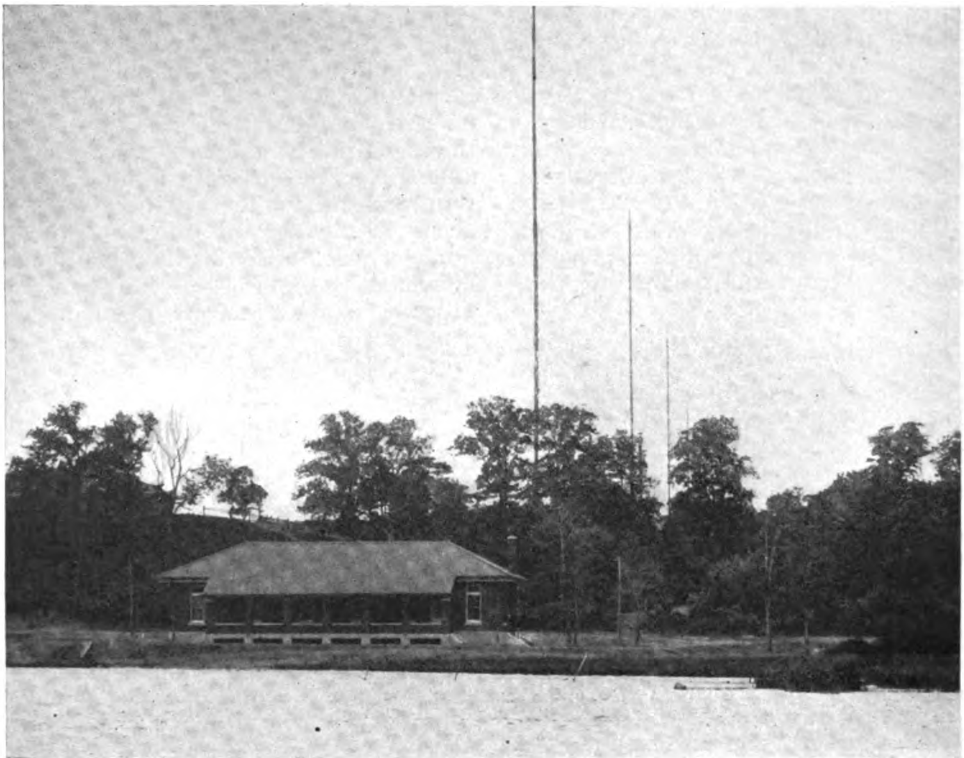
R. T. Jenssen, junior Marconi operator on the SS. Kristianiafjord, died in the Norwegian Hospital, New York City, on June 15.

The Austrian license of E. C. Werner, wireless operator, who deserted from the Patris at New York last October, has been cancelled.

S. de Winter has been appointed Pacific Coast representative of the Marconi Wireless Telegraph Company of Canada. He has opened an office at 651 Howe Office Building, 318 Richard street, Vancouver, B. C.

Charles Banta, junior operator on the City of Montgomery of the Savannah line, died from appendicitis on June 15 in Irvington, N. Y.

Among the July visitors to New York was W. H. Eccles, the English scientist whose investigations into static causes have won him the position of honorary secretary of the Committee for Radiotelegraphic Investigation, British Association for the Advancement of Science.

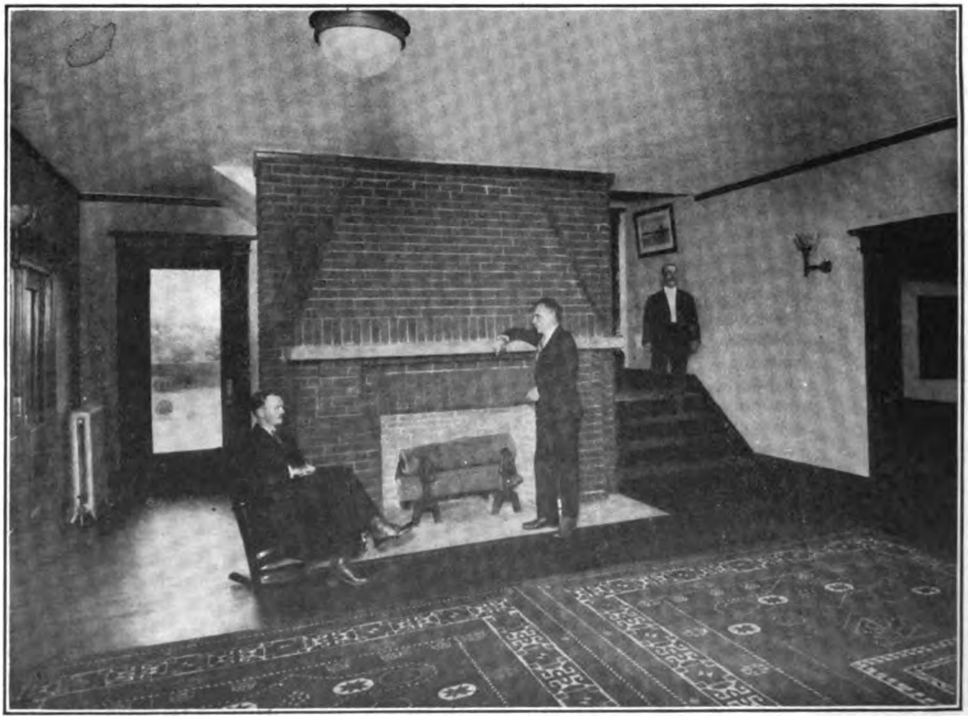


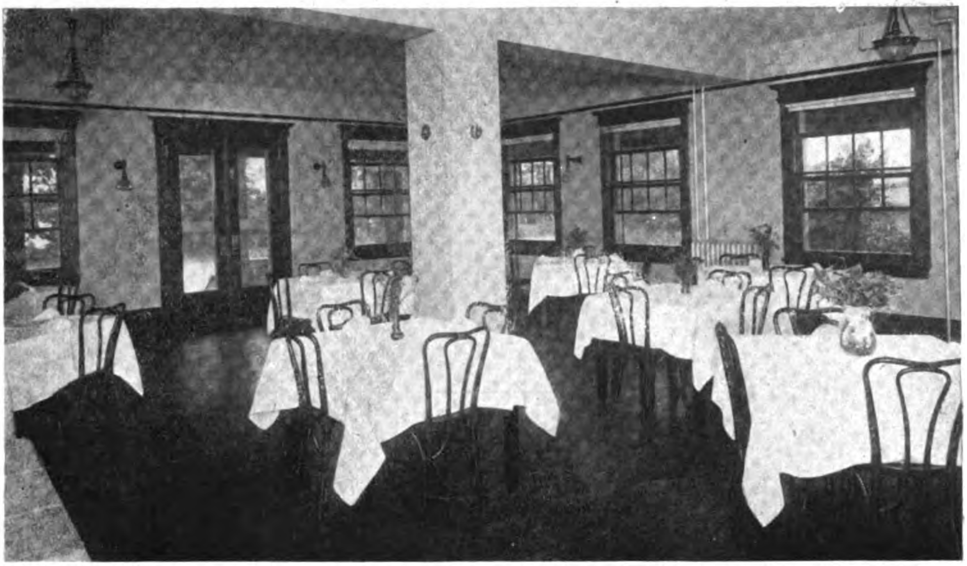
The Belmar Station

The illustration at the top of this page shows the operating building located at the water's edge at Belmar, N. J. The masts of this gigantic Marconi station, which appear in the background, are 300 feet high and the aerials carried on them stretch westward for almost a mile. It is here that the wireless messages which are soon to wing their way across the Atlantic from Wales will be received. The Belmar plant is one of the largest in the world and perhaps the most important link in the Marconi world-wide wireless chain. It has an equipment second to none, as the photographs on the pages following will testify. The operating building necessarily appears small in the illustration, but is over 82 feet long. It contains a generously proportioned office for the manager, a similar one for the engineer in charge; also a large store room and a coat room. The room containing the tuning apparatus runs the full depth of the building and is connected by a message chute with the receiving room adjoining. Nearby is the charging room for small accumulators and the main operating room with five large tables, which, when fully manned, will require thirty operators. All messages received and transmitted from this station will be handled automatically, most of them being received at the Broad Street and Madison Square offices of the Marconi Company. Similar arrangements have been made for filing Wales station messages in London, thus placing the two greatest cities in the world in direct communication by trans-Atlantic wireless.

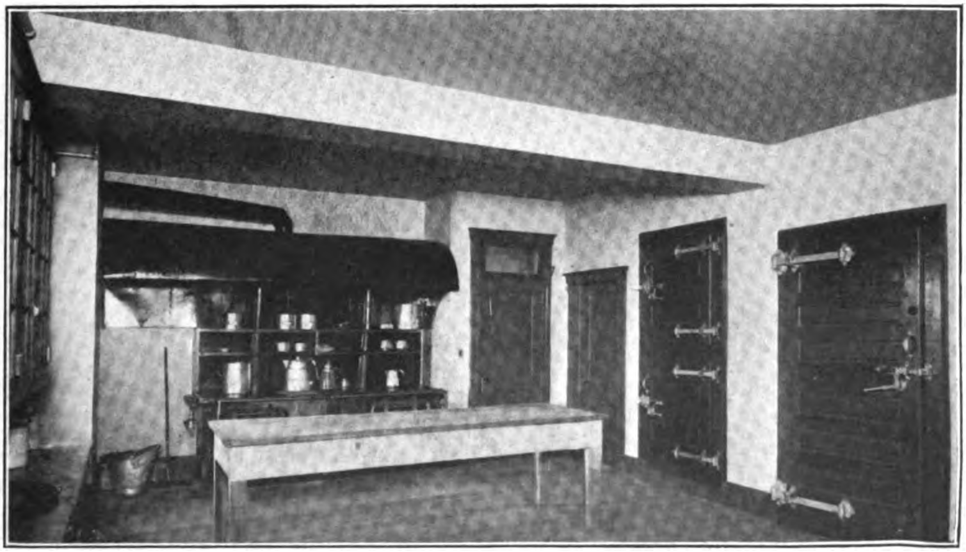
For the comfort and convenience of the large staff of operators and engineers necessary to maintain the twenty-four-hour service at Belmar the Marconi Company has erected the hotel shown in the above illustration. Built of dark red ornamental brick, with a lighter red tile roof, this fireproof structure is as handsome as any of the palatial summer resort hotels in the vicinity. It is a city block long and contains 45 bedrooms.

The photograph above gives a partial view of the hotel lounge, where the Belmar operators will congregate in the evening for relaxation and entertainment. Below, the foyer hall leading in from the porch.

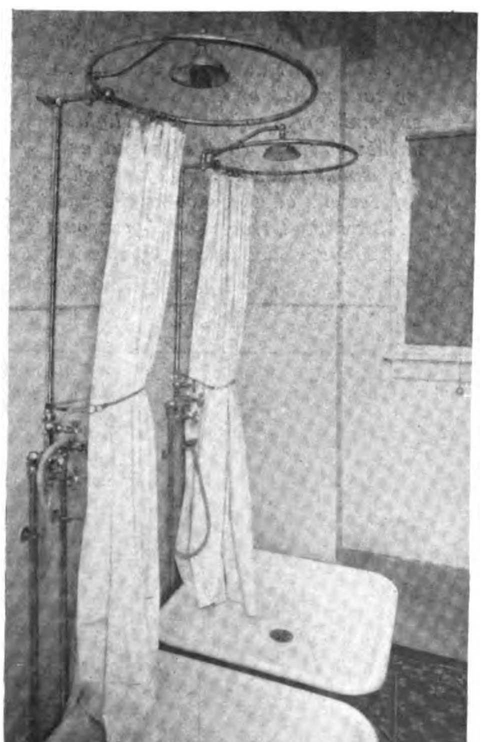




The dining-room in the hotel is a cheery apartment and is arranged so that each diner will have a pleasant outlook and plenty of room. From the windows may be seen the wide, sweeping shore lines of the Shark River and the breakers of the Atlantic. There are seating accommodations for 50 persons and many more can be taken care of whenever necessary. The kitchen, a portion of which is shown in the lower photograph, is equipped with every modern aid to the culinary art, in charge of a French chef. To the right of the illustration may be seen the heavy vault doors leading to the cold storage plant, eighteen feet square. The refrigerating plant, operated in conjunction, has a capacity of 600 pounds of ice per day.



A typical bedroom in the hotel and a private sitting room.

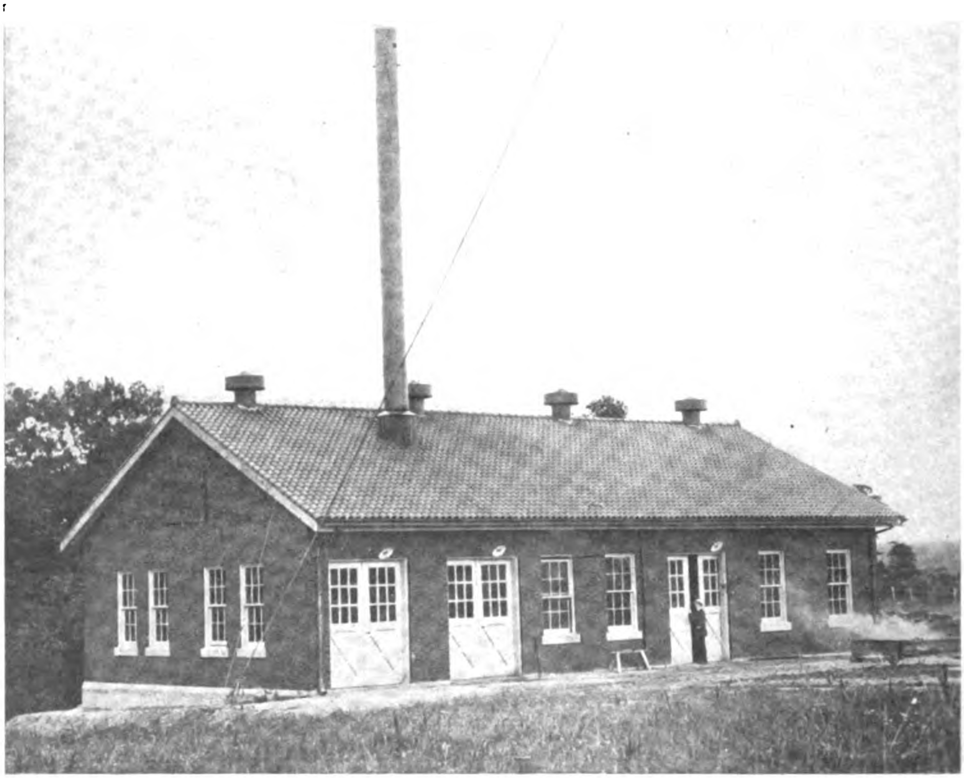


Some indication of the luxury afforded the operators fortunate enough to secure an assignment to the Marconi station at Belmar is given in the two illustrations on this page. The upper photograph shows a portion of the land set aside for the raising of fresh vegetables for the table. Twelve acres of the 600-acre tract are planted with garden truck for all seasons and experienced farm hands give this feature undivided attention. The photograph on the lower left hand shows part of the shower room in the hotel, an additional comfort to the sixteen bathrooms provided for the men. Outdoor sports play a large part in the life of the section and while the shower baths are not meant to be competitive with the sea and still water bathing, they will undoubtedly be greatly enjoyed by those coming off duty on a summer's day or returning from a hard set of tennis on the courts provided for the staff.

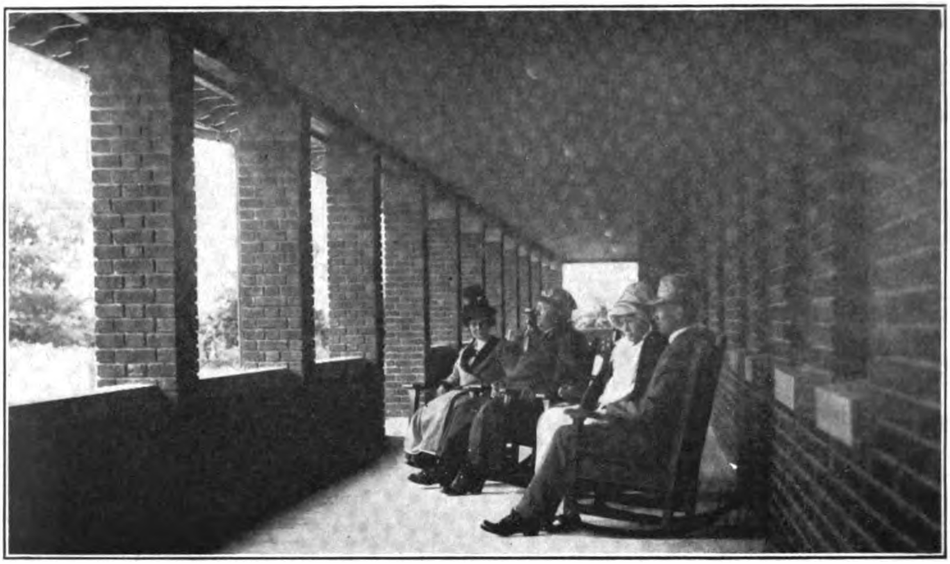
The cottages for the manager and engineer in charge at Belmar are shown respectively in the upper and lower illustrations. These most attractive bungalows architecturally conform to the hotel building, being constructed of dark red tapestry brick, laid with raked joint and black mortar, and the roofs are of lighter red Spanish tile. The best of building materials have been used throughout and structural details comprise the most modern fireproofing methods. The inside partitions are of hollow tile, the plaster work of cement on terra cotta tile and the inside wood flooring is laid on concrete. Attractive terraces and generous verandas are an additional attraction of these buildings, which are 50 feet wide and 40 feet deep.

The progress in wireless telegraphy is well illustrated by these photographs taken in the quarters provided for the management, for they clearly indicate the change to ideal living conditions, as contrasted with the cramped quarters in bleak localities which until recently were the land station operators' portion. The smaller picture on this page shows the dining-room of the manager's cottage at Belmar. The cottages, of which this is typical, have been furnished throughout by the Marconi Company; handsome electric fixtures, high grade rugs in Oriental patterns, pictures, chairs, tables, buffets and the various items of furniture, were selected by a special committee with a view toward tasteful harmony with the surroundings. The lower view is of the living room, the feature of which is the tapestry brick fireplace. Easy chairs upholstered in leather, rocking and straight chairs, settees and dining-room chairs, too, are all upholstered in leather. Bookcases and library tables are further aids to comfort. The bedrooms, of which there are four to a cottage, are finished in mahogany, with two rugs, straight and rocking chairs, enameled beds, chiffonier or dresser and appropriate pictures. The bathrooms are fitted with the very best of fixtures and the kitchen equipment includes a large range and hot water boiler. The cottages are steam heated from the power plant.

A glimpse of the manager's office and the power and electric lighting plant.



The natural beauties of the high bluff on which the Belmar station is located have been further enhanced by care in laying out the grounds under the direction of a landscape artist. The walk seen in the picture above is typical of the efforts in this direction. In the illustration below an impression of the heavily-wooded shores of the Shark River is given; here the balancing line towers are located. One may be seen in the foreground of the illustration; others may be traced by the fainter reproductions in the middle distance and background.



The piazza of the hotel is nearly a city block long and has already become a favored resting place for automobile tourists who visit the station. Situated on a high bluff at the westward end of the Shark River, a broad and navigable stream dotted here and there with sailboats, canoes and motor boats, the Belmar hotel commands a vista unsurpassed for miles around. An endless profusion of laurel, birch, oak, maple and pine trees cover the hills, and the spoils of wild grape vines and huckleberries, mulberries and blackberries are there for the wireless men and visitors. Off to the eastward may be seen the broad expanse of the Atlantic and the edge of the pine belt, and the resultant pungent blend of piney aroma and salty tang of the sea holds great attractions. A landing dock for motor boats is under construction and the wooded slopes of the Marconi property will soon become the headquarters of the numerous picnickers from the seashore cottages.

The Completion of the Carnarvon Station

ANOTHER crowning triumph for Guglielmo Marconi will have arrived when the trans-oceanic wireless stations are opened. It is only a few years ago since he announced that he had sent a wireless signal across the Atlantic ocean. A cry went up that deception had been practiced; that the reading was an error. However, it is known that the signal was actually sent and received, and to-day the trans-oceanic scheme of communication by wireless has shown that the earlier success of the inventor of the art was but a harbinger of greater things to come.

It was in 1900 that Mr. Marconi, encouraged by the success of his cross-Channel and other experiments over varying distances, arrived at the decision to make a serious attempt to send an electric wave across the Atlantic and detect it on the other side. He had long held in view the application of his system of wireless telegraphy to trans-Atlantic working, not merely as an experimental feat, but with the object of making it a means for commercial communication. It was obvious, however, that if such a purpose was to be brought to fruition it would necessitate the employment of more powerful electro-magnetic waves than those previously used, and it was, above all things, necessary to be perfectly certain that the production of these waves would not prevent or cripple the already established wireless communication between ships and the shore. Moreover, the nature of the plant to be employed required careful consideration.

The Birthplace of Trans-Atlantic Wireless

After many experiments the construction of the plant was commenced. Poldhu, on the Cornish coast, was the locality chosen for the site, and that name will go down in history as the birthplace of transatlantic wireless telegraphy. The construction of appropriate buildings was commenced in October, 1900, by Marconi's Wireless Telegraph Company. In the following month the machinery began to be erected. The aerial was to consist of a ring of twenty masts, each 200 feet high, arranged in a circle 200 feet in diameter, the group of masts supporting a conical arrangement of wires insulated at the top and gathered together at the lower points in the shape of a funnel. In December, 1900, the building was so far advanced that drawings were prepared showing the arrangement proposed for the electric plant in the station; this being delivered, experiments were carried on at Poldhu in January, 1901, for the purpose of ascertaining how far it would be efficient for the objective in view. At Easter, 1901, by means of a short temporary aerial, experiments were conducted between Poldhu and the Lizard, a distance of six miles, which was sufficeint to show that the work was being conducted on the right lines.

Communication Between Poldhu and Newfoundland

During the next four months much work was done in modifying and perfecting the wave-generating arrangements, and numerous telegraphic tests were conducted during the period by Mr. Marconi between Poldhu in Cornwall, Crookhaven, in the South of Ireland, and Niton in the Isle of Wight. A delay occurred owing to a storm on September 18, 1901, which wrecked a number of masts, but sufficient restoration of the aerial was made by the end of November, 1901, to enable him to contemplate making an experiment across the Atlantic. He left England on November 27, 1901, in the steamship Sardinian for Newfoundland, having with him two assistants, Messrs. Kemp and Paget, and also a number of balloons and kites. He arrived at St. John's, Newfoundland, about December 5, and made arrangements for sending up a balloon and an attached aerial wire, having previously instructed his assistants at Poldhu to send from three to six o'clock in the afternoon of each day a programme consisting of the letter "S" (which in the Morse code consists of three successive dots) at short intervals. Signals began to be sent out in this way from Poldhu on Wednesday, December 11, and, after some difficulty in elevating the aerial wire in Newfoundland by means of a kite, Mr. Marconi received the "S" signals at Newfoundland on Thursday, December 12, 1901. On Friday, December 13, he confirmed this result, and on Saturday, December 14, he was able to send a message to Major Flood-Page, one of the Directors of Marconi's Wireless Telegraph Company in London to this effect:

> St. John's, Newfoundland, December 14, 1901.—Signals are being received, weather makes continuous tests very difficult, one balloon carried away yesterday.

In these experiments the actual power employed in Cornwall for the production of the waves was not more than 10 or 12 K.W. In February, 1902, Mr. Marconi made arrangements for the erection at Poldhu of a permanent structure.

Opening of the Clifden Station

The plant and equipment at Poldhu have since been modified to adapt the design of the station to the requirements of modern radio-telegraphic practice, but it ceased to be employed for trans-Atlantic work in 1907, when a new station was opened at Clifden, on the west coast of Ireland, to communicate direct with another station at Glace Bay in Nova Scotia. These two large stations began to exchange radio-telegraphic messages across the Atlantic on October 7, 1907, and millions of words in press and private messages have since been transmitted. The long history of this great achievement was related by Mr. Marconi in a lecture at the Royal Institution of Great Britain, delivered on March 13, 1908, in which he recounted the various stages of the work and the steps by which success had been finally attained. After an interval of interruption due to a fire which destroyed part of the Glace Bay Station in August, 1909, commercial communication was re-established across the Atlantic at the end of April, 1910.

Now to the Clifden-Glace Bay service is about to be added another, which is calculated to more effectively bring together the two continents and to cope with the enormously increasing use of trans-Atlantic telegraphic communication which the cheapness and efficiency of the Marconi system has made possible.

Carnarvon's History Interesting

The stations are situated in New Jersey and North Wales. The British station is located in the neighborhood of Carnarvon, the whole surroundings of which are full of interest. The history of the neighborhood goes back many centuries. but the enlightened research of trained scholarship within recent years has somewhat dispelled the mists that envelop its early history. For instance, the fact has been revealed that long before Cæsar set foot on the shores of the "White Island" its every headland along the North Wales coast was occupied by what, to the military engineer of that day, must have been impregnable cities. These were so systematically grouped that the appearance of an invader at Chester could be signalled to Carnarvon, and thence along the western coast, with a promptness that, in a sense, anticipated the wireless telegraphy of to-day.

Until far into the Middle Ages, Carnarvon was the richest and busiest city in Wales. Since then, however, it has fallen on evil days, commercially. For generations its local industries have been a diminishing quantity. The riveter's hammer on the iron and steel ships of the Clyde and Tyne sounded the knell of about the last of its flourishing trades.

The station in North Wales, although familiarly known as Carnarvon Station, is not actually within the confines of that city. The transmitting section is situated, as told in a previous issue of The Wireless Age, a few miles east of Carnarvon, on the Cefn-du Mountain. The receiving section is at Towyn, one of the most pleasant seaside resorts in North Wales, about three-quarters of a mile from the village, and a distance of about sixty-two miles by road from the transmitting section.

The transmitting and receiving sections are separate to enable duplex wireless telegraphy to be effected—that is to say, to make possible the simultaneous reception from, and transmission to, America. It is not usual to have so large a distance separating the two sections, but it was necessary to do so in this case owing to certain geographical features. In duplex working the receiving section must be placed in a certain definite direction with respect to the transmitting section, and here the correct angle could not be obtained with a suitable site at a nearer distance owing to the configuration of the country.

There are four wires connecting the two stations, these being carried on the same poles as the Post Office telegraph lines.

The transmitting station consists of one large building measuring approximately 100 feet by 83 feet, which is divided into three sections, known as the main machinery hall, the annex, and the extension.

In the main machinery hall are located the transmitting sets, switchboard, transformer room, stores, offices and emergency operating room. The auxiliary plant, consisting essentially of electrically driven blowers, D. C. generators, ventilating fans, and some small motor generator sets used in connection with the signalling circuit, is placed in the annex, which also provides an office for the shift engineers and accommodation for the fitting shop. The extension is devoted entirely to experimental apparatus.

On the two upper floors of the north end of the building are arranged most of the actual wireless apparatus, consisting of condensers, bus-bars, jigger, and inductances.

Duplicate Transmitting Sets

The main transmitting sets are in duplicate, each set comprising a 300 K. V. A., single-phase alternator, generating at 1750 volts directly coupled to, and driven by, a 500 B. H. P. three-phase self-starting motor, suitable for 440 volts and 50 frequency; this in its turn is directly coupled to a shunt-wound exciter giving 300 amperes at 40 volts.

The alternator is directly coupled to the discharger, which is of the rotating disc type, the coupling being an insulated one. Lubrication throughout the entire set is forced. The disc discharger is enclosed in a sound-proof room.

An insulated foundation is provided for the disc, and should it be required at any time to run this asynchronously, an independent 50-horse-power 110-volt shunt motor having a quickly removable insulated coupling is provided for the purpose.

The Transformer Room and Main Switchboard

The main switchboard consists of ten panels, each 2 feet wide and 8 feet high, upon which are mounted the necessary instruments and circuit breakers and switches for the control of the various parts of the plant. The mains and main motor panels are provided with time limit relays; the cables from the switchboard to the various machines are all lead covered, and are suspended on racks on the sides of the trenches.

The transformer room is worthy of note. Here are transformers each having a capacity of 75 K. V. A., as well as low-frequency inductances. There is an electrically operated safety switch in the transformer primary circuit which is controlled by a master switch. Each transformer is provided with isolating switches in both primary and secondary circuits, and these are carried by an iron framework immediately over the transformers. The low-frequency inductances are arranged to facilitate adjustment of the amount of inductance required.

In the emergency operating room is all the apparatus necessary for transmission and reception from the transmitting station instead of from the distant operating station. In addition there is here a master switch, under the control of the operator, which automatically operates the safety switch in the transformer room, the receiving aerial isolating switch, the receiving crystal protecting switch, an illuminated sign, "Ready to Transmit," situated in the shift engineer's office, and a disconnecting switch in the main earth lead, to unearth the aerial when required for receiving, thus completely avoiding any possibility of damage to the receivers when the aerial is required for transmitting.

The auxiliary plant is, as previously stated, situated in the annex. Here are motor generator sets in duplicate, each consisting of a three-phase induction motor directly coupled to a 50-K.W., 110-volt, shunt wound, D. C. generator, in connection with which is used an automatic pressure regulator. The blowers are also in duplicate,, each set consisting of a positive rotary blower of the out-board bearing type, driven through spur gearing by a motor suitable for 440 volts, three-phase, and 50 frequency. Air is conducted to a reservoir, thence distributed where required. The disc discharger chambers are ventilated by means of exhaust fans, each driven by a three-phase induction motor. Duplicate signalling circuit motor generators are provided, each consisting of a three-phase induction motor running at 1,460 revolutions per minute, directly coupled on either side to a D. C. shunt wound protected type generator. Liquid starters for use in connection with the auxiliary disc motors are, like the other machinery installed here, supplied in duplicate, to guard against any possible temporary interference of the service.

From the shift engineer's office, which is partitioned off from the annex, an uninterrupted view is obtained of the machinery hall, main switchboard and the auxiliary plant.

The small but well arranged repair shop is capable of dealing with almost any class of repair work likely to be required, and it is equipped with modern power-driven tools.

Condensers of the Latest Type

The latest type condensers are installed, the banks being arranged systematically on two floors. The pots are used three in series.

The bus-bars are of copper-sheet, stiffened by Duralumin angle plates. They are supported on standards and separated by means of porcelain insulators. The main bus-bar is extended beyond the condenser banks, and divides immediately over the disc chambers, the ceiling of which is provided with specially insulated glands, through which pass the main connectors conducting the current from the condenser bus-bars to the side disc. Each branch of the main bus-bar is connected up to one transmitter by means of quickly removable change-over links.

The jigger, of the usual independent primary and secondary type, consists of a suitable number of turns of special H. F. cable wound on insulated frames, which are supported so that their axis lie along the axis of the windings. Provision is made for one of these frames to be easily movable in a line along its axis for the purpose of varying the couplings between the primary and secondary.

Three Aerial Tuning Inductances

The aerial tuning inductances are three in number, and are provided with the necessary tappings for tuning purposes. The aerial is of the directional type, and extends from the building in an easterly direction up the mountain side. It is approximately 3,600 feet long and averages 500 feet in width. Ten tubular masts support the aerial, and these are arranged in four rows of three, two, two and three, each row being 900 feet apart. The aerial diverges from the leading insulator to a line of rod insulators supported by the triatics between the tops of the first row of three masts, thence to the triatic supported by the other rows in succession, the plane of the wires following roughly the contour of the mountain at a height of just under 400 feet. Even tension is kept in every wire by means of a balance weight, thus minimizing the possibility of breakage of wire due to wind pressure.

The earth system is briefly as follows: a ring of metal plates is buried in a circle, with the building as center. This is connected by means of radial wires with another ring of larger radius. From the outer ring wires are run to the end of the aerial, whilst from the first circles of plates wires are brought overhead to the common earth wire. On two opposite sides of the building are earth terminals, passing through the wall to which the common wire is connected.

There are ten tubular steel masts, each 400 feet in height, the lower half being

3 feet 6 inches in diameter, and the upper half being 2 feet 6 inches. The lower half is built of quarter sections, or quadrants, each 15 feet in length, and the upper half is built of semi-circular sections each 10 feet in length. All the sections have outside flanges, by means of which they are bolted together. Each mast is provided with a gallery at the top, which can be reached by a ladder running up inside, access to the ladder being by means of a manhole. The triatics are attached to a halyard passing through a block at the top of the mast, and another at the bottom, and are made fast to bollards. A winch with warping drums is placed between each two masts. The foundation plate for each mast stands on a block of concrete measuring approximately 12 feet by 12 feet by 6 feet, and weighing approximately 48 tons.

Four sets of seven stays of 3-inch steel wire rope with solid core are used for each mast. A stay is insulated about every hundred feet of its length. The stay anchors consist of concrete blocks measuring about 12 feet by 12 feet by 12 feet, and weigh approximately 97 tons. The intermediate pairs of masts are provided with back stays in order to lessen the strain on the mast-head caused by the greater length of triatic which they support.

Power is supplied to the station by means of an overhead transmission line which provides a three-phase supply at 10,000 volts.

The Power Station At Cwn Dyli

The power station is situated at Cwn Dyli, about 11½ miles distant. The prime movers are high pressure water turbines, the water being obtained from a lake very near Snowdon. There is a transformer station adjacent to the wireless station, where the voltage is reduced from 10,000 to 440 volts, at which pressure it appears on the main switchboard.

At the Towyn station the receiving aerial is supported by five masts, each 300 feet high; these masts are erected on a range of hills at the back of the town, the last mast being about 1,400 feet above sea level. A balancing aerial is also erected carried on 80-foot poles, the purpose of the balancing aerial being to balance out the effect of signals, transmitted from the stations at Cefn-du, so that the signals received across the Atlantic are not in any way affected by the signals from the transmitting station at Carnarvon.

Prepared to Handle 100 Words a Minute

The station is equipped with all the latest types of receiving apparatus, and the operating building has been designed to accommodate sufficient operators to deal with a traffic of 100 words per minute duplex. The operators for both stations are all located in the various operating rooms at the Towyn station, as are also the operators for working the land lines.

The signalling switches at the transmitting station are controlled from Towyn, where the punched tape from the Creed instrument is put through a Wheatstone transmitter, which, by means of relays at the Carnarvon station, actuates the signalling switches, making and breaking 300 K.W.

The large and continuously increasing volume of traffic with which the Marconi service has had to cope is proof of its popularity. The latest inventions have been introduced to facilitate its rapid disposal, and with a view to eliminating to the greatest extent human agency.

The Marconi Company have opened large new premises at No. 1 Fenchurch street, London, E. C., which serves as a main telegraph office. The new premises are connected by direct land lines with the company's offices at Marconi House, Strand, London, W. C. The public office has a commanding position, facing as it does the banking center of the world, Lombard street, and Gracechurch and Fenchurch streets, the home of shipping and produce. The office is fitted with panelling, doors and counter of Cuban mahogany, the walls above the panelling and the ceiling being covered with lincrusta of rich and elegant design. In the basement are to be found the compressor for the Lamson tubes, and several busy motor generators vie with one another to supply power to mechanism of most recent invention in the operating room. Here also is ample accommodation for the rapidly accumulating and vast records which it is the duty of a telegraph company to keep, according to the provisions of the International Telegraph and Radio-telegraphic conventions.

To ensure an uninterrupted public service and to provide against the risk of fire, the land lines connected to both the Welsh and Irish stations can be worked from the office in the Strand or from the main office in Fenchurch street.

Let us follow the handling of a telegram from the time of its acceptance at the counter of the telegraph office. Immediately it is handed in it is dispatched by a special tube leading from the public office to the instrument room, where it is transferred to punchers. The rapid tapping will convince any onlooker that an expert is transferring the message onto the tape. Then it is passed to the man in charge of the Creed transmitter on the next table, which automatically reproduces punched tape at the high-power wireless station at Towyn. There another operator transfers the tape to the wireless transmitter by means of which the dots and dashes are flashed into space and received at the station in New Jersey. Here again expert telegraphists transcribe and hand the messages to the land line system connecting with all the important cities and towns in the United States and Canada. The same operation is repeated when a message is transmitted in the other direction—that is, from the United States to England—the only difference being that in London the signals, by means of the Creed printer, are recorded in letters on tape, which is automatically gummed, and handled by the scrutineer, who separates the tape and affixes it on the company's forms for delivery to the addressees.

The apparatus being in duplicate, there is, therefore, every assurance of an uninterrupted service, and to ensure the greatest speed the lines are worked duplex.

All kinds of telegrams are dealt with, communications in cipher being handled as easily as those of the ordinary class. The rates have been reduced so that telegraphy has been placed within the reach of a far wider public, and a saving effected of thirty-three and a third per cent. as compared with the charges for transmission by other means.

THE CHINESE CONTRACT

In view of statements in the newspapers to the effect that a contract with the Chinese government had actually been signed, the Marconi Company recently made the following announcement in London:

Negotiations have been pending between the Chinese government and this company for some time past for the erection of a number of wireless stations in China for the internal and external telegraph services.

On April 8 the Chinese government sent an official letter agreeing to authorize the Marconi Company to issue £2,000,000 (approximately $10,000,000) of five per cent. Chinese bonds in payment of the proposed stations. This document was filed at the British Legation in Peking and a formal contract has been sent forward for approval and signature.

The company has every confidence that in due course the agreement will be signed and all mutual obligations fulfilled.

MARCONI DIVIDENDS

A dispatch from London, dated July 9, says: It was announced to-night that a final dividend of ten per cent. had been declared on both the preference and the ordinary Marconi shares, making the total seventeen per cent. on the preference and twenty on the ordinary shares for the year. These rates are the same as were paid in the two preceding years.

The gross profits in the last year are £245,583 (approximately $1,227,915) and the net profit, £122,323 (approximately $611,615). After allowing for dividend payments the sum of £76,549 (approximately $382,745) was carried forward to the next year's account.

IN THE SERVICE

CONTINENT-TO-CONTINENT DIVISION

It isn't sufficient in speaking of the career of Charles H. Taylor to simply say that he is assistant chief engineer of the Marconi Company with headquarters in New York. There is considerable more of interest to relate. Take, for instance, that war experience and—but it's better to start at the beginning.

He was born in Hayes, Middlesex County, England, in 1875, and obtained his early education at Cranleigh School in Surrey. Afterward he entered upon an engineering course in Herilt Watt Technical School in Edinburgh. He was graduated from that school in 1895 and began an apprenticeship training in engineering work which lasted three years. Then he entered the employ of the Sturtevant Engineering Company, being assigned to a place in the draughting office of that concern in London.

It was in 1898 that Mr. Taylor took up his duties with the Sturtevant Company; a year afterward he heard the call of wireless and joined the service of the Wireless Telegraph and Signal Company (the old Marconi Company) as an engineer. Dr. Erskine-Murray was carrying on wireless investigations at the Haven station, near Bournemouth, and Taylor was detailed to assist him. Mr. Marconi was also conducting experimental work at the station and the task of aiding in the development of the receiving jigger for the old coherer sets devolved on Mr. Taylor and his associates.

After a few months' service at the Haven he was transferred to the Needles station on the Isle of Wight; then he went to the East Goodwin Lightship station. One night, while the weather was thick, a British war vessel bore down on the lightship. The commander of the latter, in order to avoid a collision, was compelled to slip his cable and float with the tide. The excitement resulting was accompanied by considerable racket, but Taylor remained asleep, unconscious of his peril, until the next morning, when he was informed of the occurrence.

He was assisting in the test room of the wireless works at Chelmsford just prior to the breaking out of the Boer War in South Africa. When this event occurred he was sent to the scene of activities with wireless sets which were installed on British warships blockading Delagoa Bay.

After eight months spent in South Africa he returned to Chelmsford, where he took charge of the test room. In 1910 he went to Brazil to superintend the construction of stations and came pretty close to getting in the way of a small revolution which was disturbing that country.

Mr. Taylor has great confidence in the trans-oceanic wireless service.

"What difficulties there are to overcome," he said, "will be small and it will be only a matter of engineering to overcome them."

"Only a matter of engineering" is an everyday affair to Taylor. The evening of the day he made the remark he left for Honolulu to supervise "only a matter of engineering" in connection with the work of preparation for connecting the continents by wireless.

On Waves and Wave Motion*

By J. A. Fleming, M.A., D.Sc., F.R.S.

THE principal difficulty which persons who are not trained physicists find in obtaining any clear ideas of the *modus operandi* of wireless telegraphy arises from the imperfect conceptions they are able to form of the nature of an electric wave. They hear that wireless telegraphy is conducted by means of electric waves, but the words convey no definite meaning to their minds. Hence many people, otherwise very highly educated, frequently declare that wireless telegraphy and everything connected with it is to them an unspeakable mystery, even in spite of much popular discussion of it.

This difficulty arises from two causes. First, because the only things we are able to visualize very clearly are the *motions, forms,* or *relative positions* of material substances, added to which we can recover by recollection such special sensations as colors, smells, or tastes. Secondly, because the word *wave* conveys to the ordinary mind the notion of an effect which is not strictly speaking a wave at all, and hence forms a wrong starting point for a correct idea of the nature of an electric wave. The ordinary non-technical person hearing the word "wave" pictures to himself the water curling over and breaking on the rocks or beach at the seaside, or else the irregular splashing foam-crested water in a sea or channel. Properly speaking, the water which dashes up at the edge of the sea is no more a true "wave' than a house in the act of tumbling down can be called a good residential property.

How to Form a Correct Impression

The best place to form right notions is to look at the surface of the sea at some distance from the coast on a bright, breezy day when the wind is blowing towards the coast or up an estuary or long bay. We then see rounded ridges or hummocks of water chasing each other over the surface. At first sight it appears as if the surface water itself is moving. If, however, we fasten attention upon a floating buoy or patch of seaweed we shall notice that as each wave passes over it the floating object is merely lifted up and let down again, or at most has a small forward and backward motion as well.

What a Wave Length Is

If we look at two such objects not too close together we shall see that they perform the same small oscillatory motions successively and not simultaneously. A little careful scrutiny will thus convince us that the true motion of each part of the water is merely a small motion in a circle, being moved up, forward, downwards, and backward, and that each part performs this cycle of operations in its turns, and over and over again. The speed with which this cyclical motion is handed on from point to point is called the velocity of the wave. We might, for instance, imagine a seagull to fly along always keeping himself above one particular hummock of water. His speed would then be the speed of the wave. The distance from one hump to the next one, measured crossways or at right angles to the line of the crest, is called the *wave length*. The waves are said to be long when the distance is great from crest to crest, not when the ridges themselves are long.

Such waves on water are called surface waves; and the effect of them extends a very little way down into the sea. The same class of surface wave is produced when we throw a stone into still water in a pond or lake and notice the expanding rings of ripples which are thereby produced. This latter is a typical case of wave motion in two dimensions.

Again, if we give a jerk to the end of a long stretched cord a hump or kink travels along it, which is likewise a wave motion. Each part of the cord is lifted up and then let down successively,

*From "The Year Book of Wireless Telegraphy and Telephony," 1914.

and the motion is handed on from point to point with a certain speed.

A large number of models of various kinds have been constructed to illustrate various forms of wave propagation. In the case of the water surface waves or the wave motion of a kink along a rope the displacement of each part of the medium, whether water or rope, is at right angles to the direction in which the wave is moving. On the other hand, we have forms of wave motion in which the displacement is in the direction of that motion. Thus, for instance, if a brass or steel wire is coiled into a spiral and the spiral suspended by threads attached to it at regular intervals, so as to support it in a horizontal direction, we have a medium in which we can propagate what are called longitudinal waves. If we give to one end of the spiral a smart blow with a piece of wood, striking the spiral end-on and not sideways, we shall thereby suddenly compress the end, and the turns of the spiral at that end will be squeezed closer together, but they immediately expand again, and therefore compress the next or adjacent turns. The result is that a wave of compression runs through the spiral. We see each part of the spiral in turn slightly compressed and then relaxed.

A Longitudinal Wave

The same kind of longitudinal wave of compression and rarefaction takes place in air when a sound or aërial wave is produced. Suppose an explosion to take place at any point in the air. We can picture to ourselves the air round that point as arranged in concentric shells or layers like the coats of an onion. When the explosion happens it compresses the layer of air next to it, but owing to the inertia of the air the compression does not make itself felt instantaneously at all distances. The innermost layer is first compressed; then it expands back and compresses the next outer layer, and so on, the state of compression being handed on from layer to layer, and travelling outwards with a speed of about 1,200 feet a second at ordinary temperatures. The motion of each particle of air as the wave passes over it is to and fro in the line of propagation of the wave. Hence the wave is called a longitudinal wave.

Interchangeable Forms of Energy

A little consideration will make it evident that to produce a self-propagating wave in a medium, as contrasted with a mere wave motion or successive performance of some periodic motion by a line of particles, there must be a connection between the different elements of the medium. Moreover, the medium must have two qualities, one of *elastic resistance* to some change imposed upon it, and the other of *persistence* in doing what it is set doing. In other words, it must have elasticity and inertia. Thus in the case of air the air molecules resist being compressed, and when the compressing force is removed they fly apart. But on being set in motion they continue to move and expend their energy in compressing other layers of air. The air, therefore, can store up energy in two forms—viz., as kinetic energy, or energy of motion, and potential energy, or energy of compression. These forms of energy are interchangeable, and are continually being transformed into one another. The total energy in any volume occupied by pure wave motion is at any instant half potential and half kinetic.

If we analyze in the same manner the case of the wave on a water surface we find that the water being a heavy body not only possesses inertia, in virtue of which it stores up kinetic energy, and when set moving continues to move until it is deprived of this energy, but also the water surface resists being made unlevel. Hence when the water is heaped up in one place or depressed it tends to move so as to restore the level surface. Accordingly the water surface when made unlevel stores up potential energy. It has an elastic resistance to change of level. Similar ideas present themselves in all other cases of visible wave motion.

As long as we are dealing with the case of waves on water, or in air, or on strings, we can picture to ourselves or actually see the motions of which we speak.

The moment we pass beyond this region of eyesight, or the result of eyesight, and concern ourselves with a super-material medium like the ether, the difficulties of framing adequate mental images corresponding to the words used become very great.

All the phenomena in wireless telegraphy by Hertzian waves on the system initiated by Mr. Marconi point indubitably to the conclusion that we have here to deal with a wave effect, and that these waves are not created in air as a medium and not entirely in the soil or crust of the earth, but are produced in some medium which interpenetrates matter and co-exists with the air in the space above the earth. In spite of the efforts which have been made by a certain school of thinkers of late years to render the assumption of the ether unnecessary or to throw doubts on its physical existence, it still remains the most probable hypothetical basis for certain indisputable observed effects. Hence we find much to support the assumption of some form of energy-transmitting medium which is of a more fundamental nature than tangible gravitative matter. This ether is inappreciable directly by our senses, unless we admit that the impact of certain very short waves in it called light is such direct appreciation. Nevertheless, we cannot feel it, weigh it, or confine it like gas in any vessel, and its properties have to be inferred from observed effects.

Maxwell's View of Ether

Before the date of publication of James Clerk Maxwell's great contributions to the theory of electricity it was generally assumed that this hypothetical ether must possess an elasticity resembling that of an incompressible elastic jelly-like solid, in that it can resist a shear or distortion or change of shape. Also it was assumed that it possessed inertia and therefore could store up energy as energy of motion. It followed that the only kind of waves possible in it were waves of transverse displacement—that is to say, each part of this elastic substance could be displaced a little way from its normal position by shearing, but that when released it sprang back. Hence the only type of wave motion it could transmit would be identical with that wave of distortion producible in a mass of indiarubber or jelly. If we picture to ourselves such a jelly made up in concentric layers, like the coats of an onion, and suppose that the innermost shell makes a small movement of rotation to and fro round some axis, and that each shell in turn repeats this motion round the same axis, then a wave of transverse displacement would be propagated through the medium. Such a conception affords us, however, no explanation of electrical phenomena, and when Maxwell addressed himself to the consideration of the actions at a distance with which we are familiar in electrical work it was, in his view, essential to make such assumptions as to the possible structure of the ether that it could be used to explain electrical as well as optical effects.

A Theory to Explain Optical Phenomena

Nevertheless, he realized that we know nothing about the mechanical structure of the ether, and therefore he propounded a theory which enabled him to explain optical phenomena in terms of known electrical facts, and discarded any attempt to invent hypotheses as to the mechanical structure of the ether which would permit both optical and electrical facts to be interpreted in terms of possible mechanical motions of the ether. It is perfectly certain, however, that the only actions we can visualize clearly are mechanical movements. We cannot think of the ether at all or use it as an hypothesis to explain observed effects unless we are able to make a *working model* of the ether structure in terms of the concepts of mechanics. Hence innumerable attempts have been made to represent the ether in imagination by structures made up of inter-connected cog-wheels and idle wheels or gyrostats, or fluid vortices, or in a dozen other ways, to imagine a mechanism which would act under mechanical forces as we find the actual ether does under electrical and magnetic forces. It does not follow, however, that, because we can imagine a mechanism that would produce the effects we find in Nature, the effects are actually produced in this way.

Hence a scientific hypothesis cannot at any time be regarded as giving us absolute and final truth on any matter. It is at most merely a shadow of the truth. It provides a language in which we can describe and connect phenomena, or it gives us a suggestion and incentive for further experimental work. Whatever hypothesis for the time holds the field as regards the structure of the ether, it must certainly enable us consistently to explain wave motion through it. The characteristics of wave motion are that the energy entirely leaves the radiating body and exists for some time, long or short, in the medium before reaching the receiving agent. Also that energy exists in two forms which alternate periodically both in space and in time along the line of propagation.

Maxwell employed the purposely vague term *electric displacement* to denote the change produced in the ether near an electrified body, and he showed that when the electric displacement at any point was changing there was produced around it all along an embracing line another state called *magnetic flux*, similar to the condition of space near a magnetic pole. Working from this starting point, he was able to show that a sudden application of electric force or its sudden removal resulted in the propagation through the ether of waves of electric displacement and magnetic flux. These two effects correspond in the case of ether waves with the state of compression and with the velocity of the air partitcles in the case of wave motion through the air, or with the state of elevation or depression and with the velocity of the water particles in the case of a surface-water wave.

The Velocity of a Wave

Maxwell was able to show, and abundant confirmatory proof has since been obtained, that the velocity of such an electro-magnetic wave through the ether would be identical with that of light—viz., about 300,000 kilometres per second.

The term electric displacement, as used by Maxwell, is perfectly definite in a mathematical sense, and we are therefore able to express in exact mathematical form the relation between the change of electric displacement and the resulting magnetic flux, and also the corresponding inter-connection between change in magnetic flux and electric displacement; but these terms do not of themselves raise in the mind any definite mechanical images. In one sense it is better that they should not do so. Strange as it may appear, the more definite we try to make our conceptions of Nature's machinery in this respect, the less likely are they to be true. The actuating machinery of Nature is hidden from us. We are like spectators at a play. We see the changes of scene and effects produced upon the stage, but the exact means by which it is all brought about is concealed from us. The first question which presents itself to us in considering wave motion through this ether is—What is the nature of the elasticity of the ether? What kind of change in it does it resist?

Suggested Structure For Ether

The elasticity is certainly not a resistance to compression or extension or even shearing, like that of a gas or solid. Many converging lines of thought indicate as likely that the ether elasticity is an elastic resistance to the twisting or rotation of certain ultimate elements of it. Just as a gyrostat or heavy top in rapid rotation resists being twisted owing to its gyrostatic stiffness, so Lord Kelvin, Sir Joseph Larmor, and others have suggested a structure for the ether on this basis.

Corresponding to this, we must assume that these elements of the ether can move over each other without friction, so that we have possible in it frictionless flow accompanied with resistance to absolute rotation in each particle. We must also postulate that ether flow or motion involves friction energy associated with it. We have, then, a possible storage in it of potential energy, or energy of twist, as in a coiled spring, and energy of motion. At the same time there must be some linkage or connection between the particles of the ether whereby rotation of a line of particles, or twist round any line, is accompanied by a flow of ether round the line.

Another view of the nature of an electric wave has recently come to the front which is founded upon a suggestion of Faraday's, developed in detail by Sir J. J. Thomson more recently. We now know that what we call electricity is atomic in structure. That means to say that electricity is made up of particles which cannot be divided without destroying it. The ultimate atom of negative electricity is called an *electron,* and is as much smaller than an atom of hydrogen gas as the latter is smaller than a very, very small pin's head. From the electron proceed in all directions lines of ether twist, which are called lines of electric force. We may picture it to ourselves as like a golf ball, having long, straight wires stuck into it. All conducting bodies have free electrons mingled with their chemical atoms, and in their ordinary unelectrified condition these electrons move hither and thither in all directions. If, however, a high frequency electro-motive force acts on the body, these electrons are caused to swing to and fro in an identical manner. When an electron is suddenly started into motion or suddenly stopped, the attached lines of force lurch backwards or forwards like passengers in a motor-'bus which is suddenly set going or arrested.

The Processes in an Aerial

The result is to produce a kink or bend in the lines, and the effort of these lines to straighten themselves causes this kink to run outwards along the line. If a number of electrons in a wire perform these oscillations simultaneously the result is to form a series of loops of ether twist or electric displacement which are transverse or lie across the radiating lines of force. These loops are shot outwards with the velocity of light. Hence in a wireless ærial or antenna the physical processes at work are as follows: The transmitter, whatever may be its nature, causes the free electrons in the ærial wire to oscillate to and fro with great rapidity all at the same time. The vibrations produced thereby on the radiating lines of force starting from each electron combine to produce one single vigorous etheric oscillation, which consists in the emission from the ærial wire of these loops of electric displacement. This process constitutes what we call electric radiation less. It is essentially of the same nature as visible light, but differs from it only in wave length.

When an Aerial Wire is "Earthed"

In the case of an ærial wire which is "earthed," or connected to the earth at the lower end, there is in addition to this space wave or wave in the ether an "earth" electric wave propagated through the crust of the earth. This is proved by the fact that a high collecting ærial is not absolutely necessary for reception in wireless telegraphy. The signals from the Eiffel Tower Wireless Station in Paris can be detected in London merely by using as collector any metallic mass, such as a galvanized iron dustbin, which is insulated from the earth, the receiver being connected between this mass and the earth.

In the case of long distance wireless telegraphy we are probably concerned with electro-magnetic waves of both types—viz., true electro-magnetic waves propagated through the ether around the earth, partly arriving directly and partly after reflection or refraction by masses of conducting air in the upper atmosphere. Also the effect reaches the distant station as an electro-magnetic wave which is propagated along the surface of the earth, in the same manner that it travels along a wire.

The terrestrial atmosphere is therefore the seat of waves of many kinds. We have not only long ærial waves in the air itself, produced by winds or explosions, but the co-existing ether waves of short wave length, about one fifty-thousandth of an inch in wave length, which constitute light. Then there are in addition frequent natural but irregular vagrant electric waves of great wave length, produced by atmospheric electric discharges, such as lightning, or created, it may be, by extra terrestrial causes, such as explosions in the sun. Lastly, there are the countless long electric waves now intentionally made in telegraphic work, which cause a turmoil in the former comparative ætherial calm.

The mysterious ether transmits all these waves with the same velocity of 300,000 kilometres per second. In order that it may do this the ratio of its elasticity to its density must be a least 3,600 million times greater than that of steel. It would occupy too much space to attempt to sketch in merest outline how such qualities can be combined with perfect non-resistance to the motion of material substances through it.

Suffice it to say that the electronic theory of matter provides a clue to the explanation of this mystery and to the relation of matter to ether generally. The properties of this basal medium, the ether, have occupied the thoughts of some of the greatest of modern thinkers, and the problems raised by the achievements of long distance wireless telegraphy have brought forward many other more intricate questions for consideration.

TIME SIGNAL MODIFICATIONS

THE Superintendent of the U. S. Naval Radio Service, under date of June 10, 1914, announces certain changes of wave lengths used in sending time signals. These signals will hereafter be sent by the Naval radio stations as follows:

Station.	Wave length, meters.	When sent.
Arlington, Va.	2,500	Daily at 11.55 a. m. to noon and 9.55 to 10 p. m., Standard Time, 75th meridian.
Key West, Fla.	1,500	Same as Arlington.
New Orleans, La.	1,000	Daily, 11.55 a. m. to noon, Standard Time, 75th meridian.
North Head, Wash.	2,000	Daily, except Sundays and holidays, at 11.55 a. m. to noon, Standard Time, 120th meridian.
Eureka, Cal.	1,600	Same as North Head.
Point Arguello, Cal.	750	Do.
San Diego, Cal	2,000	Do.
Mare Island, Cal.	1,600	Every day at 11.55 a. m. to noon and 9.55 to 10 p. m., Standard Time, 120th meridian.

If for any reason the Arlington station is out of commission, the time signals will be sent daily at noon, Sundays and holidays excepted, by the Naval radio stations at Newport, New York, Norfolk, and Charleston.

The time is sent from the Naval Observatory, Washington, for the Atlantic coast and from the observatory at Mare Island Navy Yard for the Pacific coast.

This modifies the information relating to this service published on the Pilot Chart of the North Atlantic Ocean for August, 1913.

OPERATOR'S STORY OF TAMPICO'S FOURTH

James A. Daggett, of Pascogula, Miss., a wireless operator on the steamship Horley, which left Tampico, Mexico, July 4, reported recently at the office of the Marconi Wireless Company, in The American Building, Baltimore, Md. In discussing the Fourth of July as celebrated in Tampico, Daggett said:

"It was a real Fourth of July at Tampico. The Stars and Stripes floated over the Imperial Hotel, the American Consulate and other places. The hotel was all decorated for the occasion and the American warships in the harbor fired a salute.

"While we were at Tampico one of the aeroplanes made an ascent for Carranza; they have two aeroplanes there."

DIRECTION FINDER ON THE COMUS

The Comus of the Southern Pacific line has been equipped with the Marconi-Bellini-Tosi direction finder. Captain Maxson, commander of the Comus, who has had considerable experience in wireless telegraphy, is making tests with the apparatus.

WEATHER SERVICE ANNIVERSARY

Just one year ago from Wednesday, July 15, the United States Navy Department put in operation a daily weather service by wireless. The earlier success of the service giving the ships at sea correct Naval Observatory time, and also special notice of storms, warranted the establishment of the daily weather service, which is said to have proven entirely satisfactory during the year's trial.

Location of New Marconi Commercial Office Showing the New York Stock Exchange in the Foreground

The First Wireless Receiving Office *for* Continent-to-Continent Messages

WHILE the eyes of the world have been interestedly watching the completion of the trans-oceanic stations by the engineers of the Marconi Wireless Telegraph Company of America, another important branch of the service —the commercial department—has not been idle. Quarters have been engaged at 42 Broad street, New York City, where the Marconi Company will establish its main commercial office, and a branch office will be located at 44 East Twenty-third street. Other offices will be opened later.

The Broad street office has a location well suited to the needs of the Marconi Company and its trans-oceanic service. Situated on the first floor of the Wall Street Journal building, its windows look out on busy Broad street. It is in the heart of the financial district and was selected with a view to its proximity to the various exchanges, bankers, brokers, coffee and cotton merchants and representatives of foreign firms. They will be able to send Marconigrams from the Broad street office by direct automatic and multiple wire circuits to the trans-oceanic stations in New Jersey, connecting with those in Towyn and Carnarvon, Wales, from which messages will be sent to London by land lines. The high-power stations on Cape Cod are also nearing completion and these will open up wireless circuits to Norway, radiating to Sweden, Denmark and Russia. Land lines will connect this service with the Marconi offices in New York and Boston. The Marconi Company is building its own land lines to connect Belmar with the transmitting station at New Brunswick and with New York.

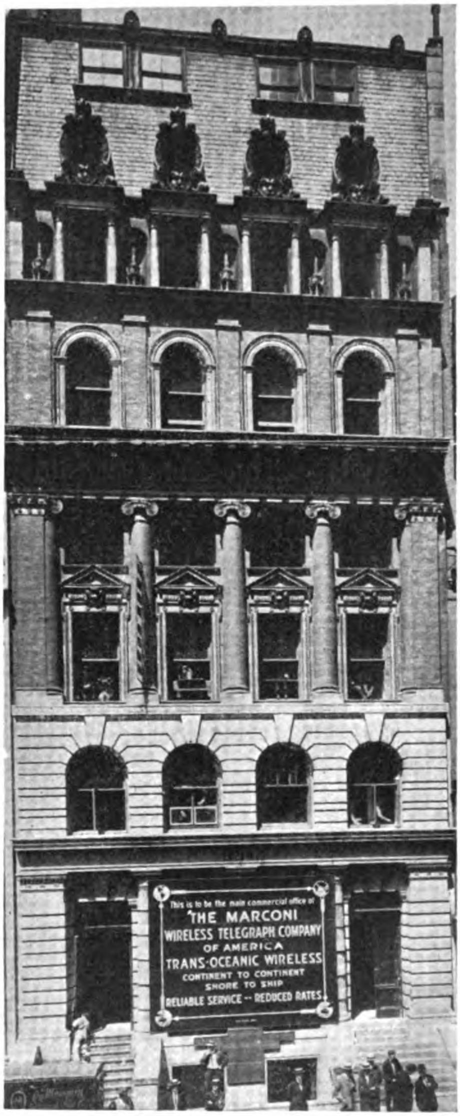
The interior of the office, which has space of about 3,000 square feet, will be finished in mahogany. It has entrances from both Broad and New streets. A counter with marble base will extend almost the entire width of the office. Behind this counter will be a force of clerks who will receive the Marconigrams. Desks and message blanks will be provided for patrons. Space will be set aside for the men who will make their headquarters in the office. These will include Lee Lemon, superintendent of the commercial and operating departments; W. A. Winterbottom, commercial manager; Harry Chadwick, manager of the office, and Paul Kast, cashier. Messrs. Lemon and Winterbottom will have desk room in a space set off by a railing in the front of the office. Mr. Chadwick will have a desk behind the counter, and Mr. Kast will occupy desk room in a space set off from the office by a partition. Near Mr. Kast's desk will be installed a telephone and an operator. The duties of the latter will not be unimportant, for he will receive Marconigrams over the wire. Every precaution will be taken to insure the accurate reception and transmission of messages.

Tables will be placed in the office for the accommodation of the operators and their instruments. Nine operators, including three supervising operators, will be employed. Their hours will be so arranged that the public will have service at any time during the twenty-four hours. Walter E. Wood, G. Jamieson and C. J. Weaver will act as supervisors. The counter will be in charge of two clerks.

In order to insure prompt delivery of messages the delivery department will be directed by an experienced chief delivery clerk. He will have two assistants and ten uniformed messenger boys. The latter will be selected with regard to their knowledge of the financial district of the city. They will wear a uniform of gray with red stripes on their trousers.

From the viewpoint of the uptown business men, the Twenty-third street office is almost as advantageously situated as the Broad street quarters. The Twenty-third street office will cater particularly to the patrons of the Marconi Company in the dry goods, automobile and theatrical districts. Five messengers will be detailed to duty in this office. It will be connected with the Broad street office by a direct wire.

E. B. Pillsbury, assistant traffic manager, is in charge of the staff organization and office arrangements.



The Main Commercial Office is in the Heart of the Financial District, Occupying the First Floor of the Wall Street Journal Building on Broad Street

OPERATORS' INSTRUCTION

CHAPTER IX *(Continued)*

FIG. 1 is a detailed drawing of the antenna construction to be found on the standard Marconi ship installation. The spreaders for supporting the wires are of spruce, giving great strength combined with lightness. It will be observed that each wire composing the aerial is insulated by a 24-inch hard rubber rod insulator. In addition, the birdles are insulated from the ship's masts and supporting halyards by special 7-foot strop insulators. These bridles are made of rigging rope covered for several feet with hard rubber tubing. The rope is then thoroughly sealed by means of hot sulphur which hardens, making the rope impervious to moisture. This extra precaution is necessary on account of high potentials employed when the auxiliary, or emergency, set is in use.

The spreaders are prevented from side-sway by means of two hemp guys on each spreader, which are made fast either to the ship's stays or the top mast. These guys are also insulated by hard rubber rods to prevent leakage through the ship's rigging to earth. The entire aerial is supported by steel halyard ropes at either mast, allowing it to be lowered to the deck for repairs with little dif-

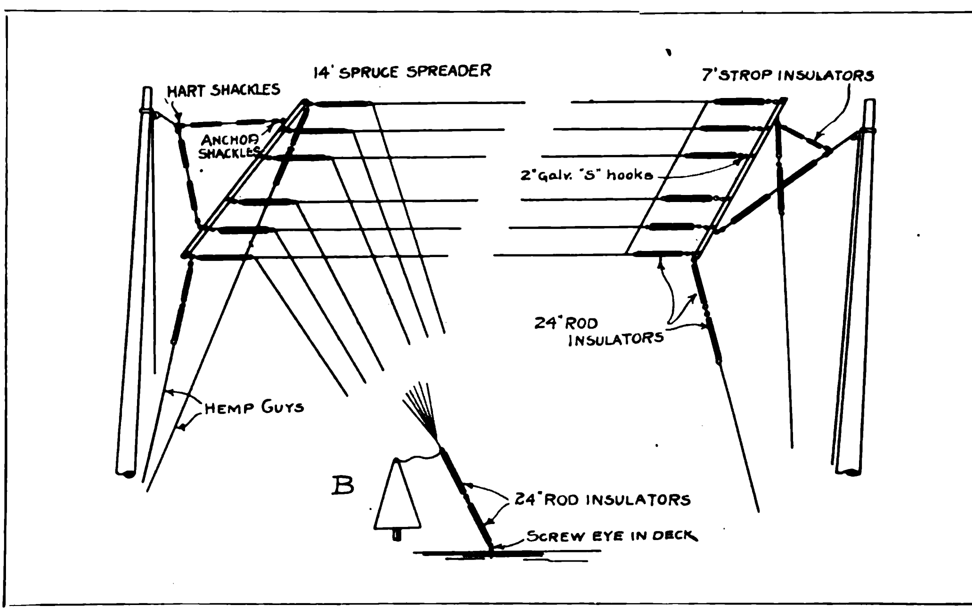


Fig. 1

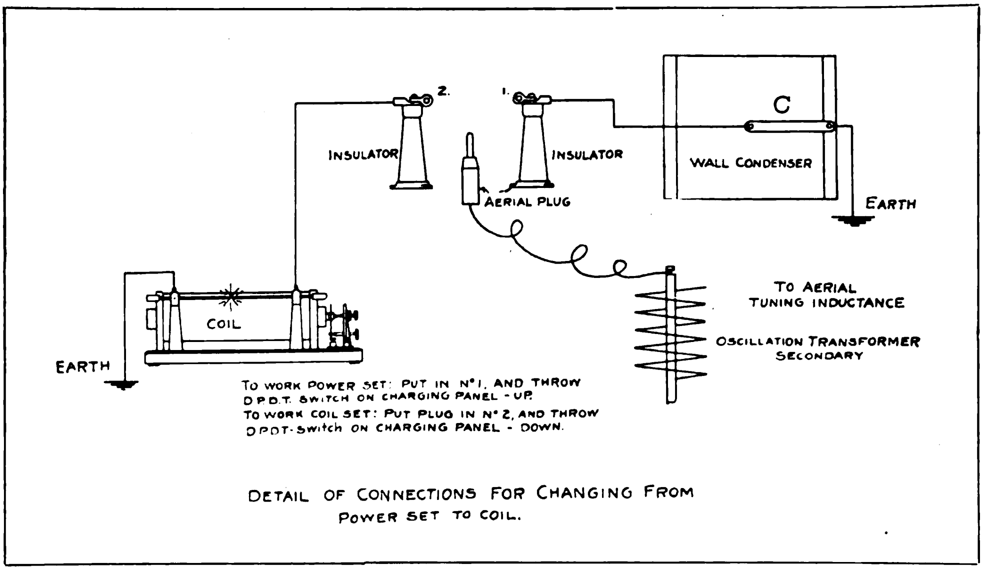


Fig. 2

ficulty. The Bradfield insulator is shown at B; it is placed through the deck of the wireless cabin or through the bulkheads. The lead-ins from the flat top are "back-stayed" by means of two 34-inch rod insulators, which take the strain which otherwise might exist from the Bradfield insulator, B.

All insulators in use should be greased monthly with a special compound furnished by the Marconi Company. This grease makes the insulators impervious to moisture and prevents leakage in wet weather. It is of course understood that while being greased, the aerial must be lowered to the deck and because of the fact that the derrick booms may be working or for other reasons this cannot always be conveniently done when the ship is in port. Therefore a time for this work should be selected at a less busy port, when more aid can be secured from the seamen aboard the vessel.

Efforts should be made at all times to keep the aerial wires sufficiently taut to prevent side-sway, for operators should know that, owing to the high potentials employed, it is not necessary for the aerial wires or the lead-ins to actually touch the mast stays in order to effect a short circuit. If the aerial wires swing within 6 or 8 inches of any stays which are connected to the hull of the ship, sparking will ensue, effectively weakening the strength of transmitter signals.

The supporting halyards should be inspected from time to time to ascertain whether they are in a weakened condition. Such wear is first noticeable in the pulley block at the top of the mast, where, owing to the swaying of the aerial, considerable chafing takes place.

Insulation

The insulation of an aerial may readily be tested by the auxiliary set. If the spark gap of this set is placed in series with the aerial and it does not function even when the points are separated by 1/8 of an inch, it is a sure indication that the aerial insulators are carbonized. They will therefore require scraping with a knife, or cleaning with sandpaper, to be followed by a new coat of grease.

While temporary repairs may be made without the use of solder, if the aerial wires should become broken at sea, it is imperative that the joint be cleaned and soldered at the earliest possible moment. The effects of a loose joint are not so noticeable in transmitting as in receiving, where it may cause a swinging in and out of the received signals.

Auxiliary Set to Power

Fig. 2 is important and shows the actual connections made aboard a ship in changing from the auxiliary set to the power set. Auxiliary sets are now required by the United States regulations to be operated on a wave-length of 600 meters, and since the open circuit of the power set is already set at that wave-length, it is only necessary to connect the spark gap of the induction coil in series with this circuit. Referring to the drawing (Fig. 2) the plug connector is connected at the end to a brass upright supporting the secondary winding of the oscillation transformer of the power set. This plug, when placed in the retainer at B, connects the power set to earth places the spark gap of the auxiliary coil in series with the open oscillatory circuit.

Auxiliary Set Connections

Fig. 3 is a detailed wiring diagram showing the actual connections of the charging panel employed with the auxiliary sets. Since the fundamental circuits have been given in previous articles on "Operators' Instruction," it is not necessary to go into the details with the exception that it might be remarked that to charge the storage cells, the 2-pole

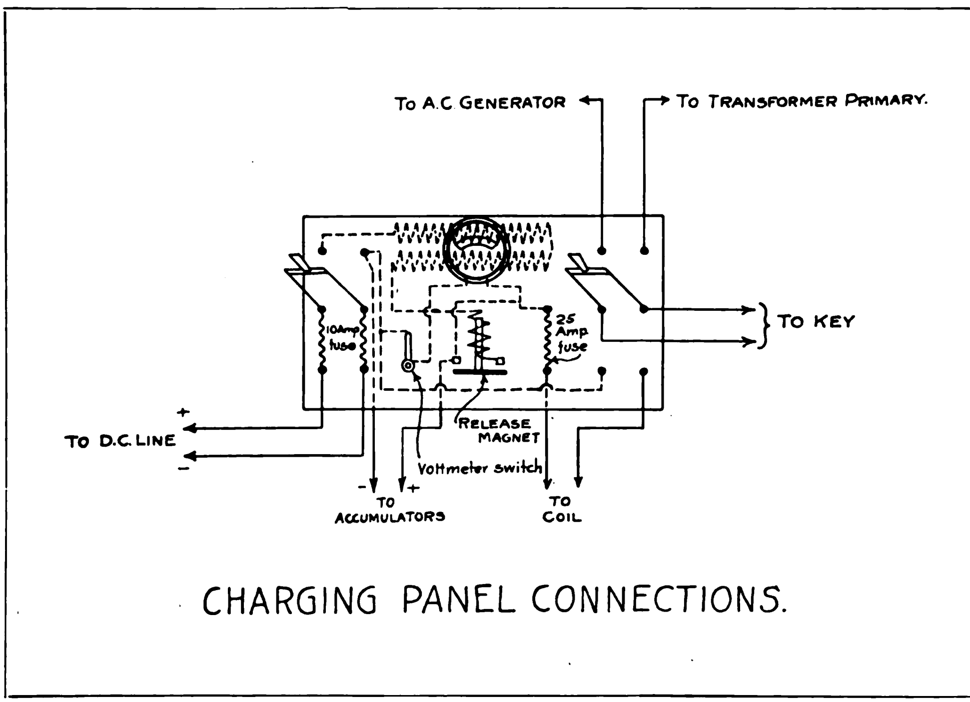


Fig. 3

through the short wave condenser; the latter may be short-circuited by the strap, C. When the plug is connected to B the D. P. D. T. switch on the charging panel is thrown upward. This places the transmitting key in series with the primary circuit of the power transformer.

When it is desired to transmit on the auxiliary set, the D. P. D. T. switch is thrown downward, which connects the transmitting key in series with the primary circuit of the induction coil. The plug is then removed from the retainer, B, and placed in retainer A. This switch on the left is closed. The plunger of the underload circuit breaker (release magnet) must then be pushed upward in order to close the circuit to the batteries. When the battery circuit is closed, the plunger is held in an upward position, allowing the batteries to charge. If the plunger does not remain in this position, it may be taken as an indication that the fuses on the main D. C. switch are "blown" or that the connections to the storage cells are broken. A small strap key (voltmeter switch) is mounted on the board and, when depressed, allows readings of the combined cell voltages to be taken.

The 25 amp. fuse to the right of the switchboard is in series with the primary

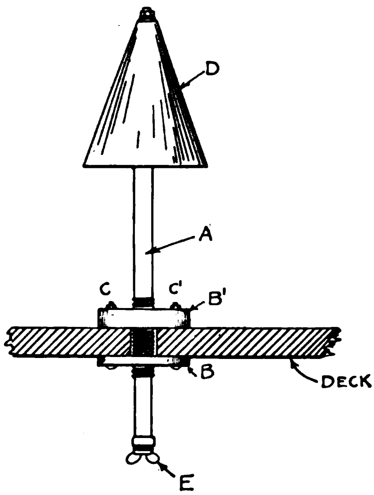


Fig. 4

circuit of the induction coil. Operators should thoroughly study this circuit diagram, having a clear picture of it in mind in case of emergency.

Fig. 4 is a more detailed view of one type of deck insulator used by the Marconi Wireless Telegraph Company of America. The hard rubber tube, A, is threaded and held in place by the disc, B and B'. These discs are clamped together by the bolts, C and C'. The space underneath the discs is covered with white lead, making a watertight joint.

The hood, D, is of metal and serves to protect the rubber from moisture during rain or that due to heavy seas. The electrical connections are made at either end of the brass rod E. This insulator is being replaced by one of new design, the details of which will be given in a later issue.

(*To be continued.*)

COMPLAINTS OF INTERFERENCE

The following statement has been issued by the United States Department of Commerce:

It has been brought to the attention of the Department that considerable interference is being caused, especially in the vicinities of New York and San Francisco, by stations conducting tests without due regard to traffic which is being conducted simultaneously. Stations desiring to conduct tests should communicate with the radio inspector by letter or telephone, stating the probable length of time that will be required. Stations conducting such tests or temporary experiments should "listen in," to determine that no interference is being caused and during the test should "listen in" frequently for the interference signal, Q R M. Stations conducting tests should transmit their official call signal frequently.

Attention is invited to the Act of August 13, 1912, section five:

> That every license granted under the provisions of this Act for the operation or use of apparatus for radio communication shall prescribe that the operator thereof shall not wilfully or maliciously interfere with any other radio communication. Such interference shall be deemed a misdemeanor, and upon a conviction thereof the owner or operator, or both, shall be punishable by a fine of not to exceed five hundred dollars or imprisonment for not to exceed one year, or both.

The Department holds that interference caused by tests of the character described is "wilful" when no "listening in" precautions are taken and the call signal of the station sending is not repeated at intervals.

PRAISE FOR MARCONI MEN

The following tribute to two Marconi men is contained in this extract from a newspaper article concerning the investigation by the Commission of Inquiry into the collision between the Empress of Ireland and the Storstadt in the St. Lawrence River: Ronald Ferguson, chief Marconi operator of the Empress of Ireland, and his assistant, Edward Bamford, were called after the luncheon interval. They told the story of the night from their point of view in clear-cut phrases. When they had finished, Lord Mersey said: "You spoke well, you young gentlemen. You are a credit to the service you are in."

A YEAR ON A TRAMP

by J. Terrence Scott

An interesting account of an operator's voyage to South American, North American and European ports.

IT was not without misgivings that a little over a year ago, I took the Oakland ferry to join the Norwegian tramp steamer Cuzco. I had been Marconi operator aboard steam schooners, oil tankers, and passenger boats, big and little; but a tramp—especially a Norwegian—was an unknown quantity.

What was she like? Where was she bound? And, above all, how were the "eats"? These are but a few of the many questions which passed through my mind on the fifteen minute trip across San Francisco Bay.

And then I was surprised, agreeably surprised; and all my questions were answered. At a glance I found a seven thousand ton cargo boat, shining from bow to stern in a new coat of paint, clearing her decks of the rubbish incidental to repair work and making ready for sea. Her commodious upper deck and the awning overhead made her look more comfortable than some of the passenger ships I had been on!

The uniformed chief officer was giving orders in the Norwegian tongue to some sailors on the foredeck, and while I was debating as to the best manner of approaching him he noticed me and came over to where I was standing. Holding out his hand and smiling pleasantly, he said: "I suppose you're the new sparkie?"

I told him of my pleasure in being the same, and Mr. Olsen soon introduced me to the other officers. About fifty per cent. of the load was lifted from my mind when I learned that they all spoke English and welcomed me with that friendliness and open-heartedness which seems to be a characteristic of the Norwegian.

The remainder of my worries were dispelled when I answered the dinner bell.

We sailed the next day, March eleventh, for Puget Sound, where the ship discharged its remaining cargo of nitrate of soda and copper ore. Here I was lucky enough to see the whole process of smelting copper ore, from the time the ore and coke went into the enormous blast furnaces until the copper had been refined and cast into ingots ready to be drawn out into wire.

I was not as fortunate, however, at the Dupont Powder Company's works, for that company's rules are necessarily very strict, and woe to the employee who breaks them by admitting visitors! About all that I learned of powder and dynamite making was that it required many large red signs, announcing, "No Admittance" and "No Smoking." These were posted on every building, gate, and fence-post.

After a week of discharging, we commenced to load. First, the general cargo; then lumber and lumber, and more lumber, for the Panama Canal. I watched go down into her holds what seemed to me to be enough lumber to fill several ships the size of the Cuzco; and then they commenced to pile on the deck load. They piled on lumber until it was eighteen feet above the deck. Finally the loading stopped, just as I was beginning to wonder if the ship was not ready to capsize. Then we loaded dynamite and blasting powder, and I gasped and wondered "what next?"

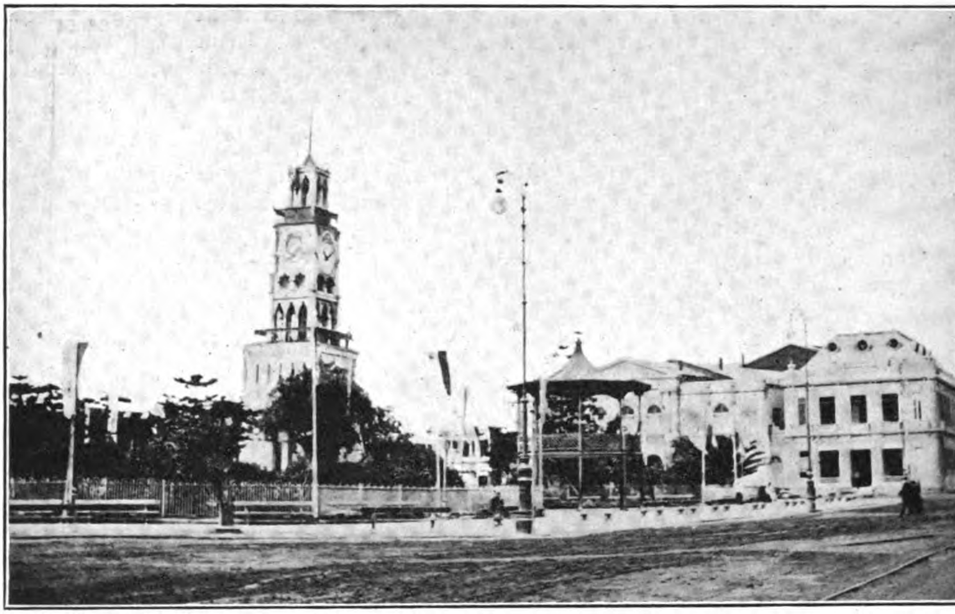
The ship returned to San Francisco on the fifth of April, and after spending a day and a half loading still more cargo, passed out of the Golden Gate and started south.

On the thirteen-day voyage to Punta Arenas, Costa Rica, I had ample time to become better acquainted with my shipmates. They had apparently decided that my lot was rather a lonesome one and did everything possible to make me feel at home. I soon noticed that whenever I came within hearing distance the officers would stop using Norwegian and continue their conversation in English. This may seem but an act of common politeness; but when one stops to consider that some of them used English with difficulty, and that at times they were at a loss for English words in which to express their meaning, it was really as great a courtesy as they could possibly show a lonesome American. This, and their many other kindnesses, soon caused me to be heartily sorry for having ever used the term "squareheads" in speaking of Scandinavians.

We arrived in Punta Arenas on Sunday afternoon. After being ashore for several hours, I did not wonder that Costa Rica is called "The Happy Little Republic." The whole populace promenaded around in their best, whitest, and lightest finery, laughing and chatting in Spanish, with apparently not a care or worry in the world. Punta Arenas, of course, had a *plaza* and a municipal band. Every Central and South American town must have these. Otherwise it would not be a town.

In the evening, everyone, even we *gringos,* marched and countermarched around the *plaza* to the tune of the latest rag. Later we attended the cinematograph—and I will say right here that a designer of Turkish baths could learn something new about perspiration producers by attendance at a Central American movie show. I was a guest of the Governor, so there was

One of the principal sights of Huacho was an old Spanish church, dating back to the Inquisition



Iiquique, Chile, has a population of about forty-five thousand, good hotels, a street car system, moving picture shows, an English club, and a plaza. No Central or South American town can call itself civilized unless it has a plaza

nothing for me to do but sit and perspire for two long hours to the tune of "You Great Big Beautiful Doll," played over and over again on a squeaky phonograph.

The following day we commenced discharging our cargo of dynamite. The natives handled it as though it were sawdust and ignored the supercargo's advice that if they weren't careful with the cases they would all be blown to—er—blazes. Finally one of the stevedores dropped a case with an unusually loud slam, and, looking up at the supercargo with a grin, nonchalantly remarked: "Lots more men ashore!"

Captain Miller had invited me to go on shore with him to look at some pets which he wished to take home, and after watching the unloading I gladly accepted. In fact, I was downright anxious to go. The Governor met us at the *muelle* and went through the markets with us. I believe that I enjoyed the captain's bargaining with the pretty *senoritas* and their *mamitas* even more than the captain himself did, although I did not understand a word of Spanish. We returned aboard ship in the evening with a five weeks' old leopard cub, two squirrels, two parrots, and three noisy parakeets. No monkeys were for sale, otherwise we would have had one.

The next port was Balboa. A ten-day stop here gave me a fine opportunity of seeing the Panama Canal, and I made the most of it. I made the trip across the isthmus one Sunday, stopping two hours at Culebra, Gatun, and Colon. This allowed me to see the big cut and the great locks, as well as the thirty kilowatt NAX station. Here I was received and entertained in the usual American style, and what with swimming in the warm waters of the Caribbean Sea, and talking shop, the time passed so quickly that I almost missed the train.

Before leaving Panama I had even a better chance of seeing the actual work on the canal. I had made the acquaintance of the conductor of a work train, and one day he took me for a trip on his run between Panama and the Pedro Miguel locks, the highest on the Pacific side. The car was at all times crowded with engineers and surveyors moving between the different sections, and their patient answers to my many questions constituted a lesson on canal building which I shall never forget. I learned more about the actual work on the Panama Canal that day than I could have learned from studying all of the books written on the subject. And when I left the train in the evening I envied, admired, and respected one man above all others—the Colonel.

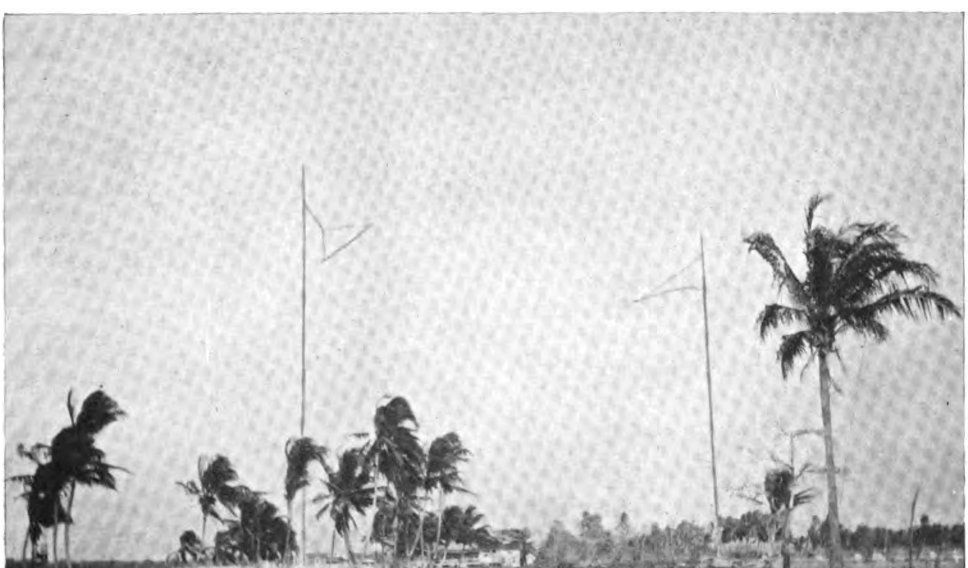
The Cuzco left Balboa on May fourth for Paita, Peru. Paita is the most desolate looking place it has been my misfortune to visit. Several dirty streets with arid sand dunes on one side and the glaring Pacific on the other, was all I could find of the town. The only things of interest were the Panama hats. Dealers in these swarmed aboard on our arrival, offering all grades at prices ranging from one to seventy-five dollars gold. These hats would probably be worth several times their original cost in the States.

From Paita the ship went down the Peruvian coast, visiting Eten, Huacho, Pacasmayo, Chimbote, Supe, and Mollendo; stopping from two hours to a day in each port. At Huacho I was tempted by the sight of what appeared to be a pretty city several miles inland, connected with the wharf by a railroad, and, needing kodak films, I decided to go ashore.

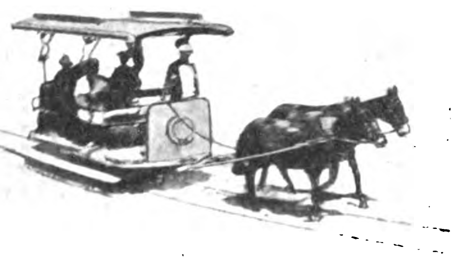
The total passenger equipment of the railroad consisted of one rickety four-wheel car pulled by a team of decrepit mules which, I learned afterwards, had been retired from the Peruvian army for senility. The schedule was regulated by the number of passengers, the conductor blowing a tin horn until the car was loaded. After a half hour wait, the full passenger list of nine was complete, and I jolted up to Huacho.

The principal sights of Huacho were the old Spanish church, dating back to the Inquisition, and the skull road. The highway of the gruesome name is so called because several miles out from the city it runs alongside a fence, the posts of which are decorated with about fifty weather-bleached skulls. I could not secure authoritative information on how their former owners came to their end, but I presume it was from some plague. But I did learn that Huacho, and the citizens of Huacho, are, with one exception, the dirtiest in the universe. The exception is a small town in China.

Our first Chilian port was Arica. What a change! Here there were trees, green grass, and a Marconi station. The town was clean; the people were clean; and the houses were



I made the trip across the isthmus one Sunday, stopping two hours at Culebra, Gatun and Colon. This allowed me to see the thirty-kilowatt NAX station, where I was entertained in the usual American style houses, not shacks. Yet Arica is uninteresting, except in the fact that it is the site of the Peruvians' last stand against the Chilians in the boundary



The total passenger equipment of the Huacho railroad consisted of one rickety four-wheel car pulled by a team of decrepit mules. The schedule was regulated by the number of passengers

war of 1882-1883, when the town was ceded to Chile.

The next port was Iquique. As we arrived, I remarked that there seemed to be a large number of sailing ships in the harbor. There were perhaps twenty. The old boatswain heard me and smiled. "You should have been here twenty years ago," he said. "Then you would have seen ships! Sometimes there were two hundred of them in here discharging coal from England and Australia, and loading nitrate and ore for Germany and the States." Those twenty ships were the last of that magnificent fleet, and within several years they, too, will be but a memory.

Iquique has a population of about forty-five thousand, good hotels, a street car system, and an English club maintained by the many Englishmen working in the offices of the nitrate companies. There are motion picture shows, and now and then a traveling theatrical company. Then there is also a race track, for horse racing has almost supplanted bull-fighting and cock-fighting in Chile.

I had been told that the street car conductors of Iquique were beautiful young *senoritas,* so, naturally, I was anxious to take a ride. But I saw the conductor-*ess* first. And I walked. Somebody had lied.

From Iquique we went to Tocopilla, a barren looking place hemmed in by high mountains in the back, and by the Pacific in the front. It was the one place where I could find nothing whatever of interest.

Our last stop on the Pacific side was Antofagasta, where we laid for fifteen days discharging the remaining general cargo, and loading a full cargo of nitrate. Antofagasta is beginning to rival Iquique in being the heaviest nitrate shipping port in the world. The ships lay far out in the bay and the cargo was towed out in lighters, or launches, and then carried aboard by the ship winches.

While there I had the opportunity of visiting several of the sailing ships in the harbor. What a contrast between the life on board those ships and that on the wireless equipped tramps! The men on the windjammers leave port and hear nothing from the outside world, and the outside world hears nothing from them, until their arrival at the destination several months later. Wars may be declared, kings may die, and new presidents elected; but the old windjammer goes serenely on her way, or stands still, at the pleasure of the wind. How different it was on board the Cuzco, where the American policy in Mexico and the latest Panama Canal bill were discussed, and the newest court scandal talked over each morning at the breakfast table.

When we left Antofagasta there were many conjectures as to where our cargo was to be delivered. The captain maintained discreet silence in the absence of any definite orders, but some of the officers thought that Germany would be our destination, others Galveston. Only one thing was certain; the ship was going around to the other side. Of course, I was delighted at the prospect of a trip across the Atlantic, as all of my traveling had been confined to the Pacific.

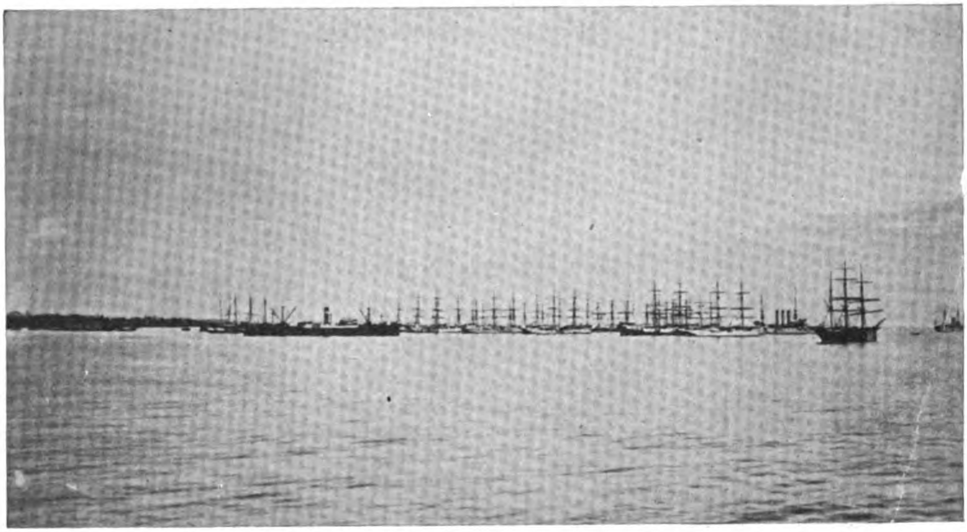
On the night of June sixteenth we arrived off Cape Pillar at the western entrance of the Straits of Magellan. A cold drizzling rain had added itself to the fog which had been with us for three days, and a strong gale and heavy sea appeared to be doing their utmost to make life miserable for us. I have often heard operators on the regular mail runs describe heavy seas, and I have been in two typhoons myself, but to see the genuine "mountain high" waves one must be off Cape Pillar in a real storm. I went to sleep that night thinking what a fine thing dry land is, and how foolish I had been to ever leave it.

I had been asleep for probably two hours, when I awakened, startled. I leaped from my bunk before my eyes had opened. Woof! I was soaked to the skin with icy salt water, and the room was filled almost to the top of the door sill with the swirling streams. My first thought was of the wireless outfit. No, not to send out the S O S, for I could hear the engine running—but to keep the water from the instruments. My living room and the wireless room were divided by a thin partition, and, luckily, I had closed the door before turning in. I piled my clothes around the crack between the door and the deck, and then investigated.

I had left the door on the hook and opened about four inches for ventilation. Consequently, when the ship was turned to enter the straits, thus putting my room on the weather side, a huge wave swept down the deck, tore the hook from the door, ripped the light screen door from its hinges, and gave me the coldest bath I have ever had.

The Cuzco was well into the straits when I finished breakfast the next morning, so I loaded my kodak and went on deck to attempt some snapshots. The western half of the strait is between almost unbroken ranges of mountains which rise nearly perpendicular from the water's edge. Their upper halves are covered with snow, and here and there could be seen blue glaciers on the sides. The width of the strait proper varies from ten to fifteen miles; we were never more than five miles from shore, and usually less. Our vessel arrived at one of the narrowest places about eight o'clock in the evening, and as it was a clear moonlight night the captain went on through. At times it seemed as though the ship was bound for certain destruction on the rocks which lined the passage; then a sudden turn would show water still ahead—and another mountain right on our course.

When I got up early the next morn-



When I remarked that there seemed to be a large number of sailing ships in Iquique harbor, the old boatswain smiled. "You should have been here twenty years ago," he said. "Then you would have seen ships! Sometimes there were two hundred of them in here" ing we had left the mountains behind and were abeam of Punta Arenas, which in English means Sandy Point. The sky was clear and the sun was out all day. The Cuzco passed Cape Virgins at the western end of the straits at eight p. m., and I sent a message from the captain to her owners advising them that she was safely past the most dangerous part of the voyage.

When off Santos, Brazil, our curiosity regarding the ship's destination was satisfied by a message ordering us into Rio de Janeiro for bunkers; thence to Montreal, Canada, to discharge.

At sunrise on the morning of June thirtieth we passed into the harbor at Rio de Janeiro. It is impossible to describe the wonder of this city—especially if one sees it for the first time at sunrise. I can only use the old stereotyped phrase: "beautiful beyond words."

Although the ship stopped at Rio only twenty-four hours, I had time to take a car ride around the bay and a walk through the city. As it was the first real city which I had seen since leaving San Francisco, you may imagine how I enjoyed again walking paved sidewalks, riding on electric cars, and seeing large buildings. Then, too, the Brazilians do not seem to be afflicted with the languid *manana* spirit prevalent on the west coast of South America. The bustle in the streets during the day, and the crowded cafes at night, bear witness that the citizens of Rio believe in the adage that "*manana* never comes," and that it is best to make the most of today.

We went to Tocopilla, a nitrate port and a barren looking place hemmed in by high mountains on the back and by the Pacific in the front. It was the one place where I could find nothing whatever of interest

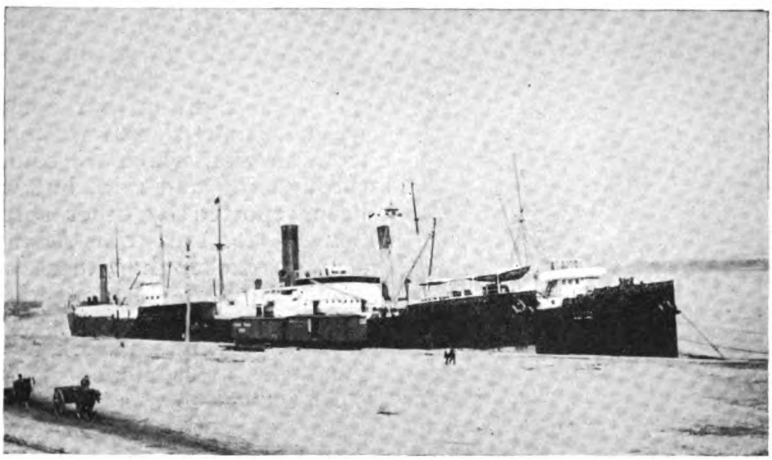
From Rio de Janeiro the ship went up the Brazilian coast as far as Pernambuco, where we set a course straight for the Gulf of St. Lawrence. Argentine, Uruguay and Brazil maintain an excellent chain of wireless stations, reaching from New Year Island near Cape Horn to Pernambuco, so that a ship is always within wireless range of some coast station. There is also a Marconi station on Falkland Islands which is one of the best stations that I have worked. At a distance of eighteen hundred miles I worked this station with my three-kilowatt outfit, and heard it as far north as Bahia, a distance of about 2,700 miles.

From Pernambuco north was a lonesome trip for a wireless operator. Our course was out of the regular passenger steamer tracks, and the strong atmospherics and tropical lightning every night made long distance work impossible. Finally, early one morning I heard DIT—the Imperator. Then followed the sparks of the other trans-Atlantic liners. At five hundred miles from the North Atlantic track there was such a babel of sparks that it was amusing to attempt copying any particular one. The many and varied toned sparks, all coming in at nearly equal strength, produced an effect in the 'phones which would have given anyone but a wireless operator "the creeps."

The first land station I picked up after losing Pernambuco was Sable Island. I was quite near this station for one whole day, and during that time I heard finer wireless than I could have believed possible. The swift and systematic handling of traffic without the use of a single unnecessary dot or dash, was a revelation. I know now what good wireless operating really is.

On the way up the St. Lawrence I heard more of the working of the Canadian stations, and after being in most places where there is heavy wireless traffic, I have come to the conclusion that, taken as a whole, the Canadian Marconi Company's operators are the best and most courteous in the world. From the time I first heard VCT, until I arrived in Montreal, being a wireless operator was a real pleasure—even with dense fog and lightning storms most of the way.

The Cuzco arrived in Montreal on the morning of July thirtieth, twenty-nine days—to the hour—after leaving Rio de Janeiro. The sudden change from salt to fresh air and the difference in drinking water deranged our stomachs, and for the first week in port every man on board was sick. I suppose the people of Montreal thought we were a wretched representation of humanity; but what we, in return, thought and said about Montreal simply could not be mentioned here. The newspapers came out the day after our arrival with nearly a column about the ship and its "menagerie," and it seemed like at least one-third of the population found time to come aboard and pet Spots or try to make the parrots say "Polly want a cracker?" Montreal was too much. Even Spots' unusually good disposition rebelled and several of the visitors suffered from scratched hands.



At Montreal our cargo of nitrate was transferred into lake steamers, to be carried on up the river to the Dupont Powder Works. The cargo filled six of these steamers and several large freight cars

Our cargo of nitrate was transferred into lake steamers, to be carried on up the river to the Dupont Powder Works on the Great Lakes. The cargo filled six of these steamers and several large freight cars. After the nitrate had been discharged, the ship was lined throughout with clean new lumber for a cargo of wheat. Ours was a happy crew when they learned that this cargo was designated for England, for it meant they would have an opportunity of visiting home after an absence of three years.

Although it had taken nearly two weeks to load the cargo of nitrate, the ship was full of wheat in less than

At every port we touched I went ashore, enjoying many a refreshing swim in the "Cavancha"

thirty hours after going alongside the elevator. Of course, this is easily explained. The nitrate must be lifted from the lighters, hauled aboard, lowered into the hatches, and then carried to the different parts of the holds; while with the wheat, large iron chutes are put over each hatch and it flows in by gravity.

We said good-bye to Montreal at noon on August twenty-first.

On the way down the St. Lawrence I was given a demonstration of the efficiency of the Canadian Marconi system. The captain was rather doubtful as to whether he would go out by way of Belle Isle or Cape Ray; the former route was much shorter, but dangerous if there was any quantity of ice, while the latter was perfectly safe if it was not foggy. The ship was off Father Point at the time and I asked the Marconi station there for information regarding the conditions at both places. Within twenty minutes I had accurate, down-to-the-minute reports from every station between our position and both Belle Isle and Cape Ray. The reports showed that the Strait of Belle Isle was almost packed with ice and the weather was from hazy to foggy, while the southern route was clear and had no ice. This eliminated all guess-work on the captain's part and he immediately set the course for Cape Ray.

After passing Cape Race I began to receive ice reports from the other ships. For two days there was a continual stream of "msgs," the text in all of them nearly the same: "Sighted large berg lat. 49, long. 51.13; growlers lat....." and so on. We passed within six miles of a large berg which had been right on our course before we had changed, and we felt the cold from several, which we could not see through fog and rain, but which had been reported by other ships. As I listened to the trans-Atlantic liners steadily exchanging these reports, I wondered if the passengers on those floating hotels have any idea of the amount of wireless work that is done for their safety alone.

As the Cuzco was bound around the north of Scotland, then down to the Tyne, she was soon out of the regular steamer track. There was practically no wireless for me to do after the first three days, so I sat back and listened to the other fellows work, and tried to count the number of stations. This pastime was only a degree better than attempting to beat "Old Sol" at cards. One night I counted thirty-three stations in four hours; besides hearing many others I could not copy. I wonder what some of the operators who complain of the interference on the Pacific would think of this jam?

We arrived off Shields on the evening of September sixth and proceeded on up the Tyne to Dunston, where the ship lay for almost two weeks discharging her cargo. From there she went back down the river to Wallsend, five miles below Newcastle, for repairs.

It was expected that the Cuzco would be only six weeks in the shipyard, but when this time had elapsed it seemed as if the repair work had been just started. As I had never before seen how ships were built, everything around the shipbuilding plants interested me immensely.

Several hundred feet from where we lay were the ways on which the Mauretania was built; the largest floating crane in the world lifted out our engine; every week a ship was launched somewhere within sight of us. Farther down the river could be seen the largest cranes in the world looming above the surrounding factories. These cranes are capable of lifting the engine from the largest ship afloat, and could easily lift one of the smaller steamers right from the water and place her on land. Up the river could be seen the nearly finished Rio de Janeiro, the largest battleship in the world. And I was actually seeing these wonders!

Two months passed and we were still in the shipyard.

Most of my shipmates were home in Norway, leaving me alone in a foreign land, and if Englishmen were really as snobbish as they like to think they are, I would have had a lonesome time of it. The first real Englishman with whom I became acquainted was Charles J. Close, manager of the Newcastle office of the English Marconi Company. Mr. Close and his staff did everything possible to make my stay in England an enjoyable one. And if there had been more sunshine, and less coal dust and smoke, they would have certainly succeeded.

But I simply could not like England. The crooked streets and the old, low, smoke-blackened buildings were depressing; the filthy barber shops brought on bad dreams about germs and microbes; and dodging street cars and automobiles which run on the wrong side of the street almost gave me nervous prostration. Neither could I accustom myself to women sitting in a "pub" drinking with always smoking, and sometimes swearing, men.

Perhaps I was homesick; I know that I often thought of the land of sunshine and flowers, and of how nice one long look at the sun and a clear blue sky would be.

And how I missed good old American slang! If one casually remarked to an Englishman, "Ain't that rummy a grouchy looking gink?" the Englishman, instead of replying, "I don't getcha," politely requested the definitions of "rummy," "grouchy" and "gink." Which does take the snap out of conversation.

Christmas Eve found us still in the shipyard. The officers had arrived from Norway a week before and we

At Wallsend-on-Tyne the largest floating crane in the world lifted out our engine; every week a ship was launched somewhere within sight of us made a jolly night of it. At eight o'clock we sat down to a table loaded with all the good things we have at home, besides several Norwegian dishes that I forget the names of. The first toast, of course, was "A Merry Christmas and Happy New Year to all"; the next: "To the place we are all thinking of—Home." The third was: "To the chap that is furthest away from there—'Sparks.'" And I made some kind of a reply; but all I remember is that it had a pretty hard time getting around the lump.

By New Year's I had lost almost all hope of ever leaving England. What had been so interesting at first, now palled. I had not spent all of the time in Wallsend, of course, but as I intend to only write of the places which I actually visited in the Marconi service, I will just mention that I made trips to the continent and spent a week and a half in wonderful London. Even now I can hardly believe that I really saw those places I had read so much about and which I had always longed to see. And it is even harder to realize that I was being paid to see them!

On the night of January sixteenth—four months after our arrival—we left Wallsend and went down the Tyne to North Shields, where we lay for two days, taking bunkers and a cargo of coke. From there we went to Port Talbot in Wales, where we stopped for three days and loaded general cargo. And then we left the British Isles for good.

Our route was down past the coast of Europe to the Canary Islands, where a course was set for Fernando Noronha, off the northern part of Brazil. On the night that we crossed the equator, Neptune, with his long rope-yarn hair and beard, paid us a visit and initiated those of our crew who had never before crossed the line. The unfortunates were led, dragged, or carried up on deck and forced to sit on a narrow plank laid across the top of a tub filled with cold water. Neptune then approached with a pot of lather—made up chiefly of soot—and with a large paint brush smeared the seaman-elect's face, then proceeded to shave with an enormous wooden razor. Any protests were quickly silenced with another application of the lather—in the mouth! These operations were followed by a ducking, both in the tub and with the fire hose, from which emerged a true son of Neptune.

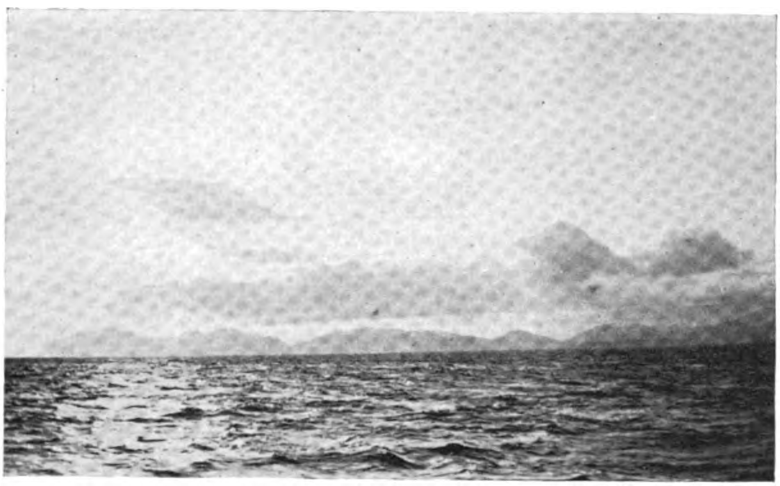
At Antofagasta the ship lay far out in the bay and the cargo was towed out in lighters and carried aboard by the ship's winches

On February eighteenth we arrived in Santos, where the ship lay four days loading coffee. Not so very long ago seamen shuddered, and sometimes mutinied, when their ship was ordered to Santos, as the place was notorious among seafarers as the most unhealthy port in the world. Hundreds, perhaps thousands, of seamen have died there from yellow fever. I have heard of ships lying there for months trying to get a crew. There is one story about a ship which had seven complete crews and three captains before she finally got away with enough live men to work the ship. Up-to-date sanitary measures have now made the place as healthy as the average South American city.

While the ship was lying here, I visited one of the large plantations and saw how the coffee was grown, picked, dried, and finally sacked ready to be shipped by rail to the seaport.

From Santos we came back to our route of nine months before. On the fourth of March, after a rough, foggy passage through the Straits of Magellan, we passed out by Cape Pillar and I was on the home stretch. The only stops in South America were Coronel and Iquique, Chile. From the latter place we went direct to Punta Arenas, Costa Rica, where we lay for nine days discharging the cargo loaded in Wales, and loading another cargo of rosewood and mahogany for New York, via the Isthmus of Tehuantepec from Salina Cruz, Mexico.

After several days, Punta Arenas began to wear on the nerves of all. The heat was almost unbearable during the day. We tried alligator hunting in the lagoon back of the city, but saw few alligators, and shot none at all. Then we tried fishing, but the fish weren't biting that week. Finally, one morning the chief officer came on deck with an enormous hook and informed all hands that he intended catching a *real* fish. After tying it to a heaving-line, and making the other end of the line fast to the ship's rail, he baited the hook with about five pounds of salt pork and dropped it over the stern—leaving me to stand by and yell if there were any bites. And the bite came! There was a sudden jerk, and I jumped for the rail and yelled at the same time. Several feet below the rail dangled the frayed end of the fish line, and two hundred feet away a large shark was churning the water in agony, trying to rid itself of the hook.



Picture making is difficult in the Straits of Magellan, where the western half is between the almost unbroken ranges of mountains rising from the water's edge

Mr. Shark was evidently not enjoying his meal of salt pork any more than the average sailor does.

Remembering that the Marconi construction men had left some of the old seven-strand bronze wire on board after putting up the new aerial, I offered to lend this if the chief officer would make another hook. He looked rather dubiously at the wire, but finally consented to another try. We had another bite the next evening. This time the line held, although the iron rail was badly bent and almost torn from the ship. After an hour's fight, during which a quartermaster was knocked from the boat and severely bruised, our catch, a monster man-eating shark, was hauled aboard. It measured slightly over twelve feet in length.

Our only stop between Punta Arenas and Salina Cruz was San Jose de Guatemala, an uninteresting little place except for the gaudy uniforms which the port officials wore. Salina Cruz is of special interest to Americans at present, not so much on account of the recent disturbances in Mexico, as for its relation to the Panama Canal. For many years much of the freight between the east and west coasts of the United States has been shipped down to Coatzacoalcos on the Atlantic side, carried across the 120 mile wide Isthmus of Tehuantepec, and re-shipped at Salina Cruz. Millions of tons of sugar has gone back over the same route to be refined in the East. For this service, the American-Hawaiian SS. Co. maintain a fleet of the finest cargo steamers under the American flag, if not in the world.

As a trans-shipping port, Salina Cruz is probably unexcelled. Fast working electric cranes swing over the ships, lift the cargo out of the holds, then swing back and deposit it direct on the cars. The wharves are made of concrete, and the warehouses the latest in fireproof construction. In the harbor is a dry-dock which will accommodate ships six hundred feet in length. These facilities, which were only completed in 1907, will be practically a dead loss after the opening of the Panama Canal.

From Salina Cruz, the Cuzco went direct to San Diego.

How I worked my tuner, adjusted my detector, and strained my ears for the first buzz from KPJ! Finally, off Cape Corrientes, I heard him; then, several nights later, I picked up KPH sending news from home—God's Country!

After that, each day seemed to be composed of about fifty hours. I spent most of the time on deck, passing uncomplimentary remarks on the Cuzco's speed. I'll admit it: I was then mighty homesick. For, after all, there's only one place for a fellow born and raised in a country where the people know they're alive from their first howl until their last gasp. Where's that? Don't make me laugh. U. S. A. it.

At daybreak one Sunday morning, the chief officer came running into my cabin, yanked off my bed-clothes and ordered me to get up quick. I tumbled out in a hurry, and without stopping to dress went on deck.

And there she was. . . .

The Cuzco was then abeam of Point Loma: within two hours she was made fast to the San Diego wharf, and I was again on American soil. My first purchase was an ice cream soda; my second a decent haircut. An American does not know how good ice cream sodas really are, nor what a treat it is to sit down in a sanitary barber shop, until he has been where there are neither.

Two days later, we proceeded to San Francisco, arriving there on April twenty-third—exactly a year and fifteen days after leaving. There my trip ended.

THE CROP

By George Mabie Todd

BR-R—IPP! Bump!

Manning turned over in his berth uneasily. Why couldn't they let him sleep; he had left the wireless room only a few hours before . . . willing to bet that there was no necessity for him to turn out for a long time yet. If only he could just get a few more winks, a little. . . .

With a sudden lurch of the vessel he was hurled violently out of his berth on to the floor amid a grinding and moaning of timbers. The big vessel quivered and shook, and outside there were muffled shouts and cries. Manning struggled to his feet, dazed. Groping his way across the cabin he had reached for the electric light switch when there then came a violent pounding on his door. He wrenched it open and a figure in dripping oilskins stood before him. It was the first officer.

"We've struck something; there's a hole in the bow as big as a house!" he flung out. And Manning, grabbing what clothes he could pick up in one handful, jumped into his trousers and dashed out of his cabin. Everything was in turmoil. The stewards were making their way from cabin to cabin, arousing the passengers, and already a few panic-stricken men and women were groping their way about the deck.

In the wireless room Harris, the junior operator, was waiting the arrival of his chief. He had already sent out the S O S call and now he surrendered the key to Manning. Again and again the senior operator flashed the appeal over the waters. Then he settled back to await a reply.

It was not long in coming. The Wiltania, steaming on her course seventy-five miles to the east, responded. She wanted to know the exact position of the Sylvester.

The captain had arrived in the wireless room by then and his face was tense with interest as he stood at Manning's back. He had guessed the unspoken request before it reached the operator's lips.

"Tell 'em we've struck a reef in latitude 16 degrees north, longitude 72 degrees west," he directed crisply. Then he added grimly, "And tell 'em to hurry up or they may not find us."

The force of this statement broke suddenly on Manning as he noticed that the floor of the wireless cabin sloped till it was almost impossible for him to retain his position at the key. The cries and shouts outside, faint at first, had redoubled. The wireless signals were growing dimmer. He knew what that meant. The water had reached his dynamos and they had failed him. And there was no storage battery equipment!

He turned to inform the captain of this fact. He had gone. Harris, too, had left, and following the direction of his superior had sought a place near the lifeboats. Manning knew then he was quite alone! His own safety came to his mind; he crawled on his hands and knees out of the door and surveyed the situation.

He was not a little dismayed by the cleared decks that met his eyes. Dawn was just breaking and in the distance he saw the Sylvester's boats making toward a cloud of smoke which he suspected came from the funnels of the Wiltania. On the Sylvester, however, there was not a person in sight.

He slid across the deck toward the stern. Then he mounted a tackling block and halloed loudly. He waved his coat wildly also, but all to no purpose; the occupants of the boats, apparently unaware that any one had been left on the sinking ship, kept steadily on their way.

The situation was desperate. Manning dimly wondered how it would end. For several long minutes he speculated vaguely on his fate, sitting still and silent, staring out over the sea.

He was aroused by a low moan; it seemed to come from the other side of the deck and he picked his way among the débris in that direction. Again the moan sounded in his ears; this time it seemed to come from directly under his feet. He looked down, but saw no one. A heavy iron ventilator had fallen there, and as he listened the moan was repeated lower and nearer than before. He tugged and strained at the ventilator, but to no purpose. Stepping to one side he managed to separate a heap of overturned deck chairs and discovered the form of a man pinned under the mass of metal. As the unfortunate raised his head, Manning recognized him as a passenger—Flanders by name—whose resemblance to the operator had been commented upon early in the voyage. Now, however, the resemblance was marred by a deep gash in his forehead and his face was contorted with pain.

"It's no use trying to help me," he muttered as Manning bent over him. "I couldn't even get into a boat now. I seem to be hurt all over and weak." A spasm of suffering seized him and he beckoned Manning closer.

"Take this," he gasped, holding out his hand which clutched a letter. "Deliver," he choked; "deliver," he closed his eyes and the wireless operator drew quickly back. Another gasp, then: "Deliver—"

Manning called to the injured man softly, but there was no response. The operator realized suddenly that he was the only living person aboard the Sylvester.

This was followed swiftly by the disconcerting observation that the wind which had been blowing from the northeast had veered around to the north, increasing considerably in force. It brought with it seas which, although of comparatively little strength, at first developed in a surprisingly short time into mountainous waves. The ship rose high up in the air and came down with a crash which made her shake from stem to stern. As the minutes flew by both the wind and seas were increasing and Manning knew that the Sylvester could live only a short time.

The end of the vessel was nearer, in fact, than he thought, for even as there formed in his mind a resolution to find out if by chance a life-boat had been left behind, there came a grinding and a tearing; and, as if by magic, that part of the ship extending from the bow almost to amidship, disappeared into the hungry maw of the sea.

Held spellbound by the extremity of his peril, Manning stood for a moment gazing in terror at the waters swirling over the grave of the hulk. The next instant he hurled himself into the maelstrom.

Down . . . down . . . down, he sank. It seemed as if he must strike the bottom, many fathoms below. His head was bursting and a horrible din sounded in his ears. Instinctively he began to work his arms and legs. Then, almost as quickly as he had gone down, he ascended to the surface of the water. Before he had time even to draw a breath he was rolled over and submerged by a giant wave. Caught on the crest of another he was then propelled a considerable distance from the wreck. His breath was gone and his muscles seemed powerless. He wondered if he would ever come to the surface again; he wondered, but was not concerned. Then the din again sounded in his ears; something bumped his arm. It was a bit of floating wreckage. He reached toward it, and as his hand closed over the end a strange sense of peace and quiet stole over him; a dark curtain appeared before his eyes.

II

The President of Zoambique had two objects in taking a cruise on his yacht the day that the Sylvester was wrecked. The first reason had to do with hygiene, but the second and more important one was a desire to leave behind for a fleeting moment the cares of state. And it so happened that he was not particularly pleased when his reverie was interrupted. He and the members of his party were basking in the sunshine aft when His Excellency was informed that a man clinging to a bit of wreckage had been sighted. Reluctantly, almost grudgingly, the yacht hove to; . . . and fifteen minutes afterward the limp form of Manning was carried aboard.

The unexpected may happen at any time to a wireless operator, and the unexpected having happened before, Manning did not permit any expression of surprise to escape him when he opened his eyes and found himself tucked in a berth in a well furnished yacht cabin. Although he was somewhat weak as a result of his buffeting from the seas, he quickly recovered his strength and engaged the first passer-by in conversation.

An hour after his rescue he was sitting in a deck chair under an awning telling his story to the President and his friends. While he was relating the circumstances concerning the fate of the Sylvester, he found an opportunity to observe His Excellency. The wireless operator set him down as the typical soldier of fortune—quick of wit, ready of courage and willing to risk any hazard to advance his own interests. But the personal charm of the man sufficed to remove any prejudice that might be formed by the calculating glance with which he was wont to appraise those about him, as if searching for some hidden weakness on which to play.

Polite and urbane, he was quite the proper host. Yet all the time that his steady brown eyes were bent upon him Manning felt that he was being probed for secrets, motives and what not; that his every word was being weighed and carefully considered. It gave him a feeling of uneasiness which he put aside as a freak of nerves.

All that day the Marie—that was the name the President had given his craft—cruised about. But as evening approached she was turned about until her nose was pointed toward Boram, the capital of Zoambique, and when Manning awoke in the morning he looked out of the port holes in his cabin upon the sparkling waters of a harbor which was surrounded by hills crowded with a wealth of vegetation.

As he stood on the deck a little later gazing with delight upon the scene which unfolded before his eyes, the President appeared and remarked upon the beauty of the new day. Suddenly he said:

"Do you think you would like to become a citizen of Zoambique, Mr. Manning?"

There was a significance in the tone in which the words were uttered that was not lost upon Manning. It seemed to imply a command rather than a question. His Excellency took Manning's consent for granted, for he nodded and walked away before the latter had an opportunity to reply. Surprised and somewhat discomfited at the unexpected development in his affairs, the wireless man was at first disposed to resent the peremptory way in which the President had made known his wishes; being of a philosophical turn of mind, however, he accepted the situation as gracefully as he could and began to make preparations to go ashore.

One of the President's aides—Captain Hungerford—escorted the operator to a pleasant inn where he found arrangements had been made for his comfort. That evening he and the captain, an agreeable young American of his own age, dined together. From the captain he learned much that was interesting concerning the history of Zoambique. It seemed that the present chief executive had been elected by right of the leadership of a majority of the forces following a revolution three years ago. The President was a very popular man personally, although he was distrusted by many because of his failure to satisfactorily explain the disappearance of $200,000 in gold from the national treasury. In fact, Baron Weiner, the leader of the opposition, who was in hiding in the foothills, had openly charged that the President knew far more than he had told about the circumstances connected with the loss of the cash.

The mention of the Baron's name brought a cloud to the brow of Manning's companion. He leaned across the table and dropped his voice to a whisper.

"How long do you intend to remain in Zoambique, Mr. Manning?" he inquired.

Manning replied non-committally.

"You seem to be the right sort and I don't want to see you get in trouble," the captain went on, "so I'm going to give you a bit of advice. Don't stay here any longer than you can help and don't walk too closely in the shadows of buildings when you are out late at night."

Manning stared in amazement.

"But——" he began.

"I can't say another word," replied the other. "Only you might need this; better put it in your pocket." And he passed a gleaming object under the table into Manning's hand.

Another engagement called Captain Hungerford away soon afterward. Over his cigar Manning allowed his thoughts to dwell for a time upon what his companion had said. The remarks of the captain did not serve to disquiet him, however. He did not take seriously his companion's warnings, although the weapon which had been handed him was a grim reminder that he had been in earnest.

The name of Baron Weiner had a familiar ring, however. Where had he heard it before? Suddenly he jumped to his feet. It flashed upon him all at once that Weiner was the name written upon the letter which the dying man on the Sylvester had entrusted to him. In the excitement of his rescue and his arrival at Boram the incident had slipped his mind. Hurriedly he took the letter from the rubber bag secured to a cord tied about his neck. Yes, the letter was safe. It was addressed to "Baron Weiner, Borem, Republic of Zoambique."

From the plaza the strains of a waltz floated up to the balcony, summoning Manning to join the crowd below. Strolling aimlessly about, he finally found himself in a quiet thoroughfare on the water front. Over the bay shone the moon, dimly re-

"I have come to arrest that man, your Excel

vealing the outlines of the President's yacht as she rode at anchor not a great distance from shore. Impressed by the beauty of the scene, Manning stopped to look and light a fresh cigar.

As he struck a match a man wearing a dark suit of clothes and a sombrero made his appearance. So unexpected was his arrival that Manning involuntarily stepped back.

"I crave your pardon," said the stranger, lifting his hat, "but could I beg of you a light?" Manning casually noted that his hair was white.

"Why, certainly," he replied graciously. The match went out and he reached into his pocket for another. "It's a beau——"

He cut short his sentence with a cry of amazement, for the stranger suddenly threw his arms about him and bore him to the ground. So unexpected was the attack that Manning for the moment was unnerved. Quickly recovering himself, he struggled to

lency," said the detective, pointing at Manning.

free himself from the grasp of his assailant. The stranger had the advantage in weight, but Manning was lithe and active.

Punch! He drove his fist with all his might into the face of the white-haired man. A muffled snarl of rage was the answer. The men clinched, falling to the pavement. Over and over they rolled with the wireless man uppermost at one minute only to lose his advantage the next. Time and again he felt the fingers of his assailant fumbling in his pockets.

Once he caught the gleam of a knife which the white-haired man had snatched from his belt. With a quick movement he seized the wrist of the other; slowly he bent his arm backward until the fellow let the weapon fall from his grasp.

Doggedly, determinedly, the stranger continued the struggle, although Manning rained a shower of blows in his face. The grim resolution of his antagonist filled him with uncertainty as to the result of the encounter. He felt his endurance giving away; an exclamation of triumph escaped his assailant. Manning saw him grope for the knife.

Then came an unexpected interruption. There was a rush of feet on the pavement and Manning's antagonist, muttering imprecations, freed himself from the weakening grasp of the wireless man and darted away. The next instant a squad of men dressed in the uniform of the Zoambique police appeared.

While some went in chase of the fleeing man, the others assisted Manning to his feet. The other policemen returned in a short time with the information that his assailant had vanished. Manning ruefully surveyed his dust-covered clothes. Then he made a discovery which caused him no little perturbation.

The inside pocket of his coat had been neatly cut out, as if by a knife, and the envelope addressed to Baron Weiner was gone.

III

The rays of the sun shining into his windows the next morning aroused Manning from a heavy sleep. Almost simultaneously there came a tapping at the door, and a servant announced that the President wished to see him at the State House. His Excellency was in good humor and greeted him cheerily.

"I've got a job for you, Mr. Manning," he began. "I want you to start right away getting your wireless station into working order."

A set had been installed in Boram, it appeared, by a sugar company to communicate with a station on Luigi Island, located about 100 miles to the north. When the sugar company ceased its operations the stations were abandoned. On Luigi there was a soldier who had obtained a smattering of wireless from the sugar company's operators. It was the President's plan to have Manning on duty in the Boram station in order to keep in communication with the island.

His Excellency's good humor continued throughout the interview. But just before it ended Manning caught a glimpse of another side of his character.

"Of course," said the President, "I am compelled to rely largely on your discretion, in which I have the utmost confidence. In other words, I don't like men around me who talk."

Manning assured him that he did not gossip about his business. The President nodded his head.

"That's good," he commented. "Good for me—and good for you." The emphasis which he placed upon the last word was accompanied by a significant glance; it was so full of meaning that it was almost a threat.

Somewhat puzzled by the President's attitude on what seemed a comparatively insignificant matter—the appointment of an operator—Manning left to find his way to the wireless station, which was situated on the shore of the harbor. The set was not in the best of condition and he tinkered with it for the greater part of the day. At nightfall he was able to exchange messages with Roberts, the operator at Luigi. The latter had learned that the station at Boram was to be reopened and expressed his surprise.

"There is no one here except the colonel, commanding about fifty soldiers, including myself, and a few old buildings," he flashed. "Why the President wants to keep up communication with this place I can't for the life of me figure out."

Manning was equally at a loss. But it was obvious that His Excellency had an intense interest in Luigi, for the very next day he appeared at the station and sent this message to Colonel Lory, the commandant on the island:

"How is the crop?"

Lory sent a terse reply, merely saying "All right."

It seemed to satisfy the President, however, and he went away from the station smiling. Manning and Roberts discussed the marconigram. "There isn't a thing growing here except weeds," said Roberts.

That night Manning allowed his thoughts to dwell on the mysterious messages until he fell asleep. His interest was aroused again a few days afterward when the President sent another message about the "crop." In fact, it became a habit of His Excellency to call several times a week at the station and communicate with Luigi.

Manning had almost forgotten his encounter with the white-haired man in the interest of his new duties. He had not reported his loss to the police; to do so, he thought, would be indiscreet. One evening the incident was again brought to his mind. He had been given a message for transmission to Luigi late in the afternoon and was compelled to wait more than an hour before he found Roberts "listening in."

It was dark before he left the station. The slight rain which was falling moved him to quicken his pace to a run. As he ran along, head down, he ran full tilt into two men talking on a corner. One of them fell to the pavement as a result of the collision; the other escaped by quickly drawing to one side.

Turning his attention first to the fallen man, Manning was about to assist him to rise when he heard an exclamation from the other; he wheeled about to find his assailant of the water front staring at him. With a cry of anger, Manning sprang toward him. The latter had already started to run; Manning darted after him. Faster and faster ran the fleeing man. But pedestrians were blocking his way, and, although he pushed them aside, he lost ground rapidly and was soon almost within Manning's grasp. Just then, however, the latter stumbled over a stone and fell headlong. When he got on his feet the white-haired man was not to be seen.

The meeting with his assailant was not the only surprise in store for Manning that night. In a carriage in front of the inn he found the President waiting for him. The latter motioned for him to enter the vehicle, which was driven rapidly back to the wireless station. His Excellency was silent throughout the drive, although Manning saw his hands working nervously from time to time.

"Get Luigi," he ordered shortly, as soon as they had arrived at the station. This was the message he dictated for transmission to Colonel Lory:

"Send crop at eleven to-night."

With expressionless face Manning flashed the words out into the night. The crop! There had come to lie for him a world of mystery in the word. And while he pondered over the many theories that suggested themselves to him as a solution of the problem, the President paced up and down the floor, stopping now and then to look out of the window over the waters. For almost an hour His Excellency continued to walk back and forth.

The nervousness which Manning had noticed before was now more apparent. The wireless man, too, began to feel something of the unrest which was stirring His Excellency. Something untoward was afoot, he felt certain.

A sigh of relief from the President directed Manning's attention to the latter. His Excellency was at the window, intently peering out; the wireless man, stealthily creeping up behind him, followed his glance.

The night had cleared and the little bay and the craft on it were plainly discernible. Alongside the pier just below the station was the President's yacht, smoke pouring out of her funnels in great clouds. She was evidently making ready for a voyage. Near her was a small tug. From the latter several boxes were being unloaded and transferred to the yacht.

While Manning was absorbing the scene the President suddenly wheeled about. The expression of relief in his face instantly gave way to a frown.

"Why don't you keep your eyes where they belong?" he snarled.

"Why, Your Excellency, I——" stammered Manning, overwhelmed by the suddenness of the attack. For a moment the President looked as if he meant to strike the other. But he contented himself with a black glance that was full of meaning, and passed out of the door. From the window Manning saw him go out on the pier.

Here was a new development in the affair. That the boxes had something to do with the messages His Excellency had been sending, Manning was sure. But what did they contain and why was the President so much interested in them?

Deciding to consult Roberts about the matter, he seated himself at the table and called Luigi. The response came immediately; in fact, Roberts told Manning that he had been about to call him.

"Has a tug landed at the pier to-night?" asked the Luigi man. Almost before Manning had flashed back "Yes," the other continued:

"Then the President's going to get away with it all right. There's been a lot going on here ever since that first message came to-night. I saw one of the men loading boxes on a tug, and when it had gone he told me that they were full of gold pieces. One of the boxes fell and burst, so he knows what he's talking about."

Manning was able to piece out Roberts' disconnected story by means of questioning. The Luigi operator had learned from a soldier that the gold had been stored in a cave where it was guarded day and night. The President's messages concerning the "crop" had of course referred to the gold which His Excellency had stolen from the treasury of Zoambique and was now planning to take out of the country.

Roberts signed off and Manning leaned back in his chair, filled with wonder at the bold methods the President had pursued. Then he became aware that someone had entered the room; he felt that he was in peril and whirled about quickly. Standing before him with a revolver pointed at his head was the President!

"You've been trying to find out about things that you have no business to," he said sharply. It was a guess, but it was a good one. Manning's expression revealed this. His Excellency did not appear to be angry. He was merely coldly resolute. His hand on the trigger, he was apparently considering what to do, when an interruption occurred.

The door was thrown violently open and the figure of a man appeared on the threshold. For a moment he stared with wide eyes at the occupants of the room. In that brief space of time Manning recognized again the white-haired man who had so mysteriously thrust himself into his life.

He halted at sight of the President. Recovering himself, he bowed respectfully.

"I have come to arrest that man, Your Excellency," said the new arrival, pointing at Manning. The President nodded in approval. Manning, at first overcome with surprise at the strange turn affairs had taken, now found his voice.

"On what charge?" he demanded.

"On the charge of planning to train soldiers to foster a rebellion in Zoambique," the white-haired man replied. He stepped forward and drew aside his coat, displaying a badge on which was engraved, "Secret Service Department, Republic of Zoambique."

"But the President knows that this is not true," replied Manning, turning toward the latter. His Excellency looked bored.

"I know nothing about the man, Brader," he said. The Secret Service agent addressed Manning.

"What's the use of trying to deny it?" he asked. "Your name's Flanders." He fumbled in his pocket and drew forth the letter which had been taken from him. "This tells the whole story," the detective went on. "Here's a letter from the Opposition forces' agency in New York—addressed to Baron Weiner."

Manning felt the net of circumstances closing about him.

"I can explain all that," he cried. "I——" The President silenced him with a wave of his hand. "You can do that at the trial—if you have one," he said quietly. "Go on, Brader," he directed.

"Why, this man Flanders is a deserter from the United States Army who came over here to train Weiner's soldiers. I had a description of him from our man in New York before he arrived and I recognized him the minute I saw him. Captain Hungerford had the same information, too, from his friends in America."

Manning gratefully recalled the captain's warning. He realized now that he was a victim of mistaken identity and that Hungerford's words of caution were well founded. He felt that he must do something to extricate himself from the web.

"Then why didn't you arrest me the night of our encounter on the water front?" he demanded.

The detective laughed. "It isn't wise to have too much publicity in these excitable times, and besides, I wanted to find out if you had any confederates with you. If you have, and they are around here, we'll nab them, too, because I'm expecting some of my men any minute."

The President seemed to consider the case as settled. He looked at his watch and, nodding to the detective, walked out of the station.

Brader, apparently relieved that the capture had been effected with so little trouble, was disposed to be talkative.

"You're caught, Flanders," he declared, "and there's no use in kicking about it. If you don't make any fuss, we'll get along together all right. But if you do—he paused and looked significantly at his coat pocket, in which the bulging outlines of a revolver could be seen. Then he settled himself comfortably in a chair to await the arrival of his men.

The operator remained outwardly cool, but his mind was working at high speed. His glance roved uneasily about the room and finally rested on the wireless apparatus. There was a chance that if he sent out a call for aid it would reach him in time to save him.

He allowed his glance to wander out

of the window. Suddenly he started. "The Marie! The President's yacht!" he exclaimed. Brader left his chair and approached the window. As the detective neared Manning he took his revolver from his pocket and pointed it at the latter. But he had given his prisoner the opportunity he wanted. Once within reach of Brader, Manning's fist shot out, striking him on the point of the jaw. At the same time the detective fired his revolver. The bullet went wide of its mark, and Brader sank to the floor. It was but the work of a minute for Manning to bind his hands and feet; then he turned to his set.

"S O S," "S O S" was the call that went flashing over the waters. Two, three, five minutes, he waited. Again the call was sent out, but with no result. Manning was beginning to despair. Then, as he "listened in," he heard the welcome words, "Who is it and where are you?" "An American in danger in Boram, Zoambique," he flashed back. There was a silence lasting for what, it seemed to Manning, was an interminable period. Then came this message:

"This is the United States battleship Alaska. Will reach you in twenty minutes."

In one bound Manning cleared the space between the apparatus and the door and dashed down the path toward the water. He knew that Brader's men had arrived, for behind him he heard a shout to stop and a bullet whizzed past his head. On and on he ran until he came to the pier. A rowboat tied to the structure caught his eye and he jumped into it. Heading toward the mouth of the harbor, he pulled with all his strength. As he cleared the end of the pier he noticed that both the President's yacht and the tug which had arrived from Luigi had steamed away. There was nothing left for his pursuers but another small boat, and into this they tumbled.

Two of the men used the oars while the others sent a fusilade of bullets after the fugitive. The short choppy waves which the wind was stirring up made their aim bad, and none of the shots took effect, although several ploughed up the bottom of the craft at his feet.

The purusing boat came nearer, despite Manning's attempts to widen the distance between the craft. He felt that the race must end soon. His heart was thumping in an alarming manner, and the oars seemed like iron weights. All at once he noticed that the course of the pursuing boat had been changed; now she was being turned about; she was actually heading the other way.

Manning sank forward on the thwart; he was too exhausted to wonder what had caused his pursuers to abandon the chase; too much worn to turn his head about and grasp the fact that it was a man-'o-war's gig, filled with bluejackets, rapidly approaching, which had sent Brader's men scurrying toward the shore to get out of the way; he realized only that for the time being his troubles were at an end; that he could relax. So he dropped the oars and, resting his face between his hands, closed his eyes. It was in this position that the members of the boat's crew from the Alaska found him when they swept alongside the craft in which he had made his escape.

A month afterward the wireless man picked up a copy of the Paris edition of a New York newspaper and glanced idly through its columns. Suddenly he straightened up with interest. This paragraph had attracted his attention:

"The President of Zoambique has arrived in Paris for a lengthy visit. He reports that the finances of Zoambique are in a flourishing condition. This is attested by the fact that he himself has just deposited $200,000 to his personal credit in a Paris bánk."

IN THE SERVICE

To devote considerable effort to some tasks without thought of reward in order to acquire fitness in which to earn an additional something has been the plan followed by G. Harold Porter, recently appointed purchasing agent of the Marconi Wireless Telegraph Company of America. He formulated his policy early in life—at the age of twelve, in fact—when it brought him a reward in the shape of a position as telegraph operator in the employ of the Delaware & Hudson Railroad Company in Carbondale, Pa.

The reader will better understand how this came about if he is told some of the circumstances leading up to this period in Mr. Porter's life. He was born in Carbondale in 1871, and when he was nine years old became ambitious to enter the working world. This was about a year after the death of his father. The best opportunity that offered itself was a position as breaker boy in the mining department of the Delaware & Hudson Railroad Company. Young Porter's mother did not know that her son's ambitions had assumed practical form until he was ready to begin his work. Then she objected. An older son, who knew something of the hardships of the employment which the boy had selected, predicted that he would give up his position in half a day. The younger brother overheard the remark and disproved the assertion by remaining a breaker boy for a year and a half.

Porter's ambitions soared above his work, however, and he became in turn newsboy, office boy and messenger, holding the latter position in the telegraph office of the Delaware & Hudson Company. While he was employed as messenger he frequently thought of the telegraph operator's desk as one of the next steps in his climb upward. Therefore he obtained all the knowledge possible of telegraphy from the operator and in return was asked to aid the latter in the routine duties of the office—work which he was not called upon to do in his capacity of messenger. But it gave him training as an operator, and one day he was able to obtain a position at the key in a smaller railroad office not far from Carbondale. In the meantime the operator and his superior in Porter's former place of employment had disagreed and there was a vacancy in the telegrapher's chair. Porter seized this opportunity to apply for the more desirable position. He obtained and held it satisfactorily, although, in the parlance of operators, it was a "roast."

A wider field was beckoning Porter, however, and in January, 1890, he came to New York. Here he found employment as a telegraph operator with the Kings County Elevated Railway Company. Afterward he became telegraph operator for the Central Railroad of New Jersey, and was later invited to join the forces of the Baltimore & Ohio Railroad. He began his commercial career in New York in 1898, when he was appointed chief clerk of the foreign freight department of the Baltimore & Ohio Railroad.

When he left the service of the Baltimore & Ohio in 1906 to become traffic manager of the Tyler Lumber Company he again put into practice his habit of doing just a little more than the duties of his position called for, becoming secretary of the company a year later.

Government Research Work

THE report of the Committee appointed by the British postmaster-general to consider how far and by what means the government should make provision for research work in wireless telegraphy has been made public. The conclusions reached by the Committee were in brief as follows:

It is desirable to establish some body or institution to initiate and control research in matters of general principle which cannot conveniently be investigated in departmental laboratories; to co-ordinate as far as possible the work now undertaken by the Post Office, Admiralty and War Office respectively in connection with experiment and research in wireless telegraphy so as to prevent work undertaken by one department overlapping work undertaken by another, and thus secure economy; and to discuss any difficulties now arising in practice.

The work now being done by the departments should be continued and extended, opportunities also being found by the departmental engineers to carry out such experiments and tests as may be approved by the body or institutions to be established for the purposes referred to.

It is desirable to establish a Research Laboratory (as distinguished from the existing departmental laboratories and service stations), in which research work bearing on the practical needs of the services should be carried out under the guidance of the body or institution in question.

Though the work to be undertaken by the new body or institution and in the new laboratory will principally concern wireless telegraphy, it is undesirable to exclude therefrom the problems of ordinary telegraphy and telephony.

The preliminary work of the Committee consisted of inquiring about what research in connection with wireless telegraphy is now being carried on by the governments in the United States, Great Britain and Germany. It was found that valuable work is being done by the engineering department of the British General Post Office, which, however, is sometimes hampered by insufficient funds, while the questions it investigates are unavoidably such as have an immediate bearing on service problems rather than on the scientific principles underlying wireless telegraphy. The work carried on by the Admiralty is almost entirely restricted to matters bearing on the adaptation of wireless telegraphy to service conditions, and the same is true of the War Office. Both in the United States and in Germany the governments make more liberal and extensive provision for research and experiments in wireless telegraphy than is made by Great Britain.

The work in the United States is undertaken by three departments—the Navy, the Army Signal Corps, and the Bureau of Standards. However, in order to obtain economy and co-operation, all these departments are for the purpose of laboratory research brought together under one roof in the building of the Bureau of Standards.

In Germany the work is carried on by the Post Office in the Kaiserliches Versuchsamt, a building containing 30,000 square feet of floor space. The work in this building is not confined entirely to wireless telegraphy, but covers the entire range of electrical engineering as applied to telegraphy, whether ordinary or wireless, and telephony. It is under the direction of Dr. Strecker, assisted by a large staff; the research work in wireless telegraphy is under the charge of Dr. Kiebitz and Dr. Breisig. Important wireless research work has also been conducted by Dr. Lindemann at the Reichanstaldt in Berlin, and by Dr. Reich in the Naval and Military Radio-Electric Laboratory in Göttingen.

The report recommends that the National Committee should consist of twelve members—two representing the Admiralty, one the War Office, two the Post Office, two (not departmental officers) appointed directly by the Treasury, three appointed by the Treasury on the nomination of the Royal Society, and one appointed by the Treasury on the nomination of the Institution of Electrical Engineers, together with the director of the National Physical Laboratory. It is planned to have the government departments conduct researches or inquiries arising out of their own administration, and where the results of these independent inquiries are of general interest, they should be communicated to the Committee. The departments should assist in the work by carrying out researches that can be most conveniently made at their respective stations, but the Committee would stand in a purely advisory relation to them as regards their stations and the work done at them. An annual report would be made to Parliament, and such researches published as may be considered useful for the advancement of science generally and are not of a confidential nature.

The annual cost of the Research Laboratory is put at approximately $24,000, including approximate expenditures of $11,275 for staff and $5,500 as honoraria for the members of the National Committee; the initial capital expenditure is estimated at approximately $36,500. Capital expenditure has been considered under three heads:—(*a*) mast, aerial and earth connection; (*b*) buildings; and (*c*) equipment. It is assumed that the National Committee will require the erection of a single wooden mast, 150 feet high, with suitable antennæ and earth connections; a one-story building near the foot of the mast, divided into three parts, one to contain the power plant, one the transmitting, and one the receiving apparatus. One room in this building would need to be metallically screened, to permit of the use of certain types of delicate apparatus. A laboratory building, with a total floor space of 4,000 feet, is also proposed.

A schedule to the report specifies the following subjects for investigation:—

Improvements in methods of measurement of fundamental electrical quantities under high-frequency conditions.

Transmitting Condensers.—Measurement of efficiency of dielectrics used at different voltages, frequencies, and temperatures; quantitative results by which losses can be predetermined.

Insulating Materials.—Behavior at high frequencies and voltages, and best methods of use.

Receiving Condensers.—Efficiency of different types.

Transmitting and Receiving Inductances.—Study of details of design with a view to minimizing energy loss.

Receiving Devices.—Investigation of crystal and valve detectors under different conditions, and best methods of modifying these to obtain desired characteristics. Effect of variation and coupling between detector circuit and the rest of the receiving circuit. Effect of variation of inductance and capacity in receiving circuit. Methods of mounting and preparing crystals. Methods of amplification of received signals, both acoustic and electrical.

Aerial Wires and Earth Connections.—Measurements of losses due to brushing from different types of aerials at high frequencies. Measurement of decrement of aerial and earth system. Conductivity of different kinds of soil at high frequencies. Measurement of losses in steel plate earth connections. Measurements on model aerial to assist in design and to predetermine losses. Investigation of "earth antennæ."

New Systems and Apparatus.—Investigation of new systems of wireless telegraphy and apparatus employed therein, which may be submitted to the Committee and deemed by the Committee worthy of investigation.

Among the subjects the following are mentioned as requiring immediate attention:

Researches into the methods of measuring and standardizing electrical quantities under high-frequency conditions. Among these would be included measurements of voltage, current, power, resistance, inductance, capacity, wave length, and decrement.

Investigations into the methods of standardization and construction of instruments such as condensers, inductances, resistances, wave-meters, etc., and the determination of the losses in such instruments.

A study of receiving circuits in general, including variations in type of inductances, condensers, detectors, telephones, relays and amplifiers.

IN THE SERVICE

SHORE-TO-SHIP DIVISION

Just about this time four out of every four wireless operators are speculating on their chances for assignment to one of those shore station jobs. They wonder how you work it. Looking about for the proper person to drop the all enlightening hint, our choice most naturally rested with Charles J. Weaver as the one best qualified to speak on the subject. So we will let him: "The quickest and surest way for a wireless operator to secure a berth at a shore station is to go to sea!" said the manager of the Marconi Sea Gate station.

Simple, isn't it? If you want to stay ashore, go to sea.

Which might properly be called, paradoxically sage counsel. The paradox is self-evident; the sagacity rests with the fact that Weaver is a permanent fixture at Marconi shore stations. And Weaver went to sea—something like nine years' service on the bounding main is noted in his record. So, adding parenthetically that sea experience alone can qualify a man to deal intelligently with the highly diversified shore traffic problems, let us see how Charles James Weaver of London, of Doncaster, and England in general, became one of the best wireless operators in the universe.

He began early, as all the good ones seem to, and at the age of fourteen demonstrated his ability as a telegrapher to a railway superintendent by getting the news of a train wreck back to headquarters. Up to that time young Weaver had been looked upon solely as a meddlesome boy, who, by virtue of his father being district superintendent, was allowed the run of the forty-five signal towers of the Doncaster yards. In an emergency the knowledge thus gained got an important message through. The praise given the youngster must have influenced his future activities, for on leaving school two years later he entered the British Government telegraph service. Between the ages of seventeen and twenty he served in the military telegraphs, then passed into the reserve for the next twelve years. A demand for good men brought him to the Commercial Cable Company, and while stationed in the Azores he received the news of the eruption of Mount Pelee.

New York called him and the brand-new American Marconi Company, then a very small concern, needed him. His first assignment was to the Babylon station, an experimental plant and school of instruction. A short turn then at Sagaponack was followed by service at Siasconset until the station was demolished. Wireless communication was then becoming more reliable, and Weaver decided to learn the ship end of the business. He arranged a transfer to the American liner Philadelphia and stayed with her for five years. A round-the-world cruise on George Gould's yacht Atalanta was followed by the honeymoon trip on the yacht Noma with the late Colonel Astor. Weaver came ashore then to stay. Two years ago he was given his present position, manager of Sea Gate, about the busiest shore-to-ship station in the United States.

Meeting of the Marconi International Marine Communication Company

AT the Fourteenth Ordinary General Meeting of the Marconi International Marine Communication Company, held in London, June 30, Commendatore Guglielmo Marconi, as chairman, made a particularly interesting address to the shareholders.

"Ladies and gentlemen," he said, "I feel sure that the accounts of the past year will have satisfied you, as they have satisfied your directors, that the company has continued to make sound and substantial progress. Comparing the figures with those of last year, it will be seen that the number of ships which we have fitted with wireless telegraph stations which we operate increased from 580 at the end of 1912 to 788 at the end of 1913, and that the same rate of progress continues, the number having become 873 at the date of the report. The receipts from ships' telegrams, news services, subsidies, rentals, &c., during the past year were £146,316, as compared with £100,322 of the preceding year, showing an increase in round figures of £46,000. On the other hand, the expenses, although necessarily higher, have not increased out of proportion. The principal item of increase is shown under station expenses, which, of course, rise with the number of stations, and likewise the amount of depreciation. Turning to the balance sheet, the only items to which I think I need make any reference are on the debit side, the issued capital, which has been increased to £213,000, which, after making allowance for depreciation, shows an addition of £69,000, which is accounted for, of course, by the additional ships which have been fitted.

Wireless Telegraphy on Ships at Sea

"It is a matter of great satisfaction to your directors—and, if I may be allowed to say so, especially so to me—to see this company now soundly on its feet earning reasonable profits and paying a fair return to its shareholders, for I cannot forget that when this company was registered in the year 1900 it had for its object the introduction of wireless telegraphy upon ships at sea to save life and to save ships, but with very few exceptions we found very little disposition to take advantage of the valuable services which we offered. In these days, when many ships have been saved by means of wireless telegraphy and thousands of people owe their lives to the fact that installations are on board most of the important ships, it will be scarcely believable to those of our shareholders who have not been thoroughly acquainted with the development of the company that we expended something in the neighborhood of £200,000 (about $1,000,000) in creating and popularizing our service before we were ever able to earn a profit. As a result, however, of the great energy of our staff and the hard work of every member of the company, we are able this year, for the fourth successive year, to pay a reasonable dividend.

The Company's "Monopoly": Reply to Critics

"I think I am warranted in saying that the nation at large, if not the whole civilized world, owes respect at least to this company for the untiring and patient work which it has done in causing loss of life at sea to be so much less than it otherwise would have been; yet, notwithstanding, there are members of Parliament who never miss an opportunity of attacking our company and complaining of the monopoly which they allege we possess. I would ask them if they can contend that we have turned that monopoly to an improper account. Does the history of our company suggest anything of the kind? Does the 10 per cent. dividend which we are now able to declare, after nine years without any return at all for the capital invested, savor of extortion? Have they any knowledge or appreciation of our vast organization? Do they know that every young man serving with us as a telegraph operator on board ship—and there are now some 1,500 of them—has been taught by us without charge; that not one of them has ever failed to do heroic duty, even to the sacrifice of his life, when circumstances have called upon him to do so?

"There has never been any evidence that a ship in distress fitted with a Marconi installation has ever yet called for assistance without receiving an answer. In every important port throughout the world there is a Marconi inspector ready to overhaul the wireless apparatus of every ship that calls, and they and the operators must work together under carefully considered rules, which have to be most rigorously adhered to by the company to ensure the magnificent discipline so essential to the public and which prevails throughout the service.

Lord Mersey and the Marconi Operators

"Only a few days ago Lord Mersey, as President of the Court at present inquiring into the disaster which recently overtook the Empress of Ireland, complimented the Marconi operators, and stated that they were a credit to the service to which they belonged; and innumerable are the letters of appreciation which are received by the company from all the important shipping companies throughout the country. I contend that it does not lie in the mouth of anybody to complain of the monopoly which this company possesses—if it possesses one—for it owes it to the inventors, to an organization and a perfect discipline, which is essential and could not exist were the business in many hands, and to the important capital which it has invested, so providing a valuable, well conducted, and reliable service to the whole traveling public, which it is very probable would never have existed at all but for the company's own efforts.

Safety of Life at Sea

"In view of the bill which has been introduced into Parliament to carry into effect the International Convention for the Safety of Life at Sea, under which wireless telegraphy becomes obligatory upon ships carrying fifty passengers or more, including crew, your directors have consented to enter into an agreement with the Board of Trade to supply their installations in a similar way as they have done before wherever they may be called upon to do so. It is proposed that the remuneration which they are to receive shall be left to a referee. Having regard to the very reasonable terms which the company has been in the habit of charging, your directors see no objection to accepting these conditions.

A Superannuation Fund

"As mentioned in the report, the directors have established, subject to the approval of the shareholders, a superannuation fund, of which the North British and Mercantile Insurance Company will act as trustees. This fund is for the purpose of providing pensions for employees of the company when they eventually retire from work. Similar funds have been brought into existence in the other Marconi companies, and it is thought that it is highly desirable, now that this company has been placed on a sound profit-sharing basis, to commence to make provision for employees upon their reaching the age of well-earned rest. The company and its employees will contribute jointly and in equal proportions to the fund, and you directors are of opinion that such a scheme is due to its staff, besides going a long way to encourage them to remain in the company's employ, and materially assisting therefore in maintaining the discipline which is of such pre-eminent importance in the responsible work which your company conducts."

After commending the efficiency of the directors, the Chairman announced the declaration of a "final dividend of 5 per cent., equal to 1s. per share, less income tax, upon the capital now issued and paid up, be and the same is hereby declared for the year ended December 31, 1913; that the said dividend be payable on July 31, 1914, to the shareholders registered on the books of the company on June 30, 1914."

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

A Hightone Rotary Spark Gap

The following is a description of a rotary gap that gives a tone similar to the one emitted by the Clapp-Eastham "Hytone" rotary quenched gap. This gap will easily stand a 1 k. w. transformer and requires a condenser of very small capacity. I use only 3 plates 8 by 10 inches, with tin-foil, 6 by 7 inches on each side, packed form, with a 1 k. w. set, the rotary running at 4,500 R. P. M. In fact, if a capacity greater than this is used, the tone is not so pure and clear; on this account this gap should appeal to the amateur using the 200-meter wave.

Procure a copper meter plate already trued-up, having a set screw for fastening on shaft. Next divide the edge of the plate into 8 sections and mark each division for the lugs. The disc or plate should be 5 1/4 inches in diameter.

The lugs are made of zinc, 5/16ths of an inch in diameter and 7/8ths of an inch in length. They are slotted at your end the width of the disc to a depth of 5/16ths of an inch and should fit the edge of the disc snugly. They should be firmly soldered in place to avoid the risk of having one fly off when the gap is in rotation. Eight lugs are required for the rotary and 2 for the stationary electrodes of the gap.

Next turn up a shaft as per Fig. 2, 1 3/8 inches long and large enough in diameter to pass through the center of the disc. Then fasten the rotary disc and also a 1-inch grooved pulley to the shaft.

The frame is made of well seasoned and thoroughly dried oak. It should have dimensions as shown in Fig. 1.

Fig. 2 shows the bearings of the gap. These must be at least 1/8th of an inch deep and fit the shaft closely. They are supported by 2 heavy binding posts.

The stationary part of the gap is made of a piece of brass rod 3/8ths of an inch by 1/2 inch by 2 7/8ths inches, bent as

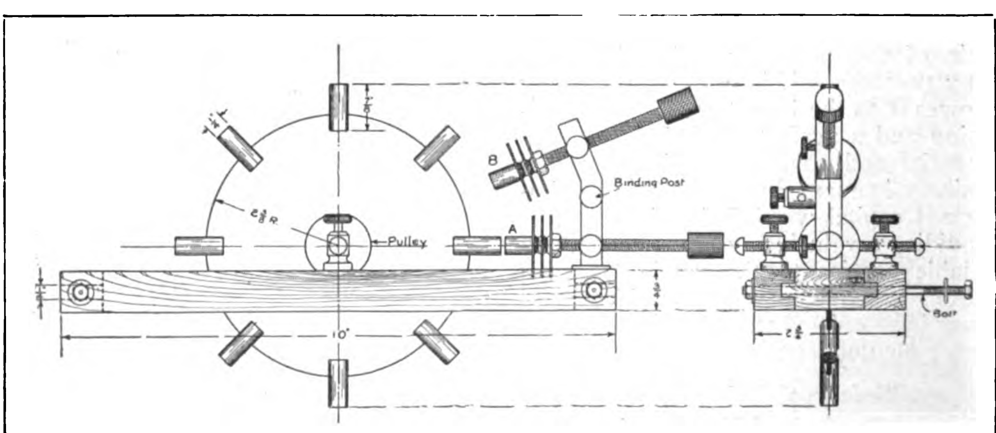


Fig. 1, First Prize Article.

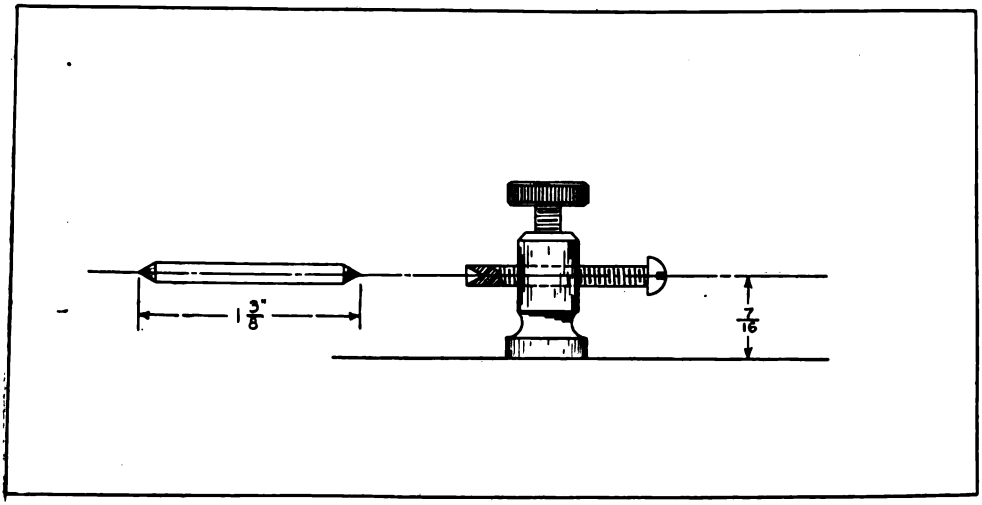


Fig. 2, First Prize Article

shown, having 2 5/32-inch holes drilled in it for the lugs and also 2 others drilled half way through and tapped for 8/32 screws. Another set of holes is drilled and one tapped for an 8/32 screw as were the other two. This is to be used as a binding post and should be placed directly between the other two.

The stationary electrodes require 2 8/32 threaded brass rods 3 inches in length, 2 brass nuts, 6 small brass or copper washers about 1/8th of an inch thick, 2 zinc lugs 5/16th of an inch in diameter and 7/8ths of an inch in length, tapped at one end for an 8/32 screw, 2 hard rubber knobs and 6 copper discs, 1/32nd of an inch thick by 1 1/4th inches in diameter with a 5/32-inch hole in the center. These are to be used as cooling flanges for each gap.

The extra gap added gives the effect of having just twice as many lugs as there are actually on the disc. The lugs should be so fixed that when a spark passes at A, none should pass at B, and when a spark passes at B, the lug A

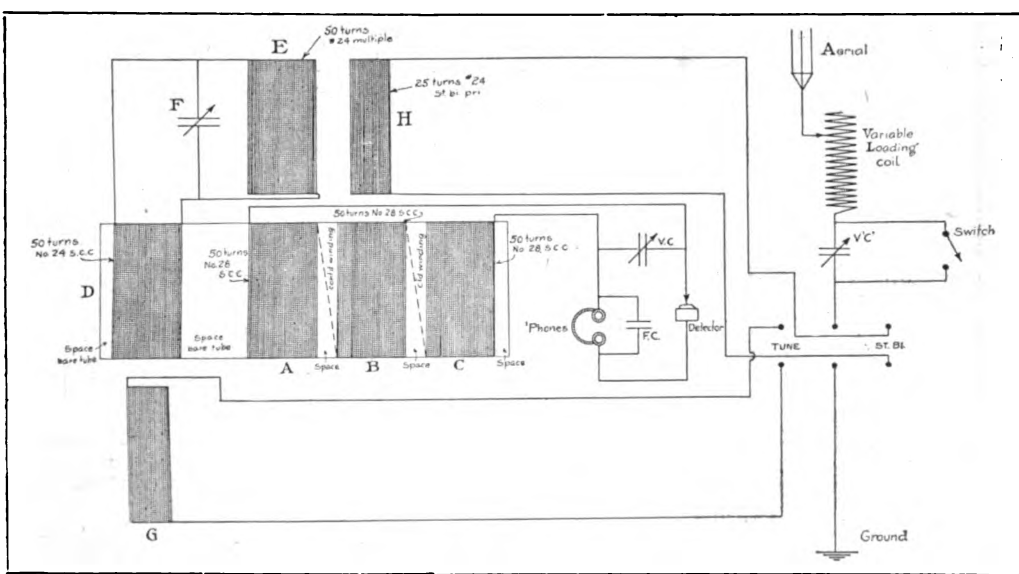


Fig. 1, Second Prize Article.

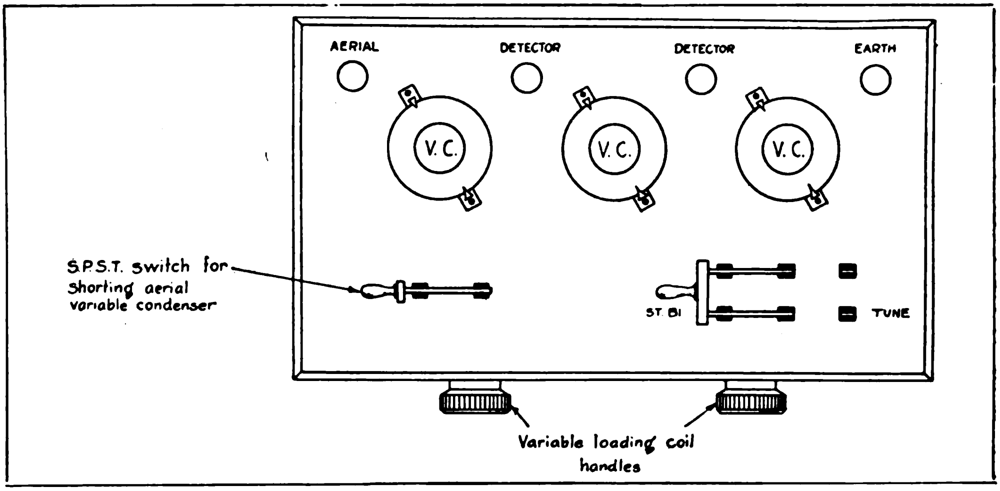


Fig. 2, Second Prize Article.

should be half way between 2 of the lugs on the disc. The whole is fastened to some sort of frame by the 2 small bolts shown in Fig. 1.

This gap is best driven by a small induction motor of about 1/10 or 1/8 h. p., as this type of motor accelerates quickly and is at full speed in 4 or 5 seconds—a very desirable feature in rotary gaps.

I have been using a gap of this design for about four months and operators in this vicinity with stations along this coast thought I was using a Clapp-Eastham "Hytone" set because of the quick start to full speed and the very high tone emitted. The motor should run 1,800 R. P. M. and the pulley on it be 2 3/8 inches in diameter.

Frank O'Neill, California.

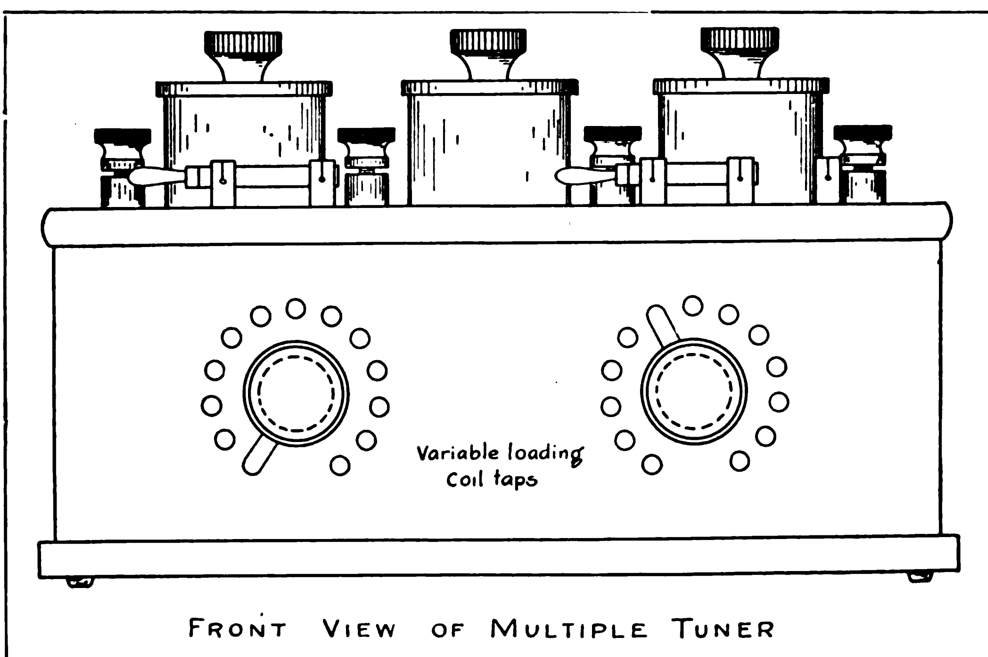


Fig. 3, Second Prize Article.

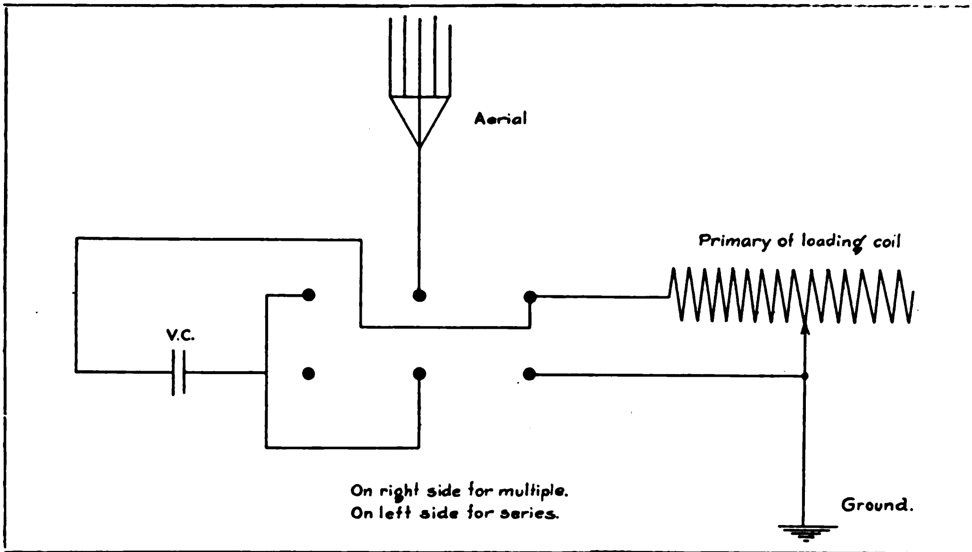
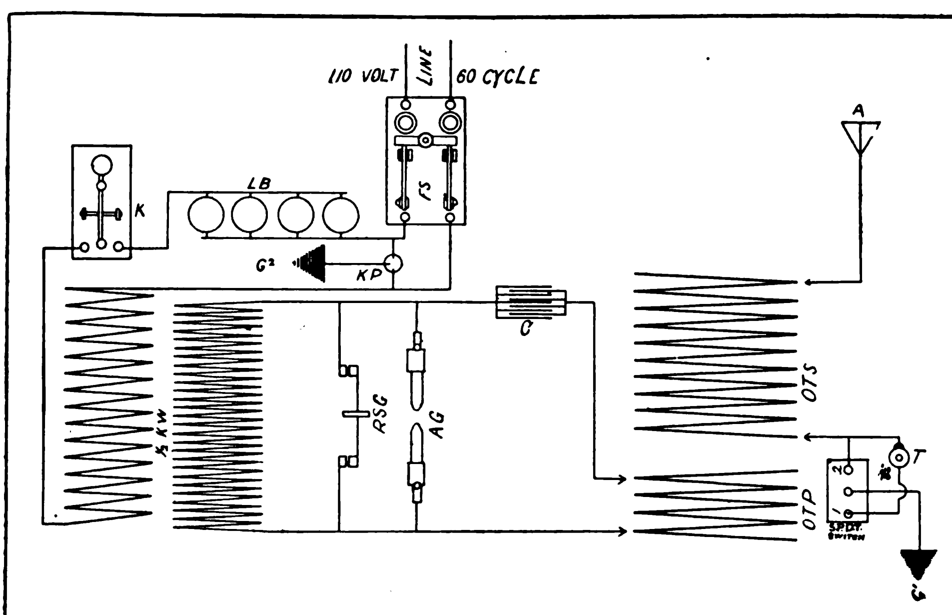


Fig. 4, Second Prize Article.

SECOND PRIZE, FIVE DOLLARS

An Amateur Multiple Tuner

The following is a description of a multiple tuner which I have constructed and found satisfactory for amateur purposes. A general idea of the construction is given in Fig. 1. The secondary windings of the transformer A, B and C, are wound on a cardboard tube about 3½ inches i diameter and 9 inches in length. Tl secondary winding consists of 3 uni comprising 50 turns of No. 28 S. C. (wire in each. The intermediate ci cuit consists of the winding, B, ha ing 50 turns of No. 24 S. C. C. wi and winding, E, comprising the sam number of turns. The variable co



Diagram, Third Prize Article.

denser, F, is in shunt to both of these windings.

When the intermediate circuit is used, the primary winding, G, is employed, consisting of 25 turns of No. 24 S. C. C. wire. When the stand-by side is thrown into the circuit by means of the change-over switch, winding H, consisting of 25 turns of No. 24 wire, is connected in series with the antenna. It is also wound closely around the turns of coil B.

It is of course understood that winding D must be at a considerable distance from winding A, and furthermore winding G should be made of a tube of such dimensions that it will slide in and out of D, or may be mounted on a shaft so as to turn at right angles to D. The same statement applies to winding E, which is preferably mounted on a shaft inside of winding A so that it can be turned at right angles. Thus the degree of coupling between windings E and A, D and G may be readily varied. When winding H is employed, the circuit is similar to that of any "loose coupler" with the exception that H is wound tightly around A or B, thus giving at all times a close coupling.

The tuner is readily changed from a stand-by circuit (broad tuning) to a sharp tuning circuit by means of the double pole, double throw switch, as indicated in the drawing. The short wave condenser, V'C', is quite necessary in a circuit of this type, as is also the loading coil, for, owing to the fact that G and H are windings of a fixed value of inductance, variations of wave-length must be made at the loading coil or at the variable condenser.

Fig. 2 is a plan view of the location of the variable condensers, change-over switches, etc., which to some extent has been copied from the Standard Marconi Multiple Tuner. Fig. 3 is a front elevation showing the location of the multiple point switches in use with the loading coil. Fig. 4 indicates a method which I used for placing the short wave condenser either in series with the aerial circuit or in shunt to the primary of the receiving transformer, by simply throwing the D. P. D. T. switch from right to left.

Myron Chace, Massachusetts.

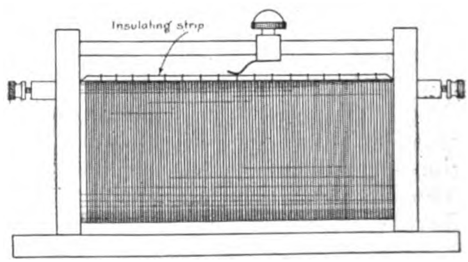
THIRD PRIZE, THREE DOLLARS

Wireless Telephony on a 200-Meter Wireless Telegraph Set

The majority of amateur wireless experimenters using 60-cycle current in connection with both telephony and telegraphy, finds it necessary to install 2 complete transmitting sets to obtain satisfactory results and comply with the government regulations.

In the following arrangement I have obtained good results using a single oscillation transformer and one-half K.W. transformer in connection with both telegraphy and telephony.

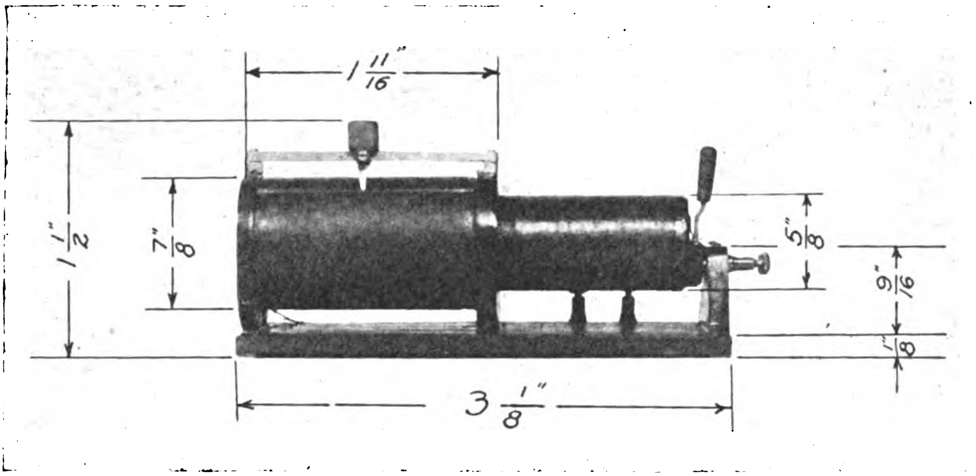
Referring to the accompanying figure, L B is a lamp-bank used for current adjustment; K is the sending key and K P a small gap used as a kick-back preventer. Around the ½ k. w. transformer are shown R S G, the rotary spark gap, and A G, the carbon arc gap used for telephony. Very little condenser being



Figure, Fourth Prize Article.

used, an arc takes place between this gap instead of a spark. C is the adjustable condenser; O T P and O T S the primary and secondary oscillation transformer. T is a carbon-grain telephone transmitter.

The carbons from 2 discarded dry cells are utilized in constructing the arc-gap. When hard carbons are used the arc is blue in color and better results are obtained both in distinctness of voice and distance covered. The carbons should be mounted on standards and so arranged as to be finely adjustable. In adjusting care should be taken that the arc does not burn between the outer edge of the carbons, as it causes the voice when heard at the receiving station to sound irregular and broken. The carbons may be ground smooth or left rough, as suits the experimenter's fancy. Any type of carbon-grain transmitter may be used provided it is in good ad-



Photograph, Honorable Mention Article, F. C. Knochel.

justment, but its sensitiveness may be increased by procuring some small carbon balls and substituting them for the grains in the transmitter.

The condenser should be so arranged that all but 1 or 2 plates may be disconnected readily, as very little capacity is necessary in connection with the wireless telephone. A lamp-bank is connected in the transformer primary circuit for current adjustment.

When the S. P. D. T. switch (around which the telephone transmitter is connected) is thrown to contact 1, and using the carbon arc, the set is in condition to be used for telephony. With this arrangement distances of 15 miles have been covered. With the switch at point 2, using more condenser and the rotary gap, the set works as a wireless telegraph transmitter. Under favorable conditions messages have been sent a distance of 100 miles.

A change-over from telephony to telegraphy can be made in a very short period of time.

Harold McIntosh, California.

Note.—This article is published without experimental verification and is presented as a matter of general information to the amateur field. It is one of the many articles of similar nature which have been received.

At sight it may appear that the device would be wholly inoperative, but a little consideration will show that some results should be obtained. When the very small value of condenser capacity, as suggested, is used, the spark assumes the nature of an arc and the number of discharges through the closed oscillatory circuit will be considerably greater than the alternations of the primary current (60 cyc.). Hence a sufficient number of discharges are produced to transmit in a crude manner the modulations of the human voice.

It should be understood that at the receiving station a more or less continuous "hum" is produced because the discharges of the transmitter are within the limits of audibility. The voice, however, is heard above the "hum."—Technical Editor.

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

Improvement in Tuning Coils

As is well known, a tuning coil equipped with the ordinary slider arrangement is sometimes very inefficient, owing to the fact that the slider spring contact touches two or more wires at the same time. This being the case, it would seem that the scheme here explained and illustrated should be welcome to those who do not wish to go to the trouble and expense of putting on a switching arrangement.

When preparing to wind a tuning coil, all that is necessary is to provide a piece of wood or other insulating material, say, 1/16 of an inch thick by 1/2 inch wide; and the length of the proposed tuner. Mark a line along the core exactly where the slider spring will come when finished. Now proceed to wind, bringing every second, third or fourth turn, depending on the size of the wire and core, up over the insulating strip, and sliding the other turns under from the end. Remove the insulation from the turns that come up over the strip.

It will be seen that by this method the slider makes perfect contact with but one wire. Also the resistance of the coil is less than where there are many leads taken off for switches, and consequently the inductive effect is increased. Of course, it may be used either on straight or "loose coupled tuners," and while simple to construct, will give practically as good results as the high-priced tuners with multiple point switches.

LESLIE LONG, Oregon.

Note.—The main objection to this construction is the lack of the fineness of adjustment obtainable with the old style of winding. It may, however, be compensated for by the judicious use of a variable condenser.—*Technical Editor.*

HONORABLE MENTION

A Miniature Receiving Tuner

I note in the February, 1914, issue of THE WIRELESS AGE a photograph of the "smallest receiving transformer." The accompanying photograph is approximately the actual size of a tuner which I have recently constructed.

The primary winding is made of No. 30 S.S.C. wire; the secondary winding of No. 36 S.S.C. wire; the sliders of brass and the handles are of hard rubber. The windings of the secondary are equally divided between the contacts of the 5-point switch. The binding posts are ¼ inch in height.

This tuner is made entirely by hand. The cost of the material complete is 75 cents. I estimate the cost of the labor at about $20.

F. C. KNOCHEL, New York.

Note.—This tuner should receive wave lengths up to 175 meters.—*Technical Editor.*

GROWTH OF THE RADIO LEAGUE

Amateurs throughout the country are displaying a great interest in the American Radio Relay League, hundreds of applications to join having been received at its headquarters in Hartford. Hiram Percy Maxim, chairman of the League, has issued a statement calling attention to the fact that it has been impossible to handle all of the communications quickly because of the fact that the work is done by a limited clerical force which is made up of volunteers and by clerks hired with funds provided by the Radio Club of Hartford.

"The enthusiasm which is felt on all sides for this Relay League of Amateurs is pushing the work along," declares Mr. Maxim, "and we will get it well organized before it becomes necessary to call upon its membership for support. It is asked that those who have sent in applications for appointment as a relay station in their locality have patience and they will in due time hear from headquarters in Hartford.

"Over 200 relay stations have already been appointed. These extend from Seattle east to Idaho, and from Maine west to Minneapolis. Some of these are able to bridge surprising distances, especially in the winter time."

Among the questions on the application blanks are the following:

"Do you use an audion detector? What is your approximate receiving range in miles? Are you trobled by interference? What are your usual listening hours and how many evenings a week do you average at your instrument? Have you a telephone connection, or convenient? Do you keep your station practically constantly in running order? Can you copy press news? About how many words a minute can you receive with certainty? What is the nearest commercial or government station to you? Have you a government license and if so what grade?"

The prospective member of the League is requested to "make any remarks or comment which you think will be of help in perfecting a chain of amateur radio relay stations throughout the country." He is also informed that "no money transaction of any kind is considered in connection with this League, the expenses being borne for the present by the Radio Club of Hartford and any voluntary subscriptions which may be made. The object of the League is strictly confined to facilitating the relaying of radio messages among amateurs."

Some of the blanks forwarded to the League came from men many of whom are forty years old; one is sixty-four.

Crossing the Atlantic in a Life-boat

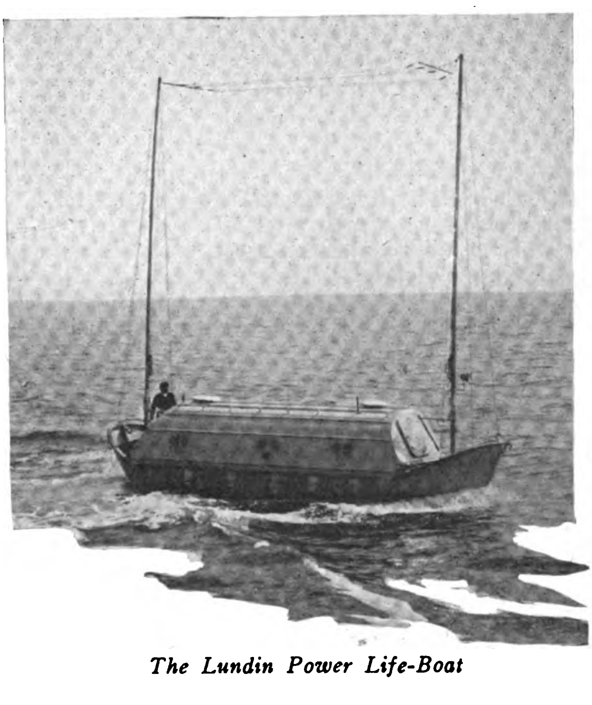
EINAR SIVARD, naval architect and superintendent of the Welin Marine Equipment Company, is about to start across the Atlantic in a Lundin Power life-boat of the type described as non-capsizable, non-smashable and practically unsinkable. His crew of five will include his young wife, Mrs. Signe Holm Sivard, to whom he was recently married, and who, in order to accompany her husband on this trip, will muster in as cook. The other members of the crew will be a navigator, a wireless operator, one engineer and one sailor.

Smallest of all the craft carrying a wireless installation, the life-boat is equipped with Marconi ½ K.W. set with the units all mounted on one panel, conveniently and compactly arranged for installing and operating. One extra break system type hand key is supplied for table mounting. The transmitter consists of 120 cycle, 220 volt motor generator; power 220-8,000 volt transformer, condenser, oscillation transformer, aerial tuning inductance, break system hand key, with reactance, aerial switch, 5-point wave length switch, change-over switch, break system aerial switch, switches for direct current and alternating current lines, generator field and blowers, change-over; a generator field rheostat, automatic starter, direct and alternating current volt meter, alternating current wattmeter, radiation ammeter.

The equipment is the same as those supplied by the Marconi Company to the United States submarine and torpedo boats. With the limited available antenna on the Lundin life-boat it is estimated that the wireless apparatus will have a transmitting radius of from fifty to 100 miles.

The craft was successfully launched on Wednesday, July 15, from the yards of the Welin Marine Equipment Company at Long Island City. While it has been constructed especially for this voyage, it differs only in size from power life-boats designed for actual use on ocean liners. The new boat has a length of thirty-six feet and a beam of twelve feet, while the largest similar craft previously built is thirty feet long and ten feet wide.

It is built of galvanized steel with a water-tight deck six inches above the load water-line. The space between the deck and the bottom is subdivided into numerous water-tight compartments, several of which may become filled with water without in the least endangering the boat. A steel house with water-tight portlights, doors and ventilators encloses all but a small part of the boat fore and aft, where short decks are provided for the helmsman and the outlook. With the house properly closed up, this type of boat has proved to be self-bailing and self-righting. Along the sides of the boat are fitted heavy fenders of Balsa wood



The Lundin Power Life-Boat

(the lightest wood in existence) that have been submitted to a special impregnating process serving at once to preserve the wood and keep it from absorbing water. The fenders constitute an almost perfect guarantee against the smashing of such a craft when lowered from a ship.

The boat is equipped with a 32 horsepower, 4-cylinder Standard engine and gasoline tanks that will enable it to remain at sea for many days.

Mr. Sivard will go by way of Boston and Halifax to St. Johns, Newfoundland. From there he will cross the ocean to Queenstown and will then proceed along the English coast to London. The total trip is expected to take a little more than a month and the open-sea crossing about fifteen to seventeen days.

BOY SCOUTS RECEIVED A MESSAGE

At the Fourth of July celebration, held in Ridgefield, Conn., a newspaper's wireless station contributed its part of the ceremonies incident to the laying of the cornerstone of the new $50,000 school house. In the afternoon, when the athletic meet and baseball game were in progress, there issued from the tent where the Boy Scouts had their small home-made receiving station several youngsters in a state of excitement. One of them bore a congratulory wireless message from a newspaper. The amateur wireless operators among the boys were somewhat chagrined that their station was not equipped so that the message could be acknowledged.

A London dispatch says that at the Isle of Grains naval air station a seaplane accomplished a speed of seventy-eight miles an hour and climbed to a height of 4,000 feet in seven minutes, fifteen seconds. Wireless equipment was carried and communication with the aerodrome was successfully maintained.

INSPECTOR KRUMM IN NEW YORK

Chief Radio Inspector Louis R. Krumm will be in New York during the month of August, while Inspector Terrell is on a vacation.

TEST OF DIRECTION-FINDER A SUCCESS

The Canadian Northern liner Royal George docked in Quebec, Canada, recently after a voyage which has been the occasion for testing the Marconi-Bellini-Tosi direction-finder.

In charge of the apparatus was an engineer connected with the Marconi company, who said that the tests had proved most satisfactory. Both he and Captain Thompson said the instrument was accurate to a degree in determining the compass directions of other stations, whether on shore or on other vessels.

In this way they had been able to ascertain the compass position of Cape Race, Cape Ray, Father Point and the vessels Columbia, Calgarian and Sicilian. The Columbia had been at a distance of sixty-eight miles away, the Calgarian fifty-three and the Sicilian eighteen.

The finder shows the line on which the wireless transmitting station lies. It is very simply manipulated, as the readings are taken by moving an indicator to different positions and noting the point at which the loudest signals are heard in a telephone.

Captain Thompson foresees great possibilities for the system, especially if occasion should arise to determine the location of a ship which is sending out the S O S call. With the ordinary wireless apparatus it is necessary for the ship in distress to give another ship its position in degrees of latitude and longitude, and the navigating officer of the ship going to render assistance must know his own position. With the new apparatus he can head directly to the rescue even when the position of neither ship is known.

IMPROVED SERVICE ON THE GREAT LAKES

A greatly improved service of wireless reports concerning the movements of boats on the Great Lakes has been arranged for. In addition to the stations at Port Arthur, Sault Ste. Marie, Tobermory, and Midland, the Marconi Company has completed the construction of stations at Sarnia, Burwell, Toronto, and Kingston.

Laws for British Ships

A bill to amend the laws relating to British Merchant shipping so as to make effective the International Convention for the Safety of Life at Sea, signed in London on January 20th last, was introduced in the House of Commons recently by John Burns, president of the Board of Trade.

The bill is divided into six parts, containing twenty-nine clauses and five schedules. The first part relates to ice and derelicts, and provides that if the master of a British ship fitted with a wireless telegraphy installation meets with, or is informed of, any dangerous ice or dangerous derelict, or any other imminent and serious danger to navigation on or near his course, he must send out the wireless danger call — — — (TTT), to be followed after an interval of one minute by the message, repeated three times at intervals of ten minutes.

Every wireless telegraphy station under the control of the postmaster-general, or licensed by him, must, on receiving the wireless danger call, refrain from sending messages for a time sufficient to allow other stations to receive the message. Compliance with this provision will be deemed to be a condition of every license granted by the postmaster-general under the Wireless Telegraph Act, 1904. This provision does not interfere with the transmission of the wireless distress call, which will remain . . . — — — . . . (SOS).

Clause 5 places the master of a British ship under an obligation to render speedy assistance on receiving a wireless distress call, and where he does not proceed to the assistance of the persons in distress, he must enter the fact and the reasons justifying his action in the official log book and, if necessary, immediately inform the master of the ship from which the call is received. This section of the bill also specifies the penalties to which a master of a ship, or any person, is liable if he fails to observe the directions set forth in the measure.

The compulsory wireless clauses (15 to 17 inclusive) are in Part III. of the bill, which is as follows:

15.—(1) Subject to the provisions of this Act, every British ship registered in the United Kingdom which carries fifty or more persons shall be provided with a wireless telegraphy installation, and shall maintain a wireless telegraphy service which shall be at least sufficient to comply with the rules made for the purpose under this Act, and shall be provided with certified operators and watchers in accordance with those rules.

(2) In reckoning the number of persons carried on a ship for the purpose of this section, persons shall not be counted who are exceptionally and temporarily carried on a ship—

(*a*) As a result of *force majeure;* or

(*b*) As the result of the necessity of increasing the number of the crew to fill the places of members of the crew who are ill or disabled; or

(*c*) As the result of the obligation on the part of the master to carry shipwrecked persons, or persons in like circumstances; or

(*d*) If so provided by regulations of the Board of Trade, as cargo hands for a part of the voyage not being between one continent and another, and not being, during the time the hands are carried, outside the limits of latitude thirty degrees north and thirty degrees south.

(3) If this section is not complied with in the case of any ship, the master or owner of the ship shall be liable in respect of each offence to a fine not exceeding five hundred pounds (approximately $2,500), and any such offence may be prosecuted summarily, but if the offence is prosecuted summarily the fine shall not exceed one hundred pounds (approximately $500).

16.—(1) The Board of Trade, in consultation with the postmaster-general, may make such rules with respect to wireless telegraphy installations and service on British ships which are registered in the United Kingdom and with respect to the carrying on those ships of operators and watchers for the purposes of wireless telegraphy as appear to them necessary or expedient to carry into effect the provisions of the Convention mentioned in Part V. of the third schedule of this Act.

(2) The Board of Trade may by rules made under this section exempt from the obligations of this Act as to wireless telegraphy: —

(*a*) Ships while on voyages the course of which does not take the ship more than a hundred and fifty sea miles from the nearest coast, if the Board are satisfied that the route and the conditions of the voyage are such as to render compliance with those obligations unreasonable or unnecessary; and

(*b*) Sailing ships on which, owing to the peculiar or primitive nature of their build, it is impossible to provide a proper wireless telegraphy installation.

(3) The Board of Trade may by rules made under this section provide that any automatic calling apparatus which is certified by them to be efficient and to have been accepted by the parties to the Convention may be substituted for the purposes of the provisions of this Act, and any rules made thereunder relating to wireless telegraphy, for a certified operator or watcher.

17.—The Board of Trade may postpone the operation of the provisions of this Act relating to wireless telegraphy as respects any particular ship for such period as the Board of Trade may determine in each case, if it is shown by the owners of the ship that they have taken all reasonable steps to comply with the provisions of this Act as respects the ship, but that they have been unable to do so owing to difficulties in obtaining delivery of any wireless telegraphy apparatus or of obtaining the services of certificated operators or watchers.

The period of postponement under this section shall not exceed one year in the case of ships which are required in pursuance of the Convention to provide a first-class wireless telegraphy service, and two years in the case of ships which are so required to provide a third-class wireless telegraphy service, and in the case of ships which are so required to provide a second-class wireless telegraphy service shall not exceed one year as respects the provision of the wireless telegraphy installation and two years as respects the provision of a continuous watch.

Clause 19 (Part IV.) proposes to confer upon the Board of Trade power not to grant a safety certificate, unless they are satisfied, on the report of a wireless telegraphy inspector, as respects provisions relating to wireless telegraphy that the certificate can be properly granted.

The postmaster-general (and the Board of Trade, if they desire to do so for any special purpose in connection with wireless telegraphy on board a ship) may appoint officers for the purpose of inspecting ships with a view to ascertaining whether the requirements of the Act relating to wireless telegraphy are complied with on board any ship.

The wireless telegraph inspector may go on board any ship at all reasonable times and do all things necessary for the proper inspection of the installation on the ship; he may also require the master of the ship to supply him with any information which it is in the power of the latter to supply with respect to the provision on the ship of operators or watchers, and require the production of any certificate granted under this Act in respect of the installation, and of the certificates of the operators and watchers on the ship.

Failure on the part of the master of a ship to supply information in accordance with this section will render him liable to a fine not exceeding twenty pounds (approximately $100) and any person impeding an inspector in pursuance of his duties is liable to a similar penalty.

According to statistics made up by the International Bureau of Posts, there were on January 15, 1914, 569 wireless telegraph stations in the world. The United States leads with 178; then come England, 91; Canada, 37; France, 35; Italy, 33; Russia, 29; Brazil, 26; Germany, 23; Norway, 21, and so on down to China and Sweden with two stations each.

New Marconigram Sign Displayed in the Telegraph Offices

LIST OF OFFICIALS

Marconi Wireless Telegraph Company of America

NEW YORK

Woolworth Building, 233 Broadway

JOHN W. GRIGGS, *President*
EDWARD J. NALLY, *Vice-President and General Manager*
JOHN BOTTOMLEY, *Vice-President, Secretary and Treasurer*
FREDERICK M. SAMMIS, *Chief Engineer*
GEORGE S. DE SOUSA, *Traffic Manager*
DAVID SARNOFF, *Contract Manager*
JOHN YOUNG, *Auditor*
WILLIAM B. VANSIZE, *Patent Attorney*
G. HAROLD PORTER, *Purchasing Agent*
J. ANDREW WHITE, *Editor of Publications*

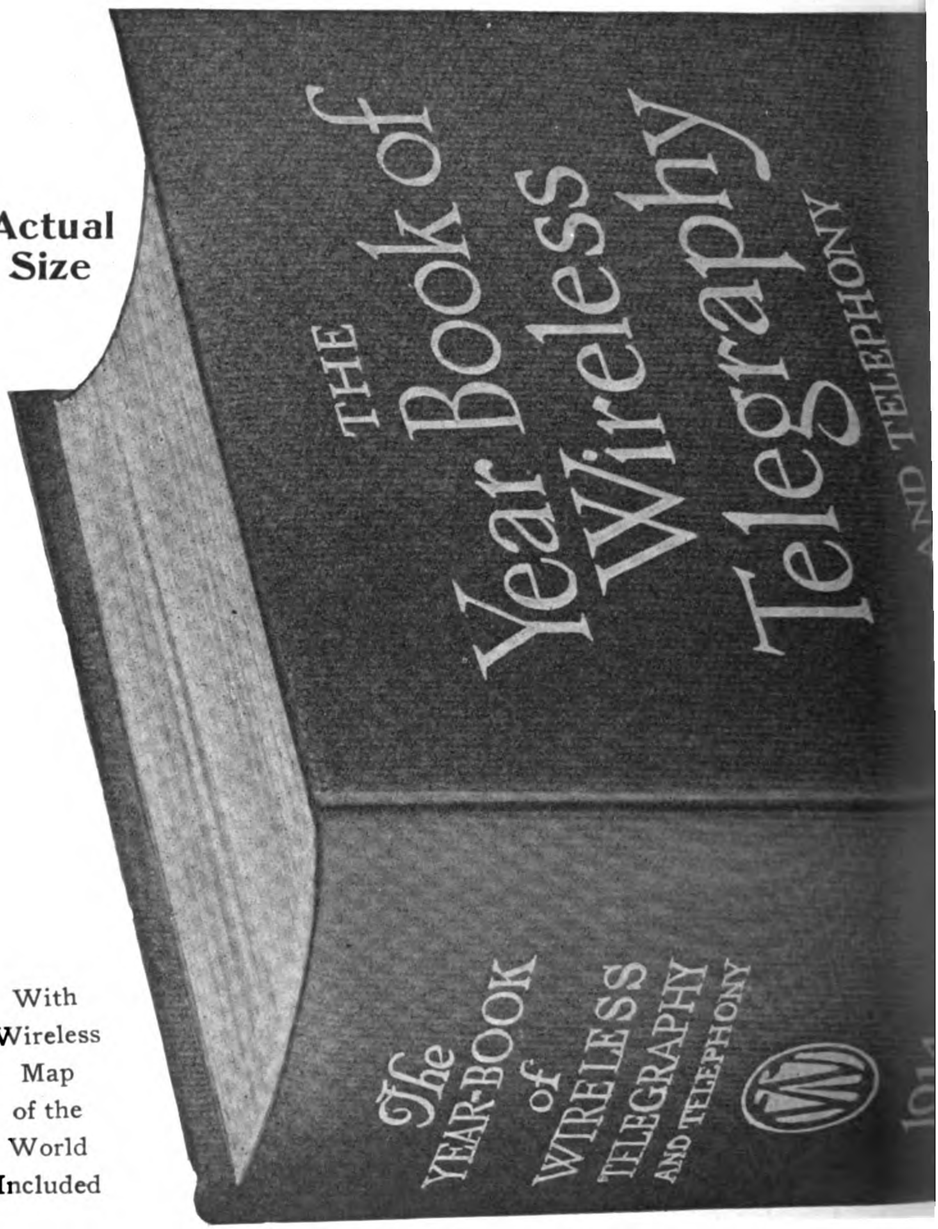
Operating Department - - 29 Cliff Street

E. T. EDWARDS, *Superintendent Eastern Division*

SOUTHERN DIVISION—American Building, Baltimore, Md. C. J. Pannill, *Superintendent*
GULF DIVISION—Metairie Ridge Road, New Orleans, La. - A. Mowat, *Superintendent*
GREAT LAKES DIVISION—Schofield Building, Cleveland, Ohio. E. C. Newton, *Supt.*
PACIFIC COAST DIVISION—Merchants Exchange Building. A. H. Ginman, *Gen'l. Supt.*

THE BOOK

Actual Size



With Wireless Map of the World Included

ALMOST TWICE AS LA

THE FIRST EDITION WAS QUICKLY EXHAU

SEND ONE DO

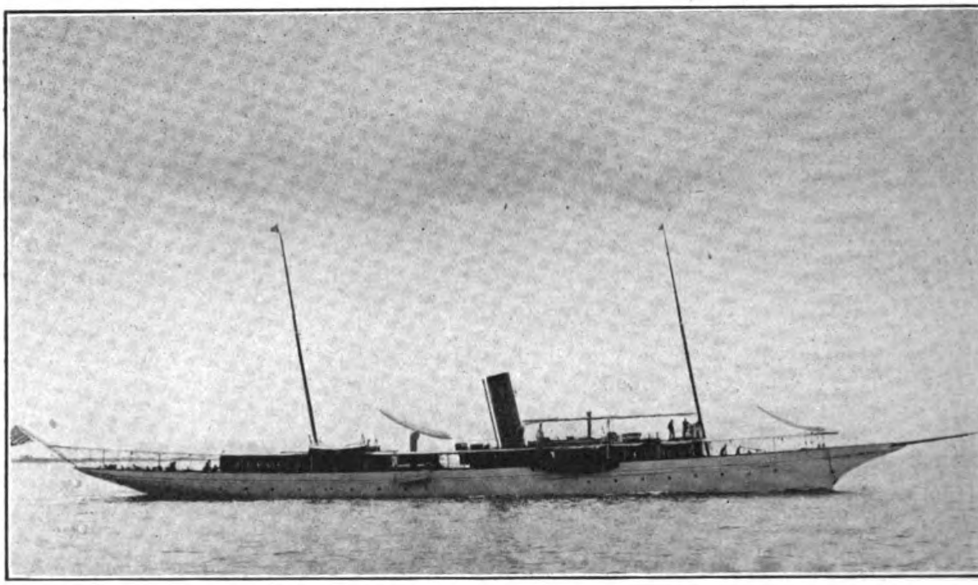
MARCONI PUBLISHING CORPORATION,

Interesting Equipments

THE steam yacht California has recently been equipped with a standard 2-K.W. Marconi set with an independent emergency outfit. She will sail soon for Panama and thence to the Pacific coast. The California combines seaworthiness, comfort and speed. She has cruised extensively on the Atlantic coast and made a winter voyage through the West Indies. She is owned by Mrs. H. H. Stocker.

She is constructed of steel, being particularly trim and graceful. Her bulwarks are of good height and she has large deck house and a main deck room. There are two galleys, the crew's being below and the owner's on deck. The sailing master's stateroom is on deck. She has ten beds for the accommodation of her owners and guests. She has six officers' staterooms.

Built in 1913, her length over all is 210 feet. Her beam is 23 feet 3 inches, while she has a depth of 11 feet and a draught of 9 feet. Her coal consumption is no greater and, in fact, less than that of other yachts of her size at the speeds at which they are usually driven.



Mrs. H. H. Stocker's Steam Yacht "California"

She was designed by Gielow & Orr, naval architects.

Her crew consists of twenty-four men. She has a mate, two quartermasters, a bos'n, two launchmen, five sailors, a chief and assistant engineer, two oilers, four firemen, two cooks, two stewards, two messmen and a cabin boy.

Contract News

The Bellona, chartered by the Atlantic Fruit Company, has been equipped with a 2-K.W. standard Marconi outfit. The vessel, which plies between New York City and Jamaica, has a special cabin for the accommodation of its wireless operator and apparatus. She flies the British flag. Her call letters are VEP.

The latest type of Marconi panel equipment has been installed on the United States, owned by the Indiana Transportation Company. Her call letters are WIT.

VESSELS EQUIPPED WITH MARCONI APPARATUS SINCE THE JULY ISSUE

NAME	OWNERS	CALL LETTERS
South American	The Texas Company	KVW
Atlantic City	Atlantic City Steamship Line	KWN

THE SHARE MARKET

New York, July 20.

Instead of responding to the optimistic views expressed by the leading financial authorities, the share market still remains weak. The pressure put upon the market does not come exclusively from the sale of long stock, in the opinion of the brokers. This selling is decidedly in the minority. The activity of the bear traders is mainly in evidence and has its effectiveness where earnings have been impaired in many directions by the decline in trade and other factors.

Liquidation in relatively weak properties is known to have its effect in slower downward movements in other issues. To this condition the brokers attribute the slight decline in American Marconi. English Marconi's were likewise affected by operations connected with the bear faction, but later rallied from the lowest levels, although a decline was shown by both common and preferred shares. Canadian Marconi's also weakened.

The consensus of opinion among the brokers to-day is that the public has lost confidence during a business depression which is unwarranted, and will not come forward to repel the attacks of the professional traders. A generally cheerful attitude is expressed toward Marconi's and the conservative traders urge buying at the present low levels.

Bid and asked prices to-day:

American, 2¾—3; Canadian, 1⅜—1⅝; English, common, 11—14; English, preferred, 9—12½.

DIRECTORS EXPRESS CONFIDENCE IN MR. NALLY

A dispatch from London referring to the annual report of the Marconi Wireless Telegraph Co. for 1913 says:

The report says considerable difficulty was experienced in obtaining the services of a man with the knowledge and ability needed for the direction of the American company. Lack of such a man rendered the business less profitable than it otherwise would have been. The directors believe that Edward J. Nally, who was eventually appointed, will fill the position satisfactorily.

NEW ORLEANS OFFICE MOVED

The New Orleans (La.) office of the Marconi Wireless Telegraph Company of America (call letters WHK) has been removed from the Grunewald Hotel to Metairie Ridge Road, where the quarters of Superintendent Mowat, of the Gulf Division, are now located.

The Boletin Official publishes a decree authorizing the Argentine post office to spend 50,000 pesos paper (approximately $22,000) on the erection of two wireless telegraph stations at Posadas and Puerto Aguirre in the National Territory of Misiones.

According to the Indianman, wireless telegraphy in India is making satisfactory progress. The wireless station at Peshawur is now in working order, while from Rangoon comes the news that the masts for the station there are being set up, and that the installation of machinery will soon begin.

Marconi Men

The Gossip of the Divisions

Eastern Division

Operator J. J. Kaleta, of the Cristobal, has been transferred to the steamer Yaguez.

Operator W. H. Davis, the hero of the Oklahoma, has been transferred to the El Sol. Davis has had designs on the El Sol for some time.

Operators B. J. Harvey and S. Hopkins have been assigned to the Trinidad, which went into commission on July 18.

Operator N. J. Kearney, who has made one trip on the Mexico since the Havana laid up, rejoins the latter vessel when she goes into commission.

Operator E. Bambourakis has been promoted to first operator on the City of Savannah, vice Arthur Cohen, resigned. D. Duffield, formerly of the Arapahoe, is second.

Operator A. Bernhard transferred to the Seguranca, when the Algonquin laid up, relieving operator Cuthbert, who is on sick leave.

M. Z. Bishop, of the Alamo, has been transferred to the City of Montgomery as second operator. O. C. Temple relieved him on the Alamo.

E. J. Quinby, who was dispatched as relief operator to the pilot boat New Jersey, showed a capacity for quick action when the New Jersey sank. Quinby immediately called Sea Gate and continued to sound the distress call until stopped by the rapid rise of the water. The call was promptly received by Sea Gate, which just as promptly notified all concerned.

C. E. Burgess and J. J. Simpson, first and second operators on the American Line steamer St. Paul, have been transferred to Belmar. J. A. Worrall and J. S. Scott have been assigned to the St. Paul.

J. W. Swanson, first operator, and F. J. Murphy, second operator, have been transferred from the Arapahoe to the Saratoga and Florizel, respectively. H. B. Cowan and A. C. Berg relieved them on the Arapahoe.

Patrick Barkley, who was relieved by F. J. Murphy on the Florizel, is now at Belmar.

Operator A. M. Mitchell has been transferred to the Grayson, vice A. H. Lynch, transferred to the S. S. Atlantic City, recently equipped with a ½ K.W. panel set.

Operator D. Brand, formerly on the Alliance, has been assigned to the Borinquen.

A. Schweider has been transferred from the Parima to the Matura, being relieved by operator Arnold.

Operator Heimbecker was transferred to the Creole from the laid-up Mohawk, leave having been extended to operator Ferrick.

Leave has been granted to operator J. M. Bassett, who will rejoin the Mohawk when she goes into commission.

Operator H. H. Hilcken, of the Panama, has resigned to go in the bookbinding business with his father at Newport, R. I. The Division has an idea that Hiram intends to abjure the ranks of cellibacy and take unto himself a life partner and its best wishes go with him.

J. B. Catanese, from the factory, who was assigned to the Karema as a listener, returned from St. Johns where he was disembarked, looking a very much-traveled man. It seems almost a pity to have to assign him to a pilot boat where his itinerary will be very limited.

Operator B. G. Suetter, who was transferred north from the City of Macon, via the El Oriente, has resigned to go to work again. We believe he is either at 253 or 195.

Second operator H. V. Griffing, of the El Oriente, was taken sick at Galveston on June 28 and removed from the vessel to the Marine Hospital.

Operator A. E. Ridley, for years on the Millinocket, has been transferred to the Calvin Austin, at his request.

Operator R. L. Brackett has been relieved from duty on the Ranson B. Fuller by operator W. J. Swett, of the Nacoochee. J. F. Forsyth has been transferred to the Nacoochee.

Operator E. E. Hayward has been placed on the Governor Dingley, which required a second operator commencing July 5.

Operator M. A. Campbell, of the Obidense, has been transferred to the El Norte, relieving C. E. Maps, who has resigned to take up his father's business.

Operator R. Toms has been transferred from the American Line steamer New York to the Bantu.

Operator R. L. Etheridge, of the Jefferson, has been granted indefinite leave in order to undergo an operation for appendicitis at Norfolk, Va. Best wishes for a successful operation and a speedy recovery.

Operator Eugene Hymel was assigned to the SS. Mexicano at Texas City, Tex.

Operator N. D. Talbot was assigned to the Maracas when the Algonquin laid up.

Operator F. Dawson has been transferred from the Antilla to the Carolina, junior operator William Sirken going to the Nickerie.

E. J. Oschman and R. Pettit, of the Comal (laid up), have been transferred to the Huron.

J. H. Rhettstatt, who has been on leave during the lay-up of the Creole, rejoined that vessel.

S. F. Patten was transferred from the Olinda to the Philadelphia.

P. H. Kriegen, from the school, has been assigned to the Olinda.

Southern Division

W. P. Grantlin has been transferred from Baltimore to the Miami station, where he will be manager.

Shallcross and Hartley have been transferred to the Miami station, Hartley from Virginia Beach and Shallcross from Philadelphia.

Summer season at Tolchester Beach opened June 1 when the excursion steamer Louise was placed in commission. Operator Linderborn has been detailed to the Louise.

Operator H. C. Fox has been transferred from Baltimore station to Cape May station, and is both painter and manager.

Engineer Eugene Murray has returned to Baltimore after accompanying U. S. Government Inspector R. Y. Cadmus on an inspection tour of the Southern Division coastal stations.

Operator Goldblatt had the misfortune last week to fall in a hatchway while visiting on the Toledo at Philadelphia. Two ribs were broken and he was otherwise injured.

Operator Edward McCauley, of the SS. City of Richmond, has resigned to accept a position on shore at Baltimore in a machine shop.

Illinsworth at Virginia Beach announces that he is very lonely since his side partner Hartley was transferred to Miami; so he has asked for two weeks' vacation.

J. C. Lewis, formerly manager at Miami, has been transferred to his old post at South Wellfleet.

Engineer Morris, at Philadelphia, intends to spend a couple of weeks at his home in Norfolk with Mrs. Morris this month.

Engineer Murray left for New York on the new ship Ohioan of the American Hawaiian Line with the Marconi equipment put on her at Baltimore.

Sammy Cessenfeld has been promoted to assistant operator at the Baltimore station.

Inspector Cadmus says the nearest approach to water south of Norfolk is coca cola.

Dempsey, of the SS. Somerset, came to life last month and captured the five dollar prize for sale of Ocean Wireless News. Dempsey looks like a new man.

Great Lakes Division

F. Benson, a graduate student from the Marconi School at Cleveland, was appointed wireless operator and purser on the SS. Ann Arbor No. 3.

Harry Lane, wireless operator on the SS. Wilpen, has been transferred to the second trick at the Chicago station. W. Miller, a graduate from the Marconi School at Cleveland, succeeds Harry Lane on the SS. Wilpen.

D. A. Nichols, formerly employed by the Marconi Wireless Company of

Canada on the Saronic, has been appointed night operator at the Buffalo station.

E. Dieghan, third trick operator at the Cleveland station, and Charles Beals, recently left Detroit for Duluth on board the City of Detroit III., with the Board of Commerce Excursion.

The City of Detroit III. started on her regular run between Detroit and Buffalo on June 23, at which date F. C. Goulding relieved operator E. Dieghan, and F. Stehmeyer relieved operator Charles Beals. Deigham has returned to his position as third trick operator at Cleveland, O. Beals has been appointed first operator on board the City of Detroit II., which has been in dry dock undergoing repairs to her engines. H. P. Roberts, a graduate from the Marconi School, has been appointed assistant to Beals on board the City of Detroit II.

W. A. Hutchins, who was operator on board the Seeandbee during the season of 1913, has returned. The Seeandbee went into commission on her regular run between Cleveland, O., and Buffalo, N. Y., on June 21.

A. E. Jackson, chief constructor of the Great Lakes Division, was recently in Port Huron installing a new one-half K.W. panel set on the Lakewood, the first of these sets to be installed in the Great Lakes Division. It is giving excellent results, a radiation being obtained of 4.4 amperes and a daylight range of 160 miles.

E. C. Newton, superintendent of the Great Lakes Division, who was recently married to Miss Bertha Sanda, is residing with his bride in their new home at 8909 Yale avenue, Cleveland, Ohio.

The Str. Eastland, formerly owned by the Eastland Navigation Co. of Cleveland, O., has been purchased by the Chicago and St. Joseph S. S. Co., and is plying between Chicago and St. Joseph, Mich. The wireless equipment has been maintained on board this vessel with operator A. Hamel in charge.

A. J. Therriault has returned to his position as operator-in-charge at the Mackinac Island, Mich., station, after spending eight months in the Gulf Division.

MARCONI AT CARNARVON BANQUET

A public banquet was held at Carnarvon, Wales, on May 20, in honor of Guglielmo Marconi, who was accompanied by Mrs. Marconi. The mayor of Carnarvon presided, and he was supported by representatives of Liverpool's shipping industry. The object of the gathering was to celebrate the completion of the new station.

Responding to the toast to his health, Mr. Marconi, who was cordially received, said that wireless telegraphy had made enormous progress in recent years, and he was certain that at the time of his first experiments, nearly twenty years ago, hardly anyone would have dreamt that it would have been possible to utilize it for direct commercial communication between England and America, or between England and South Africa. He remembered perfectly well that when he first started his experiments in England he received a letter from the Admiralty stating that if ten or fifteen miles could be covered, it would be all that was really wanted. Now if for some reason one could not communicate direct to almost any point in the Mediterranean or North Atlantic, they were all very much surprised, and had to admit that there must be something radically wrong either with the apparatus or the persons who were working it.

The uses of wireless telegraphy at the present day were many, but he thought that the first practical purpose to which it was put over seventeen years ago still remained the most important. He referred to its use on board ship in safeguarding the lives of those that travel on the sea. The number of ships and shore stations equipped with wireless telegraph apparatus was rapidly increasing, and that such equipment was now considered almost indispensable was shown by the fact that several governments had passed laws making a wireless telegraph installation compulsory in all ships entering their ports. Many of the results he had been able to obtain had been rendered possible by the work of his predecessors and by the co-operation and help which had been afforded him by his assistants.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

E. G. R., Trenton, N. J., asks:

Ques. (1) What station sends every night at 8:30 to about 9:15? It has a very high pitched spark note.

Ans. (1) We do not know.

Ques. (2) What is the wave-length of an aerial 300 feet long, 40 feet in height at one end and 50 feet in height at the others?

Ans. (2) About 530 meters.

Ques. (3) Will amateurs in New Jersey be able to hear the new high power station of the Marconi Company at New Brunswick, N. J.?

Ans. (3) It is very doubtful on account of the extremely long wave-lengths to be used.

Ques. (4) When does the Cape Cod station of the Marconi Company send press, and on what wave-length?

Ans. (4) It starts at 10:15 P. M. The wave-length used is 1,650 meters.

Ques. (5) When does Key West (NAR) send, and on what wave-lengths?

Ans. (5) From 2:00 A. M. to 11:00 P. M. on regular schedules. At 2:00 P. M. Key West communicates with Arlington on a wave-length of 4,000 meters; for the remainder of the day a wave-length of 1,500 meters is used when communicating with ships and other naval stations.

* * *

T. J. R., San Francisco, Cal., inquires:

In your description of a tuning transformer in the January number of THE WIRELESS AGE the statement is made that the primary of the receiving transformer is 3½ inches in diameter and 6 inches in length; the secondary winding 4 inches in diameter and 12 inches in length. Why is the secondary longer and larger in diameter than the primary? In all the instruments I have seen the conditions are the reverse.

Ans.—It is intended that an aerial tuning inductance should be used in series with the primary winding of this tuner and therefore the secondary winding should have considerably greater dimensions than the primary winding. The fact that the secondary of the transformer is larger in diameter than the primary and furthermore that the primary slides inside of the secondary is of no particular import, as the tuner will work equally well in either manner.

* * *

S. H., Hamilton, Ont., asks:

Ques. I desire to construct a spark coil for which you gave directions in one of the previous issues of your publication.

Ans. See the December, 1913, issue under the heading, "Instruction to Boy Scouts."

* * *

F. D. U., Elgin, Ill., writes:

Ques.—The last few mornings at 9:30, Central Standard Time, I have heard an unknown wireless station and am wondering if you can identify it. I hear a high-pitched note on a 2,400 meter wave-length and the station apparently signs WNU. Its signals run for about 5 minutes; they consist of repeated calls for another station which cannot be deciphered owing to the faintness of the signals. I notice in the July, 1913, "Radio Stations of the United States," that the call WNU had not been assigned and I am wondering if it has since been allotted to some new high power stations in this country.

Ans.—This is the 50 K. W. station of the Tropical Radio Company at New Orleans, La. It is equipped with apparatus furnished by the Marconi Wireless Telegraph Company of America.

* * *

J. E. P., Irvington, N. J., asks:

Ques. (1) Is there any formula by which I can construct condensers of different capacities? That is, is there any certain capacity in microfarads to a certain number of square inches to the surface of tin-foil or brass sheeting?

Ans. (1) The following formula would apply:

$$C = \frac{A \times K \times 0.2246}{T \times 10^6} \text{ Mfds.}$$

Where A equals the area in square inches of the tinfoil in use or, we might say, equals the area of the dialectric in use, K is the dialectric constant of the particular insulating substance used; T equals the thickness of the dialectric in inches.

The values of K may be found in tables in various text books on electricity, among them being "The Year Book of Wireless Telegraphy" for 1914. For glass the value of K lies between 6 and 9.

Ques. (2) When a condenser is said to have a certain number of square inches of surface, does the expression include one side of the plate or both sides?

Ans. (2) Generally the reference is made to the number of square inches on one side of the single plate condenser.

The information requested by you concerning the type 101 Marconi receiving tuner is not available for publication.

* * *

C. O. T., Lenora, Kas.:

It is impossible to calculate the distance you may expect to receive with your aerial and apparatus as we do not know whom you wish to receive from. There are no commercial stations in your vicinity, the nearest high power station being that of the Army at Fort Leavenworth, Kas. Your aerial is not quite high enough to receive signals from the Atlantic coast during the winter time. Under these conditions we can make no suggestions as to what your receiving range might be.

* * *

C. F. O., Marblehead Neck, Mass., asks:

Ques. (1) Do you give cash prizes for good photographs of amateur stations?

Ans. (1) The Wireless Age does not give prizes for photographs. Cash will be paid, however, for photographs that are available for publication.

Ques. (2) After taking a course in radio engineering at Columbia University, is there any field open to the graduates and what position may he expect?

Ans. (2) The field is fairly promising and positions may be obtained in the engineering departments of the commercial companies. The demand for such men is not large and you should not be mislead in this respect. The application files of commercial wireless telegraph companies are generally filled. Even after securing a first-class technical training at a college, you might find that you would be expected to enter the ship service of a commercial company and become familiar with practical wireless telegraphy before being placed in a more remunerative position.

Ques. (3) Where can I obtain a piece of cerusite like that used in the latest type of Marconi receiving sets? Is cerusite a crystal requiring a fine pressure, and what kind of wire makes the best contact—a small German silver wire or a brass wire of the same dimensions? During a conversation with a commercial operator, he said that the piece of cerusite which he used was more sensitive than galena and had more "points." Is this so?

Ans. (3) A first-class cerusite detector may be purchased from the Marconi Wireless Telegraph Company of America, 233 Broadway, New York, for $50. Cerusite requires a contact on the order of that of silicon or perikon. The contact wire is preferably of spring steel. The operator with whom you were in conversation is quite right in his statement, for it is a notable fact that with good crystals of cerusite a sensitive point of contact may be found at almost any spot on the crystal, as, of course, is not the case with crystals of galena. Cerusite is decidedly more stable in adjustment than galena, and from a commercial standpoint is far more preferable.

Ques. (4) Please tell me if this tuning inductance is of sufficient value to allow of the reception of signals from the Marconi Station at Glace Bay, N. S.:

Primary, 256 turns on a core 3 inches in diameter, inductance varied 1-20 of a turn; wire No. 26 B. & S. Secondary, No. 32 B. & S. wire on a core 2½ inches in diameter, 18 inches in length, wound closely; 11 taps. I have a Murdock loading coil with a 7-point switch, which is supposed to have 2,800 meters wave-length. The aerial I expect to use with this loose-coupler is 400 feet in length and consists of a single loose wire.

Could I receive Glace Bay with another aerial consisting of 4 wires 75 feet in length? I have a Blitzen variable condenser across the secondary and will use it if it is needed. My aerials are directional north.

Ans. (4) If your secondary winding is shunted by the Blitzen condenser you will be able to tune to the wave-length of Glace Bay. Your 400-foot aerial is a little short, and if possible, it is best to lengthen it to 800 or 900 feet. You will not be able to receive Glace Bay at all on a 75-foot aerial. If you lengthen the larger aerial to one like that which we have suggested, and the loading coil is placed in series with the primary inductance of the oscillation transformer, your apparatus should be in resonance with Glace Bay. It requires well-designed receiving equipment to receive signals from a high-power Marconi Station on an aerial of small proportions, so you should not be discouraged if you do not hear Glace Bay.

Ques. (5) Will you please give me a correct list of the letters sent out by Arlington in the meteorological report after the time signals? In the November or October number of The Wireless Age a list was given which slightly differs from the list Arlington sends out at the present time. If possible give me an authentic list and the places they represent. Also, could you tell me the comparative values of the Beaufort scale with the commonly known relative conditions?

Ans. (5) A full interpretation of the Beaufort scale is given on Page 645 of "The Year Book of Wireless Telegraphy and Telephony" for 1914. The new letters which you hear from Arlington are additional ones covering the Great Lakes district. You may secure a bulletin from the United States Department of Agriculture, Weather Bureau Office, covering the matter fully. This information will be sent from Arlington for the Great Lakes district from about April 15th to December 10th each year. The points for which weather conditions will be furnished are designated as follows:

DU, Duluth; M, Marquette; U, Sault Ste. Marie; G, Green Bay; CH, Chicago; L, Alpena; D, Detroit; V, Cleveland; F, Buffalo. The grouping is by lakes, beginning with Superior and ending with Erie.

In all other respects the method of sending this information is the same as that described on page 82 of the October, 1913, issue of The Wireless Age. A point that should be known in connection with the sending of the Beaufort scale is that no provision in the Weather Bureau code has been made for a wind force greater than 9, which designates a strong gale. Whenever a wind force greater than a strong gale is to be reported, the number representing it will be given in words instead of in figures.

If the weather conditions for any particular station cannot be supplied, the initial of that station will be given, followed by the word "missing," and if any portion of the report cannot be furnished, it will be replaced by an equivalent number of letters "X."

The circular from the Weather Bureau previously referred to contains an interpretation of the Beaufort scale.

* * *

D. L., San Francisco, Cal., writes:

Ques. (1) I have two poles, each 60 feet high and 70 feet apart. My aerial consists of 4 wires, each 2 feet apart. It also has a 20-foot lead-in consisting of two wires. What type aerial would you advise me to use to get 200 meters?

Ans. (1) If you desire to emit a 200-meter wave, using an oscillation transformer in connection with the transmitting set, the natural wave-length of your aerial should not be more than 160 meters. An aerial consisting of 4 wires, spaced 2 feet apart, 50 feet in length and 40 feet in height, will have a natural wave-length of approximately 160 meters. This will allow a few turns of inductance to be inserted in series with the antenna for the transferance of energy from the enclosed to the open circuits; thus your station will emit a 200-meter wave and the coupling may be adjusted as desired.

Ques. (2) Will you kindly give a diagram of the aerial?

Ans. (2) No diagram is necessary; it need only be of the inverted type. We note that the drawing accompanying your communication indicated that you are using a freakish arrangement of connections in the aerial. There is no advantage in zigzagging the wires as shown in your drawing. Connect all 4 wires together at the extreme end and bring lead-in wires from the other end to your apparatus.

Ques. (3) Please tell me the wave-length of a 2-wire aerial, 70 feet in length and 60 feet in height. The wires are spaced 6 feet apart, with 2 wires for the lead-in 20 feet long.

Ans. (3) The wave-length of such an aerial would be approximately 250 meters.

* * *

G. E. F., Jubilee, N. B., Canada, writes:

Ques. (1) Will you kindly give me information concerning the Poulsen trans-Atlantic station at Newcastle, New Brunswick, Canada, in reference to wave-length, power and frequency?

Ans. (1) We have no information at hand concerning this station, but understand that it has been in course of construction for some time. We suggest that you get in touch with the Superintendent of the Radio Department of the Canadian government.

Ques. (2) What station has call letters WST operating on a 600-meter wave?

Ans. (2) The Marconi station at Miami, Fla.

Ques. (3) Will putting vaseline on the electrodes of a spark gap give the spark a quick break?

Ans. (3) For a few moments it might have the effect of making the spark discharge more abruptly, but the oil will soon be burned away and the benefit to be derived lost. There is no distinct advantage in smearing vaseline on a spark gap.

* * *

G. W. D., Tracy, Cal., inquires:

Ques. (1) What amount of No. 32 S. S. C. magnet wire is required for the secondary winding of a 4-inch spark coil and also what is the effect of using No. 32 instead of No. 36? I am aware that No. 32 wire will give a hotter spark. Does the coil draw more current with the coarser winding or does that depend on the primary winding alone?

Ans. (1) You will require 2½ pounds of No. 32 wire. Wire of this size will give a lower voltage than if you used No. 36. It will, however, allow you to use a larger condenser capacity across the secondary winding. The coil will draw more current with the coarser winding.

Your second query is not concise; furthermore, a variable condenser of .0008 mfds. does not give sufficient range to make a satisfactory wave-meter. You would require too many inductance coils. It is, however, possible to construct a wave-meter, where the inductance is of the variometer type shunted by a fixed condenser, that will give considerable range of wave-lengths. No. 28 D.C.C. wire is too small for the winding of the wave-meter coil. You should use at least No. 18. In reply to your reference to the head telephones and carborundum crystals, we would say that the crystal should be connected in series with the head telephones and one terminal of the crystal connected to the condenser of the wave-meter; the free terminal of the telephones should be connected to the other terminal of the condenser. Have you any means at hand for calibrating a wave-meter when it is completed? See the article on wave-meters, page 497 of the March issue of The Wireless Age.

Ques. (3) Is Hillcrest station in San Francisco a Marconi station? Also, what is the wave-length?

Ans. (3) The station is owned by the Marconi Company. The wave-length is 600 meters.

* * *

D. C. L., North Hampton, Mass., asks:

Ques. (1) What would be the most efficient form of oscillation transformer for a one K. W. set?

Ans. (1) If you wish to comply with the government law you will find it to your advantage to install an inductively coupled oscillation transformer. The primary of the oscillation transformer should consist of 8 turns of copper tubing ¼ of an inch in diameter, or No. 4 stranded wire wound on an insulating support 15 inches in diameter. Turns should be spaced ¾ of an inch. The secondary may have more or less turns of smaller diameter arranged to telescope into the primary.

THE WIRELESS AGE

SEPTEMBER, 1914

THE RADIO REVIEW

THE character of naval warfare was profoundly modified when steamers replaced sailing vessels. Up to that time the windward position had been all important, so that a man-o'-war could manœuver for advantage of position in attacking an enemy. Steam nullified the advantage of the windward position and introduced new tactics.

Wireless in Naval Warfare

The introduction of armor and high power guns wrought the next modification. Battles became long range engagements, and the old order to ram and board passed away.

And now wireless, by which the movements of vessels at sea can be controlled from land almost as easily as the movements of armies, is looming up as the big factor in the present war. A warship out of sight of land is no longer lost to the world until it reappears at some harbor with a cable. Its course can be directed, and the course of whole fleets can be directed, from headquarters in the light of information as to the position of the ships of the enemy.

Many of the greatest sea battles in history have been won or lost through delay in mobilization, and the outcome of nearly every great struggle has hinged upon the prompt execution of the commander's orders. With modern warfare virtually controlled by the new means of communication we can expect to hear less of the daring of the individual dispatch bearer and more of the ingenuity of the operator who skillfully adjusts his instruments and disguises his spark so that the orders penetrate and pass beyond the enemy's lines without recognition.

Stepping Back 100 Years

A HUNDRED years ago the United States was at war with England, and the burning of Washington, the battle of Fort Erie and the attack on Baltimore, during which Key wrote his "Star-Spangled Banner," were events of thrilling interest. But news traveled slowly 100 years ago. It was days before New York knew what had happened, and then only through the use of relays of couriers rushing on horseback over roads that were none of the best. Since then we have developed a mechanism for the collection and distribution of news. Between the message of victory in Manila Bay, flashed more than half way around the world, and the utter lack of knowledge of the great battle of Waterloo by people, much more vitally concerned, only a hundred miles away, there lies a century in which men have used their inventive faculty more than during any similar period in the history of the world, and during which those men who seek to report and record the world's activities have covered the earth with their perfected organizations.

And now, due to the wire and wireless censorship, the mechanism is almost useless and we are back not so very far from where people were a century ago.

The rigorous censorships established by combatants have interfered with efficient news gathering until to-day the minds attempting to the limit of their capacity to grasp and understand the events in Europe can secure but the sorriest and most unstable data from which to extract a true conception of what is going on. It is but another instance of the retroactive effects of war that the great recording instrument so carefully built up is now rendered useless.

Saving An $11,000,000 Treasure Ship

ONE day a few weeks ago a great liner started from New York to Bremen in the same commonplace way in which she had started so many times before, carrying tourists, sightseers, health-seekers; but in addition she was a treasure ship, carrying nearly $11,000,000 in gold consigned to European bankers. After three days the moon suddenly shifted from starboard to port, and while the passengers were marveling at the phenomenon, the captain informed them that the nations of the world were at war, that he had been notified by wireless, and that he was fleeing back, not to New York, but to any port into which he could escape unobserved.

She was disguised, veiled in canvas, and stole through the darkness without so much as a candlelight showing. More than half way to Europe, she had turned, and now she prowled along backward, the sea alive to her passengers' imagination—and perhaps, in fact—with cruisers hunting for her and the wealth she bore. Through the fog she sped at high speed, dark and unseen, her passengers prisoners on her masked decks, no man knowing her destination, no man knowing when a short across her bows would mean that the game of hide-and-seek was up.

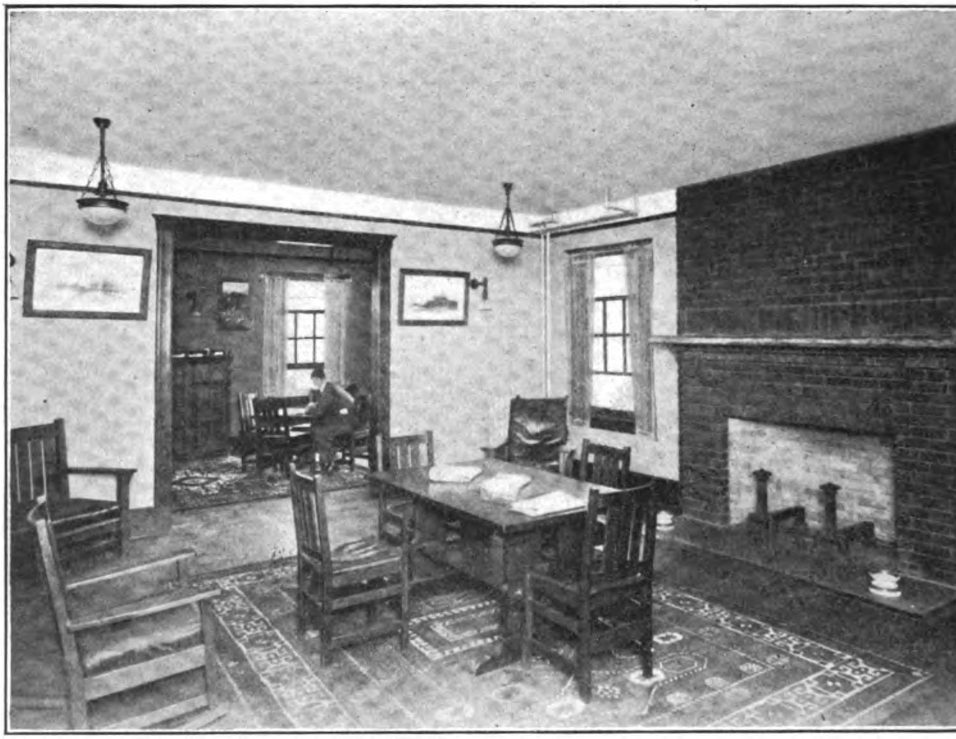
Meanwhile the whole world was watching for her, speculating on her fate; she was reported in one quarter, then in another; she had landed here, she had landed there, she had been captured.

Finally, the liner turned up in the harbor of a summer resort, to be greeted by the tangoing, tennis-playing population of summer butterflies flocking down to the shore to see the unprecedented sight, wondering what liner had gone crazy and left its course, and then discovering that it was the ship for which all the world was looking.

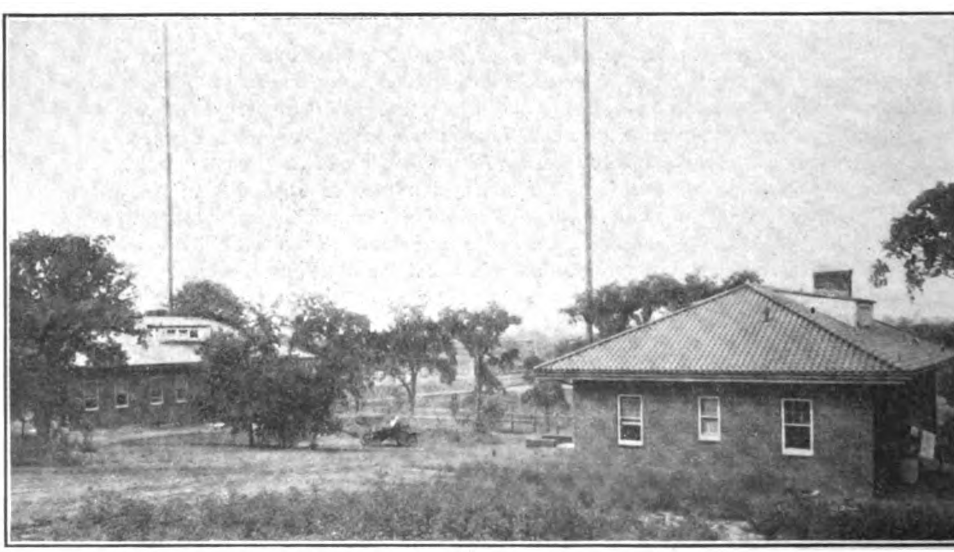
This incident of the opening of hostilities brings wireless telegraphy to the foreground in a distinctive manner. Nothing could demonstrate more clearly its great value to commerce—even in time of war. A fortune was saved. Eleven million good American dollars were returned intact to New York bankers, a vast fortune that would otherwise have gone into warfare's melting pot. Had the treasure ship been captured or sunk, the responsibility would have rested with the steamship company or its insurers. Recompense would have been forthcoming, but just when seems rather problematical when the extent of the European hostilities is considered. In any event, it is recorded that the American bankers breathed great sighs of relief when the vessel made port safely. Some expressions of gratitude toward wireless were also heard. From which it may be construed that wireless has more than one humanitarian aspect.

The New Brunswick Station

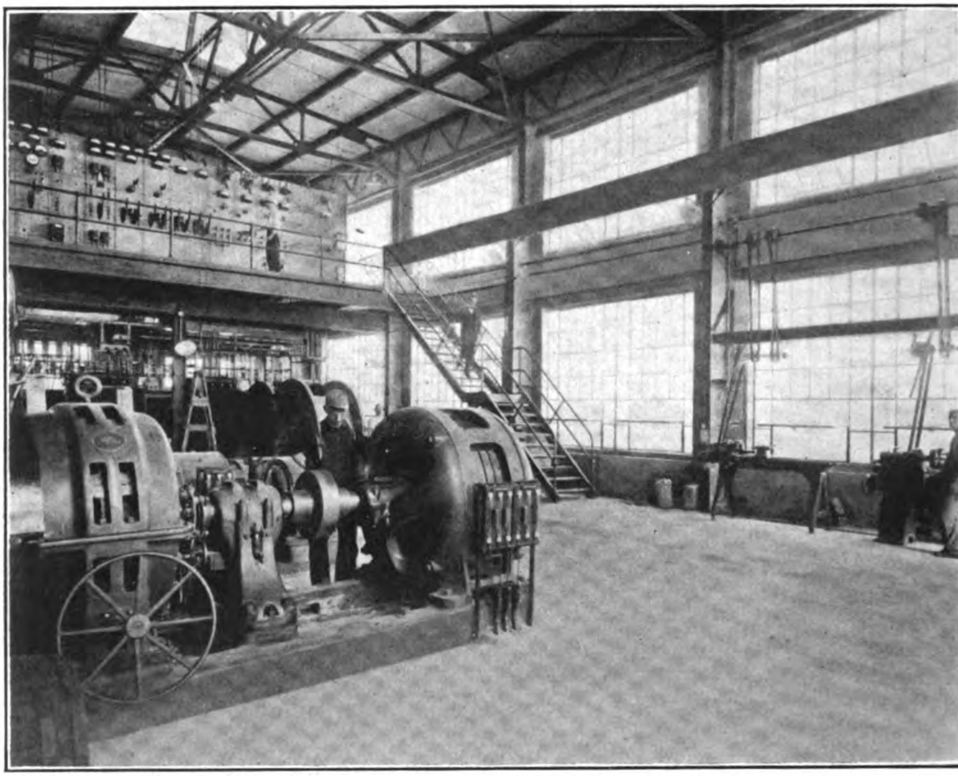
The photograph at the top of the page presents a view of the hotel which has been erected for the use of the men detailed at the New Brunswick Marconi station. This station is the transmitting half of the link which will communicate with Wales. The New Brunswick station is located two miles from New Brunswick on a road that winds along the banks of the Raritan river and the Raritan canal. The visitor approaching the site from the south is treated to a glimpse of a meadow which extends from the road to the canal bank. The land takes a sharp upward turn at the west of the road and then keeps on a level for a mile or more. By looking up this rise the cottages for the chief and the assistant engineer (shown in photographs on another page) can be seen. At a point further up the incline is the hotel. The operators needed to work the auxiliary receiving apparatus and the riggers to keep the aerials and mast system in proper condition will make their home here. The hotel, which is constructed of red brick with a concrete and tile roof, is two stories in height. Provided with broad verandas and windows which command an excellent view of the surrounding country, it makes an ideal home for the Marconi men. It has about fifteen sleeping rooms and is tastefully furnished throughout.



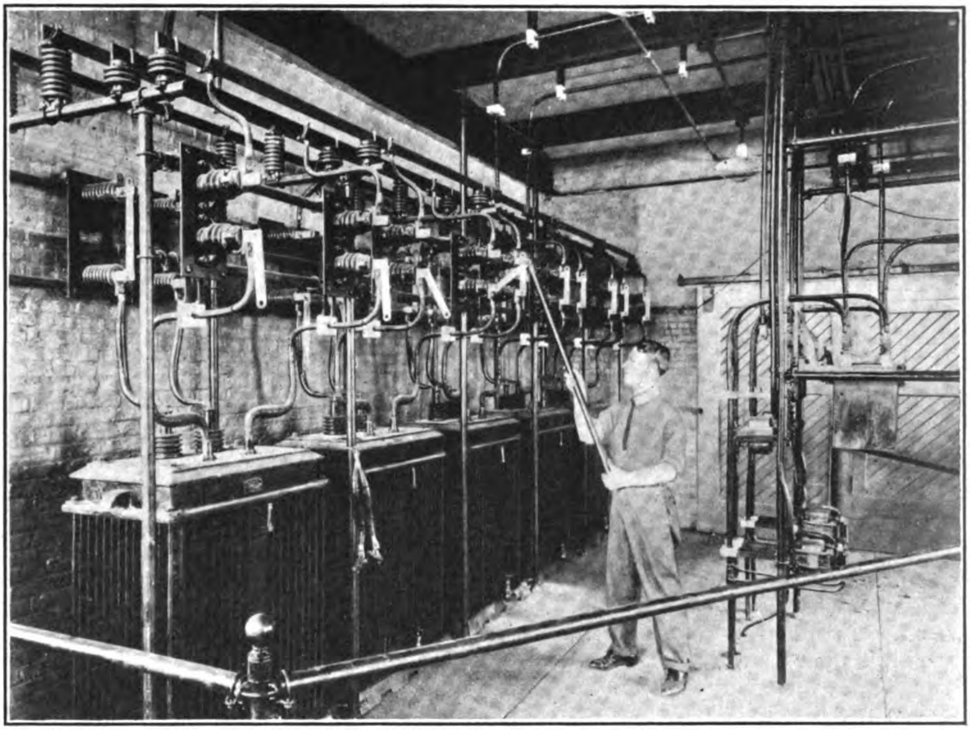
The illustration above presents a view of the living room and a glimpse of the library in the hotel. From the windows of these rooms can be seen the Raritan river and the Raritan canal. In the photograph below is a view of the cottages for the chief engineer and his assistant.



This photograph shows a front view of the power house, the main building at New Brunswick. Here the electricity is changed in form from the sixty cycle 24,000 volt current to the high frequency oscillating current required to send the dots and dashes across the ocean. The building, which is made of brick, contains the condenser and discharger rooms and offices. In the illustration can be seen the aerials anchored to the foundations and lead into the building.



An interior view of the power house, showing the 500-horsepower motors, is presented in the photograph above. About half a dozen men will be employed in the power house. The switchboard gallery, from which the electrical apparatus of the station is controlled, is in the background. From this board the machinery can be stopped or started and the lights turned on or off. Below is the control table of the station. On the table are a wave-meter and a decremeter. The engineer in charge is able to control and keep in touch with the operation of all the apparatus connected with the station from this table. When the trans-oceanic service is opened he or an assistant will be constantly on duty there, ready to send orders or to meet any problems that may arise.



The five transformers which take the current from the generator and step it up in voltage sufficiently high to charge the condensers. They carry the full power of the station whenever signals are being sent. The type of bus bar construction shown is typical of the work throughout. All parts are accessible and so arranged that any transformer may be quickly cut out and a spare unit substituted without shutting off the current.

The War on the Ocean

In Which Wireless Was Employed to Advantage

INTO Bar Harbor, Me., which seldom sees anything more pretentious than coastwise craft, there crept at 6 o'clock on the morning of August 4, a great ocean liner. It was the North German Lloyd steamship Kronprinzessin Cecilie, carrying more than $13,000,000 in specie, $10,679,000 in gold and the rest in silver, and 1,216 passengers which had been turned back by wireless orders from the steamship company's offices in Bremen, Germany, when within two days' steaming of her first port of call, Plymouth, England, for fear of capture by British or French warships.

The turn was made on the night of July 31. From that time until the great ship's nose penetrated the waters of the three-mile limit—the neutral zone—on the Maine coast, the Cecilie's screws were kept turning at full speed day and night, not abating a single revolution even in the fog that for hours enveloped the fleeing treasure ship. The run back was made with all lights blanketed or extinguished and as silently as possible, the foghorn being blown only at infrequent intervals, and at the risk of collision with vagrant icebergs or other vessels.

The Passengers Notified

When the ship was put about Captain Charles Polak called the men passengers into the smoking room and told them that a general European war was impending or had been declared, and that he had received orders to make for America and safety. Captain, crew, and passengers heaved a sigh of relief when the ship dropped anchor in the harbor and greeted the Bar Harbor hills with three long blasts of her siren.

The big steamship was in latitude 46.46 north and longitude 30.21 west when orders were received for her return. She was then about 900 miles from the English coast. A dance was in progress when the captain called the men into the smoking room and told them the news, adding that he had plenty of coal on board for the return voyage and that he would endeavor to reach a neutral port. The captain did not tell them that he had overheard the wireless of French vessels giving his whereabouts, or that he had heard that four British cruisers had come out to meet the Cecilie.

Hid in the Fog and Darkness

With a dense fog coming up, her whereabouts was concealed, and the liner turned back in the darkness. The outside lights were extinguished and the portholes all carefully stopped, so that no light might betray the presence of the ship. The captain kept the liner going at top speed in the fog, believing that somewhere behind were cruisers bent on his capture.

After the second night of such headlong running with lights extinguished, the passengers, with the Titanic disaster in mind, began to show signs of uneasiness. A committee of the men went to the captain and declared that he was needlessly endangering the lives of all aboard; that human life was of far more importance than the gold that this modern treasure galleon carried. Captain Pollak assured them that there was little danger, as he was running far north of the usual steamship course. This failed to allay their fears, but the only concession the captain would make was to blow the foghorn occasionally.

No wireless messages were sent by the ship after the order to turn around was received. There was a rush for the wireless station by the passengers, but the captain refused to allow any messages to be sent, fearing that the ship's position would be betrayed.

On her sensational run for safety, every port hole of the Cecilie was blanketed with canvas, so that not a gleam of light might betray her whereabouts. Her four stout stacks were tipped with black paint, so that she might resemble an English steamship and thus escape suspicion.

The Cecilie left New York bound for Bremen via Plymouth and Cherbourg, with 350 first-class, 130 second-class and 736 steerage passengers. About a third of the first-class were Germans, who sailed to anticipate the war crisis. Most of the rest were Americans.

While the dance was in progress on the night that the course of the vessel was changed, one of the passengers noticed that the position of the moon had unaccountably shifted to the port side of the ship. Before the significance of this was realized the captain called the men into the smoking room and made his announcement of the turn about.

There was nervous laughter, applause, oaths, congratulations, protests, which gave way to a grave state of apprehension as the seriousness of the situation became apparent. Electric lights were turned off and the ship was covered from bow to stern in a shrowd of canvas. This smothered whatever beams of light escaped through chinks in the stateroom windows.

Ship Silent as a Derelict

To some sleep was impossible. The dark, foggy nights were long vigils until the morning's sun burned its way through the mist that had hung over the North Atlantic. To those who promenaded the shut-in decks on the long watches, the ship was like a ghost ship, with only the animating throb of its engines to make it different from a derelict. The only gleam of light that relieved the dead blackness was where the ship's friction stirred the sea into phosphorescence.

"We were about 900 miles off the English Coast, and should have made Plymouth in two days," Captain Polak said, "when I received a wireless from the home office of the line, sent via England, telling me that war had been declared and ordering me to return. I immediately started back. I did not know where to go, but caught a wireless from Sayville, L. I., and messages from other ships, saying that we were being watched for by cruisers on account of the $10,600,000 on board, consigned to English and French bankers.

Wireless Gave Warning

"At one time we caught wireless messages which told me we were within a comparatively short distance of the French fishing cruiser Friant and the British cruiser Essex. I expected at any moment to see their smoke above the horizon. A thick fog bank rolled in on us, providentially, and I believe this is the only thing that saved the ship from capture. We were afraid to send messages ourselves for fear of being located.

"We got news from the Long Island coast and from as far south as Norfolk. The messages said we were being watched for. I did not dare to ask if the route to New York was clear, for fear of betraying my position. I finally decided to turn north and make for Bar Harbor, which was nearer and safer than Portland."

Two big trans-Atlantic liners flying the British flag, bound from Liverpool for New York, put into the Halifax (N. S.) harbor on August 6 as a haven of safety from German cruisers. The unexpected arrivals were the Cunarder, Mauretania and the Cedric of the White Star Line. Both had been warned by the British cruiser Essex through Marconi wireless of the presence of hostile vessels in the North Atlantic waters they were about to traverse on their further voyaging to New York, and were advised to make all haste for Halifax.

The Essex herself convoyed the Cedric into port.

The Mauretania brought more than 1,600 passengers and the Cedric more than 1,000. The Mauretania's first-class passengers were landed and sent to their destinations with all possible speed by special trains. The mails also were sent by special trains.

It was the most dramatic voyage in the history of either ship. The Mauretania reached Halifax four days and ten hours after leaving Liverpool.

The Mauretania sailed from Liverpool at 4:55 P. M. on August 1, amid the utmost excitement. Many would-be passengers were left behind on the piers. From the moment the big liner left British shores the officers were on the alert, and Halifax was held in mind as an alternative port if contingencies demanded.

In the midst of thick fog, while off Sable Island, a marconigram from the Essex conveyed urgent warning to make full speed for Halifax. At that time the Cunarder was 380 miles from New York and 140 from this port.

A German Cruiser on Watch

Somewhere lurking in the darkness and fog was a German cruiser, but watching guard over the lanes of travel along which commerce was speeding were British warships, warning the liners by Marconi wireless where danger lurked for them.

The steamer had first taken the New York route, and had to change her course to direct north when she was advised by the Essex that danger lay further south. The actual time to Halifax was four days and ten hours, which could have been reduced six hours if time had not been lost on the indirect route. Besides this, six hours were lost in steaming because of fog and in dodging steamers and cruisers, thereby bringing down to three days and twenty-two hours the time in which the Cunarder could have covered the distance from Liverpool to Halifax.

The water front was crowded as the Cedric steamed up the harbor closely followed by the dark gray cruiser Essex stripped for battle. There were repeated cheers from the crowd as the Cedric dropped anchor, and the Essex proceeded to the dockyard to take on coal. The Cedric's decks were thronged with passengers, all happy at having reached port safely. It was 5:44 P. M., Halifax time, when the Cedric dropped anchor. She had been out six days ten hours and fifty-two minutes.

The captain's statement was brief:

"I have nothing to say except that a message was received from H. M. S. Essex, Wednesday night, ordering the Cedric to proceed to the port of Halifax," he said. "We did not sight any German cruisers. Possibly the fog of that night aided us to escape."

Only the officers and crew of the Hamburg-American liner President Grant, which came in from sea on August 2 in response to a wireless recall sent out by the local office of the line were in serious mood when she docked in Brooklyn. The 105 cabin passengers, chiefly Americans, were elated and congratulated themselves and one another that they had not continued the trip toward Hamburg by way of Plymouth and Cherbourg, running the risk of being held up by the enemies of Germany and probably spending a long time in a foreign port waiting for transportation back to New York.

A Run for Safety

The President Grant, of the North German Lloyd, kept close to the three-mile limit on her run for safety. Captain Meyerdiercks had received wireless messages during the afternoon that led him to suspect that there might be cruisers of the British squadron in North American waters that might pounce upon him in the event of a sudden breaking out of hostilities between Germany and England, and he kept a sharp lookout.

A wireless message was picked up that indicated that one of the British West Indian squadron was searching for the President Grant. Her skipper made light of the message and kept right on, going full speed for Sandy Hook.

Captain Meyerdiercks said he had received the recall message from his office when he was about 435 miles east of the Ambrose Channel lightship, or about 450 miles from the line's Brooklyn pier. The message was in cipher, showing that the line believed it was not a good thing to let the world afloat know that the Germans feared for the safety of the ship. The skipper was startled after he had translated the cipher. This took him about ten minutes. He had continued on his course meanwhile, not dreaming that an emergency had arisen that would force him back to this port. He reflected over the utter strangeness of the order for a while and was for a moment inclined to suspect that he might be the victim of a hoax. But he knew that only the line's agent could send him an order in its cipher code, and so twenty minutes after he had received the message he turned on his course and steamed full speed for Sandy Hook.

Notified by wireless while in mid-ocean of the great European war, the North German Lloyd steamship Wittekind, Capt. F. Sembill, which sailed from Hamburg on July 24, with Montreal as her intended destination, ended her trans-Atlantic voyage in Boston on August 9. Upon being informed of the war and with warnings to look out for English warships, Captain Sembill shifted his course, and despite a dense fog and the fact that he was in the iceberg zone, he made all speed for Boston, a neutral port.

Icebergs and Warships

He faced a double danger, the icebergs and the warships of the enemy. The fog, which held throughout the trip except for two nights, was also a danger, but it was a protection as well, and the officers of the Wittekind agreed that the fog probably saved them from capture.

Messages from the British cruiser Essex were caught by the Wittekind's wireless operator and at one time it was evident that the warship was not far from the path of the German steamship. The captain ordered all lights extinguished and the port holes covered. He had the Wittekind's single smokestack repainted with the markings of an American line—one dark stripe between two white stripes.

Once they sighted what was apparently a fishing fleet. Captain Sembill ordered the German ensign at the ship's stern lowered and in its place he unfurled the United States emblem. He feared that the fishermen would report the presence of a German steamship to the enemy and so resorted to this subterfuge.

The Wittekind is of about 3,600 tons and having a single smokestack would easily pass as one of the American Line fleet.

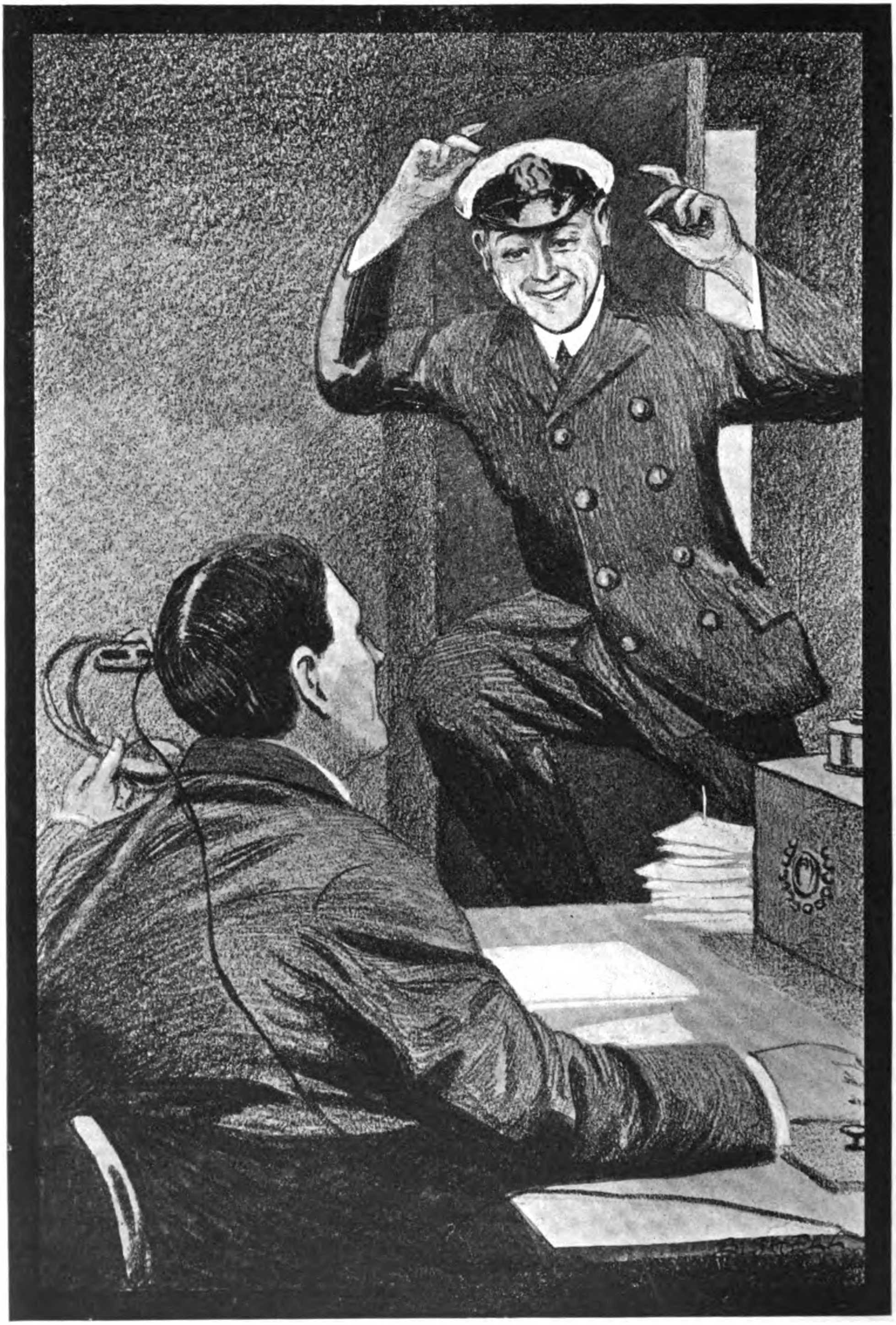
The Fog Horn Silent

The vessel plowed through the fog and the iceberg zone without once sounding the fog horn. Some of the passengers said that they passed a huge iceberg, its formation resembling an ostrich, as one of them described it.

The canvas tops of all the lifeboats were taken off and each boat was provisioned against emergency. Fresh water and zwiebach in liberal quantities were placed in each boat and the ropes were rearranged for quick handling.

The North German Lloyd liner Grosser Kurfuerst, which sailed from New York for Bremen with twenty-five first cabin and sixty-three second cabin passengers, mostly Germans returning to their homes, was 500 miles off the Hook when summoned by wireless to return to port. Captain Dietrich did not notify his passengers until the next morning, but some of them discovered through the queer conduct of the moon that they were going west. Nearly all the ship's 503 steerage passengers were reservists bound for Austria and Germany to join their respective colors. The passage money of all was refunded. The Grosser Kurfuerst had aboard about 9,000 tons of general merchandise that was destined for Bremen.

The North German Lloyd liner Friedrich der Grosse, which sailed from Baltimore for Bremen with a cargo said to be worth several millions of dollars and 121 second cabin, 22 third cabin and 125 steerage passengers, arrived in New York harbor on August 2 and anchored in quarantine. Captain Fritze had received wireless cipher orders to steam for this port. It was apparent from what passengers said that Captain Fritze feared that he might be overhauled or intercepted by a British war vessel, as he ran at night without running lights and curtained all the ports of the ship.



"Midst thunderous belch of reeking shard the world's history is being made anew!" I said, quoting from the yellow slip of copy

HOW WIRELESS BLOCKED A SEA FIGHT

SOME UNWRITTEN HISTORY OF THE RUSSO-JAPANESE WAR

BY WARREN H. MILLER

"YES, sir, we fellows got three nations into as pretty an international row as you ever saw—but we got the news alrighty, alrighty!"

The speaker was Dent, a clean-cut young wireless operator, abounding with energy and enthusiasm, and from the way he led off I knew we were in for a story. Men of his stamp are always doing interesting things.

"I always supposed that the naval engagements of the Jap-Russian war were reported by cable," I ventured, more to bring him out than anything else.

"Cable, nothin'!" growled Dent. "If the world had waited for Togo's and Rodjestvensky's cabled reports of those battles, we'd have been waiting yet—and *then* we would have had no more real truth than would be good for us! No; the Hon. Ass. P. says to Pop Anvers, 'Pop, you get the stuff,' says they. 'No hearsay reports of young "war" correspondents peacefully bottled up in Tokio; we want nothing but real eye-witness news of every naval engagement that takes place. All the money in the world is yours—hop to it, old timer, and get us the stuff—by wireless!'"

"By 'Hon. Ass. P.' you most flippantly designate the great and only Associated Press, I presume," I murmured.

"Sure thing. Those were the baby days of wireless, when sending 200 miles was a great thing and nearly all the world was using the old-fashioned metal-filing coherer, which couldn't take over ten words a minute. But we, in America, were already past that stage, and so Pop packed up two sending and receiving sets suitable for a small news tug and a land station, enough material for a good land aerial and we all beat it for China. We had electrolytic responders for our receiving apparatus. They were new then and they could take thirty words a minute—just about three times the speed of the old coherer."

"Let's see, your nearest cable station was Wei-hai-wei, wasn't it?"

"It was—not; the nearest telegraph point where we could get out of China uncensored was Chee-foo, fifty miles from Wei-hai-wei. We had a chain of Chinese runners, each man doing fifteen miles with the packet of despatches—yes, sir, that's how you all got your daily 'cable' reports of the naval end of the war at your breakfast tables every morning. Wireless from the seat of battle 200 miles to Wei-hai-wei, runners to Chee-foo, telegraph to Shanghai, and cable to the world's news centers. Three relays; *some* hustle, for those days!"

"How did you get permission for an aerial station at Wei-hai-wei?"

"Bought a town lot of the mandarin, who was in the real estate business on the side—oh, you can't beat Pop at foxy games!—otherwise we'd have been fooling with official red tape yet, but no mandarin could be expected to refrain from selling a mere parcel of real estate to foolish foreign devils, for good iron dollars; now, could he?"

"No, certainly not, in reason," I murmured ironically.

"Then we put up an aerial mast 175 feet high, jointed up of native bamboo like a big fish pole. Considerable job to rig it with Chinese facilities, too; but nothing ever stops Pop. He got it up in a week, and well he might, as the war was getting away from us fast, and we had no time to lose. Meanwhile Pop chartered the Hai-Mun or the 'High Moon' as we soon renamed her, and I went aboard and put in our second wireless set. She was an insignificant sort of a little tub, a kind of Chinese steam yacht, only 125 feet long, reasonably fast and able in a seaway. She *had* to be, in some of the weather we were in in the troublous Yellow Sea. I hid the sending and receiving set in the lazarette and made my aerials as inconspicuous as possible, besides putting in a small decoy yacht set, for we were sure to be boarded by both Japs and Russians, particularly prowling torpedo boats. Then we lit out for Port Arthur, and elbowed into that war, for all the world like a drunken cowboy into a quaker meeting."

"Did you get there in time for the battle between the two fleets off Port Arthur?"

"*Did* we! We *were* the battle of Port Arthur, man! We gummed the whole works the minute we began sending! We were some cute little disturbers all right! Before *we* arrived the war was being conducted in an orderly fashion, with each admiral signaling his squadron maneuvers and sending his torpedo boat flotillas about in peace and harmony. They were playing a game of grand strategy, and real scientific warfare—until *we* arrived and began to mingle in.

"Well, sir, we sat down on the horizon and began to tell the world how fine it all was, in pure, unbroken English, at thirty words a minute. Right then we didn't realize that every coherer on both the Jap and Russian fleet was jammed fast the minute we began to exude blurbs of rhetoric. Those old iron-filing coherers, as you'll remember, worked by the iron filings all stiffening up and taking a set every time a wireless wave hit your aerial. Then there was a little tapper which automatically tapped the glass tube containing the iron-filings, tumbling them in a heap again. If the filings took a long set, it was a dash; short set, a dot—Morse code. All this took time; time to let the filings take a set (just as if a magnet were held over them) and time to let them tumble in a heap when tapped. The best it could do was ten words a minute, and when our fast sender butted in with thirty words a minute, all the filing tubes in both the Russian and Jap fleets took a set and *stayed* set until we got through!

"Not that Pop cared a whoop! He was writing an Epic, a sulphurous one; his head was in the clouds and Literature had taken him into her bosom . . . great stuff, believe me! And me sending it to Wei-hai-wei hot off the yellow copy slips. You saw it all yourself in the papers next day—"

"Didn't they have any wireless tuning facilities in those days? Something that would only respond to one wave length?"

"Tuning, nothing!" snorted Dent. "Those old coherers had practically no selection.

"With our new electrolytic receiving set we could read every word that was said in both fleets. Presently Rossli, our Swiss interpreter, who could talk seventeen languages, began to dance about the lazarette, snapping his fingers with delight.

"'Hey, you!' he bellowed, 'jest you lissen to dis—'

"'Don't bother *me,*'" said I. 'Pop's passing it out hot, and I haven't time to lose. Get this: "Midst thunderous belch of reeking shard the world's history is being made anew!"—great, ain't it,' said I, quoting from the yellow slip of copy.

"'Great!'" he echoed disdainfully. 'I tell you Pop's gumming der whole danged battle! Here's a five-times-repeat message from Togo trying to recall his starboard column, vitch iss steaming straight up Port Arthur harbor an' like to get bottled up, an' here's Malakoff trying to get his fleet together and cut 'em off, an' not a ship in either fleet can hear a tam order, an' every one of dem is trying to tell the flagship dot dere coherers won't vork—all because of Pop and his tam newspaper history;—how can he write any *history* if he won't let 'em make it!'"

"'Trust a war correspondent for that'—I was just beginning to remark when we heard a dull boom that you all know was the blowing up of the Petropavlovsk; and I think to this day that *we* did it, for Malakoff was so rattled over the total disablement of his wireless that he clean forgot to look out for torpedo bearings. I called up the tube to ask Pop what the boom was about and then told him Rossli's news about our blocking fast all the coherers in both fleets. 'You want to revise that last copy, boss,' says I. 'You've got the Jap starboard column attacking the Port Arthur forts while as a matter of fact they're going in there in a mistaken order and Togo's busting his senders trying to get 'em back! I think we ought to can this stuff and let 'em fight it out, Pop, if you want my honest opinion about it.'"

"'Young man,' came Pop's voice down the tube just as sarcastic as you please, 'the Times composing room shuts off at three A. M. and it's after twelve there now. You've got just half an hour to send my story to Wei-hai-wei, and then its runner, telegraph and cable—three relays. Sorry for these poor boobs and their antiquated apparatus—but business is business, and we've got to get the stuff across if we have to run the whole battle for 'em.'"

Dent paused to light a fresh cigar. "For combined nerve and conceit, commend me to a war correspondent," he observed dryly.

"I suppose about that time both fleets took to wig-wagging and semaphores, eh?" I suggested.

"You bet! Just then Rossli fell down in a fit in front of our receiver tape. Never saw a man so near death from laughter in my life. 'Now . . . you *haff* . . . doned it!' he gasped. 'Dere mad clear tru over dere. Each admiral tinks de odder's sprung somethin' new, some kind of wireless wave destroyer. All devvels hass broke loose among dose coherers—now dey got a chanst to talk;—it's a tam shame, I tell you, dot's vot it iss!'

"'Sorry,' said I, opening the key and starting in again on Pop's Epic—some English-slinging, too, believe me—and from that time on the battle went along by wigwag and semaphore."

"There ought to have been some international law to stop you fellows," I growled; "hasn't the public got *any* rights that you newspapers are bound to respect? A battle between nations is a serious thing, let me tell you; everybody is in dead earnest and in no mood for foolishness. Even a couple of dogs will stop a fight to ferret out an insistent flea; it's a wonder both sides didn't detach a gunboat to hunt you out."

"Funny, wasn't it. There we lay, hull down on the horizon as innocent as any sampan. All they knew was that some powerful wireless impulses were blocking their coherers, and I do believe, up to the battle of the Sea of Japan, or Tsu Shima, as the Japs call it, each side thought the other was using some new-fangled apparatus to gum the other fellow's receiver. And here we lay, day after day, reporting minutely the naval movements off Port Arthur; and the worst of it was that everything they did or started to do was cabled right back to Tokio and St. Petersburg, besides being in every daily paper in the world! Oh, but the Japs were wild! You know how proud they were about having all the war correspondents bottled up in Tokio and hand-feeding them sterilized information from the Seat of War? And here were all their naval secrets being passed around daily like common hand-bills! It hurt their pride; that's where you get a Jap every time! They were sure some sore and puzzled.

"Boarded? Sure, we got boarded; about twice a week. Every Jap torpedo boat in the Yellow Sea took a crack at us," grinned Dent in answer to my next question. "And, of course, we were just a British pleasure yacht cruising to the Philippines . . . maybe Pop couldn't put on airs when he wanted to. Wireless? Sure; a yacht set, thirty miles capacity, gentlemen—that was his game every time our aerial was hinted at too pointedly.

Frank and above-board Pop was every time. Besides, they couldn't seize a yacht of their best ally and tow her into port, could they?"

"Lovely business!" I murmured. "How long did you keep it up?"

"Well, Pop got his at Tsu Shima, or the Battle of the Sea of Japan, as you call it. We knew all about the movements of *both* Rodjestvensky and Togo because, you see, when our thirty-word-a-minute sender wasn't filling the whole domain of the air with the hated English language, our new electrolytic responder was taking every message sent from all those slow coherers, with all the suave ease of a gentleman pirate. So over we romped to Tsu Shima in time to be early at the party. Swell time of it we had in that typhoon that scattered Rodjestvensky all over the map, too! But Pop was out after the stuff and wasn't to be stopped by every piffle of wind and puddle of water. We could hear the whole works. Rodjestvensky making his dash from Shanghai to Vladivostok, every man in the fleet scared stiff and hoping only to get through the Korea Straits without being seen. Togo laying off to the north with his scouts looking everywhere for the Russians. Funny, too, that little old Jap's fleet had only half the strength of the other man's—he ought to have been the scared one, with only four battleships to Rodjestvensky's eight, and seventeen heavy guns against forty-one for Russia—"

"Cut out the naval statistics and let's hear about the fight," I interrupted with all the landman's horror of gun figures, "we all know that Togo trimmed them signally—how did it look to you?"

"Fine! Togo had all the preponderance in eight-inch guns and the lesser quick-firers, and that new Jap shell was a wonder. That's what won the fight. Getting back to the yarn; the Russians stopped their wireless altogether the night before the row; afraid the Japs would pick them up and discover their presence. We could hear the Jap torpedo fleets calling to each other all through the night—so could the Russians for that matter, and mighty still they kept, too! Next morning there was a heavy mist and the Russians actually got through the Straits unobserved. Then a Jap auxiliary cruiser, the Sinans Maru, blundered right into the two Russian hospital ships in the mist, and then, wow! but she did make the wireless fly! She saw their whole fleet, and we heard her news being relayed farther and farther north, from one scout to the next.

"Rossli and I danced around the tape as we translated Japanese excitement by the yard. 'Mein Gott, man, do you know that Pop has the whole battle in his hands right now. Let him just open *our* key and begin talking—*anything*—and he shuts off those messages before they ever can reach Togo!'

"Yes, sir, we held the fate of Russia in our hands at that moment. We could have blocked those messages just as easy and let the Russians get by. Pop came into the lazarette just then and Rossli implored him to do it, for he had no use for the Japs, or anything that looked like a Jap. But Pop was there to get the stuff, not to pinch a poor little budding battle in the bud; besides he was too busy figuring out the safest place for the little Hai-Mun when the fun should begin. So we remained as quiet as the tomb.

"Next we picked up Togo, coming along strong, fifteen knots an hour, with his four battleships and two heaviest armored cruisers forming the principal squadron, while Kimamura with six more armored cruisers formed the flying squadron, just as in the fight at Port Arthur. Then Rodjestvensky broke his long silence and we heard him order his fleet to swing together into one line. Soon we could see them out over the sea and that they were evidently getting things mixed, for Rodjestvensky's forward column was in one line and the rest in another. Then the Japs came up over the horizon in splendid formation; six battleships led by the Mikasa, followed by the six armored cruisers, and behind a third squadron of twelve unarmored ones. It was a fine sight as they rushed along, crossing our bows, and a little after one o'clock they cut dead across the forward Russian line. The Mikasa turned, and after her the Shikishima. Then the whole Russian line opened up! Pop and I stood on the deck of the Hai-Mun with our eyes glued to our glasses.

"'Bum maneuver on Togo's part,' growled Pop. 'Each Jap ship will have to turn where the Mikasa turned, and the following half will be blanked by the leading half of his fleet.'

"I didn't agree with him, for that turn of Togo's, right at the Russian fleet, brought him in close, where all his small guns could get in their work. Those Jap shells were wonders. They burst the moment they touched anything, even water, and the stuff made a flash of liquid white-hot flame that would melt steel. Before the first ten minutes of the fight were up the Suvaroff, the Russian flagship, was afire in a dozen places, and the bright livid flashes of those shells danced and played all over her upper works! The four Jap battleships concentrated on her, and in half an hour they had her helpless with her rudder disabled and her forward funnel and military mast in shapeless heaps; all her signal gear, aerials, semaphores and signal halyards were shot away, and the clouds of smoke and shell gases went down her ventilators and suffocated everyone in the engine rooms. Still she kept on firing, moving around in circles and striking out like a blinded pugilist, while the fight went on without her. The Alexander and Borodino, both on fire from shells, now led the Russian line taking the fleet in a great loop away from the blind Suvaroff with the admiral aboard her, while the Japs swooped around them in a still bigger loop. Every Jap boat as it passed her handed out all the broadside there was time for without breaking formation, but still the battered hulk fought on."

"What of the Russian gun fire; couldn't they hit anything?" I asked wonderingly. "They had nearly three times as many big guns in their fleet."

"Oh, yes; they seemed to hit all right, but it's one thing to punch a man with a lot of big armor piercers, only a few of which explode, and it's another to hand him a swift flock of cans of bursting dynamite. There's no questioning that those new shells won that fight, for because of their superior speed the Japs actually got into several bad mix-ups, particularly when they all tried to head the Alexander off.

"Well, anyhow, the Oslyabya, one of the best Russian battleships, sank about three o'clock, just as the Alexander was leading their line back, with the Japs coming along parallel between us and them. She made a brave effort to rescue the Suvaroff, but the Jap gun fire was too strong, and so they all turned off to the south leaving her to the fate of the Jap torpedo boats.

"That ended the battle, so far as Pop was concerned. 'Togo wins my boy,' said he, 'you for the lazarette, as it's time we got to press. It's only a question of minutes before the Alexander and Borodino go under, and the rest will be torpedoed or captured before I get the copy around to them.'

"Pretty soon the first sheet of copy came down, and I opened the key for Wei-hai-Wei. I knew we couldn't hurt the Russians any, for all their wireless was shot away long ago. But I could see trouble ahead for the Japs. . . .

"In just *ten minutes* of our sending Togo and Kinamura got separated into two columns, the Suvaroff got her fires under control and actually began to form her fleet into a defensive T-shaped line and the battle was all up in air again!"

"No!" I ejaculated incredulously.

"Fact. Rodjestvensky *still* had more ships and guns than Togo, his fleet was more compact; it was getting too dark to signal wigwag or semaphore, and our confounded news despatch had put all his wireless out of business!"

"An outrage, nothing less!" I barked heatedly.

"Three nations thought so, too, when the matter came up internationally," observed Dent dryly, "but just then what really saved them was that the Russians put their foot into it, as usual. One of their torpedo boats came out to us from guarding the transports and hospital ships at the rear of the fight and arrested us! She'd had her wireless gummed, too, and as the same thing had happened to her at Port Arthur, with us hull down on the horizon just as we were then, she put two and two together, and boarded us. 'Where iss deese vireless!' was the very first question the lieutenant asked as he stepped aboard. He wasn't a bit polite about it, either.

"Pop was as suave as milk and honey, and showed him our yacht set with all the unction of a full ambassador.

"'Yuh, dat iss all righd; now ve see deese real t'ing,' grinned the officer, who had wised up to the yacht set bluff since the Port Arthur boarding. Pop tried the injured innocence act, the stiff and formal 'you-are-mistaken-sir' thing, dared him to search the ship under the British flag, put up the violation of neutrality holler—but he couldn't make any of them stick. The lieutenant was obdurate, and presently two of his men reported our little news mine in the lazarette. The 'cable' story of the battle of Tsu Shima ended, then and there. I was sending Pop's copy two letters a second, the sparks buzzing merrily, when I looked up to see the lieutenant standing in the door of the lazarette with his eyes sticking out like a crab's. Of course, he recognized that American apparatus as soon as he saw it—many a laboratory lecture had been given about it—but here it was, actually working commercially. He forgot all about the battle in the intensity of his professional interest. He didn't ask many questions; just stared with all his eyes.

"Yep; he nearly forgot the fight watching me send at that terrific speed," Dent went on. "Thinking fast, I figured that great industrial inventions make the bravest warriors sick of such a trivial and barbarous affair as war. So I jollied him along on that line of talk and finished Pop's copy with one hand while agreeing with him with the other.

"After which the Japs got a look-in on the conversational facilities of the circumambient aether—"

"What did he do? Put a prize crew aboard, or destroy the apparatus?"

"Why, Pop scared him out of the idea of harming any apparatus under the protection of the British ensign, and the lieutenant thought it went beyond his limited authority, too, so he wound up by forbidding us to use it; and, leaving a couple of men aboard, he hurried back to his station by the transports, for the battle was coming our way and the Japs were doing fine —now that our flow of English unabridged had been choked off!

"But the lieutenant had seen the whole works, so our game was up. The battle ended with a grim picture of lines of Japanese warships silhouetted against the evening sky, with ship after ship of the Russians foundering down into the dark waters of death, while the bright flashes of guns and shells lit up the twilight. By the time we got our lieutenant's men drunk on vodka and had reported the big finale to Wei-hai-Wei, he himself was captured while going to the Suvaroff to take off the admiral. Then he told all about us, to both his own people and the Japs, and soon after there was an international powwow over it; and, just to make assurance doubly sure, the Russians in Wei-hai-Wei sawed through Pop's bamboo pole one night, while the Japs, not to be outdone in courtesy, clapped Pop into prison.

"The war managed to go on without him. It wasn't half as interesting, though. England kicked, by and by, and they let him out—just in time for the treaty of Portsmouth.

"Ill effects? Not a chance! You simply don't know Pop. I'll wager right now he's looking through a field glass at some of that European battle smoke. If he isn't, he soon will be. Then we'll get some *news*. A little thing like censorship doesn't bother Pop. Cutting all the cables don't annoy him any more than a mosquito's bite; and if there's any news, right over to the U. S. of A. it will come, you can bet. Just be patient; the newspapers will be printing the real dope yet. But it's a pretty safe prediction that the news gatherers won't be able to butt in and make history as we did in the baby days of wireless!"

IN THE SERVICE

Edward B. Pillsbury had the question of choosing a vocation settled for him early in life. While some of his boyhood companions were discussing their qualifications for positions ranging from a place in the White House to that of a merchant prince, Mr. Pillsbury was silent. His future was mapped out for him, and he knew it, for as he expresses it, he came of a "telegraph family." The itching to handle a key showed itself when he was very young and at twelve he was manager of a telegraph office; now he is assistant traffic manager of the Marconi Wireless Telegraph Company of America.

In New England where he was born—to be exact in Belfast, Me., fifty-eight years ago—there is a proverbial thirst for knowledge. Young Pillsbury was no exception to the general rule, his ambition taking the form of a resolve to acquire a thorough knowledge of telegraphy. If he had not directed his aims thus, a family tradition would have been destroyed, for two of his brothers and two of his sisters were engaged in the telegraph business. So at the age of nine he became a messenger in a telegraph office. The time he could spare from his routine work he successfully employed in studying telegraphy.

Three years after he had obtained his employment as a messenger he was made manager of the Western Union office in Belfast. With promotion and responsibility came problems to solve. The messenger in the office was four years older than Pillsbury and the former could not reconcile himself to the fact that he was under the direction of a younger boy. Result: The sixteen-year-old messenger was compelled to seek other fields for his activities.

Two years afterward Pillsbury was transferred to Bangor, and for the next two years the young operator spent what leisure time he had in studying for admission to the University of Maine. He left the University to accept a position as an operator for the Southern & Atlantic Telegraph Company at Montgomery, Ala., but returned in 1900, when he received the degree of Bachelor of Science.

In 1886 he went to the Postal Telegraph-Cable Company, eventually becoming general superintendent, Eastern Division, with headquarters in New York City. He continued in the service of that company until he resigned to enter the Marconi service.

While in the Marconi service he has been studying the system with a view to making helpful suggestions. One of his ideas which will be put into execution calls for the use of the Continental alphabet instead of the Morse on the land lines of the trans-Atlantic stations. He also made a suggestion to do away with the use of envelopes in delivering trans-oceanic messages. The marconigrams will be folded and sealed instead of being placed in envelopes, following a system in vogue on the continent.

Like the newspaperman with a "nose for news," Mr. Pillsbury has an unerring instinct for good operators. On him fell the selection of the men to receive and transmit messages at the trans-Atlantic stations.

"I can tell a good operator," he said, "by the way he talks, by the way he carries himself and by the methods he employs in working."

The Censorship of Messages

THE Marconi Wireless Telegraph Company of America, through its president and general counsel, John W. Griggs, formerly United States attorney-general, has made a protest to Secretary of the Navy Daniels regarding the censorship placed on wireless code messages assumed to be in the service of belligerents. The protest of the company is based on the ground that it is a corporation serving the public; that its messages are privileged, as are the mails and telegraph lines, and that the United States has no right to interfere with the transmission of wireless messages. The following letter was sent to Mr. Daniels by Mr. Griggs:

August 19, 1914.

To the Honorable the Secretary of the Navy,
Washington, D. C.

Sir:

On August 12th I addressed to you a telegram of which the following is a copy:

The Secretary of the Navy,
Washington, D. C.

The Marconi Wireless Telegraph Company of America respectfully represents to the Secretary of the Navy that it is receiving messages to be sent by wireless to foreign countries; that the censor of the Navy Department assumes the right to forbid the sending of certain of such messages; that this company is under the ordinary duty of a forwarder of communications when paid for; that we are aware of no statute of the United States or of any treaty or rule of international law which justifies the intervention of a government censor or the stoppage of this company in sending messages in the ordinary way.

The Public's Rights Involved

We ask, therefore, to be referred to the legal authority under which your department assumes such right of censorship. We wish to respect the policy of our own government, but when our corporate rights and duty and the rights of the public are involved, we must respect only the law which governs the case.

On August 13th I had the honor to receive from you a reply as follows:

If you will send representative to Washington will be glad to take up before Attorney-General questions of law relating to the censorship of wireless messages by Navy Department under executive order of the President dated August 5th.

(Signed) JOSEPHUS DANIELS,
Secretary of the Navy.

Authority for Censorship Sought

The object of my telegram was to obtain from your Department a statement of the legal authority under which you had instituted and were exercising a censorship in the radio stations of the Marconi Wireless Telegraph Company of America. At that time I was unable to refer to any statute, treaty, or rule of international law which justified such an intervention on the part of the Executive Department with the business of my company. At the same time I recognized the propriety of the Executive Department endeavoring to the utmost to enforce the obligations of international law incumbent upon this Government as a neutral in the present state of war in Europe, and if there had been any authority to which you could have referred me justifying such intervention by your Department, I should have been glad to have had it pointed out to me. In the absence of any affirmative claim of legal authority on behalf of your Department, it would seem to be unnecessary to discuss directly with the Attorney-General questions of law which might be considered pertinent, when no such questions had been raised by any formal citation or statute or other legal rule of action.

However, as meeting your evident desire to have our views submitted to the Department of Justice, I am now stating to you the opinion which this company holds with reference to the subject under discussion.

The matter divides itself into two parts:

In the first place, is there any treaty, rule of international law, or statute of the United States which forbids a wireless telegraph corporation engaged in business in the United States to transmit messages from its stations in the United States to ships or land stations of any of the belligerents engaged in the present war?

The question is not whether the United States could act in this capacity, but whether a private corporation or a private individual engaged in carrying on such a business for commercial purposes may lawfully communicate in this way.

The statutes of the United States have prescribed with particularity the things which may not be done within their territorial boundary by private individuals in violation of neutrality. No statutory inhibition is placed upon wireless or other communication with the ships or stations of belligerents. Nevertheless, statutes regulating wireless telegraphy have been recently passed, and if Congress had been of the opinion that a regulation of this kind is necessary, it would doubtless have made such a provision in the law. Its failure to do so indicates the desire of the legislature to have communication under such circumstances as I have mentioned free.

No Rule Forbidding Communications From U. S.

There is no rule of international law that forbids communication between a neutral country and a belligerent in a foreign war. The people of this country are free to carry on with any of the European countries now in conflict, trade and commerce, to ship them arms, material of war, food supplies and other commodities which, if captured by an enemy, could be declared contraband of war. Telegraph and cable companies, railroad companies, steamships and mails from the United States are all engaged in direct trade and commerce with some or all of the belligerent powers of Europe, and there is no duty incumbent on the Executive to interfere with or prevent such trade, commerce or communication.

The Company Bound to Send Messages

Of course, if a wireless station were being operated by one of the belligerent powers from a neutral base in this country, a different question would arise, but the Marconi Company is an American corporation, has been engaged in business for years, its stations are licensed by the Department of Commerce, and it is, besides, a public service corporation bound to accept and send messages when proffered payment therefore.

I submit, therefore, that the transmission of radio telegrams from the wireless stations of the Marconi Company in America to steamships or land stations of any of the belligerents is not unlawful under the statutes of the United States, and is not in violation of any rule of international law.

In the second place, if it be assumed that in some respects or to some extent the Marconi Company were under legal duty not to send dispatches of a certain character or to certain destinations because such sending is in violation of some law of the United States rendering it liable to indictment; nevertheless, there exists no legal authority for the Navy Department, or any other department of the Government, to institute and maintain a censorship over the messages delivered at the stations of the Marconi Company for transmission. The fact that an individual carrying on a lawful business may possibly violate a criminal statute does not authorize the Executive Departments, in the absence of statutory enactment, to establish a censor over his business in order to prevent the commission of a crime. It would be quite as justifiable for the Government to place a censor in every newspaper office in order to see that no seditious article or criminal libel is printed. A person or corporation engaged in trade or commerce as a transmitter of messages or carrier of goods is liable for violations of the law, but is not subject, in the absence of a statute expressly authorizing it, to governmental inspection beforehand. A system of censorship is antagonistic to that regulated liberty of action which is the basis of our free government. Such a system could be justified only when our own government is engaged in war and it would then be an exercise of martial, not of civil, law. A censor, determining upon his own judgment whether a proposed act is lawful or unlawful, and permitting or forbidding it accordingly, assumes the functions of a court of justice, but without the right of appeal. In effect, he issues restraining orders of his own motion against parties that are unheard, and with no opportunity for future correction or reimbursement for damages.

This company favors a strict enforcement of our national duty as a neutral, but does not think that it is justifiable to broaden the scope of neutrality by adding new rules not sanctioned by general public law, especially when such new rules operate to the injury of private concerns carrying on trade and commerce, and thus augment those unavoidable indirect damages which are suffered by the people of a neutral nation on account of a deplorable war status between other powers.

WILSON'S PROCLAMATION

President Wilson has issued the following regarding the use of wireless telegraph stations:

Whereas, Proclamations having been issued by me declaring the neutrality of the United States of America in the wars now existing between various European nations; and,

Whereas, It is desirable to take precautions to insure the enforcement of said proclamations insofar as the use of radio communication is concerned;

It is now ordered by virtue of authority vested in me to establish regulations on the subject; that all radio stations within the jurisdiction of the United States of America are hereby prohibited from transmitting or receiving for delivery messages of an unneutral nature, and from in any way rendering to any one of the belligerents any unneutral service during the continuance of hostilities.

The enforcement of this order is hereby delegated to the secretary of the navy, who is authorized and directed to take such action in the premises as to him may appear necessary.

This order to take effect from and after this date.

Woodrow Wilson.

The White House, August 5, 1914.

Secretary Daniels has instructed navy-yard commandants to detail officers to wireless stations in their vicinity as censors.

These instructions for the officers charged with enforcing the president's order were issued by Secretary Daniels:

No cipher or code messages are permitted to be transmitted to, or received from, radio ship or shore stations of belligerent nations by any government or commercial radio station situated in the United States or its possessions, or in territory under the jurisdiction of the United States, except cipher to or from United States officials.

No cipher or code radio messages will be permitted to be sent from any radio stations in the United States via foreign stations if destined to a belligerent.

Radio messages containing information relating to operations, material or personal, of armed forces of any belligerent nation will be considered as unneutral in character and will not be handled by radio stations under the jurisdiction of the United States.

In general, the censoring official will assure himself beyond doubt that no message of an unneutral character is allowed to be handled

In order to insure that the censors may in all cases be informed thoroughly and correctly as to the contents of radio messages coming under their censorship, they will demand, when necessary, that such messages be presented for their ruling in a language that is understandable to them.

In case of doubt as to the character of a message, it should be stopped and its contents, with full explanation of details, be forwarded to the Department (Operation) by telegraph for instructions as to the proper procedure to follow.

Josephus Daniels,
Secretary of the Navy.

IN THE SERVICE

CONTINENT-TO-CONTINENT DIVISION

William A. Winterbottom knew a long while ago that opportunity knocks only once at the door, but he couldn't figure that this made any difference if it looked worth while to return the summons in kind later on. The first tapping which had any connection with wireless was so faint he almost ignored it. That was about thirteen years ago when he was seized with an impulse to enter the Marconi service in England, and had a chance to do so. But the impulse passed away. The second tapping was louder and more insistent. Conditions were reversed: he was summoning opportunity this time. And his thoughtful tattoo was beating on—what do you think?—nothing less than a copy of THE WIRELESS AGE. That was a year ago; to-day he is commercial manager of the American Marconi Company's Commercial Department, with headquarters in New York City.

Mr. Winterbottom is an Englishman; naturally, then, his start in the working world was made in England—but it was with the British branch of an American institution — an insurance company. From the insurance business he went into the British Telegraph service at Manchester. Here he learned to be an operator.

The Marconi Company was erecting its first stations about this time. Winterbottom, attracted by the glamour which surrounds the wireless field, resolved to enter the Marconi service. His application was favorably received, but he postponed the greater destiny to enter the service of the Commercial Cable Company.

Wireless out of his mind for a time, he applied himself to working in the interests of the cable company for the next eleven years, ten of which were spent in America. He went to the cable company as an operator, but the commercial department appealed to him as the better field, and he accordingly began to fit himself for a position in it. Eventually he reached his goal, taking charge of the traffic promotion work and directing the efforts of local managers and canvassers in the solicitation of business.

But it was written in the order of things that the latent interest in wireless taken by Winterbottom should be awakened. On a newsstand one day he saw a copy of THE WIRELESS AGE. It contained many interesting features, but that which riveted his attention closest were the photographs of the transoceanic stations. They included views of the operating buildings at New Brunswick and Honolulu, and photographs recording progress of the transoceanic construction work. Other articles in the magazine made Marconi wireless appear a very attractive field of endeavor and Winterbottom got busy right away. His record proved an open sesame to the office he sought, and wireless secured another commercial convert—a distinctly worth while one.

"Don't grumble, work," is one of Mr. Winterbottom's maxims. And the Marconi Company's new commercial manager isn't letting anything get by him. Although but a few months in the service, he already has an outfit on the roof of his home, which, he says, enables him to "literally keep in touch" with wireless matters.

The master clock in the time service department. It operates ninety circuits in New York City on which there are as many as 3,000 synchronized clocks

The New Home of the Western Union

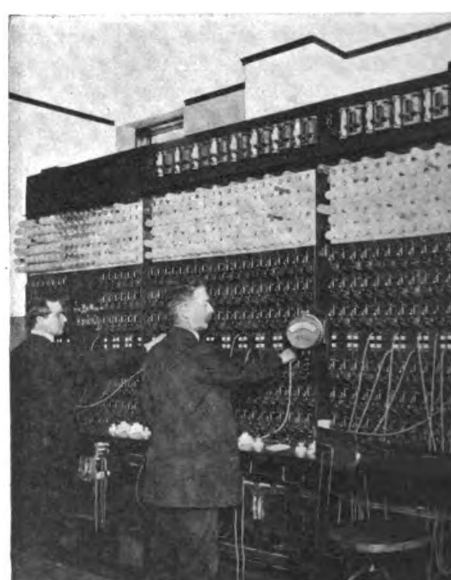
Some Details About the Operating Department of Land Lines

IN the early morning hours of June 28 the cut-over was made from the operating department of the Western Union Telegraph Company at 195 Broadway to its new quarters in the Walker-Lispenard Building, 24 Walker street, New York City. Previous to this a move had not been made since February 1, 1875, when the company moved from 145 Broadway to 195 Broadway. The building at 195 Broadway is now in the hands of wreckers. It had outlived its usefulness and had to give way to a more modern structure.

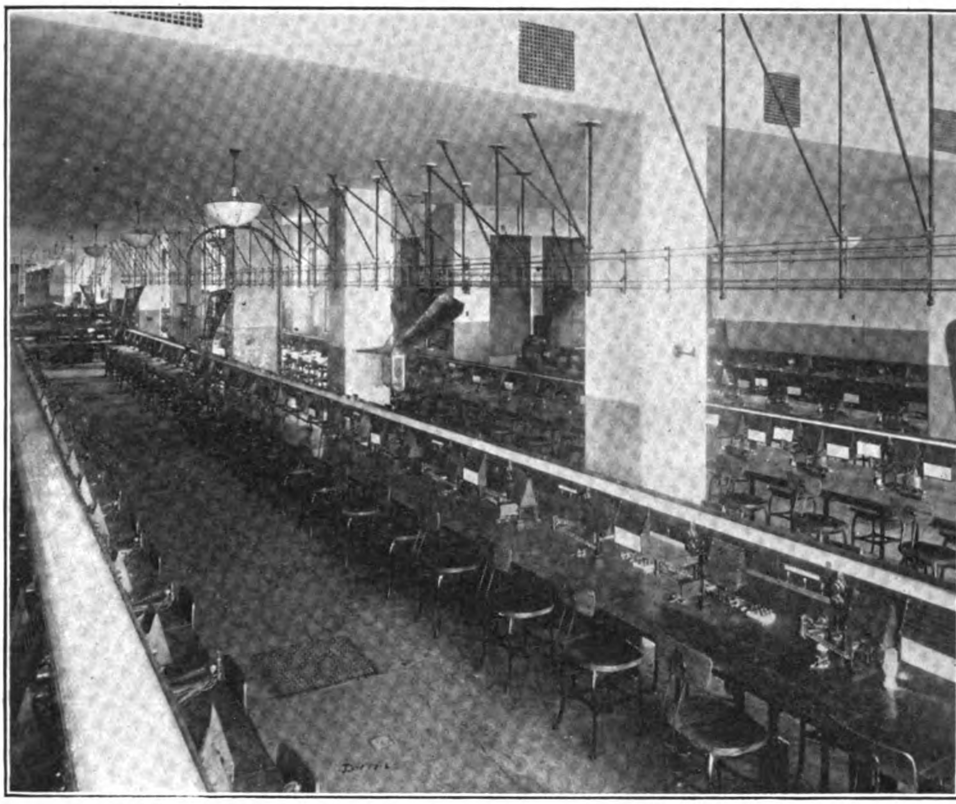
The executive offices of the company moved to 16 Dey street, but the official address of the company remains 195 Broadway.

The Walker-Lispenard Building at 24 Walker street, into which the general operating department was transferred, is a large modern fireproof structure of seventeen stories. The Western Union Telegraph Company occupies seven floors in the new building, the eleventh to seventeenth, inclusive.

Each floor has an area of about 14,000 square feet and is splendidly lighted. On the eleventh floor are quarters for the women employes, including a large rest room, a library, a hospital room with all modern surgical devices and locker rooms. On



The time service department is relied upon to send impulses over wires every second, actuating sounders in various localities. These second beats are utilized to regulate time pieces. This photograph shows the board controlling the time service



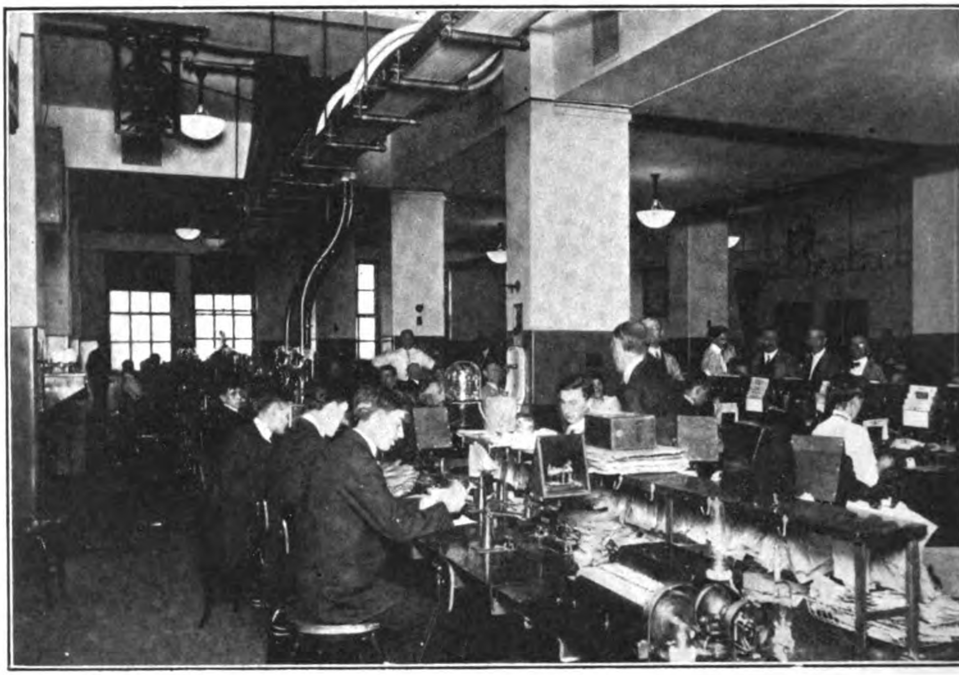
A view of the operating tables showing the automatic carriers and the chutes into which the messages are dropped

the twelfth floor there is a smoking and lounging room for the men employes, together with lockers and lavatories. The sixteenth floor is occupied by the bookkeeping department and on the seventeenth floor is a cafeteria restaurant with seats for 300 employes. The roof of the building is arranged for a roof garden for the use of employes.

The thirteenth, fourteenth and fifteenth floors are occupied by the operating department, of which a number of views are shown in the accompanying photographs. The thirteenth floor is known as the plant room. On this floor all the lines from outside points, which include the various loops around New York City and vicinity, come into thirty-four sections of switchboard. One of the photographs shows a number of sections of the main switchboard while another shows the rear of the same section and gives an idea of the method of cabling. At the left of this picture is a part of the main distributing frame, by means of which changes in connections from incoming lines to the switchboard can easily be made.

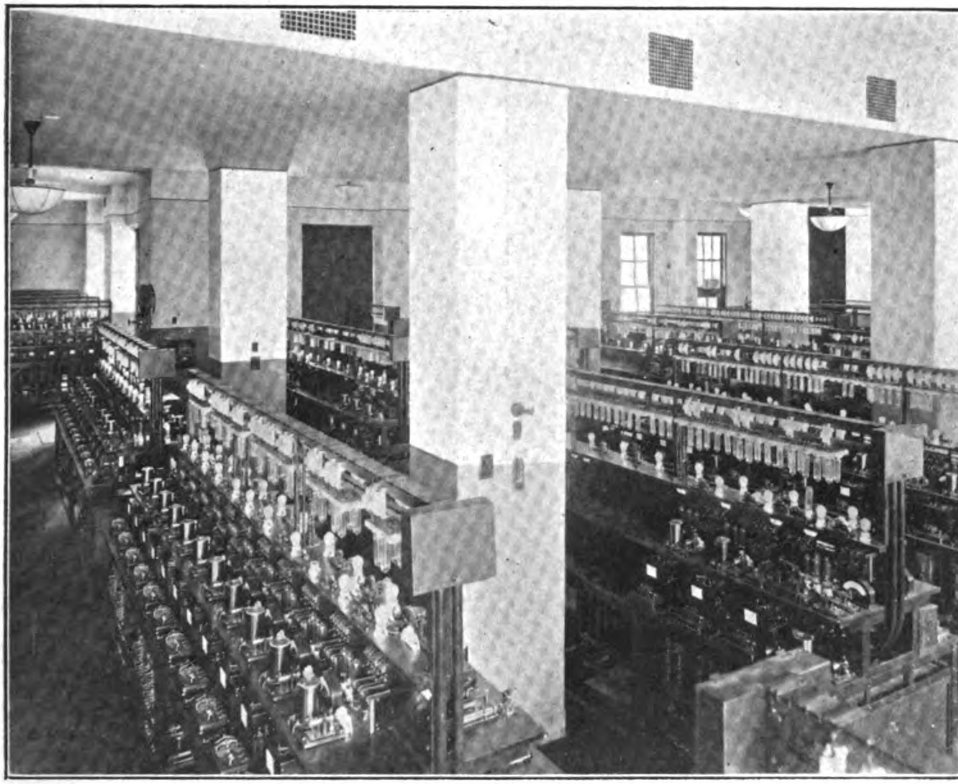
A view of one of the switchboard bays is displayed in a photograph. The switchboards serve the purpose of connecting any incoming wire with any operating position in the building or with any outgoing wire. Thus a wire from Chicago may be connected to a receiving operator in the building and also with Boston and Philadelphia and, perhaps, to several local points about New York City if that were desirable.

On the thirteenth floor are the multiplex and repeater apparatus. There are fifty-five Morse repeaters, thirty-five half Morse repeaters, three duplex repeaters and twelve half duplex repeaters. The repeater apparatus auto-



The commercial news department, from which stock quotation and general news tickers are controlled is shown above; below is a view of the multiplex which sends and receives four distinct messages simultaneously over a single wire

matically repeats a message put on the wire by an operator on the fourteenth or fifteenth floor to various distant points. Delicate adjustments are required from time to time for changes in weather and wire conditions, and it is more practical to have the apparatus for this use concentrated at one place in the hands of experts than it would be for each operator to have charge of the adjustments on the floor. It contains a master clock, which is kept absolutely correct by comparison each day over a wire with the United States Observatory at Washington, D. C. The master clock operates ninety circuits throughout New York City, on which there are as many as 3,000 synchronized Western Union clocks. From this department, at noon each day there is sent out a signal all over the United States by



The multiplex and repeater apparatus on the thirteenth floor. The repeater apparatus automatically repeats a message put on the wire by an operator on the fourteenth or fifteenth floors to various distant points

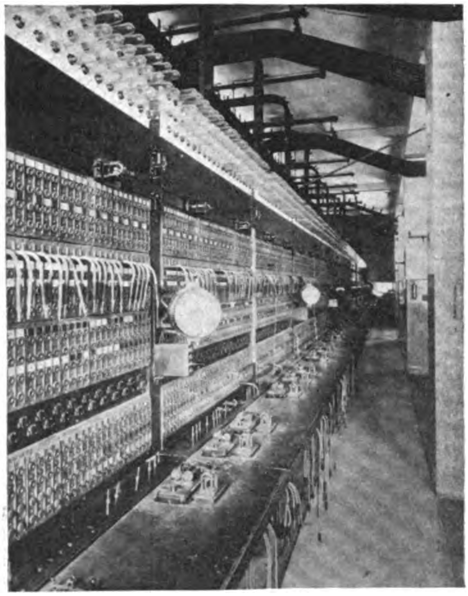
line over which he is sending or receiving.

The power plant, containing the motor generator sets, is also on the thirteenth floor. Alternating current received from the power company is here converted to direct current of the proper potential for telegraph use.

The time service department is an interesting feature of the institution. It is likewise located on the thirteenth which the correct time is known. Special wires are released for this purpose at five minutes before noon and on the stroke of the hour a signal is flashed over these wires. Thus this one clock sets the time for a large area.

Another service of this department is to send impulses over wires every second, actuating sounders in various localities. These second beats are utilized for regulating time pieces. A view of the board controlling the time service is presented in a photograph.

The fourteenth and fifteenth floors are occupied by operating rooms. The Morse operators sit at long tables;



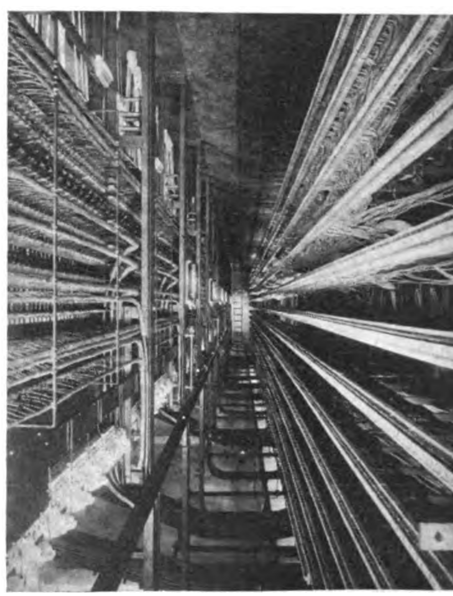
A view of sections of the main switchboard. All of the lines from outside points, which include the various loops from New York City and the vicinity, come into this switchboard

each has a key and a sounder in a resonator on a hinged arm. Typewriter drops are at positions. Altogether, on these floors there are 1,025 operating positions. These include 160 positions for forty quadruplexes. A quadruplex sends two messages and receives two messages over a single wire simultaneously, requiring two sending operators and two receiving operators at each end of the line. There are 386 positions for duplex operators. A duplex sends and receives a message simultaneously over a single wire, requiring one sending and one receiving operator at each end of the line.

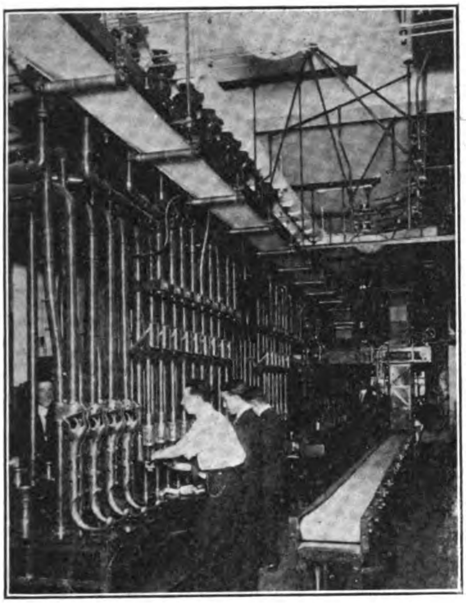
There are a number of positions on this floor in what is known as the commercial news department, from which stock quotation tickers and general news tickers are controlled.

There is an interesting installation of an instrument known as the multiplex, on the fourteenth floor. This apparatus sends four distinct messages simultaneously over a single wire. Transmission is not by means of the familiar Morse key; the sending operator writes upon a typewriter keyboard and the message appears automatically typewritten at the other end of the line. In an accompanying photograph the operator in the foreground is shown writing upon the typewriter keyboard, which punches holes in a paper tape and then passes through an automatic transmitting instrument. The second operator in the photograph is receiving and the automatic typewriter is plainly shown. With this apparatus on one wire sixteen operators are employed, four receiving and four sending at each end.

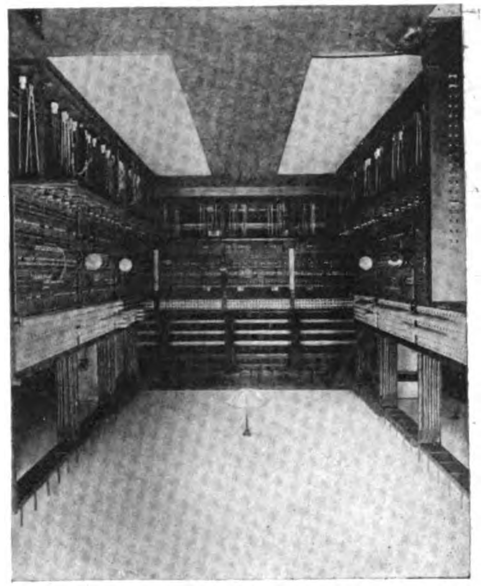
It is a curious fact that very little is known by the public of the improved methods of transmitting intelligence by wire. Most people think of the telegraph as a simple Morse key at one end of the line and a sounder



This photograph shows a rear view of sections of the main switchboard and a part of the main distributing frame by means of which changes in connections from the incoming lines to the switchboard can be made easily



The distribution center and automatic message carrying equipment



A view of one of the switchboard bays, the main line board appearing in the rear

at the other. As a matter of fact, there are at least eleven different types of transmitting sets for sending telegrams. These are of various degrees, ranging from the simple Morse key to the multiplex. There are in use several types of printing telegraphs, that is, instruments where the sending operator writes the message on a typewriter keyboard and at the other end of the wire the message is automatically typewritten by the receiving instrument.

The distribution center and automatic message carrying equipment are located on the fourteenth floor. Here are twenty-two incoming and twenty-two outgoing pneumatic tubes for receiving and sending messages to local offices in New York City. In the photographs are shown the long operating tables. Along the middle of each table, between the operators who sit at opposite sides of it, is a steel trough in which runs a moving belt. There are thirty-four of these tables with a belt on each. The belts deliver messages laid on them to six moving belts, which in turn deliver them to the distributing center. The belts thus take care of incoming messages received over the wire which at the distributing center are sent out through the pneumatic tubes or else redistributed to operators for sending out over the wire to various points.

The distribution of messages coming into the distributing center through the pneumatic tubes or from receiving operators which require redistribution to sending operators are conveyed to the proper sending position by sixteen lines of automatic carriers, very similar to the carriers used in department stores for conveying cash to the change desk. The transference of a message from a receiving operator over the belt to the distribution center and back by automatic carrier to the sending operator will not in any case take more than seventy-five seconds. Formerly a large part of this distribution work was done by girls who acted as messengers.

About 1,500 employes are required to take care of the traffic through the general operating department. This traffic amounts to about 150,000 messages a day. It exceeds this number on special occasions, such as the playing of a world's series of baseball games or other events in which there is universal public interest.

The Annual Meeting of the English Marconi Company

AT the annual ordinary general meeting of the English Marconi Company, held on July 21, in the Hotel Cecil, London, the directors submitted their report showing that the gross profits for the year amounted to £245,583 13s., and recommending the payment of a final payment for the year 1913 of ten per cent. on both classes of shares. A review of the growth of the Marconi system was presented, the American Company and its vice-president and general manager, Edward J. Nally, being favorably mentioned. The report is in part as follows:

"In October, 1913, the capital of the company was increased to £1,500,000 by the creation of 500,000 new ordinary shares of £1 each, ranking for dividends declared in respect of the period commencing January 1, 1914, and in all other respects *pari passu* with the existing 750,000 ordinary shares of £1 each. Two hundred and fifty thousand shares were forthwith offered to the shareholders *pro rata* at £3 5s. per share and the whole of the issue was subscribed and duly allotted. Of the remaining 250,000 shares. 222,688 were issued for cash in December, 1913, in connection with the arrangements made with respect to the shares acquired in the Compagnie Universelle de Téléphonie sans Fil.

"The share premium account has increased during the year by £511,958 4s. 4d., and now stands at £767,665 7s. 5d. Of this amount £397,057 15s. fell due in the early part of this year and has been received.

"The erection of the high-power station for the Norwegian Government is well advanced and should be completed by the autumn. A commercial telegraph service between Northern Europe and the United States. of America is to be inaugurated, in which this company will be interested to the extent of ten per cent. of the gross receipts.

"In December last the Trans-Oceanic Wireless Telegraph Company, Limited, was incorporated, with a capital of £200,000, for the purpose of conducting a wireless telegraph service between this country and the United States. That company has acquired the new stations which have been erected in Wales for this purpose. These stations will be opened in the near future when for the first time a direct wireless telegraph service between London and New York will be established.

"We are glad to be able to report that Mr. E. J. Nally, former vice-president and general manager of the Postal Telegraph-Cable Company of America, has become the vice-president and general manager of the American Company. Your directors have had the advantage of receiving two visits from him, and are very hopeful that his business ability and experience in all matters concerning the cable and telegraph business, together with his energetic methods and organizing powers, will soon make themselves markedly felt in the development of the American business."

"The Canadian Company has made progress during the year and steps which are in contemplation should markedly improve its position in the near future.

"The French Company (Compagnie Française Maritime et Coloniale de Telegraphie sans Fil) has declared a dividend for the year 1913 at the rate of 10 per cent. on the ordinary shares, and 31.25 francs per share upon the Founders' shares.

"The Russian Company (La Société Russe de Télégraphes et de Téléphones sans Fil) is making steady and satisfactory progress. It has declared a dividend for the year 1913 at the rate of 6 per cent.

"Marked progress has been made during the past year in the development of the Wireless Compass or Direction-finder, and Fog and Submarine Signalling apparatus."

OPERATORS' INSTRUCTION

CHAPTER IX *(Continued)*

Fig. 1 gives a complete lay-out of the actual placing of the standard Marconi disc discharger transmitting set and receiving apparatus aboard a vessel. The sketch also includes the general over-all dimensions of the various pieces of apparatus. The aerial tuning inductance is mounted either on the side of the bulkhead or on the ceiling of the Marconi cabin. On the right of the table is mounted the oscillation transformer and the induction coil for the auxiliary set. The tank for the oil condensers and the motor generator with the disc discharger is placed directly underneath, on the floor. The telegraph key. aerial switch and receiving tuner are also mounted on top of the table, while the three sets of accumulator cells are placed on the floor to the left of the table.

The small charging panel for the auxiliary set is mounted on the bulkhead just above the operating table as indicated in the drawing. The starting box, generator and motor field rheostats and D. C. main switch are mounted on the bulkhead to the left side of the room as shown. It will thus be observed that all apparatus is conveniently placed for operation and is readily accessible for repairs.

The diagram, Fig. 2, is presented specifically for the benefit of operators attached to the Marconi service because it gives a complete circuit diagram of the actual connections of the complete Mar-

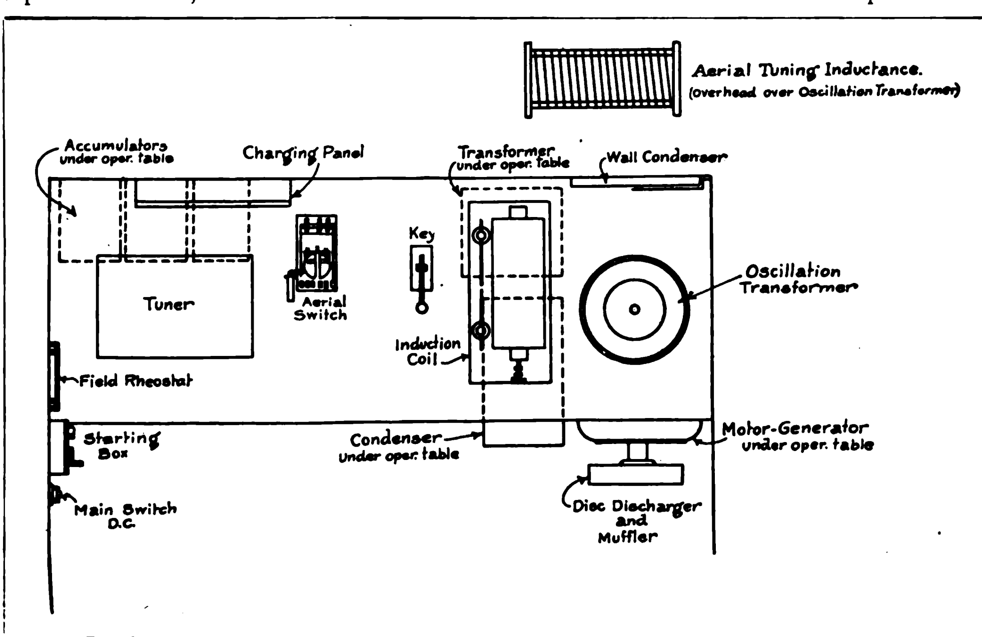


Fig. 1

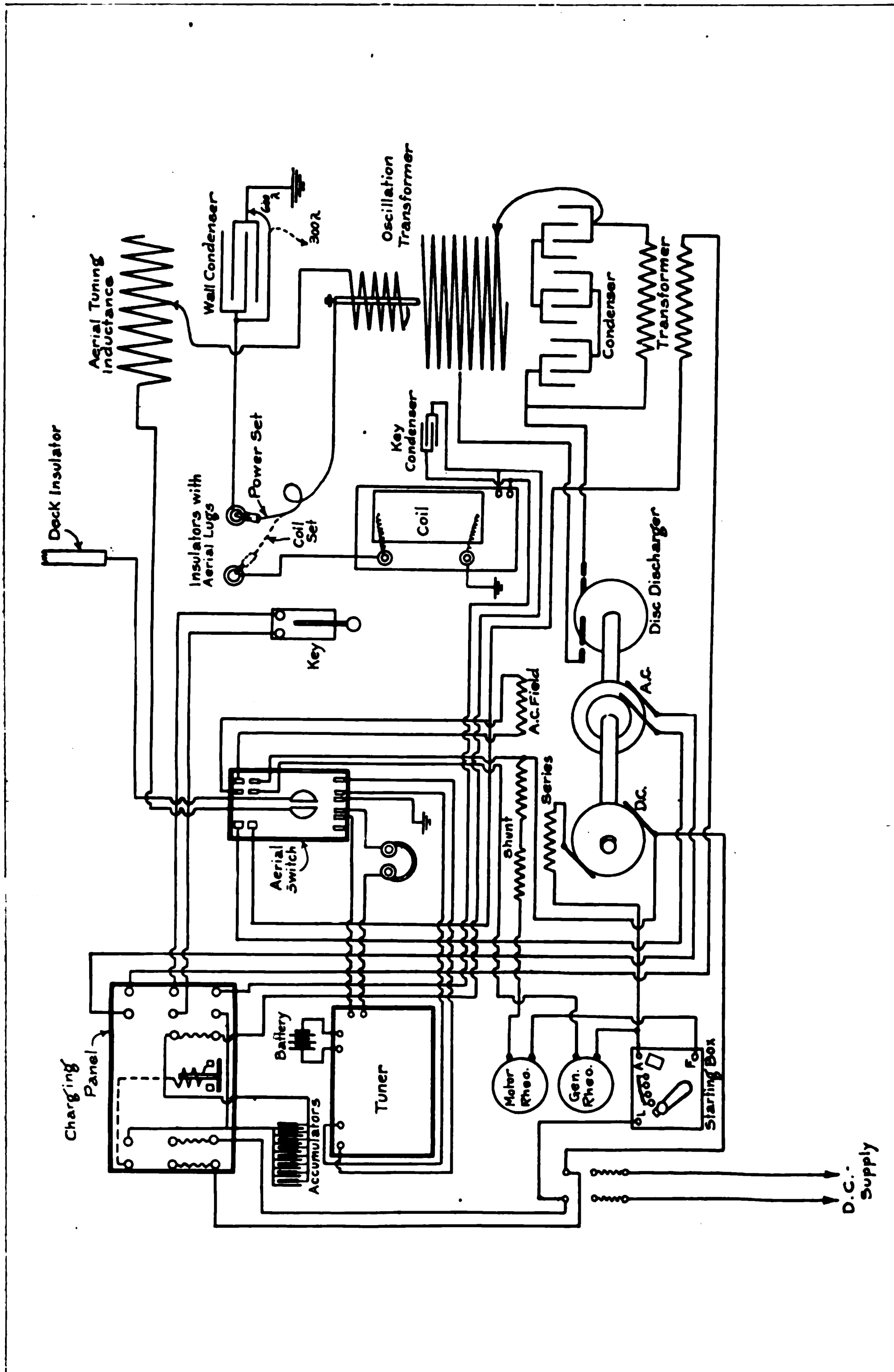

Dock Insulator
Aerial Tuning Inductance
Wall Condenser
300Ω
Oscillation Transformer
Condenser
Transformer
Insulators with Aerial Lugs
Power Set
Coil Set
Key Condenser
Coil
Disc Discharger
Key
A.C. Field
A.C.
Series
Shunt
D.C.
Aerial Switch
Charging Panel
Battery
Accumulators
Tuner
Motor Rheo.
Gen. Rheo.
Starting Box
D.C. Supply

Fig. 2

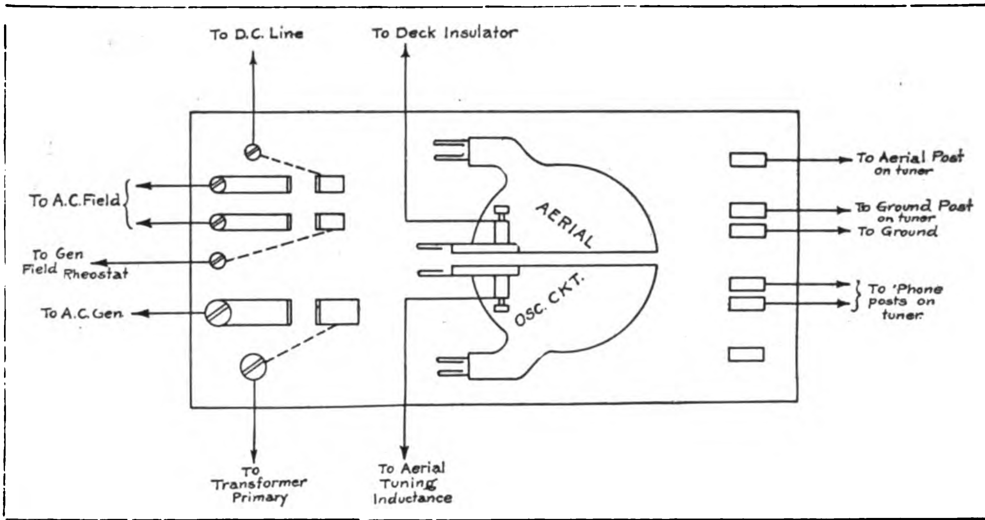


Fig. 3

coni 2-KW. set aboard ship. The diagram is laid out after the manner in which the apparatus is located in the radio cabin. The diagram should be thoroughly studied and a copy of it kept on file in the wireless cabin for reference in case of emergency.

The connections (shown in Fig. 2) between the type S switch and the receiving tuner are only correct for the old style valve tuner and must be changed to conform to the new type 103 or 104 tuners. As the fundamental circuits of the complete apparatus have been given in previous issues of Operators' Instructions, further explanation should not be necessary.

Fig. 3 is a detailed diagram of the type S aerial switch indicating the circuits to which the various lugs of this switch are to be connected. Fig. 3 is correct in connection with the old style valve tuner only and should not be confounded with the instructions given in Chapter VIII, May issue of The Wireless Age.

HIGHER STANDARD IN LICENSE EXAMINATION

The re-issuing of licenses for operators will begin next November. Men who have held their present licenses for two years will find when they are compelled to take the examination for renewal that the standard of the requirements has been raised considerably. There was little demanded of an operator a few years ago beyond the ability to transmit and receive messages. To-day, however, he is expected to be able to take good care of a set as well as to operate it.

It will be well for those who are to go before the radio inspectors for examination to be familiar with the current rules and regulations of the Marconi Company. The Circular Books, with which the ships are supplied, contain rules which if followed will reduce the work one-fourth.

The holding of any conversation or the transmission of verbal requests between stations has been prohibited by a recent instruction. Individual long distance working is a great hindrance to traffic and good operators are unanimous in saying that there is no individual glory in long distance working; the man who successfully transmits the messages is doing something better worth while.

Daily care of the apparatus adds to the efficiency of the operator's work. Care should be taken to see that the connections are good. The motor generator should be inspected and the dirt and grease wiped from it. It should be run for a few minutes to make sure that sufficient oil is circulating.

IN THE SERVICE

SHORE-TO-SHIP DIVISION

He came, he saw, he became a wireless man. This paraphrasing of an old apothegm may well be applied to David Sarnoff, contract manager of the Marconi Wireless Telegraph Company of America. To illustrate: When the Marconi Company had its offices in William street, New York City, Sarnoff, then a youngster, applied there for a position.

"I understand that you need men," he said.

"We don't need men, but we do need a boy," was the reply.

Sarnoff was hired as a boy, but a short time afterward he employed circumstances and his ability to lift him into the man class. This is the way it happened:

The manager was looking for the operator detailed in the office. He wanted a message sent at once. It came about that when he failed to find the operator his eyes lighted on Sarnoff. Could he send the message? Sarnoff could and he said so. This was not an idle assertion, for he had acquired a knowledge of telegraphy before entering the Marconi service. He made such a favorable impression, in fact, that a few weeks afterward he was assigned to take the place of the regular operator.

The research laboratory of the Marconi Company was then, as it is now, an intensely interesting place. Here the young wireless man spent his evenings and his spare hours, eagerly absorbing the knowledge which his study of the art and his association with the research engineers obtained for him.

In the meantime a vacancy had occurred at the Marconi station at Siaconsett, Mass., and Sarnoff was selected to fill it.

After eighteen months spent at Siaconsett he was transferred to the Sea Gate station, where he was eventually appointed manager. Then he was sent to the Arctic as wireless operator on a sealing vessel.

Fresh from exciting experiences in the North, he returned to New York, where he was detailed to duty in the Wanamaker's store wireless station. He felt that he had a deal of practical experience, but he was ambitious to improve his theoretical knowledge. So he enrolled as a night student in Pratt Institute, Brooklyn, taking a special course in electrical engineering. He successfully completed the course.

His next promotion was to that of inspector. Following excellent service in that position he was made chief inspector. Not the least important of his work for the Marconi Company was performed when he had charge of the initial tests for the direction finder and the installation of wireless on the Lackawanna railroad.

Mr. Sarnoff's tastes lean toward the commercial side of wireless telegraphy and he found opportunity to put his business-getting ideas into execution when he was made contract manager for the Marconi Company.

"The opportunities in wireless are greater to-day than they ever were for the right kind of a man," said Mr. Sarnoff, "but a man in order to make his services produce more value must first make himself more valuable."

Which goes to show that Mr. Sarnoff is a practical thinker as well as a practical wireless man.

The Function of the Atmosphere in Transmission*

By J. Erskine-Murray, D.Sc.

An interesting article by Dr. Eccles on certain aspects of transmission through the atmosphere appeared in the Year Book for 1913, the treatment of the subject being mainly from the point of view of his own and other physical theories for the explanation of "freak" transmissions. In the following pages I have attempted rather to analyze typical cases of unusual wireless transmission and to deduce from these, in conjunction with the known and fundamental physical facts of the case, a true idea of the function of the atmosphere in transmission without the use of any explanatory hypotheses.

That the atmosphere ought to have some slight influence on the transmission of electric or "æther" waves from place to place on the earth's surface is obvious when one recollects that the air, though a very good insulator at pressures such as exist at the earth's surface, is nowhere a perfect insulator, and has quite different electrical qualities at the low pressures which occur at heights above thirty or forty miles to those it possesses at lower elevations.

Electrical waves must necessarily have a good insulator to pass through; they are guided by a conductor, but do not pass through it, only diffusing slowly into it and being dissipated as heat in the conducting material. The better the conductor the smaller is the depth of penetration of the waves into it and the less the loss of energy on this account. At the same time every conductor, whether a wire or a great mass like the earth, does conduct—that is to say, the electrical disturbance follows, and is guided by its surface.

In Hertz's experiments, and in Mr. Marconi's earliest form of apparatus true radiation took place—i. e., there was a free and unguided passage of an electric disturbance from one conductor to another conductor, through an insulating medium, the air, in which both were situated.

In modern Wireless Telegraphy free radiation does not take place when the stations are situated on land or sea, for the receiver is actually in direct connection with the earth and the latter forms part of the transmitter. Modern wireless is thus merely transmission from one part of a conductor to another part of the same. No return circuit, such as is used in ordinary telegraphy, is needed, because the disturbance is not continuous but alternating, and is of comparatively small wave length. I may quote from the 1907 edition of my handbook a definition which puts the matter succinctly; it is as follows:

> "Reduced to its simplest terms, the modern wireless telegraph is a large conducting sphere (the earth) with two conducting excrescences on it or near its surface (the aerial conductors). In one of these a sudden oscillatory movement of electricity is started, which spreads over the surface, causing to-and-fro currents in the other wire as it passes."

It will be understood, therefore, that as these have been my views since 1898, I was not one of those whom Dr. Eccles, in his article in last year's Year Book, speaks of as being surprised at Mr. Marconi's success in transatlantic transmission round the curve of the world.

If the lower atmosphere were as conductive as the sea is, wireless telegraphy from place to place on the earth's surface would be impossible, for the electric waves would not penetrate such a material to more than a few yards from the transmitter. Thus Wireless Telegraphy between completely submerged submarines is impracticable. The same is true in re-

* From "The Year Book of Wireless Telegraphy and Telephony," 1914.

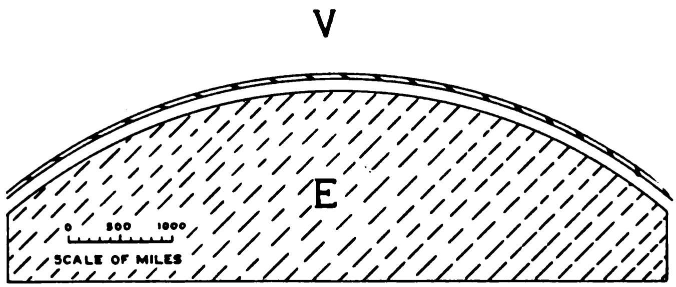


Fig.- 1

A portion of the Earth and Atmosphere to scale. E, the Earth, V. Outer Space. The shaded parts are conductors, the strip between them being the dielectric of Wireless Telegraphy. [From Erskine-Murray's Handbook of Wireless Telegraphy 1907.]

gard to wireless transmission in mines. Where the rocks are dry and insulating, transmission is possible through them up to a mile or two; but where they are wet and therefore conducting wireless telegraphy is impracticable. The non-conducting layer of air in contact with the ground and rising to some thirty miles above it is thus the stratum through which the electric waves can pass in traveling from station to station. Above lies the less dense air, which is certainly not a good insulator, and therefore must either absorb or reflect the waves which come up to it from the transmitter. There is now experimental evidence that at night this upper layer does reflect the waves down again, and thus signals are received at greater distances than in the day time; and Dr. Austin is of opinion that even in the day time the action is not always absorption only, but that occasionally there is a slight strengthening of the signals by reflection.

The first suggestion, of which I am aware, that indicates the importance of the upper atmosphere in the transmission of electrical waves over the earth's surface is contained in a paper which the late G. F. Fitzgerald read at the British Association Meeting in 1893. In discussing the probable period of an electrical oscillation of the earth as a whole, he remarks that "The period of oscillation of a simple sphere of the size of the earth, supposed charged with opposite charges of electricity at its ends, would be almost one-seventeenth of a second; but the hypothesis that the earth is a conducting body surrounded by a nonconductor is not in accordance with the fact. Probably the upper regions of our atmosphere are fairly good conductors." He then proceeds to calculate the period of oscillation, considering the earth and upper atmosphere as two concentric spherical conductors, and finds that if the height of the region of the aurora, i. e., of the conducting layer, be 60 miles, the period comes out at 0.1 second; while, if the height be 6 miles, the period becomes 0.3 second.

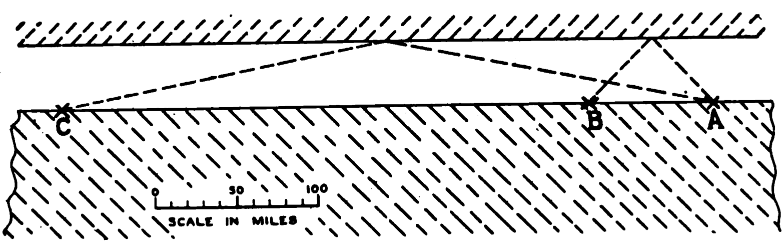
At the time this was written Wireless Telegraphy, in the modern sense, had hardly been thought of, and no application of Fitzgerald's idea was made to radio-telegraphy until 1902, when A. E. Kennelly in the Electrical World suggested that an upper reflecting layer might be the cause of the abnormally long ranges occasionally attained by night. Oliver Heaviside also, in his article on the Theory of Electrical Telegraphy ("Encyclopædia Britannica," 10th edition), says: "There may possibly be a sufficiently conducting layer in the upper air. If so, then waves will, so to speak, catch on to it more or less. Then the guidance will be by the sea on one side and the upper layer on the other."

It is clear, therefore, that, in the opinion of Fitzgerald, the upper conducting air actually existed, and that Kennelly and Heaviside looked upon its existence as probable.

The diagram, Fig. 1, which forms an illustration to the chapter on transmission in the first and succeeding editions of the writer's "Handbook of Wireless Telegraphy," published at the commencement of 1907, was arrived at from similar considerations in combination with the known facts of the conductivity of gases at low pressures, of the height of the auroral discharge and of the constant presence of ionization in the upper atmosphere. It was thus an immediate deduction from the knowledge available at the time.

As regards the ionization of the upper atmosphere, I may say that, as early as 1892, I wrote a paper in which a calculation was made of the currents in the upper atmosphere which would be necessary to account for certain magnetic storms, and suggested that these currents might be due to streams of electrified particles entering the atmosphere from the outside. A great deal of work on similar lines has been done lately by Birkeland. That ordinary sunshine containing ultra-violet light ionizes air was well known, as also the fact that ionization does not die out at once.

The diagram indicates that if the under surface of the upper conducting layer were sufficiently sharply defined, the waves would be reflected downwards and might, therefore, increase the strength of signals received, the wave form becoming ultimately—i. e., at great distances—cylindrical instead of hemispherical, and therefore giving a much slower reduction in the strength of received signals than would occur if the waves were free to extend into upper space or were absorbed by and dissipated in the upper layers. I consider that the existence of this upper conductive layer is no longer a matter of doubt, and that the problems now in the process of solution involve only its form and functions. To be able to discuss these we must leave for the meantime the physical side of the question and look into the evidence obtained in the actual working of Wireless Telegraph Stations.



A. Victoria; B. Pachena Point; C. Ikeda Head.

Fig. 2

The first time that an obviously atmospheric effect was noticed was in 1902, when Mr. Marconi received signals from Poldhu on board the S.S. Philadelphia at nearly twice as great a distance by night as by day.

Since the conductivity of the surface of the sea is not appreciably different by day and by night, it is evident that the cause of this increase of distance of transmission at night must be some atmospheric variation. Mr. Marconi suggested that at the time the effect might be a local one, i. e., a loss of energy at the transmitting aerial due to ionization by day light of the air in its immediate neighborhood. This theory, however, does not fit in with the more recent observations of the phenomena which clearly indicate that the cause is situated in the atmosphere intervening between the stations, and is not due to variations in the amount of energy radiated.

Take, for instance, Edward's observations on transmission by day and night on the coast of British Columbia, and in particular the case of communications between Victoria, Pachena Point and Ikeda Head. These three stations lie in nearly a straight line, Pachena Point being about seventy-five miles and Ikeda Head about 400 miles northwest of Victoria. Electric waves in transmission from Victoria to Ikeda Head thus pass Pachena, and if they traveled by the shortest route, i. e., along the earth's surface, should be received there.

As a matter of fact, however, with the small power station originally installed, it was very difficult to communicate between Victoria and Pachena at all, either by day or night, whereas communication was easily maintained between Victoria and Ikeda Head almost every night, though not by day.

There appears to be only one rational conclusion which can be drawn from these observations—viz., that at night the waves which reached Ikeda Head actually passed Pachena high overhead without approaching the ground on which the station stands; that is to say, they rise from Victoria and are bent down again after they have passed over Pachena Point. There is no other way by which they could get to Ikeda Head without affecting the intermediate station. We have thus a direct proof from actual wireless operations that there must be some stratum of the upper atmosphere which, at least by night, is not transparent to electric waves, but reflects or refracts them downwards from its lower surface.

From the consideration of the physics of the atmosphere and from actual wireless observations we have thus obtained two quite independent proofs of the existence of the upper conducting layer depicted in Fig. 1.

The above are, of course, only instances taken from a very large number of observations, all of which go to prove the existence of a strengthening of signals due to reflection from the upper atmosphere. These "freak" transmissions occur in all latitudes, but mainly in the fine weather belts which surround the world between latitudes 20° and 45° on both sides of the Equator. It is also there that the atmosphere is, as we know from the work of meteorologists, in a comparatively steady condition, such as must favor the formation of a smooth reflecting layer. There is also evidence which shows that stormy weather is unfavorable to transmission.

It is notable that many of the greatest distances of "freak" transmission have been in large part over land and indeed over high mountains—a further proof that in these cases the main conductor is not the earth, but the upper shell.

It is also a fact that signals between stations at a comparatively small distance from one another are not appreciably strengthened at night, and this further confirms the idea that the increase at greater distances is due to reflection. In the case for instance of Victoria and Pachena Point the angle at which the waves would have to be reflected from the upper layer is about 45° or more in order to reach the latter station. So high an angle is, of course, very unfavorable to reflection, and a very small proportion, if any, of the waves received at Pachena Point could come that way. For Ikeda Head the angle would only be about 10°, which is very much more favorable; hence, as the phenomenon of better night transmission is observed at the latter, reflection is indicated.

We may take it, therefore, that it is practically certain that during the

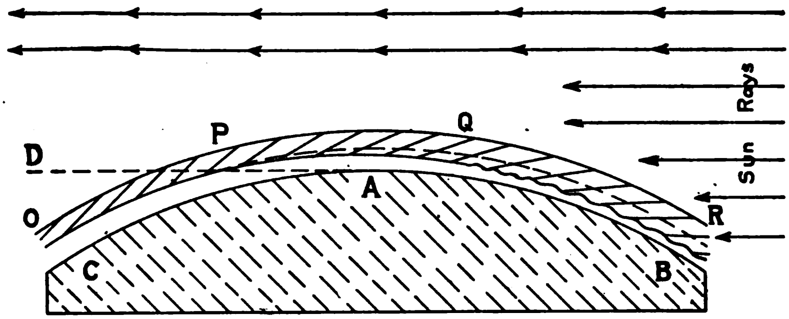


Fig. 3

C.A.B - The Earth; O.P.Q.R - the Conducting Shell; A.D - Line dividing Sunshine above, from Darkness below. A, Station where Sun is just rising.

night the waves are conducted to great distances by two conducting surfaces, the earth and the shell outside it. The argument put forward by Dr. Eccles against conducive transmission—viz., that a high receiving aerial is better than a low one—is really fallacious and neglects Poynting's proof that, in all electrical transmission, the energy travels via the dielectric and not in the conductor. Of course, a higher aerial will show greater energy in the receiving instruments in any case, for the integral effect of the electromagnetic forces on it will be greater than that in a small one, whether the waves be conducted or free. I have demonstrated this many times in lecturing on the subject by using a long horizontal straight wire to represent the conducting strip of ground between the transmitting and receiving stations, with two vertical wires attached to it as aerials.

It seems, therefore, that at night the lower surface of the conducting shell is often well-defined, thus becoming a good reflector, while during the day the transition from the upper and conducting to the lower and non-conducting air is gradual—the surface in fact becomes fuzzy and incapable of giving a clear reflection.

We now come to the curious phenomena which take place at sunrise and sunset. Let us see what function the atmosphere performs in these after stating generally the results which have been deduced from Mr. Marconi's interesting observations at Clifden and Glace Bay and from those of later workers.

In a paper on the "Daylight Effect in Radio-Telegraphy," read to the Institute of Radio Engineers in July, 1913, Professor A. E. Kennelly sums up the experimental facts, and shows, as he says in his summary, that "changes of intensity of signals near sunrise and sunset are explained by reflecting effects which may be expected at the boundary surface or 'shadow wall' between darkness (air of small conductivity) and illumination (ionized air of marked conductivity)."

This is good if it applies only to the middle atmosphere, below the layer which as we have seen must be a good conductor even at night, and above the lower layers which under no conditions ever become appreciably conductive; but it neglects the fact that there are also long night ranges to be explained which demand something essentially better than merely a non-conducting atmosphere.

The real effect is therefore something like that shown in Fig. 3, a figure which I have frequently drawn on the blackboard for the benefit of a class during the past six years.

I have indicated that over the station A, at which sunrise is just taking place, the conducting shell is at least as sharply defined as during the night, and is, therefore, capable of reflecting; while at B, where the sun is high, the under surface of the shell is indefinite and no longer reflects. Between P and Q the shell slants downwards towards the earth, forming what Kennelly calls the shadow wall. It therefore strengthens forward radiation or condenses the received waves at A. Between O and P the shell is horizontal, as also between Q and R.

In order to follow the variations in strength of received signals which sunrise produces it is necessary to suppose that the earth, represented by the lower part of the diagram, rotates slowly clockwise. The stations will then pass from where, in darkness, the height of the shell is great to where, in full daylight, it becomes lower and less well defined; and in their passage their positions relative to the shell will indicate the variations in signals.

To study the sunset effect we may turn the earth counter-clockwise, starting with both stations in full daylight —i. e., on the right—and turning them gradually over into darkness. The point of view will, in this case, be from above the North Pole, while in the use of the diagram to illustrate sunrise it was from above the South Pole.

As. Dr. Kennelly points out, the boundary between light and darkness is a line which is only due north and south at the times of the Equinoxes. At other times of the year it has a northerly and easterly or northerly and westerly slant, according to the season of the. year. This boundary line is, in fact, a great circle of the globe, the axis of which is always directed towards the sun, and therefore cuts the surface of the globe at some point on the Ecliptic. Sunrise and sunset effects, therefore, vary from month to month, and depend not only on the times of sunrise and sunset, but also on the angle between the fixed great circle along which transmission takes place from the one station to the other and the great circle separating day from night.

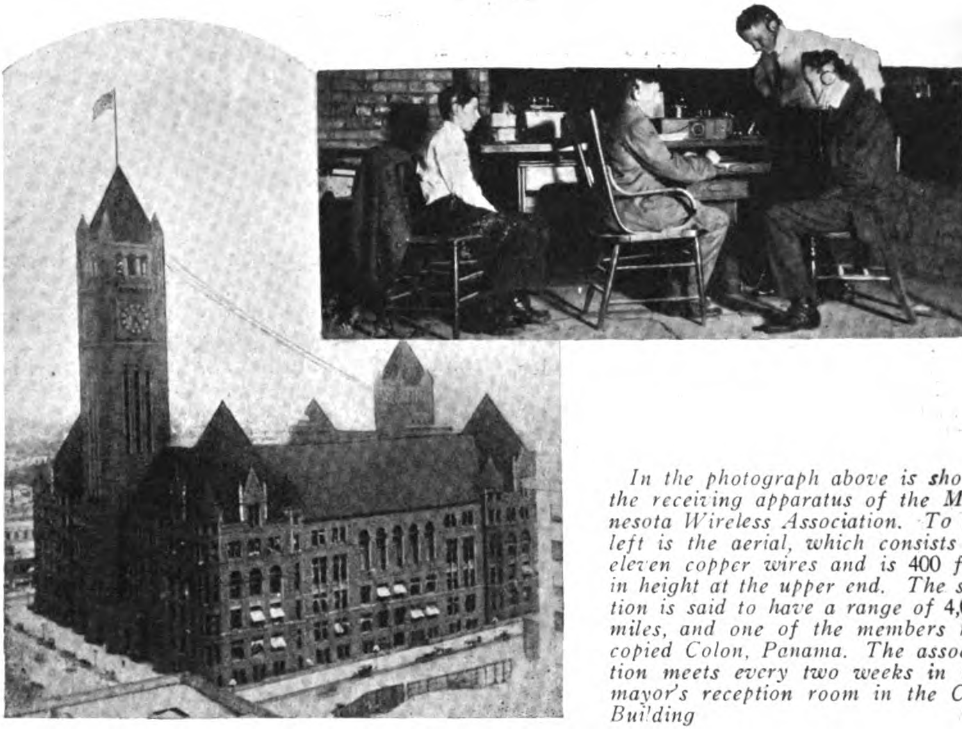
In conclusion, I would suggest that there is another factor in the case of which no account has hitherto been taken. This is the possibility that there may be resonance to some of the natural wave lengths of the oscillator, consisting of the earth and the shell. These wave lengths are many in number, and include a range of waves of lengths h, 2h/3, 2h/4, etc., etc., where h is the distance between the earth and the shell.

Thus, if the height of the shell be 50 km., these natural wave lengths would be 50 km., 33.3 km., 25 km., and so on; while if the height were different the whole series would be different. We have here, therefore, another possible explanation of the fact that, both with damped and undamped waves, it has been observed that at certain times certain wave lengths are more easily transmitted than others. I would suggest that, although this may be due to interference of direct and reflected waves, it may also be due, in part at least, to a change in the height of the shell, whereby the natural resonance wave lengths of the terrestrial oscillator are altered.

TIME SIGNALS FROM WASHINGTON TO OTTAWA

Listening to the seconds ticked off from Washington through the wireless telegraph apparatus recently installed at the Dominion Observatory was a feature of a recent meeting of the Royal Astronomical Society at Ottawa, Canada. Shortly before ten o'clock in the evening the Arlington town signals could be distinctly heard throughout the hall through the gramophone which was connected with the wireless receiving instrument at the Observatory. At five seconds to ten the ticking ceased, and at ten o'clock a long stroke gave the striking of the hour. This corresponds almost exactly with the hour at the Observatory. A lecture delivered by C. P. Edwards, superintendent of wireless telegraphy for the Dominion, was replete with interesting features.

A Station in the Minneapolis City Building



In the photograph above is shown the receiving apparatus of the Minnesota Wireless Association. To the left is the aerial, which consists of eleven copper wires and is 400 feet in height at the upper end. The station is said to have a range of 4,000 miles, and one of the members has copied Colon, Panama. The association meets every two weeks in the mayor's reception room in the City Building

THE Minnesota Wireless Association has just installed a powerful radio station in Minneapolis, under the direction of Philip E. Edelman, the president.

The station is located in the City Building, and the aerial, consisting of 11 copper wires, stretches between the two towers of the building, as shown in the accompanying photograph. The aerial is 400 feet high at the upper end. Mr. Edelman secured both the aerial and a fine operating room, located on the fourth floor of the building, for the association, both being donated. The apparatus installed was also largely donated, the plan having been to designate some part for each member to furnish.

The installation was made in accordance with modern practice, and the ground connection was secured by connecting heavy wires to the frame of the building and the pipes located in it. The station is claimed to have a range of 4,000 miles. Claude Sweeny, one of the members, has copied Colon, Panama.

For ordinary transmitting purposes ½ K. W. or less is used in order to restrict the range to the stations in communication. The time signals are very clear at this station and it is possible that they will be utilized for controlling the city clock, thus giving Minneapolis the first radio municipal time. Improvements are planned for the station and more complete and powerful equipment will be installed this fall. The station is at present operated under a special license with call letters 9 Z. E., and will be devoted largely to experimental work.

The Minnesota Wireless Association is in its fifth year. Meetings are held every two weeks in the mayor's reception room of the City Building.

ALADDIN IS OUTSHONE BY MAGIC OF WIRELESS SPARK

By JACK BECHDOLT

In the Seattle Post-Intelligencer.

Life's lesson is here with its fascination,
In this wireless thing that since creation
Has been laid away in nature's store,
Awaiting for someone to open the door.

And when we hear our big spark thunder,
Sending our signals away off yonder,
With the very speed of the wings of light,
Through rain or shine or darkest night.

Or when we hear our ear phones rapping
And answering signal comes clear and snapping,
We can't comprehend the wonder—the why,
Of this thing harnessed 'twixt earth and sky.

—CHARLES B. COOPER.

CHIEF Operator Cooper says that static has interfered somewhat with the meter. Possibly it has, but the idea of his verse is in tune with the spirit of wireless, one of the most thrilling mysteries of our day.

It is strange that we are so slow to recognize the romance of our own times. The troubadour in quest of adventure would lead a life as spiritless as that of a garbage wagon driver compared to the lot of the adventurous youth of to-day who puts in three or four months preparing for a government examination, then slips grandly away to sea holding at his fingers' ends the power to chat comfortably across several thousand miles of lonely ocean, talking from strange, sweating foreign ports with the familiar home office, listening in hours, when the man-made ship is a pitiful toy in the grip of the senseless giant of hurricane, to the comforting, familiar dull routine of ship's position reports or the recital of the day's news whispering down the gale which sings through the aerial.

At the bidding of boys fresh from the school room is a wizard more potent than any Aladdin conjured from his lamp. No magic carpet of old can eclipse the marvel of the enchanted spark that responds to the touch of a youth already half contemptuous through familiarity. It is not that we haven't enough romance in this day—rather we have a surfeit of it.

About thirteen years ago I was one of a crowd visiting the laboratories of the state university. A strange little key on one side of the room ticked off sparks which passed through the pushing visitors and registered upon a crude little receiver at the other wall. The little demonstration was one of the marvels of the day, a device based on the experiments of Marconi.

To-day a hundred young men report in and out of the local Marconi office as they come and go with the ships that ply west and north and south, and the records of their long distance communications have become so commonplace that they are no longer good news. Recently the Manchuria, out of San Francisco, spent four nights in mid-Pacific in communication with California and China, and during the entire voyage published the world's news fresh every morning in the daily paper as it was sent from one shore or the other. The spark has contracted this great ball of a world to the dimensions of a city block.

The young fellows are always the ones who have taken to the sea, but to-day the young American is more apt to go as guardian of the magic spark than before the mast. Federal laws requiring day and night service for the safety of passengers have opened a new profession for youth. Even before the new laws the steamship companies were finding the wireless a marvellous convenience, and even the old-time sailing ships,

The cub begins with a dummy key, learning the continental code

plowing along the lonely Alaskan shores as they take the cannery outfits North, carry the wireless and report daily to the home office in Seattle.

At the Y. M. C. A. is a school for young operators. There the cub begins with a dummy key, learning the continental code. When he has mastered this he graduates to real sending, with a wave so short it does not interfere with any professional communication. He hears lectures on the mechanics and theory of his strange trade, and he studies the standard text book prepared for the United States Naval Academy.

After the Federal examination and a certificate he is turned loose, ready for adventure. He is likely to find a berth on a tugboat to begin with and put in a month or so rolling off Cape Flattery. He may graduate to a fishing steamer or to a "second" on a liner, and so eventually through a first operator's job to a land station.

New as it is, the profession has a long history full of thrilling adventure. The young fellows who report in and out of the office in the Maritime building bring with them stories of strange ports both amusing and serious, and sometimes stories of "freaks" so uncanny as to defy belief.

Most decidedly it is a young man's job. Jack Irwin, superintendent of the local division, who was wireless operator with the ill-fated Wellman balloon expedition, has been at it but a few years. Chief Operator Cooper, who is a veteran, began wireless work twelve years ago in Canada. Its pioneers are scarcely at middle age and its heroes are apt to be the boys who last summer were graduating from short pants.

This North Pacific division alone has many traditions of heroism and quick thinking. For instance, there was Donald Perkins, lost on the State of California at Gambier Bay last summer. He relieved his assistant at the time the wreck wakened him and took the key, sending his S O S.

In the few brief moments the steamship floated he raised a land station. A lifeboat fell against his stateroom door and blocked it as the vessel listed. The assistant escaped, but Perkins stayed at the key.

There is George Hayes of the Olympia wreck. When that steamship piled up in a shrieking blizzard in Prince William Sound, balancing precariously on a reef, Hayes stayed at the key all night

The wireless has reduced this great ball of a world to the dimensions of a city block

and next day, talking with the land stations and sending to the passengers huddling terrified in the saloon below bulletins of good cheer as fast as they were relayed to him. As long as power lasted Hayes stayed on the job, despite cold and exposure.

W. R. Keller, of the Princess May, used his wits when that steamship climbed half way over a hidden reef and hung teetering. That was before the days of auxiliary power. Hayes scrambled down to the engine room, where the water came to his waist, and connected up the storage batteries for the call bells with a buzzer outfit in his wireless cabin. He made his call heard.

Another boy who probably has not yet forgotten his first job was operator on the fishing steamer Chicago. The Chicago piled onto an island in the Inside passage and listed so far over that the wireless aerial lay along the water.

The young operator could not stay in his cabin, but he climbed along the wall of the deck house as it listed far over and with a long stick reached through the window to his key. By some queer chance of wireless his call reached the Seattle station, then at the university grounds. It was heard at no other place. The message gave the steamer's name and plight, but no position. There were some anxious hours before the facts of the wreck were learned.

It is a marvelously romantic thing to have this genie of the wireless our servant of every day. but we have already forgotten the strangeness of it. The boys who serve the spark have ceased to wonder. They talk learnedly the lingo of their trade, a lingo full of terms unintelligible to any save the electrician, but of its mystery they say little. The miracle having been set to a serviceable occupation, they have ceased to find anything miraculous about it. Only the outsider can enjoy the romance.

WIRELESS AND WEATHER INFORMATION

The application of wireless telegraphy to the collection and distribution of information regarding the weather has received a further extension by the steps recently taken by the governor-general of Madagascar to warn mariners by means of wireless of the approach of cyclones. A service of wireless storm warnings has been organized by way of trial on the eastern, northwestern and western coasts of Madagascar. The telegram of alarm emanating from the observatory at Tananarivo will be issued during the whole duration of the probable passage of the cyclonic disturbance in the zone of action of the stations at every even hour (except between midnight and 6 A. M.) alternatively by the stations at Mayotte and of Majunga in case of a cyclone affecting the northwestern part of the island or on the Channel of Mozambique, and alternatively by the stations of Mayotte and of Diego in case of a cyclone affecting the northeastern and eastern parts of the island. The telegram of alarm will be preceded and followed by the warning — — — — . . . — — — — repeated at short intervals; this signal has been specially reserved for this purpose, and, should occasion arise, will indicate in itself, for want of more precise details, that there is a reason to fear the passage of a cyclone. The masters of vessels at sea, provided with wireless telegraphic installations, will be able to signal directly to the wireless telegraphic stations of the Colony of Madagascar any disturbance of cyclonic appearance which they may encounter, in order to extend as much as possible the range of this service of warning signals.

PROGRESS OF RESEARCH

The International Commission for Radio-Telegraphic Research, which was inaugurated at a meeting in Brussels in April last, has held a further meeting, at which its constitution has been adopted in definite form. W. Duddell is president; Professor Wien, vice-president; Dr. R. Goldschmidt, general secretary, and R. Braillard, assistant secretary.

A large number of technical matters were brought up at the meeting. Dr. Goldschmidt described the latest improvements at the Laeken station, and it was decided that a small high-frequency alternator be acquired. Reports were also read by Professor Schmidt (Halle) on observations by a barreter and galvanometer; by Mr. Vollmer and Professor Wien (Jena), Dr. Marchant (Liverpool), Mr. Lucas (Namur), and Mr. Wulf (Volkenburg), on photographic registration of signals.

Wireless and Two Marine Accidents

THE steam pilot boat New Jersey was sunk in a dense fog on the morning of July 10 at the eastern entrance to the Ambrose Channel, New York Bay, by the United Fruit steamer Manchioneal, bound for Kingston, Jamaica.

Captain Hendricksen of the Manchioneal held the nose of his vessel in the hole in the bow of the tug until her crew of eighteen men and sixteen pilots were taken off safely. The New Jersey sank three minutes after the steamer backed away and exactly ten minutes after the collision.

The Marconi operator on the New Jersey, E. J. Quimby, sent the S O S signal for aid, and it was picked up by H. Barbalate, Marconi operator at the Sea Gate Station, and relayed to the Morgan Line steamer El Sud, inbound. Daniel Cawman, Marconi operator on El Sud, answered that she was hurrying to the rescue.

In the meantime the crew and the pilots had got away in their own boats and two boats from the Manchioneal and another from the United States dredger Raritan. The only persons injured were two pilots, Captain S. H. Cooper and Captain August S. Johnson, who received severe bruises.

Captain Eugene McCarthy, a pilot who had taken out the steamer Kelvinbank, said he had just got on board the New Jersey when the accident occurred.

"It was 8 o'clock," he said, "and the boat was stopped in a thick fog just inside the whistling buoy, near the eastern end of Ambrose Channel. Most of the pilots were on deck, trying to see through the fog what was coming our way. Suddenly the steamer Manchioneal struck the New Jersey on the starboard side just forward of the beam. There were sixteen pilots on board. Mate Hauffman was in charge, with a crew of seventeen.

"The two yawls were lowered at once from our boat, and the Manchioneal, which held her bow to the hole, lowered two of her lifeboats in shipshape without loss of time or confusion. There was no time to save any effects, and many of the pilots and members of the crew lost their clothing, money and jewelry when their boat sank almost under their feet."

A cable dispatch from Londonderry, Ireland, dated June 29, says:

Three hundred and forty-eight of the 1,106 passengers of the Anchor Line steamer California, ashore on Tory Island, were landed here to-day. The others were taken to Glasgow.

In a thick fog the California ran on the rocks last night, while bound from New York for Glasgow. According to the passengers, there was no panic when the liner struck. The sea was calm, and the vessel apparently was moving less than seven knots an hour. The shock was slight, but the sudden stoppage of the California caused some commotion. The captains and officers speedily restored confidence, and as a precautionary measure the boats were swung out. They were not lowered, however.

About 1 o'clock in the morning the searchlight of a British destroyer, summoned by wireless, penetrated the mist. The California had been left almost high and dry by the receding tide. At low tide the islanders were able to get close to the bow of the vessel.

The Donaldson Liner Cassandra, which followed the California throughout the voyage, but lost sight of her in the fog, came into view two hours after the destroyer. Other destroyers soon reached the scene. From daylight the work of transferring the passengers proceeded. For several hours lifeboats plied back and forth, and the passengers were hoisted to the deck of the Cassandra in baskets.

Something to Think About

We get everything we prepare for, and nothing else. Everything that happens is a sequence; this happened today because you did that yesterday.

❦ ❦ ❦ ❦

Take time when time is—for time will away.

❦ ❦ ❦ ❦

A journey of a thousand miles is begun with a step.

❦ ❦ ❦ ❦

Wisdom is better than weapons of war.

❦ ❦ ❦ ❦

It is our own fault if we are overwhelmed by the tasks or difficulties or sorrows of life.

❦ ❦ ❦ ❦

Nothing is so foolish or wretched as to anticipate misfortunes.

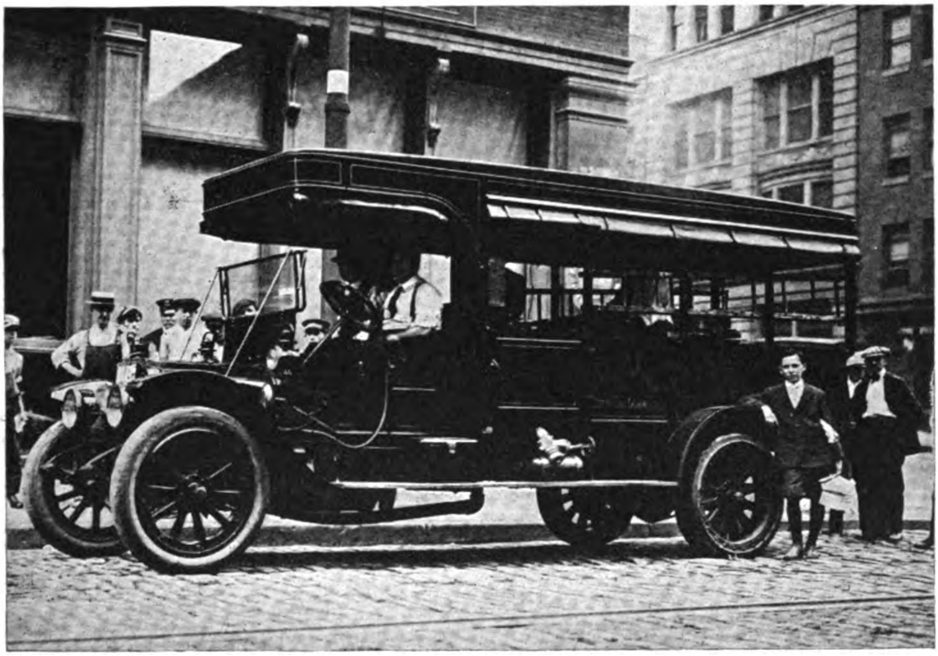
❦ ❦ ❦ ❦

Fear kills more than the physician.

❦ ❦ ❦ ❦

The wise and prudent conquer difficulties by daring to attempt them.

An Installation on an Automobile Truck



Baltimore city truck equipped with wireless

SOME very interesting experiments have been conducted in Baltimore, Md., with standard receiving apparatus installed on an automobile truck. The preliminary tests of the equipment installed by the Marconi Wireless Telegraph Company were made between the American Building wireless station and a truck used by the Electrical Commission for pumping water from manholes throughout the city.

Wireless signals were received by the truck equipment as far as seven miles in the suburbs, also while the car was running and standing at the manholes in the city limits. Then the truck was taken to the City Hall, where a demonstration was made, and later it was sent out according to routine equipped with the wireless outfit, in charge of wireless experts of the Marconi Company. It consists of a standard Marconi receiving apparatus, similar in detail to the equipment used on board merchant vessels. The receiving antenna consists of about 25 insulated wires hung in the roof of the car, directly under the cover.

The frame of the truck acts as the earth connection. The signals were plainly audible while the car was running on the streets. The experiment demonstrates the feasibility of installing wireless receiving equipments on automobiles in order that the business man can easily be in touch with his office while riding in his car.

On commercial trucks the system, as a means of saving time and wear and tear is obvious. The Fire Department is interested in the tests, as it is possible to equip engines and other apparatus with the receiving machines, and when sent out they could be instantly recalled, saving time and trouble, and increasing fire protection to the city.

How to Conduct a Radio Club

By E. E. Butcher

ARTICLE VII

THE writer of this series is frequently requested by amateur organizations to describe a simple method for the measurement of the inductance and capacity of an aerial, taking into consideration the limited amount of equipment at hand at the average amateur club. Such measurements may be easily made, but they necessitate the use of a wave-meter and a standard of inductance or capacity. A wave-meter may be readily assembled at the workshop of the club, but there is generally no means at hand for calibration.

It is therefore suggested that a wave-meter be constructed along the following lines and sent to the Bureau of Standards at Washington for calibration.

The variable condenser should be of the rotary plate type, having a 180° scale. It should have a maximum capacity of .004 mfds. The inductance coil may be made on a square wooden frame 4¾ inches by 4¾ inches. The frame is then wound closely with 15 or 16 turns of No. 18 D. S. C. wire, which may be coated afterwards with shellac or dipped in hot paraffin.

When this coil is connected to the terminals of the rotary condenser, the circuit will have a minimum wave-length

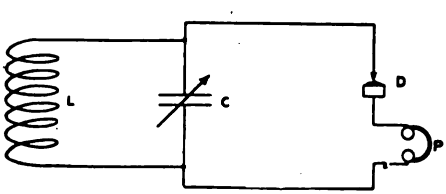


Fig. 1

of about 125 meters and a maximum wave-length of about 800 meters. The intermediate points of calibration will, of course, be determined at the Bureau of Standards.

Six points of calibration are quite sufficient, as a curve can be drawn, showing the intermediate values on the condenser scale. If it is desired to construct a wave-meter of greater range, a second coil, having three times the number of turns of the first coil, may be wound.

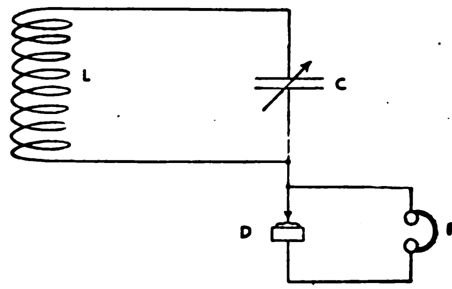


Fig. 2

Another set of wave-lengths will have to be determined for this coil.

When the coil and condenser have been completed, a detector may be mounted on the side of the variable condenser, also binding posts for connection to the head telephones. The connections shown in Fig. 1 should be used.

Determination of the Point of Resonance

For obtaining the point of resonance on the wave-meter, any of the following "hookups" may be employed:

In Fig. 1 the inductance coil is represented at L, the variable condenser of the wave-meter at C, a silicon or carborundum detector at D, and a pair of high resistance telephones at P. When the wave-meter is so connected and placed near to a transmitting set in operation, the capacity of the variable condenser is altered until a maximum of sound is heard in the telephones. This is the point of resonance and by reference to the chart, the wave-length of the circuit under measurement is obtained.

The crystal and head phones need not necessarily be placed across the condenser, but may be connected unilaterally, as shown in Fig. 2. A crystal connected in this manner is not so apt to affect the constants of the wave-meter itself.

If more visible indicating means are desired, a 2 or 4-volt straight filament battery lamp may be connected in series with the inductance and capacity, as shown in Fig. 3.

This method is generally used when taking readings of the spark gap circuit.

If a neon or carbon dioxide tube, N, is available, it may be connected in shunt to the variable condenser, as shown in Fig. 4, or may be hooked to the circuit unilaterally, as per Fig. 5. The point of resonance is easily determined by the maximum glow of the tube and particularly sharp readings are secured with the connection shown in Fig. 5.

Measurement of the Capacity of the Aerial

In measuring the capacity of an aerial, in addition to a wave-meter, a high voltage leyden jar of known capacity must be secured. If a standard navy leyden jar can be obtained, it will serve the purpose admirably, as all are coated to that height, which will give capacity of .002 mfds.; the capacity of the jar, however, is preferably of .001 mfds., and therefore two of these should be placed in series.

With the known condenser at hand, the capacity of the aerial is obtained by two measurements.

The spark gap, S, is connected to the secondary terminals of an induction coil. With the spark discharging across the gap, the wave-meter (with crystal and

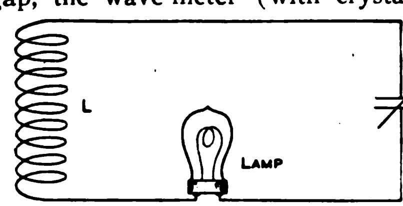


Fig. 3

head telephones, as per Fig. 6) is brought in inductive relation to the aerial and is preferably placed near to the earth lead. The capacity of the condenser is then altered until a point of maximum intensity of signals is found. This wave-length reading is known as the natural wave-length of the aerial which we will designate by W_1.

The known condenser, K_1, is then placed in series with the aerial as in Fig. 7. The spark gap is energized and a second wave-length reading taken, which we may call W_2. Obviously W_2 will be of smaller value than W_1.

After these two readings have been

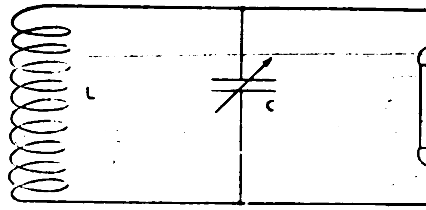


Fig. 4

taken, we may substitute their values in the following formula:

$$K = \frac{W_1^2 - W_2^2}{W_2^2} \times K_1 \quad \text{(No. 1)}$$

where

K = capacity of the aerial in mfds.

W_1^2 = square of the natural wave-length.

W_2^2 = square of the wave-length of the aerial with K in series.

K_1 = condenser of known capacity.

When the value of capacity is thus obtained, the value of inductance of the aerial may be calculated by the use of the following formula:

$$L = \frac{W_1^2}{3552 \times K} \quad \text{(No. 2)}$$

where

L = inductance of the aerial in centimeters.

W_1^2 = square of the natural wave-length of the aerial.

K = capacity of the aerial in microfarads as determined in the first reading.

The value of L may be converted from centimeters to micro-henries by dividing by 1,000.

The values of inductance and capacity after determination may be checked up by the following formula:

$$W_1 = 59.6 \sqrt{L K}. \quad \text{(No. 3)}$$

where

W_1 = natural wave-length as previously measured.

L = inductance of the aerial system.
K = capacity of the aerial system.

Reduction of Wave-Length by a Series Condenser

Suppose, then, it is desired to determine what value of capacity in a series condenser is required to reduce the

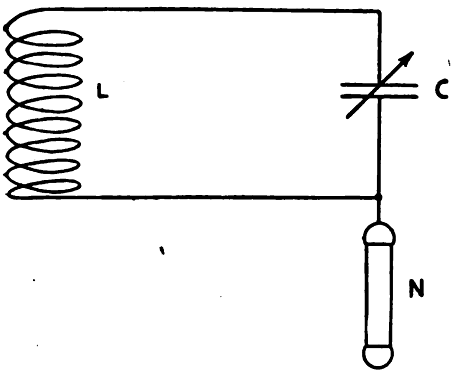


Fig. 5

wave-length of the aerial to a definite amount. Having already determined the capacity and inductance of the present aerial in micro-farads, we may make use of the following formula:

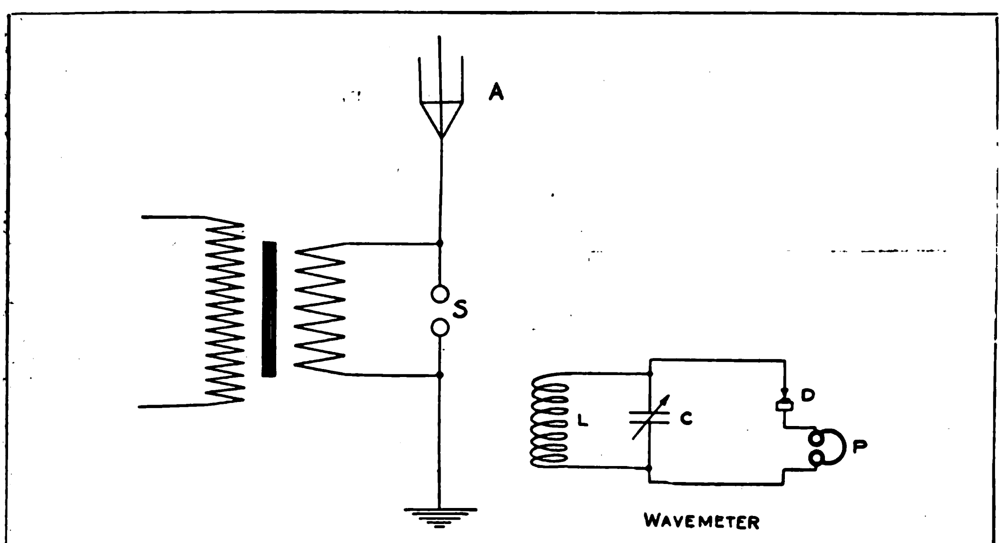


Fig. 6

$$K_3 = \frac{W_3^2 \times K}{3552\ LK - W_3^2} \quad \text{(No. 4)}$$

where

K_3 = the capacity of the series condenser required to reduce to a certain wave-length.
L = inductance in cms. of present aerial.
K = capacity in mfds. of present aerial.
W_3^2 = square of the new wave-length desired.

It is thus seen that a number of measurements of exceedingly useful value may be made in a simple manner.

Suppose it is desired to determine the value of inductance (1) necessary to raise an aerial of given wave-length to a new value; then letting

L = value of inductance of the present aerial determined as in No. 2 in cms.
W_1 = wave-length corresponding to this value of inductance.
W_3 = new wave-length desired.
1 = value of inductance to be inserted to obtain W_3.

then

$$1 = \frac{W_3^2 - W_1^2}{W_1^2} \times L \quad \text{(No. 5)}$$

W_1 being obtained from the wavemeter by excitation of the aerial with a spark gap in series.

The effective inductance of an aerial

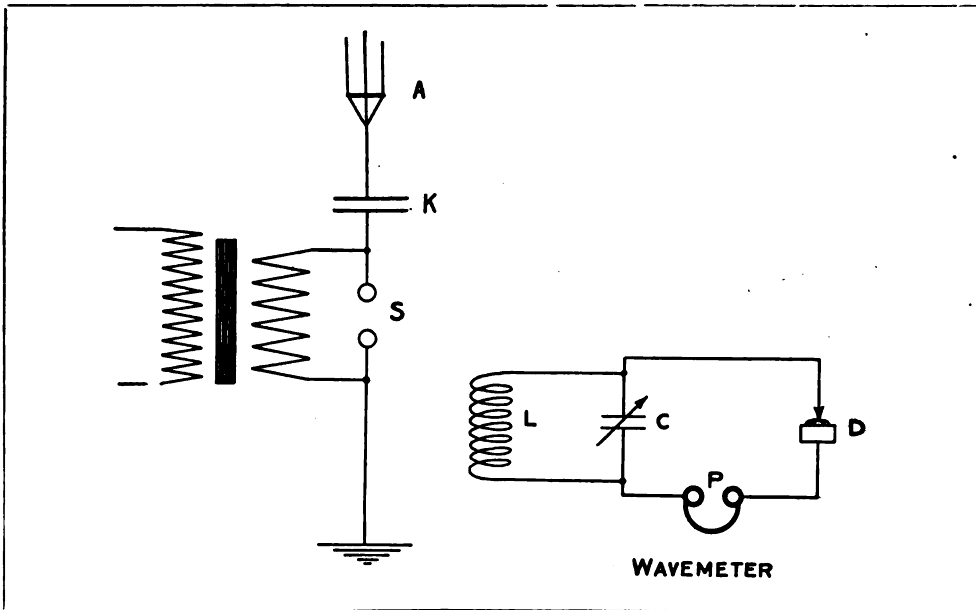


Fig. 7

may also be determined by the insertion of an inductance of known value in series with the aerial. The method is similar to that employed when obtaining the value of capacity by the insertion of a known condenser.

The natural wave-length having been obtained, as shown in Fig. 6, an inductance of known value 1 is inserted in series with the aerial, as in Fig. 8, and a new reading of wave-length is obtained which we may call W_8.

We may then substitute these values in the following formula:

$$L = \frac{W_1^2\, 1}{W_8^2 - W_1^2} \qquad \text{(No. 6)}$$

where

L = inductance of aerial in cms.

W_1 = natural wave-length of the aerial.

W_8 = wave-length of the aerial with the known inductance 1 in series.

1 = inductance of known value.

For amateur use a standard of inductance may be made in the following manner:

A mandrel of glass or wood 5 inches in diameter is wound closely with 12 turns of No. 10 D. B. R. C. stranded wire. At a wave-length of 400 meters corresponding to a frequency of 750,000 cycles the inductance value was approximately 15,000 cms. or 15 micro-henries. This standard may be effectively employed in measuring the inductance of an aerial by the method described and is sufficiently accurate for amateur use.

A standard of capacity cannot be readily constructed on account of the variation in the dielectric constant of various grades of glass, but if the value is known the following formula may be employed:

$$C = \frac{K\,A\,2248}{t \times 10^{10}} \qquad \text{(No. 7)}$$

where

A = area of dielectric in use.

T = thickness of dielectric in inches.

and

K = dielectric constant.

C = capacity in micro-farads.

The value of K varies from 6 to 9.

Operation of the Wavemeter

Many experimenters, when using a wave-meter do not take into consideration that, if the meter is placed too near to the circuit to be measured, the crystal requires periodical readjustment, owing to the strength of the oscillations. This is particularly so when the sensitive

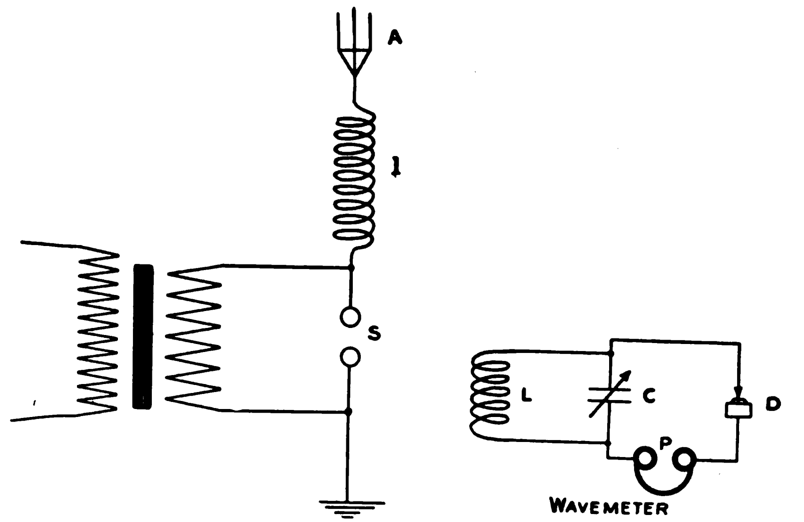


Fig. 8

crystals, such as galena or silicon, are employed.

The same precaution applies to the use of the small battery lamp as an indicator. If the wave-meter is placed too near to the spark circuit, the oscillations may be of such strength as to burn out the filament or puncture the insulation of the coil of inductance. Several trial readings are required, making sure that the coil is placed so that it is properly acted upon by the magnetic fields of the high frequency circuit.

When a crystal, connected unilaterally to the circuit, is employed for determining the point of resonance, the wave-meter must invariably be placed nearer to the circuit than when connected in the regular manner (Fig. 1). If so the inductance coil should be placed near to the earth lead.

Owing to the fact that greater radiation takes place from the open circuit than from the closed circuit, the wave-meter may be placed at a greater distance, when making the first measurement, than when making measurements of the closed circuit.

Calibration of a Wavemeter

If a calibrated wave-meter can be procured, the wave-meter described at the beginning of this article may be calibrated from it in a simple manner as per Fig. 9. In the diagram L and C are respectively the inductance coil and condenser of a standard wave-meter, which is set into excitation by the buzzer, H, and batteries, B. The windings of the magnets of the buzzer are shunted by the condenser, K, of about 1 microfarad capacity. A non-inductive resistance of about 100 ohms may be substituted for K.

When the buzzer is set into operation, the wave-meter, L C, becomes a miniature transmitting set, emitting waves of a definite frequency, which will be recorded on the wave-meter, L^1 C^1, when it is in resonance with L C.

The standard wave-meter, L C, is then set at various wave-lengths and the buzzer set in operation, being carefully adjusted for a clear tone. The capacity of condenser, C^1, is then altered until a maximum of sound is heard in the head telephones. Obviously L^1 C^1 has the same wave-length as L C and a record of the setting is made accordingly. Thus if six or eight readings are taken, covering the entire scale of C^1, points may be located on cross section paper and a curve drawn. Intermediate values of wave-length are readily determined from the curve.

For accuracy during calibration, the degree of coupling between L and L^1 must be kept as low as is consistent with the strength of signals. If response is

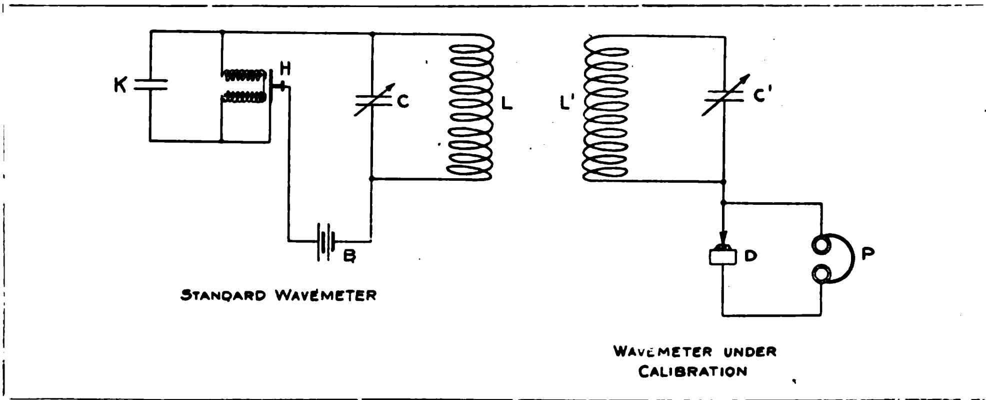


Fig. 9

not readily secured at the wave-meter, $L^1 C^1$, it may be that the values of inductance and capacity are such as to be out of resonance with the standard wave-meter, L C. If so, different values of inductance or capacity must be selected until a resonant response is secured.

The crystal rectifier need not necessarily be connected unilaterally to the wave-meter, but may be employed as indicated in the diagram (Fig. 1).

(To be continued)

BOMBAY WELL EQUIPPED.

Bombay, like all the principal ports in the world, is now fully served with wireless telegraphy equipment to meet present requirements, and this has been demonstrated in the work that has been carried out at the new wireless station on Butcher Island. When wireless facilities were first given to Bombay it was in the form of a low-power station at Back Bay, and as the apparatus had a radius of only 200 miles the value of the station was not sufficient to induce a great deal of business. If a steamer approaching Bombay, for instance, wished to communicate with the station this could only be done when the vessel was within a comparatively few hours of land, but with the new station on Butcher Island a message can be sent to Bombay by a passenger on a steamer when she is almost two days' journey from Bombay. A little over 600 miles is the furthest distance at which Butcher Island has been able to "pick up" a steamer, but at Karachi there is also a wireless station with a radius of 600 miles, and as a steamer coming from home to Bombay enters the zone of the Karachi waves first, time may be gained by sending Bombay messages through Karachi.

All these improved conditions have tended to increase the volume of wireless business transacted at Bombay, and at the present time an average of thirty inward and outward messages are dealt with per day. The principal source of business comes from passengers on the passenger steamers travelling to and from Bombay, and business usually reaches its most brisk stage when a home steamer is in touch by wireless. Although the Butcher Island station is further away from the point of receiving and despatching messages—the Bombay Telegraph Office—than the old station at Back Bay was, no appreciable time is lost in dealing with messages, as the station and the Bombay office are connected by cable. The Butcher Island Station is under the control of the Indian Telegraph Department, but the officers stationed there are military officials.

Advice From Amateurs

R. FERRIS, of Michigan, writes:

I have occasionally noticed queries from amateurs in respect to construction of flat plate glass condensers, which would indicate that trouble is often encountered. The following advice was taken from Stanley Curtis' article, "High Frequency Resonators," in the Electrician and Mechanic for July, 1911:

> To coat the plates, place them in an oven and heat for five minutes; remove them and rub the surface with beeswax. The tinfoil should have rounded corners, and just before it is spread over the surface of the glass, a piece of copper or brass ribbon should be slipped underneath, making a lug for connections. Spread the tinfoil on the other side in the same manner, and when completed paint the edges with hot beeswax. Beeswax is far superior to shellac because it does not blister like shellac.

I have tried this method and can heartily recommend it, having constructed all my plates in this manner. I have never experienced failure with a single plate.

* * *

F. C. Beekley, of Pennsylvania, says:

A good many amateurs use photographic plates 8 by 10 inches, for single condensers, but experience difficulty in removing the film from the plate. Here is a process that works to perfection: Make up two solutions as follows: No. 1, sodium fluroide, ¼ ounce; water, 16 ounces; No. 2, sulphuric acid, ¼ ounce, water, 16 ounces.

Place the plate in solution No. 1 for about two minutes, then change to No. 2. The film should then slip off in about three minutes. It should not be necessary to scratch the film off.

Should the amateur wish to construct copper-plated condensers, he may do so in the following manner:

Have the glass plates silvered by some firm who make mirrors. Then copper plate on this, using the ordinary copper plate sulphate solution. This makes a highly conductive surface very close to the glass and is not likely to blister.

Black shellac will make your instruments look like a hard rubber finish. It may be prepared in the following manner: Use one package of black Diamond Dye to a ½ pint of orange shellac. If this does not give the desired lustre, put on a final coat of regular orange shellac.

* * *

Page Hazleton, of New Hampshire, writes:

Amateurs usually desire an aerial of the greatest possible height, and to obtain a light weight antenna of sufficient height for use with portable sets presents a problem difficult of solution. To fulfill this want, the writer constructed a kite such as is described in Volume 4, Part 4, of the Mount Weather Observatory Bulletin. This publication, which describes several good types of kites, may be obtained from the Superintendent of Documents, Washington, D. C., for 25c.

The kite was flown with No. 22 steel wire, which of course also acted as an aerial. The wire offered considerable resistance, but notwithstanding the aerial was found to be very efficient for receiving. All attempts at using copper wire for the aerial were found to be useless, for the wire was either too light to stand the strain or if heavy enough required several kites in tandem to raise it.

If the kite is very high, even on clear days, a Geissler tube will glow brightly when held on the wire, and unlooked for shocks may be felt. Therefore it would be well to have some sort of protective device for the receiving set.

Using this type of an aerial, I have heard all wireless stations of high and low power, between Key West and Glace Bay, besides several others using long wave-lengths whose location I have so far been unable to determine.

* * *

Orrin E. Dunlap, of New York, writes:

I notice in the May issue in E. A. M. Jr.'s query, you state that the stations VBG and VBF are not listed. VBG is the Marconi station at Toronto, Canada, and VBF is the Marconi station at Fort Burwell, Ont., Canada.

* * *

H. M. Umburger, of Michigan, says:

I find the discussions I often hear as to the sensitiveness of the various forms of receiving detectors amusing in the extreme. Personally, I have never seen the piece of galena or, for that matter any other crystal, that could approach the audion in sensitiveness. I would wager almost anything that those who have contrary views did not use the audion properly. The first night I used the audion (at home) I heard more stations in one minute than I had picked up with galena in three weeks. The tuning effect that can be accomplished by a variation of the voltage in the telephone circuit is remarkable.

COLORADO AMATEURS ORGANIZING A LEAGUE

A Mesa County (Col.) Wireless League, with stations at various points, as well as a central station in Grand Junction, is the latest plans of the wireless enthusiasts who are organizing the club in that city. Secretary Cox of the Y. M. C. A. has received numerous requests for further information. Wireless enthusiasts have sprung up from many places, and the plans for the club are being rapidly formed.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

A Spark Gap Possessing Several Advantages

This is a description of type of spark gap which I believe to be of novel construction. It possesses several advantages, such as freedom from noise and airtightness; it gives quenched effects and, owing to the extreme lightness of the moving parts, allows quick starting and stopping with a very small motor. Referring to the diagram, Fig. 1, the rotating wheel is 7 inches in diameter and shaped somewhat after an 8-pointed star. It is cut from 1/16-inch aluminum and mounted on a 3-inch fibre insulating hub as shown. The wheel may be cut with ordinary tin shears and bored with a hand drill. It is then placed between flat slabs or boards under pressure, which should flatten out the aluminum, giving a true wheel.

The casing for enclosing the wheel should also be turned from fibre, although hard wood may be used at less expense if care is taken in the cutting, with the additional precaution of making the walls somewhat thicker. The inside diameter of this drum is 8 inches and the depth ¾ inch; the walls may be from ¼ inch to ½ inch. The cover is turned from ¼-inch fibre and screwed on tightly, making the casing airtight. If the hole for the motor shaft is made an easy fit and all work well done, the shaft will run in the centre of the hole without contact or vibration. The cas-

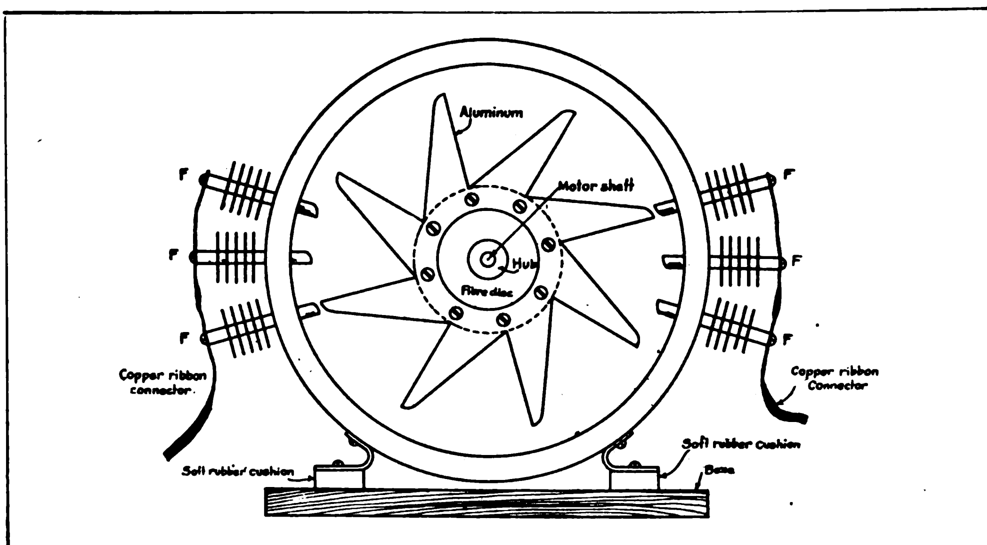
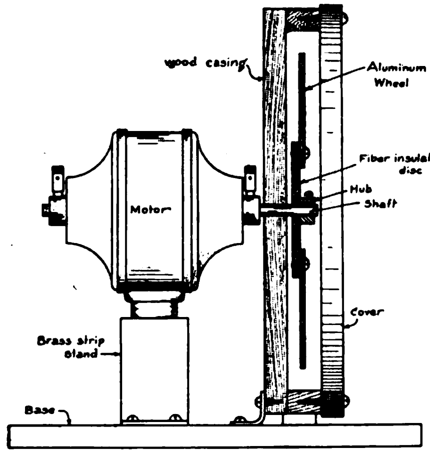


Fig. 1, First Prize Article

ing may be mounted as shown with brass angle pieces or in any convenient manner.

The fixed electrodes F are turned from brass and are supplied with cooling fins. They are made from ⅜-inch shanks with the outer ends tapped with an 8/32-inch thread to take a screw which is used to clamp the connecting ribbons from the condenser and inductance. The 3-pair arrangement of electrodes as shown, properly spaced, gives much better cooling than that afforded by the usual construction, for each electrode gets only every third spark during rotation. This gives, with an 8-tooth wheel, 24 sparks per revolution, producing a high tone with a low speed, whereas the ordinary gap would require a 24-tooth disc, a heavier wheel or as an alternative a small wheel and an extremely fast motor. My arrangement allows quick starting, which is further facilitated by using a 2-point switch in the motor circuit; that is to say, full power is thrown on the motor for quick acceleration, and when the switch is placed on the second point, a resistance coil is cut into the circuit.



Side View, showing gap in cross-section

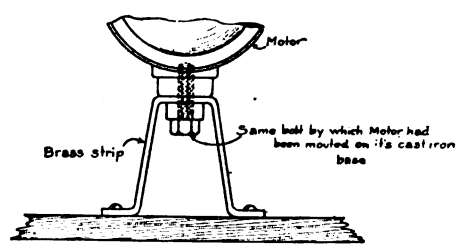
Fig. 2, First Prize Article

The wheel should be carefully balanced on the hub before final mounting, shaving off the material on the heavy side. The motor I use is a high speed series Universal motor, which may be purchased at a cost of $5.00.

The speed regulator is made by winding No. 30 bare German silver wire on a 1-inch porcelain tube 10 inches in length. The wire may be easily spaced by winding two wires closely side by side, then fastening one and unwinding the other. The tube thus wound is suitably mounted and a slider attached to it, after the same manner employed in connection with tuning coils. If a very high voltage (15,000 or 20,000) is used, two or three plates of the ordinary quenched spark gap type should be used in series with the rotary, or if this is not done, the wheel may be made larger or two pairs of fixed electrodes may be used with a higher speed. The latter is probably advisable because in order to secure a good tone on any rotary gap, the electrodes must be set very close and the spark must not be allowed to jump two electrodes at one time, as would happen if the wheel were too small.

Fig. 2 is a side elevation of the gap, showing the mounting of the motor and the disc to the shaft. Fig. 3 is a detailed diagram of the base and the method of mounting the motor.

In regard to spark tones, it is my opinion that a low resonant tone is as pleasant as a high whistle, but I note that the condenser capacity should be of small value if quenched effects are desired. I believe this gap will be a welcome relief to amateurs from the noise of the open rotary gap and from the ponderous flywheel type having a rotary disc with brass plugs.



Showing best way to mount motor, for looks, lightness, and absorbtion of vibration.

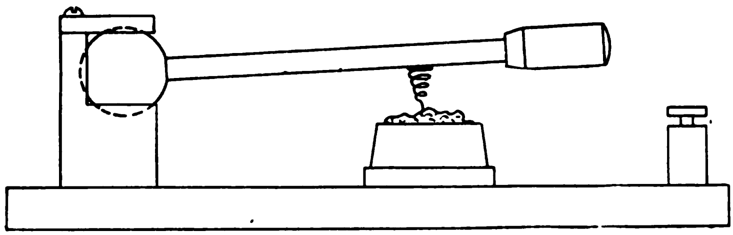
Fig. 3, First Prize Article

D. F. Stetson, Minnesota.

SECOND PRIZE, FIVE DOLLARS

A Detector of Simple Construction and Great Stability

After reading the many articles on the construction of galena and silicon



Diagram, Second Prize Article

detectors in various publications, I thought it advisable to offer a description of a design (accompanied by a drawing) which has fully proven itself of value for use at any commercial station and at present is employed on the 2 K.W. radio tractors (auto trucks) of the United States Signal Corps. As to stability, it is all that can be desired. In a certain test which I witnessed, the detector was shunted by a 5 Mfd. condenser while the transmitting set was in operation, and I was surprised to note that it did not lose its adjustment in the smallest degree when the 2 K.W. transmitter was operated not more than one foot from it. Incidentally, when the generator and engine was started, the entire auto shook so that the spring contact of the detector vigrated violently; still the detector did not lose its adjustment. This, I believe, is a more severe test than it will receive in the average amateur station.

The upright consists of a piece of ½-inch square brass rod filed out as shown, the figure being to scale. A piece of 1/16-inch brass, ½-inch square is then cut and fastened with screws as shown. A ½-inch brass ball is next drilled and tapped for 8/32-inch thread and a piece of No. 8 brass wire 1¾ inches long is threaded at both ends for 8/32-inch thread. One end is placed in the ball and the other end has a hard rubber knob fastened to it. The spring consists of about three inches of No. 28 silver wire coiled in three widely separated coils as shown. The projections into the brass rod for the ball to fit into are made with a 5/16-inch drill.

The upper part should clamp the ball fairly tight so that the spring will remain in any position it is placed, at the same time allowing a wide range of adjustment. The cup is one inch in diameter and fastened so it can be revolved. In it are mounted crystals of silicon and galena.

MORTON W. STERNS, Pennsylvania.

THIRD PRIZE, SEPTEMBER, THREE DOLLARS

A "Loose Coupler" of New Design

Of late I have seen described in THE WIRELESS AGE many types of inductively coupled receiving transformers, but none, I believe, are as easily constructed or are more efficient than the one I am about to describe. My design has two distinct advantages over the general type of this tuner: first, it takes up less space (a matter of importance in cabinet sets); second, it takes less time to operate the secondary switch and coupling.

If the cabinet is made of hardwood, say, quartered oak or mahogany, and is fitted with hard rubber knobs, scale and slider, it makes an instrument of beautiful appearance. The general idea of design of the cabinet and the instrument itself is shown in Fig. 1. It will be observed that the primary winding is similar to that employed in any tuner, while the secondary winding is made on a thin, narrow, circular disc placed inside the primary winding and so mounted that it can be readily turned at right angles to the primary or at any angle as desired.

The essential dimensions of the cabinet are shown in Fig. 1. The cut-out piece in the top for the primary slider is easily made. The two pieces of wood for the top should have dimensions of 2½ inches by 8¾ inches, and so placed that a space ¾ inch in width is left in the middle. The overhang should be to it at each side ⅛ inch away and have it pass completely around the core. At any point on the centre line drill a hole of sufficient size to allow a piece of 3/16-inch tubing to turn easily in it. Beginning ½ inch from the ends of the core, start the winding of the primary coil. On reaching the first line ⅛ inch from the center, bring the wire across to the other coil in such a manner that it does not cross the hole. Then continue the winding to within ½ inch of the other end.

The secondary coil is wound with No. 30 D.C.C. wire on a disc ⅜ inch in diam-

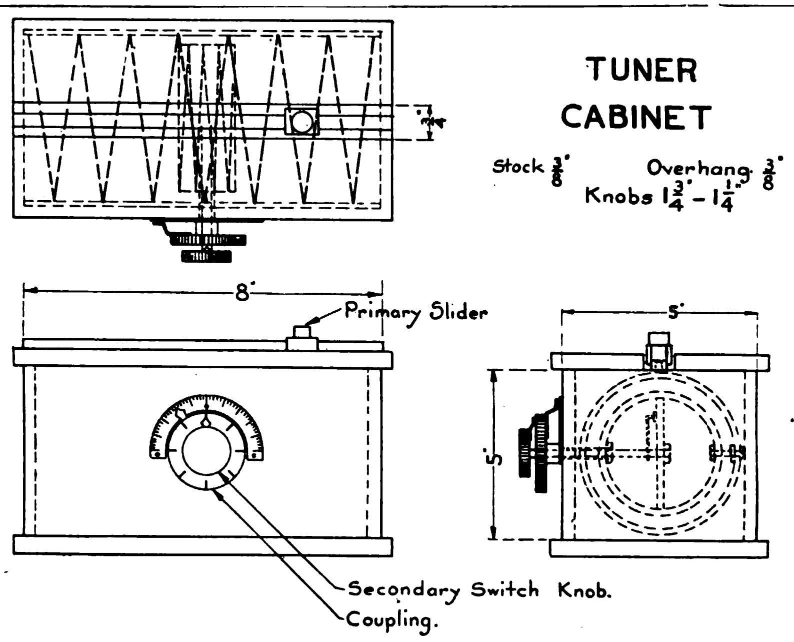


Fig. 1, Third Prize Article

⅜ inch on all sides. Blocks ¾ inch by ¾ inch should be fastened in the ends of the cut, making sure that the ends of the blocks set flush with the ends of the top, so that they have the appearance of being a part of the same piece. As the rod for the slider is fastened down on the blocks, the joint is not very noticeable. The primary is wound with No. 24 D.C.C. wire on a core 4 inches outside diameter, 3/16 inch in thickness and just long enough to fit tightly inside the cabinet (about 7¼ inches). Next find the centre of the core and draw a line complete around it. Draw a line parallel eter, 3/16 inch in thickness and 1¼ inches in width. The circular disc is mounted inside of this core and the switch points for the secondary taps are placed on it. Grooves are cut in the opposite side of the core of sufficient size to allow the disc to slip into its correct position. A little glue will hold it in position, but it should not be fastened until the secondary winding is made. This disc is preferable made of hard rubber ⅛ inch in thickness and should have a diameter of ⅛ inch more than the inside of the secondary core.

The size of the circle in which the

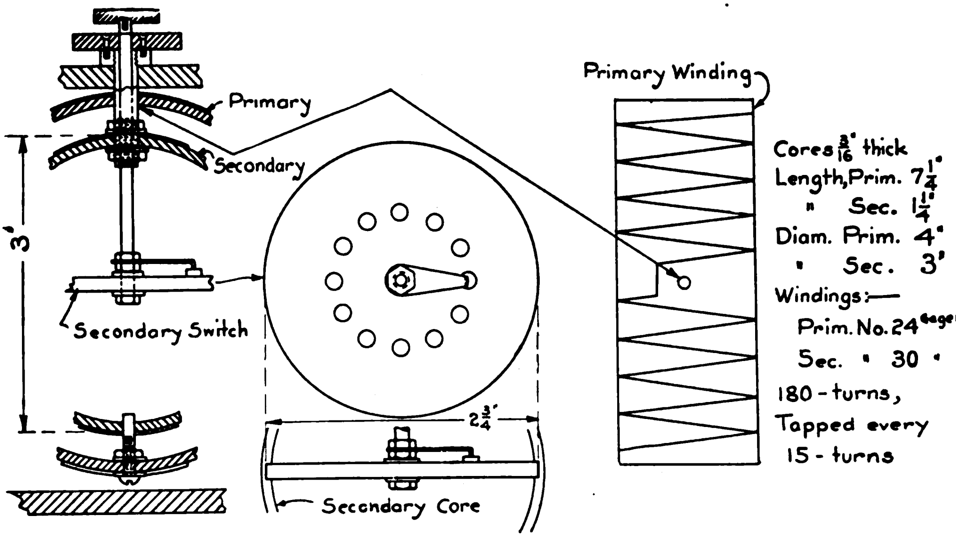


Fig. 2, Third Prize Article

taps of the secondary winding are placed will depend on the size of the heads of the switch point and consequently the dimensions of the lever will have to be left to the maker's discretion. A point should then be found on the circumference of the core half-way between the two grooves and a hole drilled just large enough to fit a 3/16-inch rod. The rod is then cut off to the length of 2⅜ inches and the end glued in the hole. A bolt is placed directly opposite this as shown in Fig. 2. This forms the other bearing for the secondary winding. A piece of ⅛-inch brass rod is then fastened to the smaller knob, placed through the rubber tubing and fastened, as shown, to the hard rubber secondary switch. The secondary leads should be of flexible wire and brought to two binding posts on the right hand end of the cabinet. The primary binding posts should be placed on the left hand. To complete the equipment, screw down the top and attach the primary slider.

Alex. Cochran, New York.

Note.—We see only one objection to this design. The secondary winding being placed in the center of the coil, it is possible that for certain wave-lengths the values of inductance in use for the primary would be small and the turns would be widely separated from the secondary windings, producing little or no effect. We therefore believe that the secondary winding should be placed on one end of the coil so that it is in the magnetic field of the primary turns, regardless of the number of turns in use in the primary winding. We are aware, however, that this would spoil the neatness of the design.—*Technical Editor.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Novel Non-Inductive Potentiometer

This is a description (with sketches) of a non-inductive potentiometer which I have constructed and which I believe is of novel design. The completely assem-

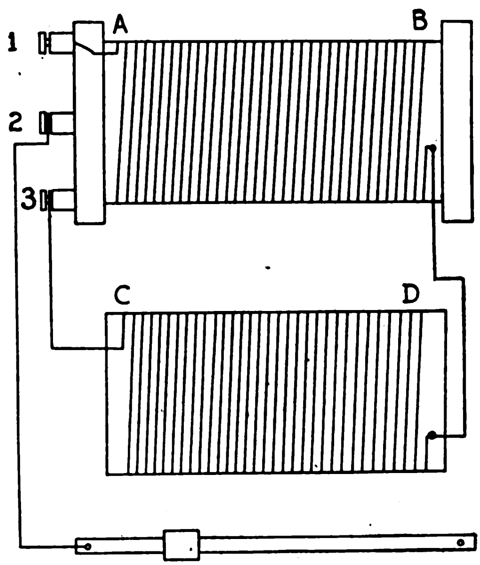


Fig. 1, Fourth Prize Article

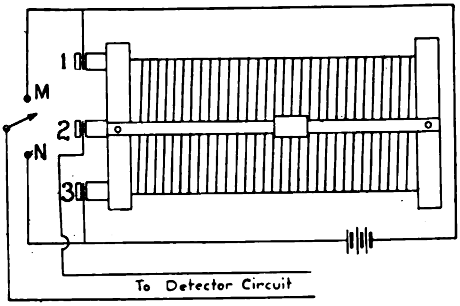
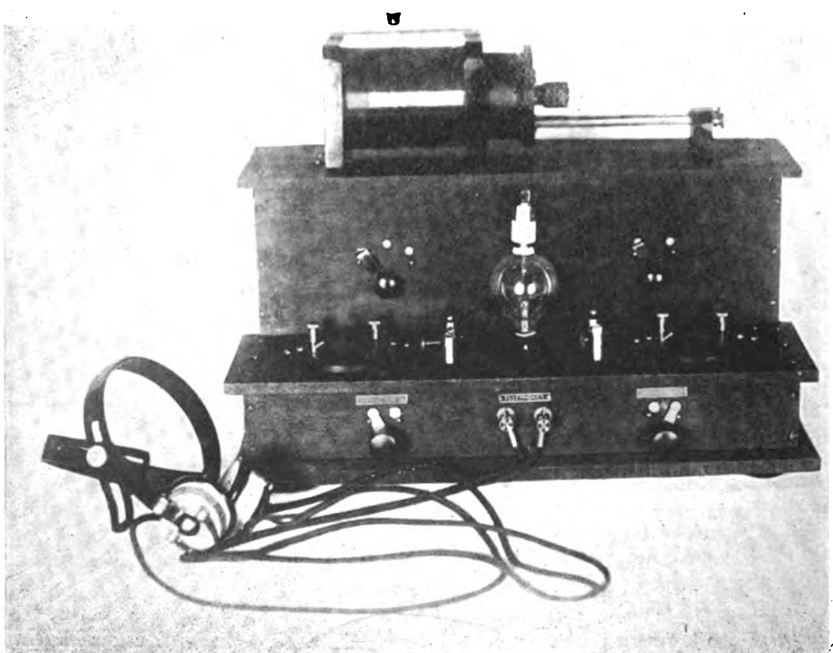


Fig. 2. Fourth Prize Article

bled instrument is shown in Fig. 2 and its schematic drawing in Fig. 1. The potentiometer consists of two windings, namely, AB and CD. CD is wound in the opposite direction to AB and is placed directly over the slider shown in Fig. 2, which makes contact with the coil, CD. The construction of this potentiometer requires a sixth of a pound of No. 30 bare German silver wire. The coil, AB, should take about half of this wire and should have resistance of about 500 ohms. Coil AB should be covered with shellac or any insulating material at hand. The remainder of the wire is, of course, put on CD. The turns of bare wire may be conveniently separted by spacing the wire with thread during winding.

The slider, S, may be such as employed with any receiving tuner. I use in connection with this poteniometer a 2-point switch, MN. If the switch is only placed on point M, the energy in the detector circuit must pass through coil, AB, which is the under-winding, having a resistance of about 500 ohms. Then, by variation of the position of the slider in the top winding, the resistance value of the potentiometer may be progressively varied from 500 to 1,000 ohms. If the switch only is placed on point N, only the upper winding, CD, can be used; therefore by the use of the slider, any resistance value from zero to 500 ohms is obtained. The entire potentiometer, however, gives a range of resistance from zero to 1,000 ohms. It also makes a very neat and compact instrument, removing to a great extent inductive effects, which, I believe, is a very common fault with potentiometers constructed of German silver wire.

Arthur Kenison, Massachusetts.

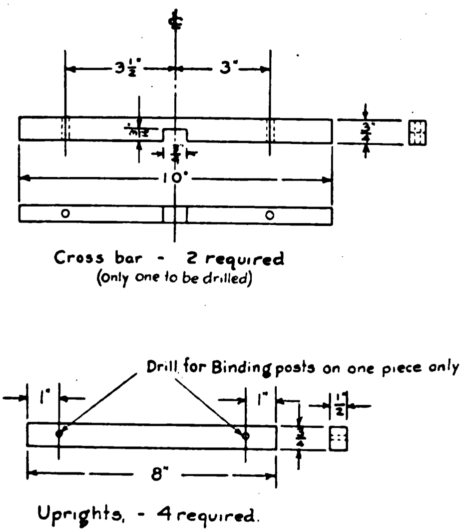


Photograph, Honorable Mention Article, Orrin E. Dunlap

HONORABLE MENTION

An Efficient Receiving Set

This article contains a description, accompanied by a photograph, of a com-



Honorable Mention Article, Roy Yates, Fig. 1

plete radio receiving equipment which I have designed and partly constructed. It has found great favor among the amateurs who have visited my station. I feel it would be well worth while to put it before other wireless enthusiasts and give them a chance to make a similar outfit, thereby deriving the benefit from a compact and efficient receiving set.

It has been possible under good conditions to hear NAX (Colon, Panama) and NAR (Key West, Fla.) and other distant stations on this set. Everything is well balanced and the connections are short and made of stranded wire, thereby decreasing the resistance.

The case is of ⅜-inch mahogany and measures 12 inches in width, 7 inches in height and 18 inches in length. The base is ½ inch, cut so as to extend ¼ inch. The top and sides are fastened with round head brass screws.

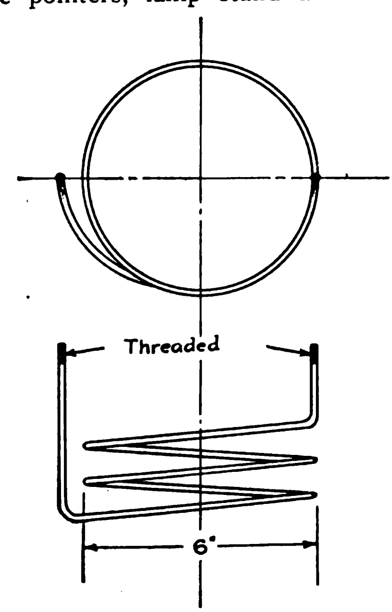
It will be necessary to buy or make a loose coupler. I prefer to purchase one, as it will be made correctly and, furthermore, I can then select a tuner suitable to my needs. When mounting on top of cabinet do not forget to bring through 1 connection from each end of primary, 1 from slider and 1 from the terminals of the secondary.

It is best to buy two 15 or 20 plate rotary variable condensers. Those used in this set are of the Clapp-Eastham type. The rheostat for the audion detector is the regular round battery type and is fastened on the back of the cabinet.

There are 2 switches: the one at the right of the bulb is in series with the bulb; the other connects with the flashlight cells which are located under the loose coupler in wood partitions.

Two holes are drilled on the lower front and in the middle for the telephone binding posts. The switch to the left of these binding posts throws either of the two galena detectors into use. When galena is used the telephones should be placed in the binding posts on the right side of the case.

All connections are made with silk covered stranded wire. This is easy to work with, as the insulation can be pushed back to make the connections. The pointers, lamp stand and binding



Honorable Mention Article, Roy Yates, Fig. 2

posts are all lacquered brass. The knobs are made of hard rubber.

This completes the description, and if followed out carefully (consulting drawing), there ought to be no trouble in

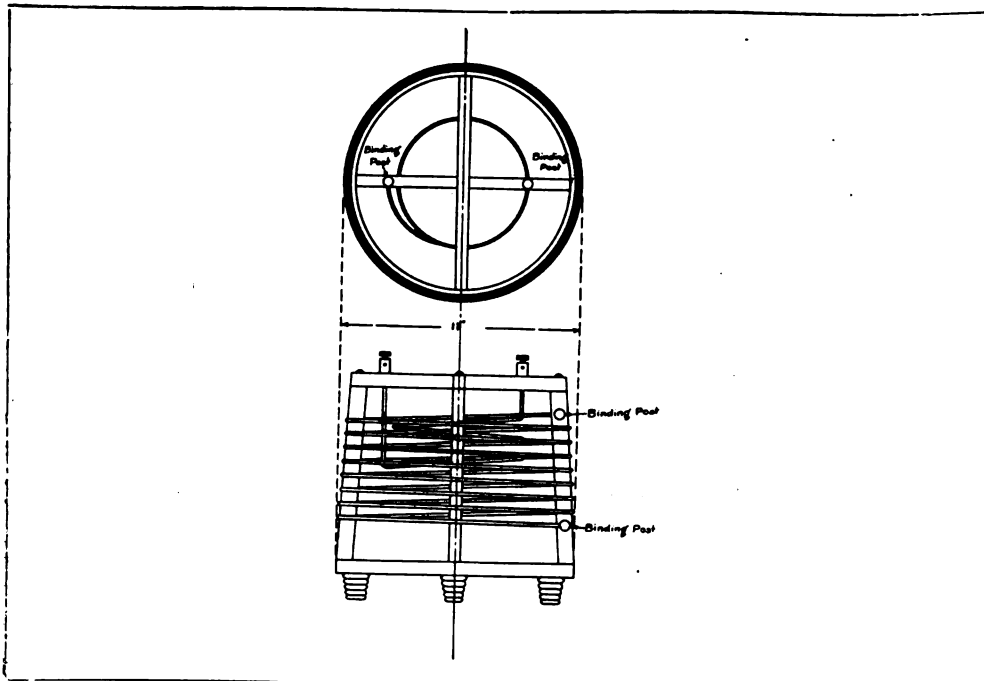


Fig. 3, Honorable Mention Article, Roy Yates

making it work and getting exceptional results.

Orrin E. Dunlap, Jr., New York.

HONORABLE MENTION

A New Oscillation Transformer Design

A properly constructed oscillation transformer is generally an instrument not to be found in many amateur stations. The following description tells of one the writer recently constructed. This transformer not only works efficiently, but has quite a "nifty" appearance. The pieces of wood needed are shown in Fig. 1. They are cut from ¾-inch quartered oak. The cutting may be done at the mill where the wood is bought for a few cents extra and a good job assured. Assemble the pieces as shown in the drawing, using 1½-inch brass screws. Next, sand paper well and dry the frame in an oven to expel all moisture. Apply a thin, even coat of a good grade of shellac and set away to dry. (In case of using varnish, be sure that it contains no mineral matter, as the instrument would be rendered almost useless. Shellac is preferable to varnish.)

Procure 25 feet of No. 6 and 5½ feet of No. 4 brass helix wire. Take the No. 6 wire and file the ends down. The ends are then threaded for the length of an inch with an 8/32 die. This is for attaching the binding posts. After the wire is wound on the frame the ends are put through the holes in the piece, B, in Fig. 1. The binding posts are then attached and screwed up until the wire on the frame is pulled fairly tight. Bend the No. 4 wire as shown in Fig. 2. The ends of this are also filed down and threaded the same as the No. 6. The wire is then attached to the frame as shown in Fig. 3. The ends are drawn through the holes in the cross piece and the binding posts attached. After placing three large insulators on the bottom you will have an instrument to be proud of.

Roy Francis Yates, New York.

Note.—We infer that the small coil is intended to be used as the primary winding (for the spark gap circuit), while the larger winding is connected in series with the aerial. We believe it desirable to boil the wood in hot paraffin as shellac is apt to retain a certain amount of moisture, causing leakage.—Technical Editor.

List of Officials

MARCONI WIRELESS TELEGRAPH COMPANY

OF AMERICA

NEW YORK

Woolworth Building, 233 Broadway

John W. Griggs, *President*
Edward J. Nally, *Vice-President and General Manager*
John Bottomley, *Vice-President, Secretary and Treasurer*
Frederick M. Sammis, *Chief Engineer*
George S. De Sousa, *Traffic Manager*
David Sarnoff, *Contract Manager*
John Young, *Auditor*
William B. Vansize, *Patent Attorney*
G. Harold Porter, *Purchasing Agent*
J. Andrew White, *Editor of Publications*

Operating Department - - - 29 Cliff Street

E. T. Edwards, *Superintendent Eastern Division*

SOUTHERN DIVISION—American Building, Baltimore, Md. C. J. Pannill, *Superintendent*
GULF DIVISION—Metairie Ridge Road, New Orleans, La. - A. Mowat, *Superintendent*
GREAT LAKES DIVISION—Schofield Building, Cleveland, Ohio. E. C. Newton, *Supt.*
PACIFIC COAST DIVISION—Merchants Exchange Building. A. H. Ginman, *Gen'l. Supt.*

Interesting Equipments

The steam yacht Wakiva, which has recently been equipped with a Marconi set, was put into service by her owner, H. S. Harkness, for the purpose of cruising in foreign waters to bring back some of his friends who had been stranded abroad when war was declared. It was decided not to begin the voyage until wireless had been installed on the vessel.

The San Silvestre was in Newport News for only thirty-six hours recently, but during that time she was equipped with Marconi wireless apparatus. Before she departed from England for this country arrangements were made with the English Marconi Company for the installation of a set on her arrival in the United States. The English company notified the American Marconi Company and the Southern Division was instructed to send men to Newport News to equip the vessel. She steamed out of Newport News as soon as the work had been completed.

The Gulflight, Gulfstream, Neches and Medina, which have been equipped with Marconi installations, are vessels in course of construction.

VESSELS EQUIPPED WITH MARCONI WIRELESS SINCE THE AUGUST ISSUE

NAME	OWNERS	CALL LETTERS
Louisiana	The Texas Company	KUL
Northtown	The Texas Company	KUN
Texas	The Texas Company	KUR
Northwestern	The Texas Company	KWO
Neches	Mallory Steamship Line	KEE
Medina	Mallory Steamship Line	KEF
Gulfstream	Gulf Refining Company	KTB
Gulflight	Gulf Refining Company	KUW
John D. Rockefeller	Standard Oil Company	KTO
Nantucket	Merchants & Miners Trans. Co	KVN
Henry M. Flagler	Peninsula & Occidental SS. Co.	KOX
J. L. Luckenbach	Luckenbach Steamship Co.	KGT
Atlantic	Emery Steamship Line	KIR
San Silvestre	Eagle Oil Transport Company	MAK
Wakina	H. S. Harkness	KYI

GIFTS FOR WINTERBOTTOM AND KAST

William A. Winterbottom and Paul C. Kast, recently resigned from the service of the Commercial Cable Company at New York to enter that of the Marconi Telegraph-Cable Company, were handsomely remembered by their office associates. Mr. Winterbottom was presented with a fine traveling bag, and Mr. Kast received a silver-mounted pen suitably inscribed, and also a very handsome set of engrossed resolutions expressing regrets at his departure and good wishes for the future.

The article on the share market is omitted from this number of The Wireless Age because of the closing of the Stock Exchange, due to the European war.

HAWAII IN COMMUNICATION WITH CALIFORNIA

Announcement has been made at Honolulu by N. H. Slaughter, resident engineer for the Marconi Wireless Telegraph Company, that preliminary tests of the two great plants erected at Koko Head and Kahuku have been successful and that day and night communication with the Pacific coast has been established.

The station in Hawaii has succeeded in transmitting day and night messages, but owing to the non-completion of the California station full communication cannot yet be established. The California station is not ready to send. The delay in completing the California station is due to inability of the manufacturers to supply the immense amount of glass used in the condensers.

MARCONI KNIGHTED

A dispatch from London says: The King received Guglielmo Marconi at Buckingham Palace on August 24, and conferred upon him the honorary knighthood of the Grand Cross of the Royal Victorian Order. This is the newest order of knighthood, dating from 1896. It has five classes, of which the Grand Cross of the Victorian Order is the highest. The English members of this class take the title of "Sir," but honorary members are chiefly foreigners, and do not use the title.

"I received a telegram calling me to Buckingham Palace," said Mr. Marconi to a newspaper correspondent. "The King talked with me for twenty-five minutes on wireless telegraphy and all my latest discoveries and the application of them to the naval service. The King knew a very great deal on the subject. particularly about the use of wireless for naval purposes. As I was leaving his Majesty handed me the decoration of the Order. The King spoke very kindly to me about my work. I appreciate the honor all the more because his Majesty found time to confer it on me at this busy time in politics."

Mr. Marconi is the third Italian to receive this honor. The others are the Duke of the Abruzzi and the Marchese de San Guiliamo.

RECEIVING OFFICES FOR MARCONIGRAMS

The Marconi Wireless Telegraph Company of America has made arrangements whereby messages to Great Britain and Ireland, to be sent via its transoceanic service, will be accepted at the John Wanamaker stores in New York and Philadelphia as soon as the service is opened. The rate from New York will be seventeen cents a word, and from Philadelphia twenty cents. An announcement made by the Wanamaker store in New York is as follows:

"Marconi messages to friends and relatives on incoming ships will be accepted here for delivery at the official Marconi office here in the store—at the information bureau, main floor, old building. Trans-oceanic wireless messages to Great Britain and Ireland will soon be accepted here also. Deferred marconigrams, lettergrams and week-end lettergrams will be transmitted at considerable reductions below existing cable rates. To deliver marconigrams promptly it is essential that you furnish us at once with your registered cable address, which will be sent to the main Marconi office for filing. Those having charge accounts with us may have their Marconi messages charged on their regular monthly statement."

CANADIAN CO. EXPANDING

The Marconi Wireless Telegraph Company of Canada, Ltd., has found it necessary to increase its office accommodation, and the address of the company is now Room 507, Shaughnessy Building, 137 McGill street, Montreal.

The company's manufacturing business has also outgrown its accommodation, and new works have been acquired in Rodney street, comprising a three-story brick factory building, which will provide excellent accommodation for the staff.

WAR STOPPED VOYAGE

The proposed voyage of the Lundin power lifeboat across the Atlantic has been abandoned because it was feared that she would be mistaken for a submarine by craft of the warring European countries.

Marconi Men

The Gossip of the Divisions

Eastern Division

Harold Mack, recently returned from a trip on the British SS. El Cordobes, was assigned to the SS. Texas of the Texas Oil Company, which was equipped on August 1.

L. M. Burt, formerly second operator on the Sabine, was assigned to the Louisiana of the same company, equipped on August 1. C. M. Meyer, a school graduate, relieved Burt on the Sabine.

C. A. Biddinger, a school graduate, has been assigned to the El Valle of the South Pacific line.

John Lohmann and R. R. Squires have been assigned to the El Dia of the Southern Pacific line.

James Devenport has been assigned to the Desola as assistant to Operator Trautwein.

A. Bernhard and C. A. Werker of the Segurance have been transferred to the Algonquin. H. E. Ingalls and E. A. Arnold relieved them.

R. H. Poling and A. G. Berg were assigned to the Esperanza on August 6, when she went into commission again.

J. P. Eckhardt is relieving P. B. Lewis on the Radiant for one trip. Eckhardt has just recovered from a two months' siege of typhoid fever. He was formerly on the W. B. Keene.

J. C. Stewart of the Northland has been transferred to the Maracas. His place on the Northland has been taken by J. B. Harte, formerly of the Guiana.

H. B. Cowan of the Arapahoe has been transferred to the Maracaibo, being relieved by Operator C. L. Beach, formerly on the Maracas. E. A. Beane is second.

C. E. Burgess has relieved J. A. Worrall on the St. Paul.

P. Barkley has relieved F. J. Murphy on the Florizel.

B. P. Adams has been transferred from Belmar to Sagaponack.

N. D. Talbot has been assigned to the Admiral Dewey and I. L. Church to the Admiral Schley. These vessels sailed for the Pacific coast the early part of last week. They were equipped in the spring of the year and had been expected to leave daily since then.

F. S. Monschau, recently disembarked from the Orteric, to which he was assigned several months ago, has been temporarily assigned to the Jamestown, relieving Operator H. C. Tuttle, who is having trouble with his teeth.

F. J. Murphy is en route for Hayti on the Prinz Muaritz of the Royal Dutch West India Mail.

E. B. Hayward of the Marconi School, has been assigned to the Illinois of the Texas Oil Company.

R. T. Willy and R. Green have been assigned to the Antilla.

G. N. Robinson and C. T. Thevenet sailed on the Morro Castle on August 13. The Morro Castle has been laid up since July 13.

J. C. Maier has re-entered the Marconi service and was assigned to the Guiana on the 13th inst.

J. J. Simpson of Belmar has been assigned to the New York of the American line.

C. B. MacPherson, formerly of the Parima, has been transferred to the SS. Atlantic City, relieving Operator A. H. Lynch, who has been detailed to the S. Y. Wakiva, sailing for European ports. It will be remembered that Lynch was formerly operator of the S. Y. Wakiva stationed at Tampico, Mex. There are two Wakivas.

L. R. Rogers has been transferred to the Brazos, his place on the Bermudian having been taken care of by William Travers, formerly of the Brazos.

H. J. Meldrum, who was detailed to the Ludin Lifeboat, has returned to New York and is back at the Boston station again. From all accounts the lifeboat had every appearance of a submarine boat and might have encountered all sorts of difficulties had it continued on its trip to Europe.

J. F. Forsyth has relieved E. E. Oxner on the Currier, as a result of which Operator Ericson has been made first operator of the Nacoochee, assisted by W. J. Henry, who just entered the service.

J. R. Byers and G. Entwistle have been assigned to the North Star, which went into commission on August 6.

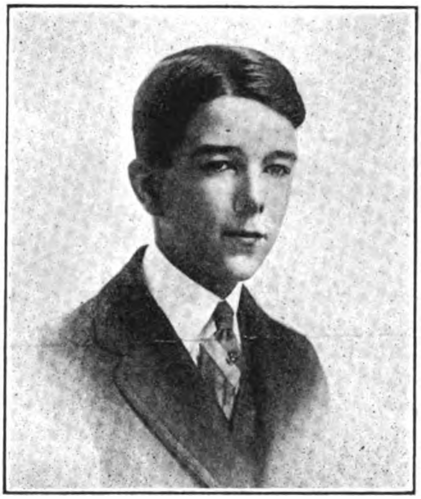
E. B. Seaman, who has re-entered the service, has been assigned as second operator to the City of Atlanta.

Since August 1 the following graduates of the Marconi School has been given employment: C. M. Meyer, the Sabine; C. A. Biddinger, the El Valle; John Lohmann, the El Dia; R. R. Squires, the El Dia; James Devenport, the Desola; H. Van Cott, the Northland; P. J. Goss, the Maracas: E. B. Hayward the Illinois; R. T. Willey, the Antilla: R. Green, the Antilla.

Southern Division

Operator W. P. Kelland, formerly of the SS. Ontario, has resigned to take a position with the Western Union at Norfolk. The attraction at Virginia Beach was too strong for Kelland.

Chief Inspector Eugene Murray has returned to Miami to complete the installation and test with Nassau on long wave lengths.



James H. Coolidge, youngest wireless operator holding a first grade commercial license

Operator W. J. Phillips has the misfortune recently to injure his right hand in attempting to start the engine at Virginia Beach, but is rapidly improving, after treament at the Johns Hopkins Hospital, Baltimore.

Installer M. C. Morris of Philadelphia with Installer Wyble from Baltimore recently equipped the British steamer San Silvestre off Lambert's Point in twenty-four hours.

Operators Rosenfeld and Brubaker of Philadelphia have been assigned to the San Silvestre for a voyage abroad.

The installation on the new Mallory steamer Neches was completed on the 11th. Operator L. H. MacDonald of Philadelphia will be assigned to her.

Miss Margaret Groton, bookkeeper at the Baltimore office, has returned after spending a week at her home in the country.

Operator Shallcross has been transferred from Miami to Cape May, and Operator Nelson from Cape May to Miami.

Manager Grantlin has been relieved at Miami, owing to poor health. He will be succeeded by Operator Chapman from Hatteras.

Operator J. Lessenco has returned to Baltimore from Virginia Beach. Lessenco has been on the extra list.

There are now ten new ship installations under way in this division. Good luck to our new contract manager.

D. J. Heilig has been promoted to the managership of the Philadelphia station.

This division was honored recently by a visit from Mr. and Mrs. Duffy of the Eastern Division. They took in all the points of interest at Baltimore and Washington.

Business is brisk in the sale of Ocean Wireless News. Special war bulletins are being sent out from Baltimore via wireless to Cape May and other stations for transmission to ships.

Operators on the SS. Dorchester were startled recently when the British cruiser ordered her to stop and fired three shots across her bow, off New York.

Great Lakes Division

R. C. Cutting, formerly operator and purser on the SS. Ann Arbor No. 3, has been appointed operator and purser of the SS. Ashtabula.

H. W. Walters, purser and operator on the SS. M. & B. No. 2, has left for his home at Port Royal, Pa., where he will spend a two weeks' vacation. Operator Miron Pesek is acting as relief operator.

G. Zanders, formerly operator and purser of the SS. Ashtabula, has returned to the SS. W. P. Snyder, on which he was detailed during the season of 1913.

The Marconi Training School at Cleveland, O., has been closed. C. I. Hoppough, who was instructing engineer at the Marconi School, is at his home in Smyrna, Mich., where he will spend a few weeks' vacation.

Operator E. C. Wahl has been appointed second operator on the SS. Northland, relieving Operator W. H. Chattfield, who has returned to his home at Ann Arbor, Mich.

Operator R. O. Hein has been transferred to the SS. City of Cleveland III as first operator. Operator G. Hospers relieved him on the SS. Western States.

Engineer A. E. Jackson recently made a trip to Detroit, Mich., accompanying United States Radio Inspector J. F. Dillon, to inspect the boats entering that part.

Engineer H. G. Smith was recently at Manistique, Mich., making alterations on the Manistique, Mich., station.

James H. Coolidge, fifteen years old, of Cleveland, O., a graduate of the Marconi School at Cleveland, is the youngest wireless operator holding a first grade commercial license.

Pacific Coast Division

W. P. Giambruno replaced G. H. Wheeler aboard the SS. Argyll August 5, Mr. Wheeler taking a vacation.

Mr. Smith relieved H. D. Jaggers on the SS. Asuncion July 29.

R. J. Phair relieved F. Mousley as second of the Bear July 29.

C. Bailey was assigned to the position of first aboard the SS. City of Sydney July 18.

L. T. Franklin joined the Celilo as assistant July 20.

E. D. Bryant, assistant on the Celilo, relieved A. M. Greenwell of the Astoria Station July 16.

A. M. Greenwell, who has been in charge of the Astoria Station for the past year, is taking a two weeks' rest cure. He will return to his position about August 11 and prepare himself for the benedict class. "CQ." Everybody copy.

O. Thiess was re-assigned to the SS. Enterprise July 28, relieving J. Miche, who is taking a two or three weeks' vacation at Monte Rio.

W. H. Friend, in charge of the Eureka Station, visited San Francisco during the middle of July for a couple of days. The Eureka climate seems to be very agreeable. Mr. Campbell of the SS. City of Topeka acted as his relief.

J. W. Ritter was assigned to the SS. El Segundo July 24.

A. E. Evans joined the SS. Falcon July 29.

J. A. Falke and E. T. Jorgensen relieved M. Smith and O. E. Johnson as first and second, respectively, aboard the SS. F. H. Leggett August 4.

N. A. Woodcock, formerly of the Seattle District, is now acting assistant to G. F. Roberts of the steamer F. A. Kilburn.

J. M. Langston relieved E. W. Lovejoy on the George W. Fenwick July 21.

J. H. Baxter, wireless operator and purser of the steamer Hilonian, rejoined his ship July 23 after a month's vacation.

F. C. Stucky was assigned to the Hazel Dollar August 5.

H. G. Austin was assigned to the Lurline July 21 as assistant to B. E. Fenn.

F. Mousley and H. R. Sprado were assigned to the Manoa August 3 as first and second, respectively.

J. F. Smythurst and E. Castle were assigned to the Nile as first and second, respectively, July 21.

P. R. Fenner is temporarily relieving I. W. Hubbard as assistant abroad the SS. Nome City.

H. Bodin and O. B. Mills will leave August 8 as first and second of the SS. Pennsylvania.

F. W. Shaw and C. E. McNess are temporarily holding down the SS. President.

G. H. Davis, a trans-Pacific appointee, is temporarily filling in as second operator of the SS. Rose City.

Congratulations to George Croasman, first of the Rose City. He's married, boys. It came off on the fourth.

H. D. Jaggers, who for the past fifteen months has rendered excellent service aboard the SS. Asuncion, was transferred to the SS. Richmond, the pride of the Pacific Standard fleet, July 29.

L. Fassett, formerly of the operating, later of the construction, latest of the operating, is serving on the SS. Santa Rita.

F. Deckard and R. Camp left San Francisco for Panama, July 28, as first and second of the SS. San Jose.

L. J. Tappan, formerly of the SS. W. S. Porter, joined the SS. W. F. Herrin August 4.

E. Smith was assigned to the SS. Wilhelmina July 27 as assistant.

W. D. Collins and M. J. Ensign were assigned first and second of the Yosemite July 23.

A. E. Gerhard, formerly of the Nile, is now temporarily in charge of the SS. Yale.

Seattle Staff Changes

Staff changes in the Seattle District during July were few, because all ships are in commission and busily engaged in filling the Alaska storehouse with supplies in exchange for the millions in gold and ore they are bringing out; also, all vessels have been crowded to capacity with an ever-increasing number of tourists, so that the operators have been too pleasantly busy with handling increased ship and tourist business to think of changes.

R. S. Powell, ex the SS. Senator, relieved G. V. Wiltse as first on the Mariposa.

A. E. Wolfe and Wiltse are now on the Admiral Evans, ex A. N. Marquis and A. E. Johnson, who resigned.

R. F. Harvey, a San Francisco operator, who has been second on the Humboldt, was transferred to the A. F. Lucas relieved by H. Lee.

William Christensen of the Seattle Station staff made one trip south on the Governor, being relieved by C. H. Trevatt, of that steamer. Chris says he didn't get sick, but he forgot to ask the second operator to keep "mum."

L. H. Simson, formerly second on the Queen, has been given charge of the tug Oneonta at Astoria.

J. F. Hammell, formerly employed in the San Francisco Division, is assigned as second on the A. G. Lindsay.

George L. Hayes, one of the best known of the Seattle District "old boys," who has been ill for a number of months, was recently assigned to the Stanley Dollar, but again found it necessary to be relieved from duty.

A. M. Greenwell, Astoria Station manager, is visiting his home in California. Mr. Hamilton is in charge, Mr. Smith is second, and Operator Bryant, ex the Cecilo, is filling in on third trick.

F. M. Ryan and H. Jones are first and second, temporarily, on the Senator.

H. Hatton and A. Lange have been transferred to the Spokane and the Northwestern, respectively.

P. C. Millard, ex second on the Spokane, has been promoted to take charge of the Tatoosh, relieving M. W. Michael, who takes Millard's place on the Spokane.

J. R. Irwin, superintendent of the Northern Pacific Division, has just returned from a two weeks' visit to San Francisco.

THE ROYAL GEORGE GETS SOS

While the steamship Royal George was in the Gulf of St. Lawrence bound for Montreal on July 22, an SOS call was received from the French steamer Sacha. Her position having been ascertained, the captain of the Royal George ordered full steam ahead for the point given, which was just off St. Pierre, Newfoundland. After proceeding for half an hour the Sacha signalled that she was out of danger, and that assistance was not required. It was learned later that there had been a serious fire on board, which, however, the crew had been able to extinguish.

WRECK OF THE INVERMORE

The steamship Invermore of the Reid Newfoundland Company, went ashore near Brigg Harbor, Labrador, on July 11, and is likely to become a total wreck. Her cargo included supplies for the Canadian Marconi Company's stations along the coast. A part of the supplies have been landed.

Queries Answered

Answers will be given in this department to questions of subscribers, covering the full range of wireless subjects, but only those which relate to the technical phases of the art and which are of general interest to readers will be published here. The subscriber's name and address must be given in all letters and only one side of the paper written on; where diagrams are necessary they must be on a separate sheet and drawn with india ink. Not more than five questions of an individual can be answered. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail

E. B. W., Belfast, Me.:

Replying to your first query, we can give you no specific advice concerning the strange station which you hear.

In Fig. 1 we have given you a complete circuit diagram of the Fleming oscillation valve and all accessories. R is a rheostat of about 10 Ohms; B is a 6-volt storage cell and C is a potentiometer of about 400 Ohms resistance. The fixed condenser, D. in shunt to the head telephones has a capacity of .0025 mfds. Variable condenser, V, in shunt to the secondary winding should have a maximum capacity of about .0001 mfds. Bear in mind that the Fleming valve gives best results when a large value of inductance and a small value of capacity is employed for a given wave length.

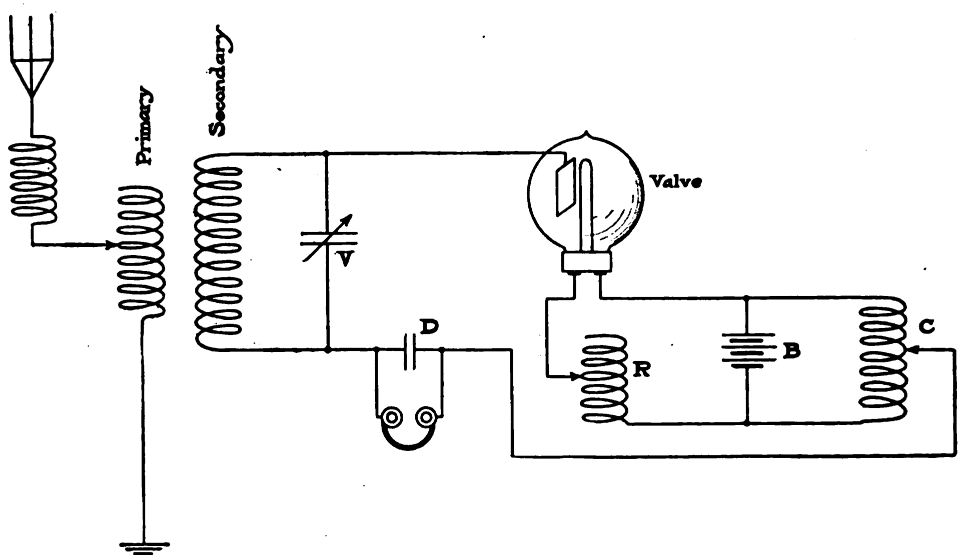


Fig. 1

Ques.—(3) How far should I be able to receive with a valve and accessory instruments in conjunction with an aerial 60 feet in length and 40 feet in height?

Ans.—(3) About 100 miles.

Ques.—(4) What are the stations BEC, MRT and MEC?

Ans.—(4) BEC—H. M. S. Suffolk; MRT—SS. Kafue; MEC—SS. Naragansett.

Ques.—(5) Approximately how far should I be able to receive when using a loose-coupler, silicon detector, fixed condenser, 1,000 Ohm receivers in connection with the aerial described in question 3, the earth wire being connected through a water pipe leading to a well and the country being somewhat mountainous?

Ans.—(5) Under the conditions it is very difficult to conjecture your range; possibly you may be able to hear 150 miles in daylight and during the winter months at nighttime you may be able to receive 1,000 miles.

H. D. A., Newport News, Va., writes:

Ques.—(1) Exactly what is a variometer?

Ans.—(1) According to your fourth query, we note that you have seen the sketch on page 745 of the June issue, which illustrates the principle of the variometer better than we can describe it. We have never seen in print an authentic definition of the variometer, but to our sense it refers to two coils of inductance so mounted that their magnetic fields can be placed in repulsion or attraction. Hence if the coupling between two such coils is continuously varied a variable inductance is produced.

Ques.—(2) What should be the length of

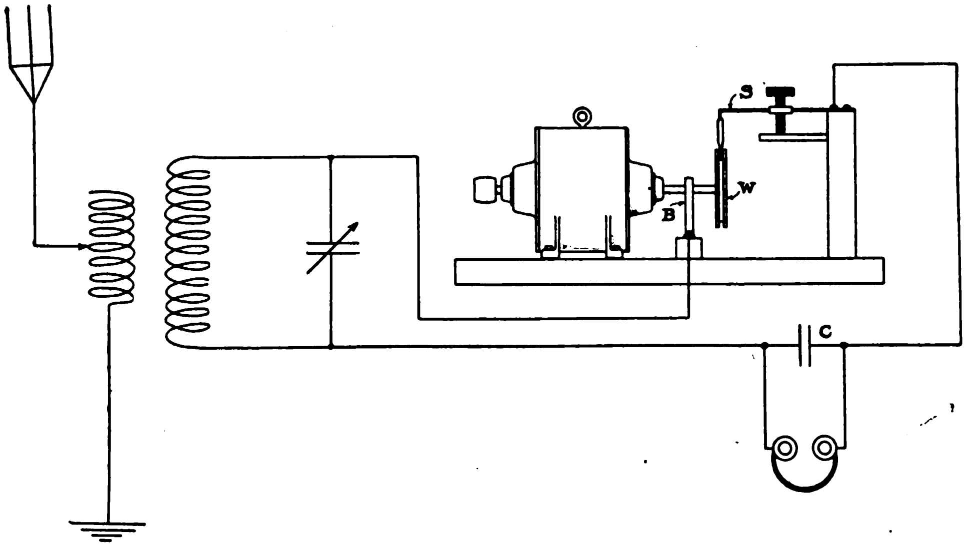


Fig. 2

this aerial to work on 200 meters, the other dimensions being 80 feet high at one end and 40 feet at the other; two wires 5 feet apart, the lead-in 25 feet and the ground 25 feet.

Ans.—(2) At the height of 80 feet the length of the flat top portion should not be more than 42 feet. This will give your aerial a natural wave-length of approximately 200 meters. We suggest that you make your aerial of 4 wires spaced 2 feet apart. If you desire to transmit on this aerial and also wish to employ an oscillation transformer, its natural wave-length should not be more than 160 meters. This will allow a few turns of inductance to be inserted for the transferance of energy. A 4-wire aerial 50 feet long and 40 feet in height will have approximately a natural wave-length of 160 meters.

Ques.—(3) I wish to construct a miniature receiving transformer to work on 200 and 600 meters and therefore wish to eliminate all unnecessary wire, etc. I am using crystal detectors. What is the very smallest wire I can use to secure good results and exactly how many feet must I use in the primary and how many in the secondary? This transformer is to be used with the above aerial.

Ans.—(3) The primary winding should be made on a tube 4 inches in diameter and should be wound closely with 45 turns of No. 24 wire. The secondary should have 65 turns of No. 36 wire and should be made on a form 3½ inches in diameter. The secondary winding should be shunted by a variable condenser having a maximum capacity of .001 mfds. If a number of taps are taken from this winding, a range of wave-lengths will be had from 200 to slightly above 700 meters, depending on the value of the capacity used in shunt. Of course if you employ very tight coupling, you do not need a condenser in shunt with this winding to obtain a wave-length of 600 meters.

Ques.—(4) Would it be an advantage or disadvantage to wind the wire for the transformer referred to on two coils as in the variometer on page 745 of the June issue?

Ans.—(4) Inductances of the variometer type could be employed, but are not advisable in a tuner of such small proportions. It is preferable to vary the inductance by multiple point contacts or by a multiple point switch.

Ques.—(5) Where can I get thorough instructions for the operation and construction of a tikker? Where I can I purchase one?

Ans.—(5) We do not know of any publication in the United States which gives as thorough instructions as you apparently desire. Mention of the tikker is made in the "Naval Manual of Wireless Telegraphy for 1913" and a brief description is given. The tikker is used as a circuit interrupter, however made. One of the most promising types at present in use is the sliding wire tikker, which is shown in Fig. 2. W is a brass wheel about 3 inches in diameter rotated at a speed of 2,500 revolutions per minute. S is a piece of steel wire so made that its pressure on the wheel, W, can be firmly adjusted. B is a brush which makes contact with the shaft supporting the brass wheel. The telephone condenser, C, is of large capacity,—about .03 mfds. The wheel is then set in rotation and adjustments to the spring are made until the note of the transmitting station is of the nature of a humming sound, sounding much like the escaping of steam from a radiator.

We do not know where you can purchase a tikker. There is no reason why you cannot construct one yourself.

* * *

A. B. C., Lamoni, Iowa, inquires:

Ques. (1) Please tell me how far I should be able to receive with the following set (day and night range):

My aerial is of the inverted L type composed of 6 strands 150 feet long, spaced 3 feet apart and stretched over a 120-foot smokestack and a 70-foot mast. The lead-in is at the lower end. My apparatus consists of a Blitzen receiving transformer, a loading coil (E. I. Co.'s 5,000 meters variable), a Blitzen rotary variable condenser, two fixed condensers, 3 detectors (radioson, silicon and galena), 3,000 ohm E. I. Co.'s government telephones, ground lead 6 feet, No. 4 copper wire soldered to a 1-inch water pipe.

Ans. (1) Day or night time during the winter months you should be able to hear stations on the Atlantic coast. Your daylight range for receiving is approximately 100 miles, possibly more, but as there are no commercial stations in your vicinity, we do not know whom you expect to receive from.

Ques. (5) Please give a hook-up for the first and second queries.

Ans. (5) Herewith is published a hook-up covering this apparatus (Fig. 3). There is no distinct use for two different condensers, so we have connected them both in parallel. The switch, S, allows the battery current to be passed through the radioson when it is in use. Another switch could be employed to connect the head phones in series with the battery when using the radioson.

* * *

R. S. H., Albany, N. Y., writes:

Ques.—(1) Kindly show by diagram the latest method for construction of the primary

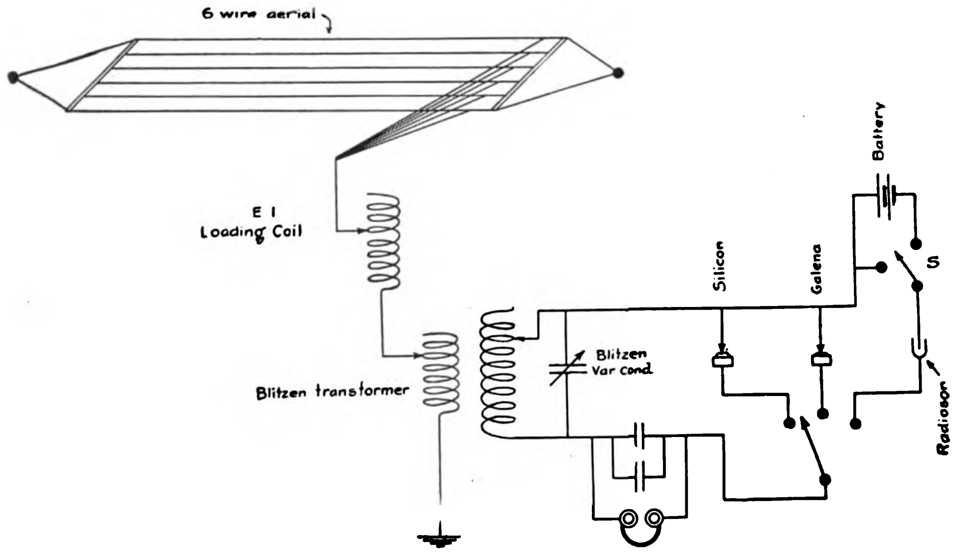


Fig. 3

Ques. (2) What improvements and instruments would you recommend for long distance receiving and for sharp, close tuning?

Ans. (2) If you wish to do extremely long distance receiving work, you had better purchase an audion detector or audion amplifier, which also has the property of giving extremely close tuning. As regards the instruments themselves, we have nothing further to suggest as the set seems to be quite complete.

Ques. (3) For long distance receiving what type of aerial is the best, the T or inverted L type?

Ans. (3) It depends upon local conditions. For the average amateur's aerial, we would suggest one of the inverted L type. If, however, the flat top portion is extremely long in comparison with the vertical portion, you will experience decided directional effects.

Ques. (4) How are the following detectors classed for sensitiveness and stability of adjustment: Audion, electrolytic, silicon, perikon, ferron, galena, peroxide of lead and radioson?

Ans. (4) From experience they may be classed in the following order: Audion electrolytic, perikon, silicon, galena, ferron, peroxide of lead, radioson.

of a Navy type loose-coupler. Also state what the size of the primary should be for amateur's use.

Ans.—(1) See the second prize article in the June issue of The Wireless Age, where a simplified improvement is made on that employed in the Navy tuners. The latter part of this query cannot be definitely answered for we do not know over what range of wavelengths you desire to receive nor do we know the size of the aerial on which it is to be used.

Ques.—(2) Please list several companies from which I may obtain perikon crystals.

Ans.—(2) Wireless Specialty Apparatus Company, Boston, Mass.; Messrs. Eimer & Amend, 205 Third Ave., New York City.

Ans.—(3) We are unable to give you any information concerning the strange station you hear each night at 8:30.

Ques.—(4) Will you kindly advise why I am only able to get a fat spark when I disconnect the ground wire from the lightning switch; the switch base is of slate. Could the difficulty like there? I have several friends who find the same trouble.

Ans.—(4) We cannot answer this query definitely without a sketch of connections or a more complete description of the apparatus employed. It is very likely that leakage of some sort is taking place. We suppose, of course, that you are aware that when the antenna and earth leads are connected to the spark gap of the induction coil, the spark discharge is considerably decreased in length, but is of greater volume.

* * *

R. E. D., Milwaukee, Wis., writes:

Ques.—(1) Give a diagram of how the magnetic lightning switch described in the June issue may be used with the looped aerial with and without an anchor gap.

Ans.—(1) This switch is entirely unsuitable for use with looped aerial either with or without an anchor gap.

Ques.—(2) What is the maximum wavelength the improved loose-coupler described in the first prize article of the April issue will respond to?

Ans.—(2) With the secondary winding in shunt to a large variable condenser it should respond up to 6,000 meters. The range of wave-length to be expected in the primary will vary according to the size of the aerial used. Having no information in this respect we can give no definite advice.

Ques.—(3) What kind of covering has the wire on the one-to-one transformer described by E. E. Butcher in the January issue?

Ans. (3)—It makes no difference, it may be either silk or cotton covered wire.

* * *

F. J. C., Yonkers, N. Y., writes:

Ques.—(1) An article in a recent magazine states that for long distance reception, the aerial need not be more than 20 or 30 feet above the earth, providing it is 200 or 300 feet long. If this statement is correct, what is the idea of raising an aerial 50 feet long to 100 feet in height for receiving?

Ans.—(1 The statement is only approximately correct. It is a fact that for ship to shore communication neither of the aerials need be as high as those used for overland work, but the statement in question, however, has not been definitely proved. Better results have generally been obtained with the aerials of the greater height. It is a noticeable fact that the longer the wave-length, the nearer to the earth the receiving aerial may be placed, but this is no argument for the lower aerial because if it was raised to the greater height, undoubtedly stronger signals would be received.

Ques.—(2) I have an aerial consisting of one strand of No. 14 wire 500 feet in length, 30 feet above the earth, situated on the highest hill in town. Using the following instruments, Brandes Superior Head Telephones, a large loose-coupler, a 4,000-meter loading coil, fixed condenser and galena detector, I cannot receive further than Cape Cod. Do you think the height of my aerial is the cause? I can do good tuning even though I am shy variable condensers.

Ans.—(2) Undoubtedly you would secure better results if your aerial was placed at a greater height. After careful inspection of your apparatus we could give more definite advice. Possibly your circuits are out of resonance. For the shorter wave-lengths, such as 600 meters, you would require a series condenser in the antenna circuit. We suggest that you erect a 2-wire aerial, if possible, at a greater height.

Ques.—(3) The wireless station at Sayville uses a sharply tuned transmitter, but I can hear their signals from 800 meters all the way up to 3,200 meters. The signals are very loud on about 2,800 meters. My station is about 45 miles distant. This work is being done with the above aerial and instruments. Is it the fault of my instruments?

Ans.—(3) This is undoubtedly due to bad design of your entire receiving equipment. Apparently the circuits of your receiving tuner are of high resistance, rapidly damping out the oscillations, or perhaps you are using a very tight coupling and of course cannot expect to do much tuning. You should have a variable condenser in shunt with the secondary of your receiving transformer and then reduce the value of coupling. You will find under such conditions that Sayville will tune very sharp. The primary of your receiving transformer should be wound with No. 24 wire and the secondary with, say, No. 32. Furthermore, it may be that your receiving transformer is so designed that there are a great number of unused turns. If so, the coil may have a natural period to make it respond to one of the harmonics emitted by the Sayville station.

* * *

B. S. Wilmington, N. C., writes:

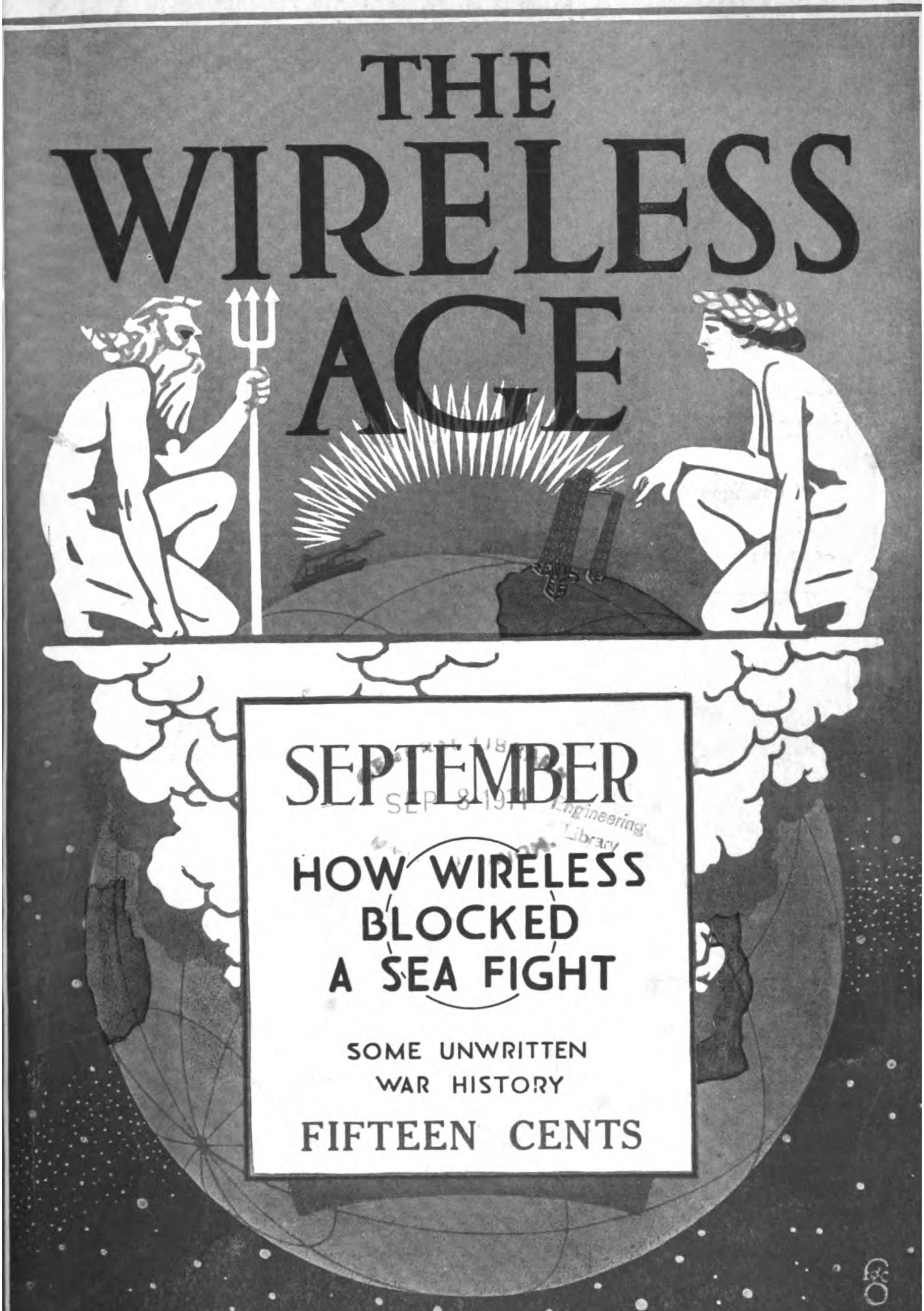
Ques.—(1) What places do the letters and groups of letters stand for when Arlington sends the weather for the Great Lakes, as V94381, CH000041?

Ans.—(1) V relates to the weather at Cleveland, O., and CH, Chicago, Ill. This query was fully covered in this department in the August issue. A circular issued by the United States Department of Agriculture, dated May 25th, fully explains these abbreviations.

Ques.—(2) Are abbreviations used in commercial work other than those beginning with Q and PRB? If so, where can I obtain a list of them?

Ans.—(3) No other abbreviations are used with the exception of the message prefixes adopted by the London convention. A list follows. P, ordinary paid message for delivery; X, ordinary paid message for re-transmission; S, government message for delivery; XS, government message for re-transmission; MSG, master's service message for delivery; XMSG, master's service message for re-transmission; PDH, frank message for delivery; XDH, frank message for re-transmission; Presse, press message for delivery; XPresse, press message for re-transmission; A, telegraphic service message for delivery; XA, telegraphic service message for re-transmission; OL, ocean letter for posting.

This OL should not be confounded with the expression "OL collect," used in the United States ship services, which means "other line tolls collect," the other line in this case being the Western Union or the Postal Telegraph-Cable Company.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SOME UNWRITTEN WAR HISTORY
FIFTEEN CENTS

THE WIRELESS AGE

An Illustrated Monthly Magazine of RADIO COMMUNICATION

Incorporating the Marconigraph

J. ANDREW WHITE, Editor WHEELER N. SOPER, Asst. Editor

Volume 1 (New Series) September, 1914 No. 12

CONTENTS

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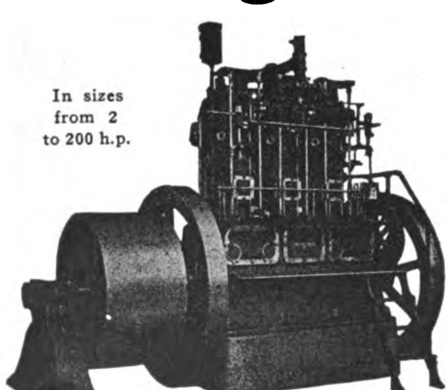

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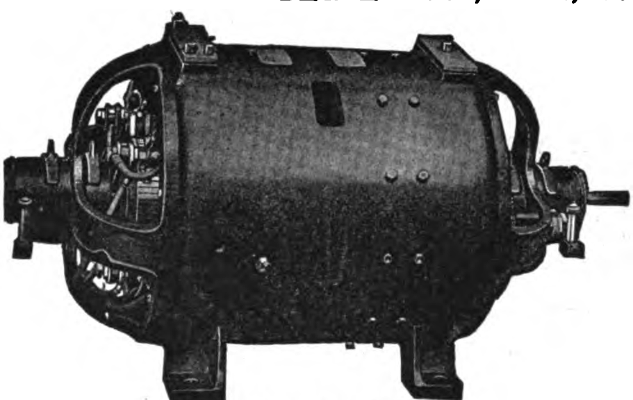

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The case is of nickeled brass.

Total weight including cord and headband, 16 ozs.

The lower cut shows type "B" a later design. The case is aluminum, as small as it is possible to make and get the proper amount of magnets in the case.

The case is curved out to permit the use of a diaphragm 2" in diameter, the size which has proved the best for good commercial work.

This type 'phone is provided with an enclosed protective spark gap.

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