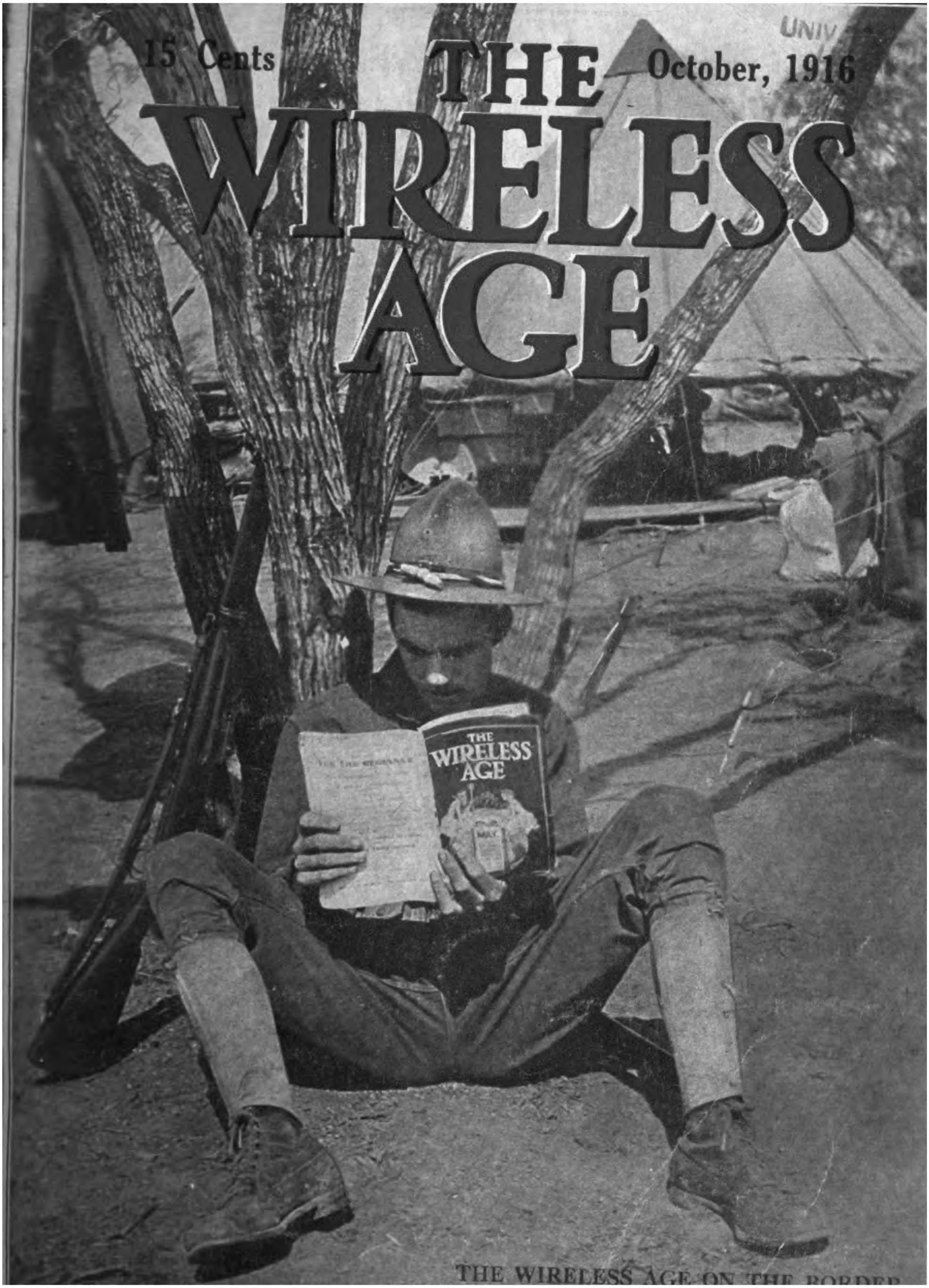
The Wireless Age

15 Cents

THE WIRELESS AGE

October, 1916



THE WIRELESS AGE ON THE BORDER

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THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

OCTOBER, 1916

An Equipment That Marks Progress

The Advantages of the Latest Installation at Siasconset

By J. B. Elenschneider

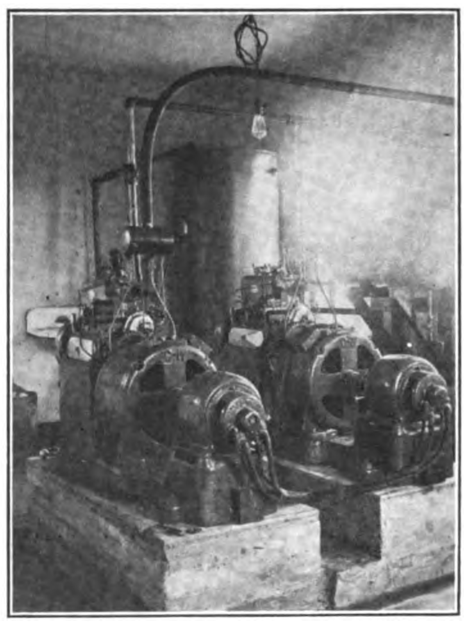
Construction Engineer of the Marconi Wireless Telegraph Company of America

WITH the installation at the Siasconset (Mass.) station of its third distinctive type of wireless apparatus another interesting chapter was added to the history of radio development. Several advantages mark the new equipment, chief among them being a generating plant which reduces energy loss and effects a saving in the cost of operation.

One of the striking features of the new equipment, which is of 2 k.w. power, is the novelty of its design. It differs from the average apparatus in that instead of employing a large storage battery for operating the motor-generator which supplies the energy to the transformer, the 500-cycle generator is coupled to the shaft of the engine by means of a gear, with a ratio of 2 to 1. This plan of construction eliminates practically all losses which, in the ordinary storage battery installation, are caused by the many different transformation of energy necessary to obtain the high frequency oscillations for transmitting.

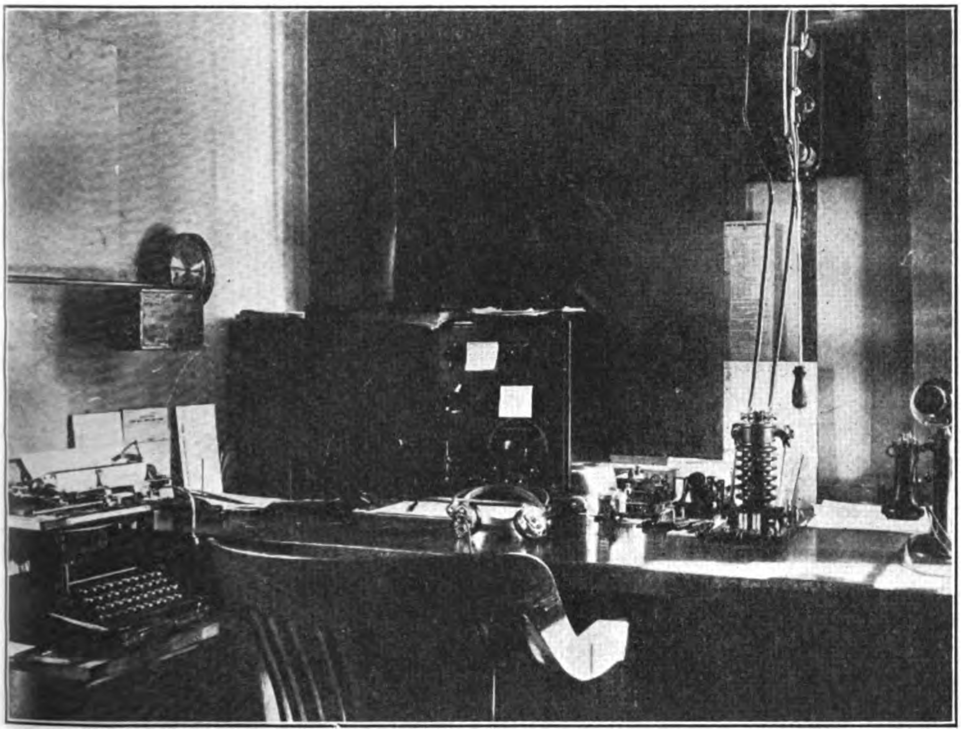
As a rule the energy generated by the engine is transferred through a belt with considerable loss to the dynamo which charges the battery; thence it is conveyed to the batteries at the cost of at least another twenty-five per cent. loss; from the batteries the energy is supplied to the motor which drives the alternating current generator and another loss of at least forty per cent. results. So before the alternating current reaches the transformer a large part of the initial energy generated by the engine is lost through different causes such as belt slip, friction, heat, low efficiency of storage batteries and motor-generators. These losses are eliminated or reduced to an insignificant quantity in the recently-installed apparatus, and the energy generated by the engine is directly applied to the alternator whence it is led in the form of alternating current to the power transformer.

The equipment consists of a ten horsepower, four-cylinder, four-cycle engine, geared to a 2 k.w. 500-cycle



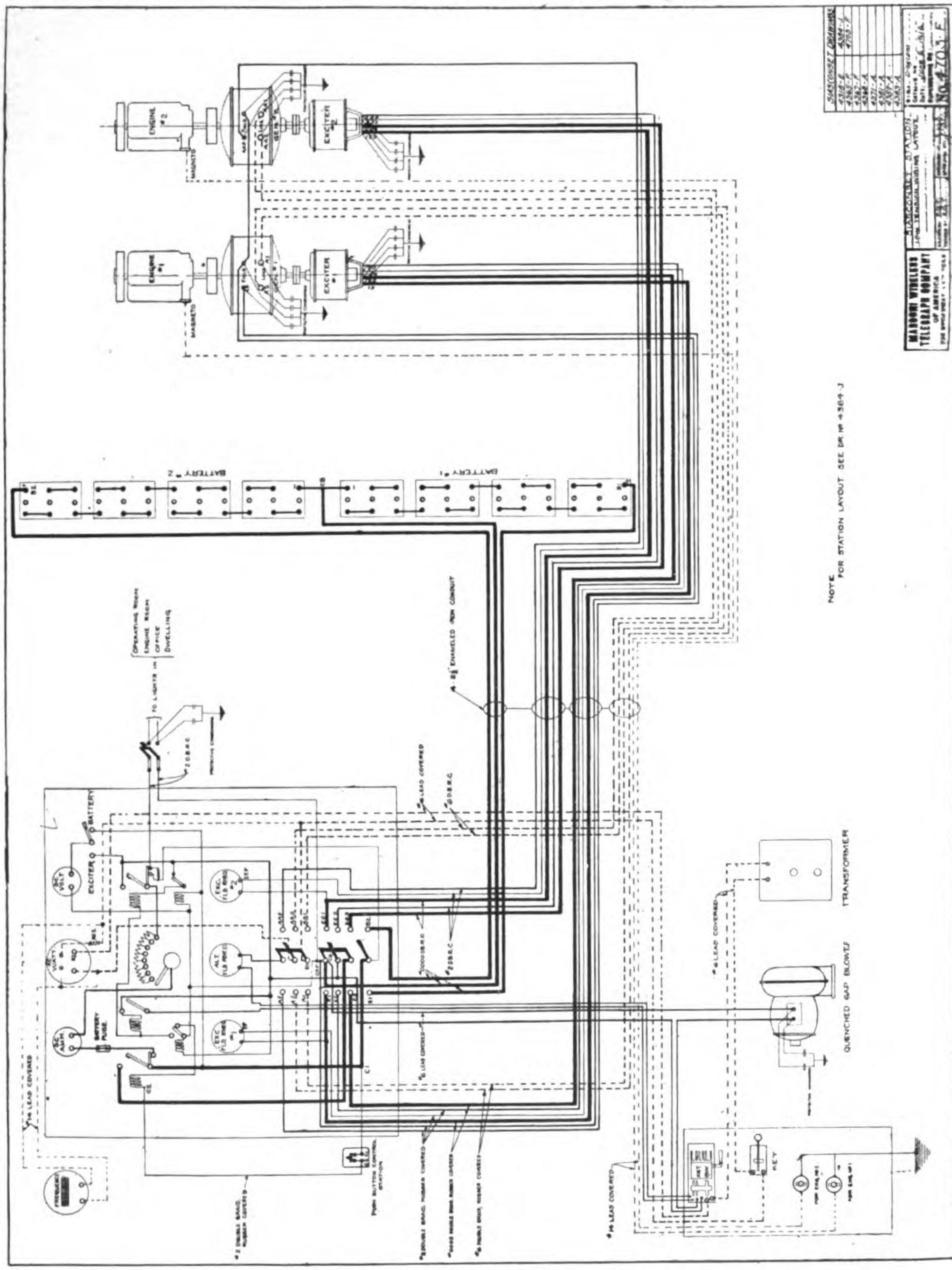
The twin generators of Siasconset, showing, in the rear, the 10 h.p., four-cylinder engines, geared to the 2 k.w., 500-cycle generators. The batteries are also duplicated so that in case of accident the station can be operated from an independent power source generator of the standard Marconi type, the latter being flexibly coupled to a thirty-two-volt direct current exciter, a twenty-four-volt exide starting battery of 160 ampere hours' capacity, an automatic control and charging panel, a 2 k.w. 500-cycle Marconi transmitter of the panel type, and a Marconi type 101 receiver. The engine generating set and batteries are duplicated so that in case of accident the station can be operated from an independent power source while repairs are being made. The engine is of the ten horsepower, four-cylinder, marine type, capable of high speed and possessing high tension magneto ignition. The cooling is effected by a water pump which sends the water from the large cooling tank through the engine and back again. A pump propels the oil from a small tank through an oil sight into the crank case. The amount is regulated by an adjusting screw on the pumps and can be changed to any number of drops necessary to keep the oil in the crank case at the proper level.

A thin wire rope runs over the pulleys from the operating to the engine room, where it is connected to the high tension magneto which, while the engine is at rest, is held in an advanced position by a spring. This enables the operator without moving from his place, by simply pulling the wire rope, to start the engine on a retarded spark so as to prevent back-firing. The engines are run at a speed of 1,000 r.p.m. which, by means of the gear at a ratio of 2 to 1, gives the generator and exciter 2,000 r.p.m., which is the normal speed of the machines.



The operating table is connected with the engine room by a thin wire rope running on pulleys and attached to the high tension magneto, enabling the operator to start the engine on a retarded spark without moving from his place

A fly ball governor maintains the speed of the engine under all conditions, i.e., under all changes of the load on the generator exciter set. The exciter is a twenty-four-volt series wound motor with very heavy windings,

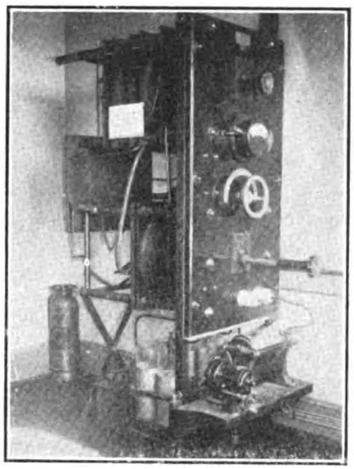

BATTERY #2
BATTERY #1
NOTE
FOR STATION LAYOUT SEE DR. No 4384-J
TRANSFORMER
QUENCHED GAP BLOWER
MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA

which becomes a thirty-two-volt shunt wound generator when the engine attains full speed. The connections effecting this change are made by the magnetic switches on the automatic control panel. The exciter is utilized as a starter for the engine. The starting circuit, which includes the batteries, control panel and starter motor, is closed by means of a solenoid switch of 250 amperes' capacity. A pushbutton near the operator's table, which is about forty feet distant from the engine, closes the solenoid circuit and this in turn closes the starting circuit. It takes over 200 amperes about one second to turn over the armature of the starter motor, the armature of the generator and the engine. This current rapidly falls off to zero and it requires from five to eight seconds for the engine to attain full speed.

When the engine is running at full speed the electromotive force of the exciter closes a solenoid switch of thirty amperes capacity, this switch controlling the generator field circuit and the blower motor circuit. It is mechanically interlocked with the starting switch and as soon as it closes the former opens. Almost at the same time another thirty-ampere magnetic switch closes the battery-charging circuit and, while the engine is running, the starting and lighting batteries are charged at the rate of fifteen amperes and thirty-two volts. The time required for starting the engines and closing all circuits is from five to eight seconds—results which are at least as good as those obtained with any commercial starter for a motor-generator.

The charging panel contains the different magnetic switches and relays, one of which is continually connected across the battery and adjusted so as to automatically cut off the charge when the batteries reach a certain predetermined voltage. It closes the charging circuit again when the battery voltage falls below that for which the relay is adjusted. Thus the batteries are charged automatically, requiring no attention except for replenishing the electrolyte and taking gravity readings from time to time.

The control panel contains a wattmeter which indicates the power used in the transformer of the transmitter, a voltmeter with a changeover switch for reading the battery voltage or the generator voltage, an ampere meter indicating the charging current, a battery charging rheostat of fifteen ampere capacity, a generator field rheostat and two exciter field rheostats; two 3-pole, double throw switches are used for changing from one engine generating set to the other so that if anything should go wrong with one set, the operator can throw the switches to the other side and start the engine of the second set. A single-pole, double-throw switch makes it possible to use either one of the two starting and lighting batteries on either of the two engine generating sets. The operator can determine which battery has the lowest voltage by examining the voltmeter. The battery-charging is done while the transmitting set is used. It will not be necessary to operate the engines for charging alone.



The transmitter is of the panel type, tuned to four different wave-lengths, 300 meters, 450 meters, 600 meters, and 1,880 meters

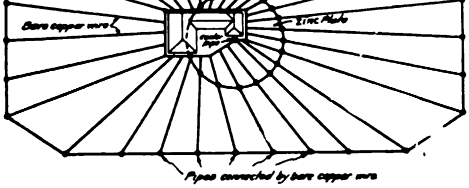
A gasoline tank with a capacity of about twenty-seven gallons supplies the fuel. This tank is connected by means of a galvanized pipe and a gasoline hand pump with a large storage tank holding more than 100 gallons, the larger supply of fuel being buried under the earth several feet away from the station.

The transmitter is of the panel type and has a wave-length range of from 300 to 1,900 meters. It is tuned to four different wave-lengths, 300 meters, 450 meters, 600 meters, and 1,880 meters. The maximum radiation obtained is more than eight amperes.

The aerial is of the four-wire T type and has a natural period of 405 meters and an antenna resistance of approximately 21 ohms, of which the radiation resistance is 14.4 ohms. The aerial is suspended on two wooden masts, each of which has three sections and is 170 feet in height.

The ground system, which is shown in an accompanying drawing, consists of the old zinc circle of 50 feet diameter, to which have now been connected a number of copper wires. These run radially from the station and terminate in galvanized iron pipes, driven into the ground to a considerable depth. This system has reduced the resistance considerably and has made it possible to obtain a decrement on the 600 meter wave of .13. Before this ground system was installed the decrement could not be brought below the .2 mark.

The first set installed at Siasconset was of the type originally invented by Guglielmo Marconi and used in his early experiments. In this apparatus the principal parts consisted of an induction coil, which was employed as a transmitter, and a coherer, which was used as a receiver. There were several drawbacks to the equipments, however, one of them being lack of speed in operation.



SIASCONSET GROUND SYSTEM.

A few years after this equipment had been installed, therefore, it was replaced by the then latest type of "tuned transmitter" and a magnetic detector. The transmitting equipment, which was installed in 1904, was used to transmit for distances of considerable length. It was destroyed by fire in 1907, and the station was operated for about two months with emergency apparatus.

Meanwhile a new station was being built and equipped with new apparatus. The greater part of this equipment was of the same type as that which had been destroyed with the exception that it had a non-synchronous musical spark in place of the plain spark. The non-synchronous spark gap set was in operation until a few weeks ago, when it gave way to the latest type of transmitting apparatus for shore stations.

The first message was received at the original station on August 12, 1901, at ten o'clock in the morning. Sent from the Nantucket lightship, anchored off South Shoals, it was as follows

"Signals clear; am using plain aerial. Good luck."

This message was flashed forty-three miles and at the time its transmission was looked upon as a remarkable accomplishment.

The station, which is owned by the Marconi Wireless Telegraph Company of America, has been in the public eye from time to time, one of the occasions being when it received an S O S from the steamship Republic after that vessel had been rammed in the fog by the Floride south of the Nantucket lightship. The operator at Siasconset broadcasted the news, getting into touch with the Baltic, which turned back from the course she was pursuing and went to the aid of the distressed craft. The Republic sank, but, due to the activities of the men in the Siasconset station in summoning rescuers, no lives were lost.

At the time of the Titanic disaster Siasconset was the first station to communicate with the Carpathia, which was then on her way to New York bearing survivors of the wreck. Hundreds of messages to and from the

The men who made the installation: left to right, J. C. Cowden, manager of WSC; George Schuller; J. B. Elenschneider, designer of the station equipment; Harry Holden, operator; also young Richard Cowden, in front, who hopes some day to become manager of 'Sconset

vessel were handled by the operators at the station.

Among wireless men Siasconset is remembered chiefly because of the fact that it is the last station in the United States that outgoing trans-Atlantic vessels communicate with and the first that incoming vessels get in touch with. It is the oldest commercial station in the United States.

A MOTORCYCLE EQUIPMENT

Captain John B. Christian is in command of a motorcycle wireless outfit that is attracting considerable attention among the troops stationed on the Mexican border.

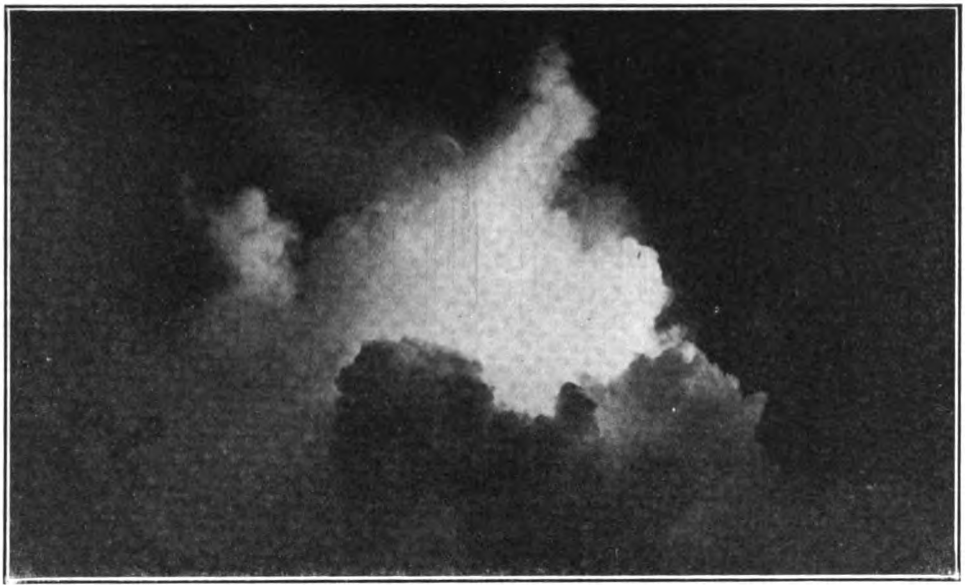
The apparatus consists of a sending and receiving equipment carried in the side cars of three motor cycles. A motor attachment is provided to be run by the engines of the motor cycles. One of the features of the equipment is an aerial which can be raised to a height of forty feet.

The set has been used to communicate between points thirty-three miles apart, the messages sent and received being highly satisfactory as regards clearness.

THIS MONTH'S COVER

Sergeant Norman R. Hood, Co. I, 1st Iowa Infantry, reading the "magazine that kept me posted in the advance of the radio art," as he expresses it, is the subject of the cover of this issue. The picture was taken in camp at Brownsville, Texas, and is titled, according to the suggestion of its donor, "The Wireless Age of the Border."

Sergeant Hood, a charter member of the N. A. W. A., who wears the association button with pride, arranged to have the magazine sent to him wherever he might be stationed, stating that he could not do without it. "The value of wireless telegraphy," he says, "was brought vividly home while on the Border.



Photograph of a storm cloud snapped by a wireless amateur in the glare of a lightning flash on Mount Monadnock

Receiving on Mt. Monadnock

The Story of an Experimental Trip to the Summit of a New Hampshire Mountain

By Louis G. Barrett

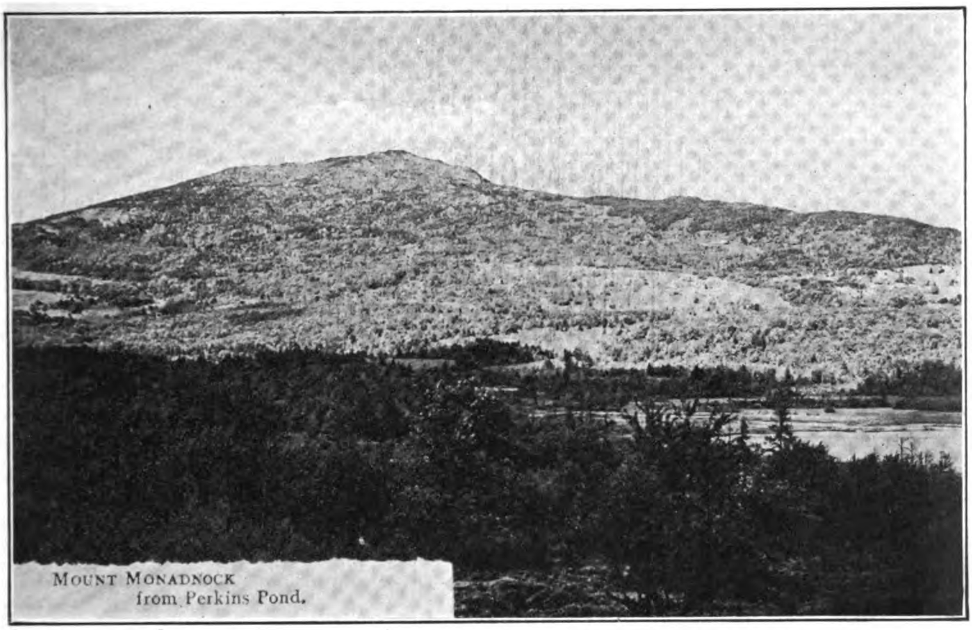
ONE day in August brought such clear weather and a wealth of sunshine that I was seemingly invited by the powers that rule over meteorological conditions to journey with my wireless receiving apparatus from Keene, New Hampshire, to the top of Mount Monadnock in Cheshire County. So, accompanied by a friend, I started early in the afternoon on a motorcycle with a side car attachment.

After we had left Keene in the rear and had passed many small towns, we arrived at a deserted house, which was partly in ruins. Here we left the motorcycle. Then, with our food, aerial wire, and receiving equipment carefully packed on our backs, we started for the summit of Monadnock.

Two hours of climbing over a narrow path brought us to the little house at the top of the mountain. This structure is used by a forest-fire warden as a "look-out" station, the latter being one of the most important posts of its kind in New Hampshire. The house is about sixteen feet square, and has windows on all sides, many maps covering the walls of the interior. From its four windows we were able to glimpse Mt. Washington far up in the north and also the other mountains in the Presidential Range. In the west we could see the little valley in which Keene is situated; beyond, the Green Mountains stretched from north to south.

With the aid of the warden's glass my friend and I were able to view the customhouse tower in Boston—eighty-three miles to the east. In the south the landscape was specked with Massachusetts towns, including Athol and Fitchburg. Many villages in New Hampshire were also brought into view.

Our interest in the view having been satisfied we began the preparations for our wireless work.. We had cut the spreaders on the way up the mountain, and one end of our aerial was attached to the top of the flagstaff on the top-house; the other end we suspended about twenty feet above the ground on a small spruce pole, made fast between the rocks 200 feet down the mountain. We used the regular telephone ground, consisting of earth-sunken plates in a damp spot about a quarter of a mile down the mountain. And so, before the sun had sunk behind the lofty peaks, we had constructed a three-wire aerial, 200 feet in length. This task completed, we connected a Marconi Type "D" tuner to our aerial and earth connections and sat on the door step of the top-house to enjoy our supper and wait for darkness.



On top of the mountain shown in this photograph two amateurs spent the night copying signals

The time passed quickly and at about half past eight o'clock we put on our receivers, adjusted the detector carefully and drew up the sliders to seven, eleven and one-half, and seven, respectively. The detector, well designed and of the carborundum type, is hard to jar from adjustment and very desirable for portable work.

With the sliders set as described, we were surprised at the very sharp and clear tone of NAA (Arlington), which was sending the half past eight report. The signals were not much louder than those heard in the valley of Keene, but they were considerably sharper and clearer, and, of course, were easier to read. There was little static. We copied the signals by lantern light for some time, and then rested.

At about fifteen minutes to ten o'clock we again adjusted our headsets and were struck at once by the increase in static. For the next ten minutes we listened on a wave-length of 600 meters. I have some difficulty as a rule in copying ships with the tuner, as it is direct-coupled and its adjustments are rather broad, but on this occasion, no trouble was experienced. In that ten minutes we heard signals from many stations, including those of IZL in Northampton, Mass., which were particularly strong. Later we heard IZR in Rockland, Me., calling IAT (Arthur H. Lawford) in Bar Harbor, Me.

At quarter past ten a station on the Atlantic Coast began to send, and for a while we listened to its signals. After a time, however, the static increased to such an extent that we were unable to listen for fear of injury to the phones. Therefore, we disconnected the set and went outside.

In the northwest brilliant flashes of lightning were lighting up the sky, and, as we realized that the storm was coming toward us, we began to take down our aerial. When my friend attempted to disconnect the ground lead he dropped the wire, saying he felt a shock. I ridiculed his statement and made my way 200 feet down the mountain side in order to roll up the aerial, while my friend remained above. As I started to roll the wires on the spreaders I received a shock that hurled me off my feet and sent me tumbling down among the rocks. My friend hurried to my assistance, and we spent the remainder of the night in the top house.

From the windows of the structure we obtained an excellent view of the storm. Twice the lightning came in on the telephone line and passed on down the ground lead.

The forest-fire warden's house which provided protection for the author of this article and his companion during a storm

The next morning we returned to Keene well pleased with the results of our trip, and adequately provided with a fund of not uneventful wireless reminiscences.

A MONKEY ARRIVES VIA WIRELESS

The United Fruit Line steamship Almirante arrived in New York recently from West Indian ports flying at the masthead a monkey's tail as a flag. The tail was the balancing pole with which a four-foot monkey had been nonchalantly doing a tightrope act on the wireless aerials for three days, despite the efforts of the crew to make him come down and behave himself.

Naturally the aerials handn't been destined as his quarters when the monkey was put aboard with a large consignment of assorted animals. He was billeted at first in a cage with seventy-nine other monkeys, but he soon broke up their happy household. When his teeth required sharpening this particular ringtail sharpened them on the other monkeys. Likewise he gave his muscles some much needed exercise by clawing the first simian that came handy.

His fellow voyagers gave the crew no peace until the offender was exiled on the third day out and sentenced to be tied up on the after deck. There he was christened by the sailormen "King William" because of the way he had conquered his companions. But the king lost no time in fletcherizing his rope until it broke. Then he shinned up the main mast.

A seaman was sent up after him, and King William promptly skated across the wireless rigging to the foremast, 250 feet away. When another A. B. was despatched to the foremast the simian equilibrist loped to the middle of the aerial, sat down and scratched himself meditatively. He seemed to feel that he had been "saved by wireless."

"I wish the wireless operators would turn on the current full force and burn you to a crisp!" shouted one sorely tried sailor, shaking his fist at the monkey. For which he received an outburst of vitriolic monkey abuse.

When the ship reached port a flanking party was sent up the shrouds on each side of the foremast, the monkey's habitat for the time being, and he was captured and brought to the deck.

With the Naval Expedition in the Congo

Something About the Work of the Field Station Operators

"I AM writing this in a tent on the shores of Lake Tanganyika."

Thus runs a message from William V. Moore of the American Marconi Company's Trans-Oceanic staff, now with the Allies' Naval African Expedition in the Congo region. In it he tells of warfare as he learned it at first hand—the bombardment of German trenches, the sinking of an enemy war craft, the taking of prisoners and field station work.

Moore, who is a senior warrant officer, relates that barrels containing 6,000 gallons of gasoline on the vessel on which he voyaged to Africa, caught fire on June 16th and an S O S was sent out. The appeal was promptly answered by other craft, but several volunteers, among whom was Moore, threw the blazing barrels overboard. For this action his name was favorably mentioned to the Belgian consul at Teneriffe. Another exciting incident of the voyage was the discovery of a German spy, who was placed in the hands of the British authorities and locked up when the vesles arrived off the African coast.

"My journey through the Congo . . . . was interesting," narrates Moore. ". . . Plenty of sport shooting hippos, crocodiles and monkeys. We experienced plenty of storms and tornadoes until the middle of last month (May) when the dry season commenced. . . . We were put under the Belgian army authorities and come under the Navy only for discipline. . . . One of our boats visited the German shore, bombarding the trenches, sinking (a coasting vessel of Arabian origin, common in the Indian Ocean), and capturing five prisoners, ammunition . . . and contraband of war."

In describing the wireless work of the expedition Moore said that there were four operators and one sub-lieutenant to operate the 2 1/5 k. w. field station sets, each station consisting of two wagons and two limbers. One limber contains the seven horsepower water-cooled petrol motor, the dynamo and A. C. generator, the disc discharger, the D. C. board and A. C. board. The wagon contains the receiving and transmitting gear. There is a supply cart for petrol and oil and a mast cart to transport the two seventy-foot masts in thirty sections. The stays and stay adjusters are contained in two trunks, and the aerial and earth nets in one trunk. These are carried in the mast cart.

The operators established their quarters on top of a hill near Lake Tanganyika. The west shore of the lake is owned politically by the Congo Free State, the east shore by German East Africa and the south shore by the British colony of Rhodesia.

The northern end of the lake is 175 miles southwest of Victoria Nyanza lake and its southern end 190 miles northwest of Lake Nyassa. Terrific hurricanes and tornadoes make Tanganyika full of peril for navigators. There are a number of fresh water fish, crocodiles and hippopotami and also several groups of deep water mollusks and crabs, said to be of marine origin. The presence of the crabs and mollusks has given rise to the theory that at one time the lake was an arm of the sea and became separated by upheavals.

"Radioville" is the name given by the wireless men to their camp. However, it is not permanent and they constantly hold themselves in readiness for marching orders, for Moore says: "In a few weeks I shall be departing for the firing lines toward the north of the lake and probably follow up behind the troops as they advance."

How to Conduct a Radio Club

(Especially Prepared for the Members of the National Amateur Wireless Association)

By Elmer E. Bucher

ARTICLE XXVIII

A NUMBER of inquiries regarding amateur and commercial radio telegraphy, some of which have been answered in the Bulletin of the National Amateur Wireless Association, have been received. Many of the questions remain unanswered, however, and, since they are of universal interest to amateurs, it has been decided to publish them in this article of the series on "How To Conduct A Radio Club."

A reader residing in St. Louis asks:

"Can the Fleming oscillation valve be used for the reception of undamped waves in a manner similar to the three-element vacuum valve?"

Several experiments have been conducted along this line, but the results have not been published. We know of no circuit by which this valve can be made to oscillate.

He continues:

"Why are such extremely long coils used in the circuits of the beats receiver described in the book 'How To Conduct A Radio Club'?"

This query has been answered several times in THE WIRELESS AGE. It should be self-evident that to obtain the best results from a vacuum valve the grid must be supplied with a fairly high value of potential and this can only be obtained by the use of large values of inductance in the oscillating circuit and small values of capacity; hence, to obtain wave-length adjustments of 8,000 to 10,000 meters, we use large loading coils in the secondary circuit, also in the antenna circuit.

The correspondent also asks:

"Can the loading coil be eliminated in this set and the inductively-coupled tuner employed for the reception of signals at the lower range of wave-lengths?"

There is no reason why these coils cannot be eliminated, but the complete apparatus will then respond to wave-lengths including 4,000 meters. However, the apparatus will not be efficient at the lower range of wave-lengths in the vicinity of 1,000 meters on account of the "dead end" effect.

Desiring to make this equipment responsive to amateur wave-lengths, the reader inquires:

"Can the tuner be fitted with switches so that the circuits are adjustable to 200 meters?"

This is possible, but it is not recommended. The unused portions of the winding should be broken up by a "dead end" switch to cut down the energy losses occasioned by the unused turns.

In conclusion he writes:

"Can other sizes of wire than those given in the book 'How to Conduct a Radio Club' be substituted in case the experimenter does not have the designated size?"

A small variation from the sizes given may be made without a great sacrifice of efficiency, but the size of wire recommended should, if possible, be used, for it will give the maximum degree of efficiency. If you change the size of the wire the dimensions of the coil must be reduced or increased accordingly. To calculate the inductance of a tuning coil follow the method given in the second edition of the book "How To Conduct A Radio Club." The primary winding for this tuner may vary from No. 22 single silk covered wire to No. 26 and the secondary winding from No. 26 single silk covered wire to No. 34. You are, however, advised to hold to the design given in "How To Conduct A Radio Club."

Constructing a Receiving Set

Constant Reader desires a compact long distance receiving set, but cannot see how such a set is possible with the coils described in the book "How To Conduct A Radio Club." He asks:

"Is it necessary to employ the extremely long loading coils described in the instructions for constructing a long distance receiving set as per the book? Is there no other method by which a required value of inductance can be obtained? For example, I want to mount this apparatus in a cabinet, but after careful reflection I find that the equipment would be exceedingly cumbersome."

Multi-layered coils may be employed provided the precaution is taken to separate the various layers by a space 1/4 or 1/2 inch. If four layers are used, a winding, 4 1/2 inches in diameter by about 7 inches in length, will give practically the same value of inductance as the long coils described in "How To Conduct A Radio Club."

Another subscriber inquires:

"Why do commercial wireless telegraph companies use carborundum crystals in preference to other detector crystals, in the face of the fact that amateurs get far better results with galena, silicon, etc.?"

The answer is simple. Experimental apparatus does not fulfill the requirements of a commercial service. Picture a commercial operator constantly changing his apparatus from a sending to a receiving position and finding himself compelled to "tickle" and "fuss" with a cat whisker adjustment. What would be the effect on the traffic department of a commercial company in these circumstances? Carborundum is without doubt the most stable of all the crystalline detectors and the crystals furnished by the Marconi Wireless Telegraph Company of America are especially selected from a large supply. Remember that it improves the action of a carborundum crystal to mount it with soft metal in a containing cup.

The reader then asks:

"Why is it that I often hear amateur stations with my receiving tuner adjusted to commercial stations whose wave-length I know to be 600 meters or above?"

Either the amateur violates the law in regard to wave-lengths or your receiving aerial has considerable resistance and therefore no distinct time period of vibration. It then responds to all wave-lengths within a certain range, but with no particular degree of efficiency. The energy that you receive under these conditions is due to forced oscillations. Sometimes these effects are due to a badly designed receiving tuner.

He also asks how to account for the long range of small amateur sets operating at the low wave-length of 200 meters during the night hours.

This is probably due to the small absorption of energy, augmented by the use of a very short wave.

Increasing Energy

Several amateurs have sent in a query to this effect:

"Does a receiving detector increase the amount of energy flowing in the receiving aerial during the reception of signals from a distant station?"

Those detectors *not* employing a local battery or other source of local energy do not increase the amount of energy flowing in the antenna circuit, but the three-element vacuum valve, the electrolytic and the carborundum crystal with auxiliary battery current are believed to increase the value of the received energy. Keep in mind that there is still some argument concerning the operation of these detectors.

A member of the National Amateur Wireless Association writes:

"What should be the resistance of a potentiometer for a receiving set, and the potential of the local battery?"

The maximum value of resistance may vary between 300 and 600 ohms. The battery should have a potential of between two and four volts.

An experimenter residing in New York City takes issue with us on the following point. He writes:

"Why do you constantly advise against the use of enameled wire when my receiving set works well with this type of winding?"

We should like to know if actual quantitative tests have been made to assure our inquirer that the results he obtains are equal to those possible with the commoner forms of windings. The fact that he hears signals is no criterion to follow as the mere reception of signals is possible with practically any type of winding. Enameled wire coils generally have excessive distributed capacity, which, at certain wave-lengths, destroys the efficiency of the set.

Another enthusiast writes to ask why we object to the use of No. 32 insulated wire for a loading coil in a receiving aerial circuit.

Experiment proves that a coil of this type has such a value of impedance that it seriously impedes the flow of energy in the antenna circuit.

Receiving Damped or Undamped Oscillations

A member of the National Amateur Wireless Association asks what type of apparatus or circuit is the most sensitive for the reception of either damped or undamped oscillations.

We have found from experience that the type where one vacuum valve is connected up to become an oscillator of variable frequency to supply energy to the antenna circuit for "heterodyning" and a second vacuum valve is coupled to the same antenna for recording the "beats" seems to give the best results. A circuit of this character was fully described in preceding issues of this magazine, also in the February National Amateur Wireless Association Bulletin.

An amateur in Boston who is skeptical concerning the reports of amateur long distance receiving asks:

"Are all the reports we hear regarding the reception of signals by experimenters from Nauen and Hanover, Germany, etc., correct? For example, some report that signals are received on an aerial 100 feet in length and other seemingly impossible performances are now and then recorded."

These reports are for the most part authentic, but in many cases the amateur hears Tuckerton and Sayville, mistaking them for Hanover and Nauen, Germany.

Difficulties of Using Microphonic Amplifiers

A reader who believes that commercial companies in some respects are not up to date in the production of efficient apparatus asks why they do not use microphonic amplifiers for dispatching traffic, particularly in view of the fact that these devices increase the strength of signals considerably.

It has been shown by experiment that the adjustment of microphonic amplifiers is too difficult for the average employee and that they do not possess sufficient stability for commercial service.

An amateur in Milwaukee asks if any type of detector can be used for picking up a wireless telephone conversation excepting, of course, the coherer.

All detectors using a telephone receiver are applicable provided the remainder of the apparatus can be placed in resonance with the transmitting station.

"How far will a three-inch spark coil transmit in daylight?" asks a subscriber. In some localities twenty miles have been covered in daylight, but the actual range of course depends upon the sensitiveness of the receiving detector employed at the receiving station.

A reader who is contemplating the purchase of a high potential transformer says that he cannot decide between the open and a closed type of apparatus.

He should purchase the transformer costing the least, irrespective of type, if constructed by a manufacturer of established reputation.

The same inquirer has had trouble

with an electrolytic interrupter and asks why it functions so badly on sixty-cycle alternating current. He should know that this is due to the fact that the flow of energy in a sixty-cycle circuit is not constant as in the case of a direct current circuit. The electro chemical action necessary in the interrupter can only take place when at least 80 volts flow through the circuit and since the value or the amplitude of the current varies constantly, an actual interruption cannot take place until an alternation of each individual cycle attains the value of eighty volts or over.

A beginner asks concerning the apparatus to be purchased by one who wishes an equipment that will communicate thirty or forty miles. We suggest the purchase of a ½ k.w. transformer of the closed core type with magnetic leakage gap constructed for a secondary potential of 15,000 to 18,000 volts; a non-synchronous rotary spark gap giving 240 breaks per second; a copper plated leyden jar type of condenser of .008 microfarad capacity and a small inductively coupled oscillation transformer.

For the receiving apparatus two receiving tones should be purchased, one having a maximum wave-length adjustment of 600 meters and the second a maximum adjustment of 3,000 meters.

X-Ray Static Machine as Transmitter

A physician interested in wireless writes that he would like to use his X-ray static machine for the transmission of wireless signals and asks for an explanation of how the apparatus may thus be employed.

The writer has never heard of a machine being put to this use, but if there can be designed a special high tension switch by means of which the energy in the condensers can be controlled and the circuit opened and closed to make the dots and dashes of the Continental Morse code, it will be possible for the energy to be transferred to an antenna circuit and radiated in the form of electric waves. The average X-ray static machine generates an excessive voltage for wireless telegraph work, giving a spark discharge of abnormal length and excessive damping.

Reverting to the subject of receiving apparatus the physician asks if the vacuum valve bulb can be made to oscillate at the wave-length of 600 meters. Experiment shows that the bulbs which are highly exhausted will oscillate at all wave-lengths, but the ordinary bulb cannot be relied upon for this work.

Tikker Experiments

A resident of California says that he is experimenting with the tikker detector, but he has observed that the receiving tuners for this device are wound with Litzendraht wire. He inquires if this winding is positively required and why.

The tikker is a current operated detector and consequently functions best in a secondary circuit of the lowest possible damping. Of course, response can be obtained with ordinary windings, but better results are obtained with Litzendraht wire.

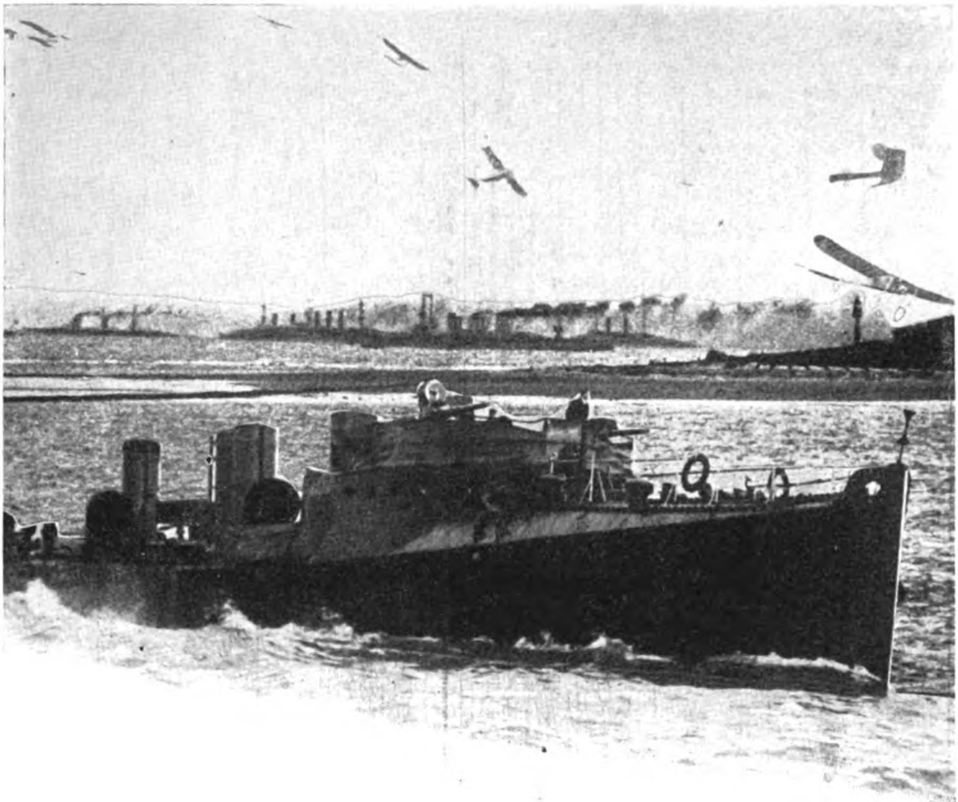
He then asks if the statement is true that during the summer months amateur stations are limited to a few miles' communication, whereas in the winter months a range of several hundred miles can be obtained.

Our experience has been that in some sections of the United States the statement holds true. Generally in the entire northern part the range of amateur stations is decreased considerably during the hot summer months. Foliage and vegetation are said to absorb a considerable amount of energy in the passing wave. The subject is discussed at length in the Proceedings of the Institute of Radio Engineers and also in The Year Book of Wireless Telegraphy and Telephony, 1915. No definite conclusions have been reached, however.

Wireless in Gulf Storm

Wireless was employed to advantage recently when a hurricane swept the coast of the Gulf of Mexico and destroyed all means of communication south of San Antonio, Tex., except those by radio.

A wireless station has been built at Navassa Island Light station, the West Indies.



Flight of the War Birds*

By Patrick Vaux

In a dandy frigate or a well-found brig,
In a sloop or a seventy-four,
In a great First-rate with an Admiral's flag,
And a hundred guns or more,
In a fair light air, in a dead foul wind,
At midnight or midday,
Till the good ship sink, her mids shall drink
To the King and the King's Highway!
—NEWBOLT.

WELL?"

"Still jammed."

"Confoundedly awkward!"

Lieutenant Perwynne made a wry mouth and continued to contemplate the wireless cabin's slip. He did not speak again. The sub-lieutenant, who had brought him the unwelcome news, began to make the best of it.

"Of course, it is an annoyance to Whitehall, but——"

"Just so. It is an annoyance." Perwynne interjected dryly, bending a little closer lest the whistling wind carry away his words. "It cuts both ways."

Deland chuckled grimly.

"It serves us better than them, at any rate, sir. East'ard there'll be a chance of doing something 'stead of hanging on to the Admiralty's wires for the moves."

"Well, yes. But at home they won't know soon enough if—if——"

Lieutenant Perwynne ceased. The two haggard-faced officers looked at each other. Their tired eyes were charged with a meaning which but five weeks ago would have been derided exceedingly.

"This jamming, if it is atmospheric, can't hold much longer," said the sub-lieutenant, cheerfully. "We'll soon know with all this play of fire around."

"There is something else. Don't forget," snapped his superior officer.

The grayness of the air that had hung confusingly along the horizon when first the destroyer, like many others that af-

*From Sea Salt and Cordite. Copyright, George H. Doran Co.

ternoon, had been ordered to extend her scouting area consequent on the breakdown in the wireless communications, was now resolving into murky vapor veiling the farther reaches at sea. As with eyes narrowed against the current of air pouring across the bridge, Deland searched the ever-shifting curtain that merged indistinguishably into the banks of lurid cloud stretching the while length of the north and east horizons, a feeling of desperation took him. But it was only for the moment. Firmly he put from him all thought of home and of those dead to him.

England was suffering slow anguish.

Far astern, the coasts of the Mother of Nations, She—the Mistress of the Seas—were now protected by but submarines and destroyers, two-fifths of which, after the weeks of incessant rip-and-range night and day, were as halt and broken-winded as the heavy vessels stiffening in the flotillas were death-traps in the obsolescence of their strength. Out of the corner of his eye the commanding officer glimpsed the forward lookout suddenly peer into the southeast.

"What d'ye see, Collard?"

The seaman knuckled a leash of brine out of his eyes. Again he strained his tired sight, and shooting out his left arm, pointed to a speck low down in the vague demarcation of sky and water. Deland also switched his glasses on it. But the minute blur was gone already.

"A sea bird, sir," roared the lookout against the wind.

"A sea bird," echoed Perwynne, taking the binoculars from his eyes. But he glanced at Deland as if for corroboration.

"The haze mucks up everything!" said the sub-lieutenant doubtfully. "Sooner thunder clears the air the better for us."

"Something in God's skies that My Lords didn't allow for," he muttered to himself. dodging a gout of spray spurting over the forecastle and weather-screen. "But it's some folks' cocksureness that has brought us to this."

The course of the war had depleted the battle squadrons of Britain as well as those of her adversaries.

On both sides every nerve was being strained to repair disabled vessels and complete those launched. Many British men-of-war detailed at the outbreak for commerce protection had been recalled for the reinforcement of the squadrons now striving to hold the North Sea and of that in command in the Mediterranean.

That which is more poignant than all the horrors and sufferings of invasion was now tearing at England's heart.

Of a sudden Deland touched his C. O. on the left arm, for the thud of a gun, jerky, emphatic, even in its faroffness, rapped through shrouding murk and falling breeze. Almost immediately it was followed by an outburst of firing, irregular, yet fierce and sustained.

"We'll run slap into it, glory be!" the lieutenant jerked out, his gray face stiffening. By G—d, what a flash!"

In a dazzling gleam forked lightning had stabbed the sickly red heavens from north to east. An abrupt, rattling peal shattered the sounds of the guns. Then in the succeeding silence the reports mounted again, fiercer but more puzzling.

"Vessel is makin' nor'nor'east," cried Deland. "More than likely we'll settle what is really interfering with the wireless."

Perwynne, without taking the binoculars off the distance ahead, nodded in reply. There was that in the scattered cannonading which gave grounds for ominous surmise. As, at forty miles an hour, the oil-driven war craft raced down on the engagement the spray hurled white and solid from her bows sheeted to leeward over forecastle and bridge-works, the particles stinging the skin like buckshot and penetrating all clothing. The sub-lieutenant turned to leeward to wipe the salt off his face and cast a look over the deck where the bluejackets had been piped to their posts. He noted that the wind had dropped to a dead calm, and out of the centre of the cloudbanks, traveling westward from north and east, their foremost phalanx almost overhead, steely blue fires were flickering and flashing to the crash and rumble of thunder booming along the desolate waters like the sound of an approaching cataclysm.

"More than us having a hand in this!" he grunted under his breath.

A feeling had come to him of the uncontrollable elemental force sweeping down to fall on them all, just like a vial of wrath on a blind man's helplessness.

From Lieutenant Perwynne burst an exclamation of exasperation and incredulity. His voice rang harsh, his words like expletives.

"Aeroplane—no sea-bird."

"Aeroplane," confirmed the sub-lieutenant, binoculars glued on the speck that had appeared from out of the murk ahead.

At an almost inconceivable velocity it was now heading for the scout.

"The explanation at last of the unaccountable finds in Essex and elsewhere of petrol and bombs," Perwynne rapped out fiercely, scrutinizing the devil machine.

"The move is very plain."

"They are striking before our reinforcements get away to sea," reflected Deland, catching his breath as with a strange sensation at heart he watched the war-bird grow into the outlines of a monoplane.

Thoughts flashed into him of the home aeronautic force depleted to reinforce the Expeditionary Forces—of Shearness and other main bases now to be wrecked and totally devastated. Thoughts, too, of London in flames and horror, and of the country panic-stricken. With terror ravening on their vitals, would the multitude clamor for the cessation of hostilities—and at what price?

It was to hasten the work being affected by hard times and nervous throes that the raid by air had been launched.

"A Taube, sure enough," said Perwynne, harshly. "This confounded calm helps 'em. Hope to G—d a thunderbolt shrivels 'em all up."

That instant a streak of flame ripped athwart the sky ahead, illumining in a horrid glare the ash-colored waters. In the distant rolling that followed the strident hum of the nearing enemy was lost to the ear.

The next second the shrill scream of the monoplane's propeller cut the air—a furious cackling arose from the destroyer's bow-piece.

Tilting steep, the air-craft shot higher then, to evade the shells bursting around under her. She swerved like a bird to port and starboard, escaping the wing fire. Then, with engines throttled, she swooped down, just above the vessel's amidships, and wholly out of the quick-firers' trajectories; for gun-mountings including vertical firing had not yet been fitted on board the older vessels.

Even to the British rifles cracking out, upturned eyes saw the aviator, who sat in a cradle abaft the lifting plane, drop a missile; the devil machine obliquely cleaving upward as he did so.

The Kreutzer projectile missed the port quarter by six feet, and the impact of its explosion jolted the destroyer severely. Another shell almost simultaneously tearing up the depths a few feet away, the combined geyser of spray and water fell like a waterspout across her deck, and men were almost carried off their feet.

"She's hit! she's hit!" Deland shouted, blinking his eyes on a tortuous shaft of lightning searing the vision.

"She's tumbling!" crowed the lieutenant. "Her—" but the terrible crashing and ricochetting peals convulsing the heavens overwhelmed his voice.

His whistle shrilled the "Cease Fire." In maniacal joy he motioned to the gray-winged air machine that was hurtling down tractors first as if her motors had been disabled. When she was within 200 feet of the surface of the water her occupant fell out of the skiff-like structure, some way back from the engines and behind the main planes. With arms and legs outspread as if in vain resistance, the unfortunate aviator whirled down, and disappeared in the scatter of spray on the air-craft hitting the water.

Just then an excited voice hailed the bridge.

"Running into the thick of 'em," boomed the C. O. "A hold-up. How many tackling 'em?"

"London and Britannia," trumpeted the signalman, without taking the glass from his eye. "Cruiser seems to be standing by the flagship, sir."

"She's hit, for'a'd," burst out Deland, a thumbnail blob of flame jetting forth on the nearer vessel's fore deck, to be succeeded by a mushroom-like puff of lightish vapor.

"Yes. London almost done for. Seems to be on fire, too—same as Britannia—somewhere aft. Cruiser trying to draw the attack."

A zigzag of lightning fretted the eastern horizon in a brilliant greenish flash, sharply outlining the sea-line; and, as a solemn hollow, distant peal reverberated, a spitter of rain fell. There was not a breath of wind, and the whack-whacking and spits of flame from the warships came threatening over the darkening sea.

Astern, crimson haze obscured the spoke-like beams from the sun now dipping behind the ridge of dark clouds lining the west horizon; and the wrecked monoplane Deland noted to be already hidden by the distance. To him the air machines looked in the livid gloom like a fantasy of monstrous devil birds hovering and swooping, turning and mounting in a widely scattered formation around and above the two vessels that were steaming slow in line abreast N. N. E., the Britannia drawing most of the enemy's virulence.

Now and again a jump of white water, or a fleck of red, showed when a bomb had missed its blinded prey or had struck her deck or upperworks.

Perwynne replaced the stopper of the wireless cabin's voice-tube. Catching his junior officer's eye, he shook his head.

"God help England this night," said Deland within his heart. "Ninety minutes of their rocketing ahead, and Sheerness'll be in flames—and London in terror."

"They have swept across Holland, keeping out of sight topsides of the dirt we have had all day," cried Perwynne to him. "Between forty and fifty of them. . . . . Yes, I make out forty-five at least. . . . We've to try to stop their rush, somehow."

"Flagship down by the bows, sir. She's been knocking about previously."

Already a subdivision of four monoplanes had stood out of the mazy concentric disposition, and was coming along full tilt. Stridently, with canted muzzle, the destroyer's bow quickfirer spat forth shells.

The leading unit of the racing line pivoted out of the area of bursting projectiles; but the splinters evidently damaged the second craft's left balancing wing. She tilted dangerously as if turning over on that side, then slowly glided seaward to get rest on her pontoons. Under the shock of rifle fire meeting her, the aviator was riddled with the bullets and the frail fabric smashed into tattered wreckage.

Yet the other two had, bird-like, darted up to 4,000 feet, out of the gun's trajectory, and even now were dropping like hawks to inflict the deathblow. The destroyer veered away to enfilade them. From her deck the concentrated small-arms fire killed the bomb-thrower in the third aeroplane, his squirming body half in and half out of the cradle, upsetting the machine in its tumble seaward.

But on the sea craft's forecastle a missile from the rearmost enemy fell with a sickening thud, to roll off into the water to port, unexploded. Another burst in the sea to starboard ere the foe had fled astern.

Then into Perwynne's eye leaped a dim, midget figure on the top of the flagship's after barbette; the destroyer, having hoisted her private number, now making to pass astern and come up to starboard. With unparalleled coolness amid the infernal hubbub of spluttering gun and erupting bomb, the signalman using his arms was swiftly semaphoring her orders. Sheet lightning flashing out beyond, he and the battleship—crumpled and wrecked upperworks and jury-rigged wireless mast—stood outlined, exact and rigid like details of a picture etched in fire.

Upon the impenetrable darkness filling the vision for a moment or two, there gushed a yellow splash that billowed into a dull glow on the London's afterdeck. Amidst the scuffling thunder overhead, Perwynne felt lips touch his ear, and heard his signalman's voice. Its frail, indomitable sound symbolized an infinity of thought, resolution and purpose of duty.

"Flagship signals, sir . . . . Come up . . . port quarter . . . wounded."

When the destroyer swept around the stern of the battleship the top of her after barbette was a flaming pyre; and bluejackets with wet sacks were endeavoring to beat out the blazing fluid flowing over the barbette structure and adjoining deck. Monoplanes swooped down from different points; one succeeding in dashing her fire bomb on to the flagship's forecastle; another in lodging a missile that blew out the face of the forward superstructure.

A projectile, dropped wide, threw up a great cone of spray, washing over the destroyer's bows as she surged abreast of a large jagged gap just above the London's waterline. But, to a signalling arm from a group gathering there, she fell into station alongside.

At a glance her Bridge took in that the London had been severely handled in a very recent engagement. It was noted, too, that the Britannia drew ahead, away to starboard, taking the weight of the attack. The air-craft were seen distinctly, save when electric fluid emblazoned the air, some diving in "volplane" to discharge their shells on the cruiser's sputtering deck, some rising to return and swoop down again, trying to blast the gun positions and small arms fire. A few on being hit exploded in midair into gouts of fire, others plunged headlong waterward.

Obscured by the sultry murk and the fast-falling darkness—glimpsed in the play of lightning which was most intense in the north—the scene was as a nightmare of Hell. Yet, on the destroyer's afterdeck, two bluejackets, as ordered, were making every effort to rescue a half-burnt and blinded aviator, who, groaning heavily, was floating near by, supported by the air-chambers of his disabled machine.

The light of the lanterns, dimly shining in the wrecked bunker behind the gap in the ruptured armor, showed a small cluster of bareheaded, dishevelled men urging a grey-haired flag officer in torn uniform to be seated in the cradle. He, stiff in bandages and splints, was stubbornly resisting the faithful arms supporting him. Indignantly, with his free hand, he indicated the wounded being put down behind him by stretcher-bearers.

Just then a bomb broke on the flagship's upper deck between amidship and forward casements; and down her side seethed a broad cascade of purplish fire; a burning figure leaped screaming into the sea. Singed, half-naked, blackened beings, led by a cursing officer, plied hoses and sodden "gummies" desperately on the fresh conflagration.

Of a sudden, Perwynne hailed the London peremptorily. Even as the hawser was cut, there came the first swirl of wind, a confusing run of sea joggling the small craft, and then hard upon this a terrific flash of pronged fire sheer across the darkness ahead. The stunning effect of the crashing, rolling peal was lost in a vast, quivering white blaze that enveloped sky and sea as if creation had burst on fire.

For that infinitesimal fraction of time everything appeared to stand still in the shadowless glare, to be gulfed instantaneously in inky darkness. Yet with Perwynne—ringing his engines to full-speed ahead, and deafened, blinded by the elemental outbreak—there remained an impression of the gaunt, grey cruiser ahead with bows hove up on a crumbling wall of rushing, white-lipped seas; and of specks overhead—some afar, bursting into flaming atoms in the lightning stroke—some nearer at hand, broken and turned somersault by the tremendous breath of the gale, the shrieking of which now belched on the ear.

It came down with appalling swiftness. The few remnants of the aerial force vainly tried to flee before it, keeping low to escape the danger zone above.

Half an hour later, when the destroyer, tumbling, smashing, cleaving invincibly, drove along the homeward track amid buffeting seas, her C. O. clinging to the rail of his bridge, lifted his eyes from where astern there last had been seen the outlines of cruiser and sinking battleship.

"In touch with Whitehall and running off the news. Good," he exclaimed, mouth close to the ear of Deland who had reported. "It's been touch-and-go for Old England's nerves. Queer how what brought about the wireless jam should save us. Coincidence—of course!"

That was just what Deland did not think.

Marconi Company Asks Million Dollars' Damages From U. S.

ON July 29, the Marconi Wireless Telegraph Company of America filed in the Court of Claims a petition charging that the United States Government, through the Army and Navy and other departments, has constructed or used apparatus in violation of the patent rights of the Marconi Company. A claim for damages to the amount of $1,000,000 has been entered by the wireless company.

The patents named are re-issue No. 11913, granted to Mr. Marconi on June 4, 1901, for transmitting electrical impulses and signals and apparatus therefor; patent No. 609154, dated August 16, 1898, and granted to O. J. Lodge for inventions in electric telegraphy; Mr. Marconi's tuning patent No. 763772 issued on June 28, 1904; and No. 803864 granted to J. A. Fleming on November 7, 1905, for an instrument for converting alternating electrical currents into continuous currents, (the valve detector).

The Marconi Company alleges that in violation of its rights and privileges under these patents the United States, through its officers and agents, has, since June 25, 1910, entered into agreements with various persons and corporations for wireless apparatus which constituted an infringement of the Marconi patents, and that the Government has used, and is still using, the apparatus so obtained. Those specifically mentioned in the petition are Fritz Lowenstein, Emil J. Simon, Telefunken Wireless Telegraph Company, Atlantic Communication Company, Kilbourne & Clark Company and Wireless Specialty Apparatus Company.

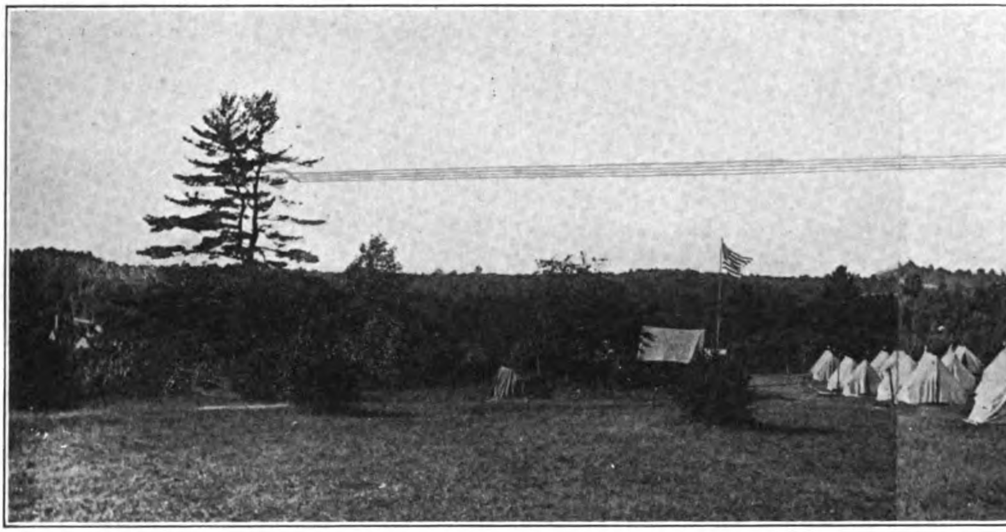
The Marconi Company will substantiate its claim for damages with evidence that it has at all times been ready, able and willing to furnish and supply to the United States any of the inventions set forth in the patents mentioned, together with apparatus embodying these inventions and to charge the United States only reasonable prices therefor.

The petition to the court also states that upon learning of the infringement, the Marconi Company notified and warned the Government to desist, but that the United States "neglected and refused so to do, and still continues to make and use the inventions set forth and claimed in said letters patent."

The petition, over the signature of E. J. Nally, vice-president and general manager of the Marconi Company, states that the Government "well knowing that the validity of said letters patent had been adjudicated in favor of your petitioner by several of the courts of the United States, has, since the twenty-fifth day of June, 1910, and before the filing of this petition, without license of your petitioners, and without lawful right, made and constructed, and used, a very large amount of apparatus containing and embodying in use the inventions covered." The Marconi Company claims that the infringement "has resulted in great injury, damage, and loss to your petitioner, in the aggregate sum of $1,000,000, which sum is justly due to your petitioner and which sum, or such other reasonable compensation as this honorable court may find to be due your petitioner, your petitioner avers it is justly entitled to recover, after allowing all just credits and offsets."

The outcome of this action will be watched with interest throughout the technical world, as the decision of the Court of Claims will indicate the degree of protection afforded inventors whose patented apparatus is useful to the Government. The statute which permits patent holders to appeal for redress is a comparatively new one, the Court of Claims having been established to determine the validity of claims against the Government, which cannot be sued in court as is the case of private corporations or individuals.

Views of the Summer

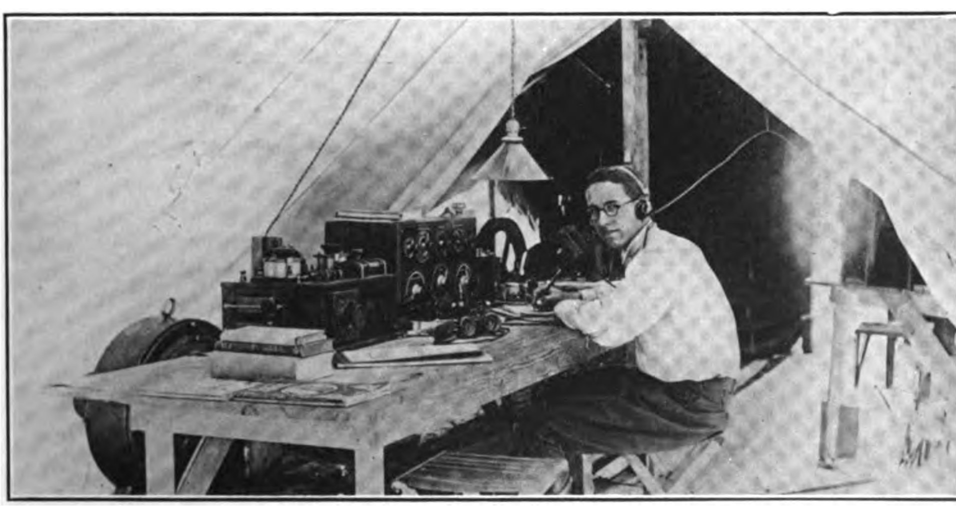


The double-page photograph across the top shows the company streets from the senior end, also the 250-foot aerial suspended from trees. The center photograph gives a view of Birchwood Lake, the club house and mess tent showing in right of background

Assembly for retreat at sundown, showing some of the 250 juniors who attended

Military Camp of N. A. W. A.

The small illustration to the right is a view of the reservation upon which the International Order of Military Women were camped. There were more than 100 enthusiasts of the gentler sex who received instruction. The group shows Major White and staff at morning tent inspection.



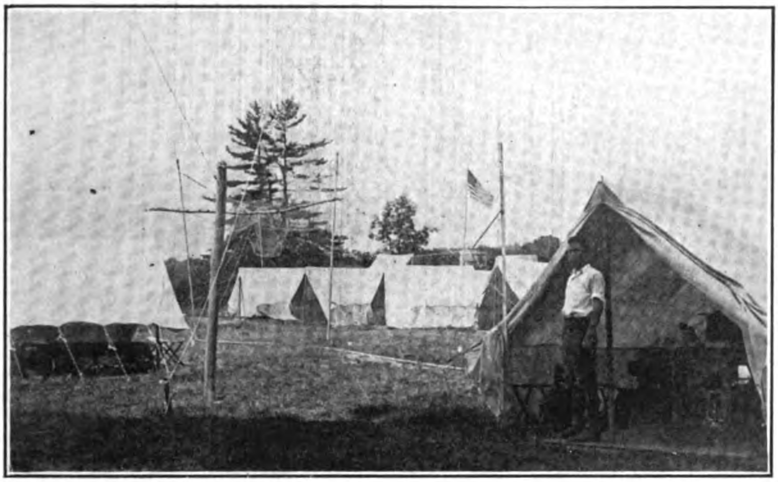
Interior of the wireless station, Lieut. Hotchkiss at key of the 2 k.w. Marconi set

Views of the Summer

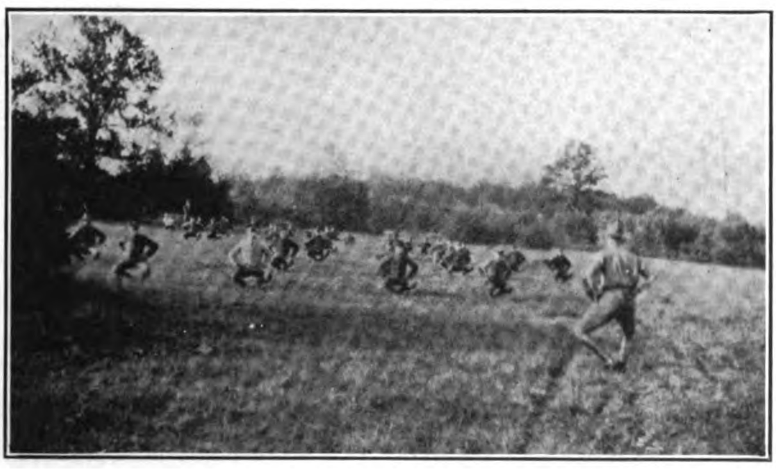
Above, the military headquarters' wireless station, giving a glimpse of the condenser rack and the 8 h. p. Fairbanks-Morse engine used for generating power for the 2 k.w. set loaned by the Marconi Company. Both engine and wireless apparatus were donated by the respective makers in the interests of patriotism. In center, Officer of the Day on inspection rounds

The bathing hour, a daily frolic for the embryo soldiers

Military Camp of N. A. W. A.



Just left of the center, in the photograph above, may be seen the counterpoise erected under the headquarters' station aerial. Newspapers seldom reached the camp and the press bulletins posted were practically the sole means of keeping in touch with the outside world. The illustration on the right shows the water supply at the head of the company streets, separate pipes being installed for washing and drinking water



Setting-up exercises, part of the healthful daily routine

MY TRIP TO THE BORDER

By C. S. Gould

Marconi Operator and Member of the New Jersey Signal Corps

In these warlike days all that pertains to things martial is of interest, and wireless is not the smallest feature in the picture of preparedness and battle. This in brief is my reason for setting down on paper the story of the trip of the New Jersey Signal Corps to the Mexican Border.

The afternoon of June 30 found all of the members of the Corps in the New Jersey State military camp filled with excitement due to the orders they had received to make ready to go to the Border. At the noon mess word had come to break camp and entrain the next morning at seven o'clock. Delay followed delay, however, and it was not until late the next day that the Corps marched to the railroad station at Manasquan. Here the roll was called and those who had been rejected by the doctors fell out of the ranks, the remainder finding seats in the cars. Two of our number—one a private and the other a sergeant—were so much absorbed in saying good-bye that they were left behind. Our train waited at a point fifty miles from Manasquan, however, until the missing ones arrived on the express that followed.

Making only one stop—Fairmount Park, Philadelphia—the troop train thundered straight through to Harrisburgh, where we were transferred from the day coaches to Pullmans. At Pittsburgh the Women's Preparedness Association served us with coffee and sandwiches and at Trafford, Pa., other members of the Association distributed stamped postal cards and pencils. Not the least interesting feature of the trip were the receptions accorded us at the various stations by girls who stood on the platforms cheering and waving flags. At Little Rock we visited the Y. M. C. A. and then again resumed our journey, speeding across the hot levels of Oklahoma and Texas, into the deserts of New Mexico.

When we reached El Paso I was given ten cartridges for my revolver and ordered to allow no one to leave the train until instructions to that effect were issued. These came an hour afterwards and the troops marched out of the cars. Instead of remaining at El Paso, however, we were ordered to Douglas, Ariz., 200 miles away. On the way we passed through Columbus where a large tent surrounded by a high wire fence heavily charged with electricity and patrolled by a strong guard was pointed out to us as a military prison for Mexicans.

Arriving in Douglas at noon on July 7th, we at once set about pitching tents. The thermometer registered 112°, but at night the weather was so cool that we were compelled to sleep under blankets. The routine of camp life occupied our time during the next two days and then came a heavy rain storm which developed into a cloudburst accompanied by brilliant flashes of lightning. This meant additional work—digging sinks, grubbing roots and extra attention devoted to the care of the horses. And so passed our days on the Border, one being very much like the other.

MILITARY MEN PRAISE CAMP EQUIPMENT

Major A. F. Kilbourne, U. S. A., who has charge of mediums of communication between the camps along the Mexican border, recently made an inspection of the methods in practice at Camps McAllen, Pharr and Mission. After an examination of the wireless plant which is taking care of all official business of the three camps, he said that the New York division's wireless communication was the best he had yet found along the border.

The wireless system at McAllen has a radius of more than 100 miles. Although Major General O'Ryan and Squadron A were "somewhere in Texas" a few weeks ago on a tour of inspection, communication with headquarters was maintained by means of the wireless.

It is understood that General O'Ryan has been much impressed by the fine showing made by the wireless, and although he personally has refrained from expressing his opinion, other officers have predicted that, should trouble come, the wireless would play an important part in concentrating the widely separated units. Many of the telegraph and telephone wires have been cut repeatedly.

The Problems of Interference*

By Percy W. Harris

THE ever increasing popular interest in wireless telegraphy and the fact that in practically every school at least the elements of this modern application of electricity are included in the course of instruction may, perhaps, account for the large number of specifications relating to radiotelegraphic apparatus which find their way to the Patent Office.

Most of these, unfortunately, prove to be of little value, mainly because the inventors are unacquainted with practical work. It might be said that had they known of certain difficulties connected with the transmission and reception of wireless waves, the greater proportion of the specifications would never have been filed. Particularly is this case with regard to patents for eliminating interference with the reception of wireless signals.

When Senatore Marconi first erected a pair of stations for intercommuication over short distances, there was, of course, no interference from other stations, as these did not exist; but directly the stations were multiplied a difficulty arose. This will be understood when we consider that the transmitting aerials radiated electric waves equaly in all directions, and these were recorded on paper tape as dots and dashes. We thus see that if one station were working to another at a distance of, say, fifty miles, any other receiving station within that radius from the transmitter would be affected equally. The disadvantage of this is obvious, as no two pairs of stations close to one another could work at the same time. Wireless telegraphy being of the greatest use on board ship, working in congested shipping zones, such as the English Channel, would have been practically impossible had no remedy been found.

With the invention of the tuned transmitter in 1900 some of the disadvantages were removed. The early transmitter to which we have just referred radiated strongly damped waves, which excited the receiving aerial by impact. The tuned transmitter, on the other hand, radiates a train of more or less feebly damped waves, no one of which is sufficiently strong to create an effect in a reeciver (except at close range); whereas the cumulative effect of the whole train on a suitablv adjusted instrument within range is very appreciable. By having various pairs of stations, each pair on a different adjustment, many can work at the same time within a comparatively small zone. Were it not for tuning, the giant stations at Poldhu, Clifden and other places would interfere with all ship stations for a great distance; whereas in reality vessels almost in sight of these stations are unaware of their working unless the operators make special adjustments.

Under present conditions, however, and owing to international agreement, it is impossible to make full use of the principle of tuning to avoid interference between stations. The most stringent rules have been framed and need to be enforced to avoid interference, and it must not be imagined that because all transmitters and receivers have apparatus to enable them to be adjusted to particular wave lengths, they are by any means immune from disturbance. The reason for this is as follows: First, the most important application of wireless telegraphy is to communicate with ships at sea and between ships and coast stations. In cases such as distress calls it is necessary that as many ship and shore stations as possible should hear the signals. Again, at the present time special warnings may be issued from the Admiralty by wireless regarding alterations in light vessels,

* From The Year Book of Wireless Telegraphy and Telephony, 1916.

calling at certain places, the presence of submarines, and such matters. Operators, therefore, have their apparatus adjusted in such a way that they can hear any call from any station within range. Were it not for this international agreement, distress calls would often go unheard. For some years all mercantile ships and commercial shore stations have had their apparatus normally adjusted to transmit and receive signals on a wave-length of either 300 or 600 meters. The case of naval stations we shall refer to later.

Quite apart from warnings and special calls, the handling of ordinary radiotelegraphic traffic requires to be carried out upon a common wave-length, so that every ship may be ready to receive its traffic. Thus a liner may have had a message for another vessel, which the latter is not expecting. The operator of the second ship, listening on the standard wave-length, is bound to hear the call of any ship within range, and thus will not miss the message. If, however, he were listening on some other wave-length he would probably miss the call.

Mercantile Ship Wave-Lengths

Three wave-lengths only are allowed to be used by mercantile ships—namely, 300, 600 and 1,800 meters. This last is only permitted in certain circumstances and is seldom used; whilst for reasons into which we cannot enter here the first-mentioned wave is but rarely utilized. To all intents and purposes we can say that commercial messages between ships and coast stations are practically all transmitted upon a wave-length of 600 meters. As the range of the average ship is some 200 to 250 miles, it will be understood that great care is needed to prevent interference.

Naval stations, both ship and shore, have very great latitude in the use of wave-lengths, working on numerous adjustments between 600 to 1,600 meters, the whole of this range of wave-length being reserved for official use. Warships are thus immune from interference by vessels of the Mercantile Marine and by coast stations handling commercial traffic; whilst the mercantile vessels, on their part, are not "jammed" by the installations of war vessels—incidentally often of very high power and considerable range. The giant stations used for trans-ocean communication, the distribution of news, time signals, etc., invariably work on wave-lengths considerably longer than those normally used by ships, and cannot be heard on ordinary adjustments.

The reader will now understand why it is that under present conditions the advantage of tuning cannot be fully utilized, particularly by vessels of the Mercantile Marine.

Modern receivers which give audible signals in a telephone headpiece enable the operator to distinguish the signals of one station through the signals of many others operating at the same time, owing to individual differences in sound. Although to the layman this may seem by no means easy, in practice reading through interference does not always present difficulties, particularly where the station it is desired to read has a pure musical note of a pitch appreciably different from that of the other stations. The position is somewhat analogous to that of a man in a railway carriage who unconsciously picks out the voice of a friend who is talking to him above the noise of the train and the voices of other people who are conversing in the same compartment. The coherer and similar receivers in use in the early days did not allow of this kind of reception, and therefore were useless in all cases where interference occurred on the same wave-length.

Defects of Call Signal Inventions

The reader who has followed us so far will now realize why so many of the call signal inventions are useless in practical work. Most of them depend for their working upon the coherer, which, as is well known, will readily actuate a relay controlling a strong current. Whilst many of the devices would work excellently with a pair of stations free from any interference, they are useless on the ocean, where many vessels are working upon the *same wave-length,* for the bell or other indicator would act whenever any ship happened to call any other, as well as when a call was made for the particular ship. Later we shall get other reasons for the non-success of many such devices due to atmospheric troubles.

In recent years a number of improvements have been devised in wireless transmitters and receivers for the purpose of facilitating the reading of one set of signals over interference of one or more other sets. The main advance has been in the direction of making the sound heard in the receiving telephones of a musical nature and of a clearly defined pitch. All early transmitters gave a rough, low and totally unmusical note, whereas those of modern design cause a sound similar to that of a flute or whistle. This has been effected by substituting for a fairly large fixed gap smaller gaps between electrodes rotating at a high speed or between a number of flat electrodes with very small space between them. To give an analogy between the old and the new notes, we may compare the sounds given by ordinary carpenters' saws and machine-driven circular saws. The ordinary saw gives a rough, coarse sound very little distinguishable from that of other saws being used at the same time; whilst the circular saw gives a hum of a more or less clearly defined pitch, and it is comparatively easy to pick out by ear the sound of one circular saw from that of others working in the vicinity.

Utilizing Note Tuning

In aural reception the frequency of the spark is of the greatest importance, whereas in reception by coherer and similar detectors this counts for very little. A number of devices have been invented within recent years to utilize *note* tuning. Amongst these we may instance a telephone receiver in which the diaphragm was made to resonate to a particular note, but was unaffected by others. It would seem on first consideration that such a device would overcome many of the difficulties of interference on the same wave-length, for, if we imagine a pair of stations to work on a note of high pitch, their telephones would not be actuated by signals of lower pitch. However, it has been found that this telephone does not give sharp signals, there being no rapid cut-off at the end of the dots and dashes. Such lack of sharpness interferes with reception at anything but a slow speed. Another device tunes the telephone circuit, by means of large capacities and inductances, to the particular musical note which it is desired to receive; but no extensive use has been made of the idea, as it has not been found very successful in practice.

Some years ago a series of investigations were made for the purpose of finding the best frequency to use with ordinary telephone receivers, and it is now recognized that frequencies from 500 to 1,000 per second are the best. Wireless operators find that very high notes, although clearly audible above interference from atmospheric noises and sounds from installations giving a lower note, are very tiring to the ear; and the writer's experience, in common with that of many others, is that after working for an hour or two with a note of 1,000 per second a form of mental strain is created, a kind of nervous irritation sets in, and one seems to hear the sound long after it has ceased. On the other hand, a frequency of about 600 per second is pleasing to the ear, easily readable, and has not the effect above referred to.

The most succcessful call-signal devices are those which have a time-lag, not being actuated by short signals, such as dots and dashes at ordinary speed, but only by prolonged signals of several seconds. Such devices are not affected by occasional jamming from other installations, neither do atmospheric disturbances, except when very strong, give unwanted signals.

So far we have dealt mostly with interference by signals of the same wave-length, assuming that the reader is fairly well acquainted with the principle of tuning and the usual methods of selecting, by resonance, the wave-length required. Most modern tuners will easily differentiate between waves differing by as little as 5 per cent. in length, provided the stations are not too near. To effect this sharp selection, however, there is usually considerable sacrifice in strength, and means have now been devised by which the selection can be made without much loss. Several pairs of very high power stations have recently been erected for working "duplex"—that is to say, sending and receiving taking place at the same time.

Duplex Operation

To explain this method of working we may instance the giant stations at Clifden and Glace Bay. The transmitting station at Clifden is situated some miles from the receiver, separate aerials being used. A similar arrangement exists at Glace Bay.

Transmission across the Atlantic takes place in both directions at once, the receiving station in Ireland not being jammed by the transmitter a few miles off, although the difference in wave-length is by no means large. Without some special arrangement the received signals in Ireland ad Nova Scotia would be hopelessly jammed by the enormous power being radiated from the adjacent transmitters, as, tuning or no tuning, any individual wave of the train being radiated would be sufficiently strong at that distance to force the receiver into strong electrical vibration. In this case intererence is eliminated by what is known as a "balancing aerial" at the receiving station, this aerial being placed at right angles to the aerial which is taking signals from across the ocean. Both receiving aerials are led to a specially designed receiver, where they act in opposition to one another. The aerials used by the Marconi Trans-Ocean Stations are directional in the properties, receiving stronger signals in the plane of their length and weakest in the plane at right angles to this. We have mentioned that the balancing aerial is erected at right angles to the ordinary receiving aerial, and in this case it receives practically nothing from across the ocean, although both aerials are affected about equally by the strong signals from the adjacent transmitter. The signals in the receiving and balancing aerials from the adjacent transmitter are made to neutralize one another, all that is left being the weaker signals from across the ocean. Here we have a case of interference successfully overcome, not by ordinary tuning or note selectivity, but by balancing.

The Balancing Principle

The balancing principle has also been applied to signals of different wave-length received on the *same* aerial. The method is to tune the aerial to two wave-lengths, one of which is the same as it is desired to receive. The aerial is coupled to two receivers tuned to each of the wave-lengths respectively, and the resulting rectified oscillations are opposed in a common telephone transformer.

Powerful waves differing from both the tunes of the aerial will excite both wave-lengths, and by carefully adjusting both receivers a good balance can be obtained.

The desired signals excite only one wave in the aerial, and so come through, as both receivers are not affected. This method has been worked at Letterfrack, but does not give results equal to the balancing aerial method.

Hindrance to Sharp Tuning

We have so far omitted reference to one trouble arising in connection with the emission of damped waves from a transmitter, and which may prevent sharp tuning. When a closed oscillating circuit is coupled to an open radiating circuit, there is an interaction between the two circuits, which in case of tight coupling causes waves of two frequencies to be radiated. The weaker the coupling, the closer these waves become in frequency; and when the coupling is very loose practically a pure wave is given off. In the case of a very weak coupling, however, there is some diminution in strength, and in most cases where very sharp tuning is not required the coupling is made sufficiently strong to utilize most of the energy of the close circuit, but not strong enough to give waves which differ to any great degree.

If the arrangement of the discharger in the closed circuit is such that the spark can be fairly rapidly quenched and the circuit opened after a few oscillations, the energy which has already passed into the antenna oscillates freely. As there can now be no interaction, the wave emitted is very pure, and a minimum of interference is caused. The quenching should not be too rapid, as, if the first oscillations in the aerial increase very rapidly, interference will be caused on other receivers by impact excitation.

The Marconi high power stations, with their high speed discs and rotating side electrodes, are adjusted so that their sparks are quenched as soon as the energy of the primary circuit has been delivered to the aerial. Another method of quenching extensively utilized consists in passing the spark between a number of flat metal plates separated by a distance of not more than 1-100th inch, the small gaps being in series. The large metal surface rapidly conducts the heat away, this being one of the chief causes of the quick quenching. When any considerable power is used the metal plates need to be artificially cooled by an air blast, and the power required for driving the blower may be considerable. A good quenched gap enables a tight coupling to be used without causing the emission of a double wave, thus yielding higher efficiency. Such discharges need to be very carefully designed, or there may be losses which more than outweigh the advantages gained in other directions.

The growing use of continuous waves has recently brought into prominence a number of receiving devices which overcome many difficulties caused by interference. Many people with a slight acquaintance with wireless telegraphy believe that continuous waves must be vastly superior to damped waves for purposes of tuning; but as most modern transmitters are but feebly damped, the superiority is by no means so great as would be thought—in fact, the Marconi Company has found that there is very little difference in the sharpness of tuning between continuous wave signals and signals from their very feebly damped high power transmitters.

A Continuous Wave-Receiving Device

A highly ingenious continuous wave receiving device is known as the "Goldschmidt Tone Wheel," really a commutator run at a speed closely approaching that required to commute the oscillations received into a continuous current. As, however, the speed is purposely not exactly that required to commute the current, a low frequency alternating current is produced, having a frequency equal to the difference between the received wave frequency and that of the commutations of the tone wheel. For a description of the working of this instrument we would refer our readers to the "Wireless Telegraphist's Pocket Book," by Dr. J. A. Fleming. Its great advantage is that interference from a continuous wave of only slightly different frequency will give a greatly different note in the telephones. The Heterodyne receiver, another ingenious device, gives a note the tone of which depends on the difference in frequency between the received waves and that of a continuous oscillating current generated in the receiver. This is also described in the book above referred to.

The Poulson "Ticker," another continuous wave detector, is useless in jamming, as the note given depends for its frequency upon the rate at which a circuit is opened and closed, and is quite independent of wave frequency, all signals, including atmospherics, therefore being of the same tone.

Atmospheric Interference

Having dealt at some length with interference caused by other wireless stations, we must now turn to the problems arising through interference from atmospherics and other troubles. How to eliminate atmospheric disturbances has long been a serious problem for the wireless expert, and, although we may reasonably expect a complete solution of the problem before many years have passed, it must be confessed that at present much needs to be done. Directly Senatore Marconi came to communicate over an appreciable distance he found that all kinds of irregular signals recorded themselves upon the tape machine. It soon became evident that these irregular signs were not produced by wireless stations, but originated from lightning discharges and electrical disturbances in the ground or atmosphere. From a fancied resemblance of many of the signs to the Morse character for the letter X, and from the fact that they were an "unknown quantity," these signals came to be known as "X's"; they are also termed "atmospherics," "strays," and in the United States "static." Whenever these signals were frequent they made the reception of real signals most difficult and frequently impossible. Some of the trouble vanished when the coherer was taken from the aerial and placed in a separate tuned circuit, as it had been found that Xs partially arose from accumulation of electricity in the aerial, which when the pressure had reached a sufficiently high figure suddenly discharged through the coherer. With the tuned apparatus direct metallic connection of the aerial with the ground prevented such an accumulation. The trouble, however, still continued, and, as voyages to various parts of the world were soon made with wireless installations, investigators discovered that in the tropics and some other parts atmospheric trouble existed almost continuously throughout the day and night.

With the introduction of detectors which permitted aural reception a further improvement was manifest, as the skilled operator could often distinguish the sound of the transmitting station from that given by atmospheric and similar discharges, and the provision of musical notes marked still a further step. In regions where atmospherics are very prevalent, such as Equatorial Africa, the Amazon region, and tropical waters, the power required for effective communication over a given distance needs to be considerably in excess of that needed for the same distance in regions comparatively free from such trouble. It has been observed in many instances that atmospherics are more troublesome on a long wave than on a short one, but this is not always the case. Large and high aerials, presenting as they do a very great surface to the atmosphere, are affected far more than small ones; and recent experiments have shown that a long, low aerial is not affected to anything like the same extent as a tall aerial containng the same amount of wire, even when the received signals from a particular station are of the same strength on each.

Sounds Due to Atmospheric

The operator listening with the telephones on his head when atmospherics are prevalent hears a variety of sounds. Some "X's" seem to give a low, rumbling noise, others have a sound resembling the tearing of calico; others, again, sound like escaping air, and still others give a frying noise. One peculiar variety well known to experienced operators almost invariably precedes a squall of sleet, and the writer has on more than one occasion created a sense of wonderment by telephoning from the wireless cabin to the bridge to say that such a squall would arrive within five minutes. There may be no visible signs of any such squall, but invariably it arrives within the time stated, to the great astonishment of those who do not know how its arrival is foretold.

Much that we have written with regard to the elimination of interference from other wireless stations applies equally to the elimination of atmospherics, although not so much has been done with regard to this last. The Marconi Balanced or Opposed Crystal Receiver, which is described in the "Handbook of Technical Instructions for Wireless Telegraphists," has so far proved the best device for the elimination of this form of disturbance, although many experiments are now being carried out in other directions.

Instances of Freaks

It is a remarkable fact that in the case of two stations separated by a distance of a few hundred miles a particular atmospheric trouble will sometimes affect both equally, and at other times disturbs one and not the other. A land station will oftentimes find it practically impossible to read signals from a ship at a much smaller distance than this, whilst the ship has not the slightest difficulty in reading the coast station. This is occasionally acounted for by the fact that the coast station aerial is much higher, but such an explanation does not often satisfy.

Land stations are sometimes subject to interference by induction from power transmission lines, tramway systems, electrified railways, and current leakages generally. The elimination of such troubles as this, however, gives little trouble to the practical engineer, and need not concern us here.

In this consideration of the problems of interference we cannot, of course, offer anything like complete information on the subject. Our endeavor has been rather to indicate to the student who has acquired some knowledge of the theory of wireless telegraphy, and also to the theoretical worker unacquainted with practical conditions, some of the troubles which arise and which need to be taken into account when designing apparatus and thinking out improvements. If we have been able to point out new paths of investigation to even a few of our readers, this article, incomplete as it is, will be more than justified.

Long Distance Transmission on Low Power and Short Wave-lengths

The Aerial Current

By A. S. Blatterman, B.Sc.

Part. II

THE writer has presented in another publication a formula for calculating the current in the base of a transmitting aerial. That formula can easily be thrown into the form:

$$i_2 = 54400 \sqrt{\frac{W_1 C_2}{\delta_2 \lambda} k} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where:

W_1 = watts in the condenser circuit.
k = per cent of W_1 transferred to aerial.
C_2 = capacity of aerial in farads.
λ = wavelength in meters.
δ_2 = decrement per semiperiod.

Now the aerial decrement δ_2 is the sum of the decrements due to the equivalent resistance of radiation, the resistance of the earth connection and the ohmic resistance of the antenna wires.* That is: $\delta_2 = \delta R_1 + \delta R_2 + \delta R_3$

R_1 = decrement due to radiation resist.
R_2 = decrement due to antenna ohmic resist.
R_3 = decrement due to earth resistance.

Thus:

$$\delta_2 = \frac{R_1 + R_2 + R_3}{4 n L_2}$$

$$= \frac{3 W \pi 2 (R_1 + R_2 + R_3) C_2}{\lambda} 10^8 \quad (6)$$

R_1 = radiation resistance.
R_2 = ohmic resistance of wires.
R_3 = earth plate resistance.

If the value of the antenna decrement as given by this last equation be substituted in the original equation for i_2 we obtain a very important result, namely,

$$i_2 = \sqrt{\frac{k W_1}{R_1 + R_2 + R_3}} \quad \ldots\ldots \quad \ldots\ldots\ldots\ldots (7)$$

This means that *when the power W_1 in the condenser circuit is invariable the aerial current is affected only by the total equivalent resistance of the given aerial circuit, but is independent of an added self-inductance, altered wave length or capacity, and hence the addition of any foreign element into the circuit must be judged solely by the change it occasions in the total aerial resistance.*

Thus, while a power of 1 k.w. may produce six amperes in one aerial it may only produce three or four amperes in an aerial of higher equivalent resistance.

It is interesting to note that equation (7) could have been derived another way. It is plain that the total power supplied to the aerial, W_2, is dissipated in three ways, namely, as heat at the surface of the aerial conductors and at the earth plate, and in electromagnetic radiation.

The power radiated is $P = i_2^2 R_1$.

The power lost in heat at the earth plate and in the aerial conductors = $(R_2 + R_3)\, i_2$.

Therefore, the total antenna power W_2 is:

$W_2 = k W_1 = i\ (R_1 + R_2 + R_3)$

and

* There is another component of aerial resistance due to the effective series resistance of the aerial acting as an absorbing condenser. This is negligible at wave-lengths near the fundamental.

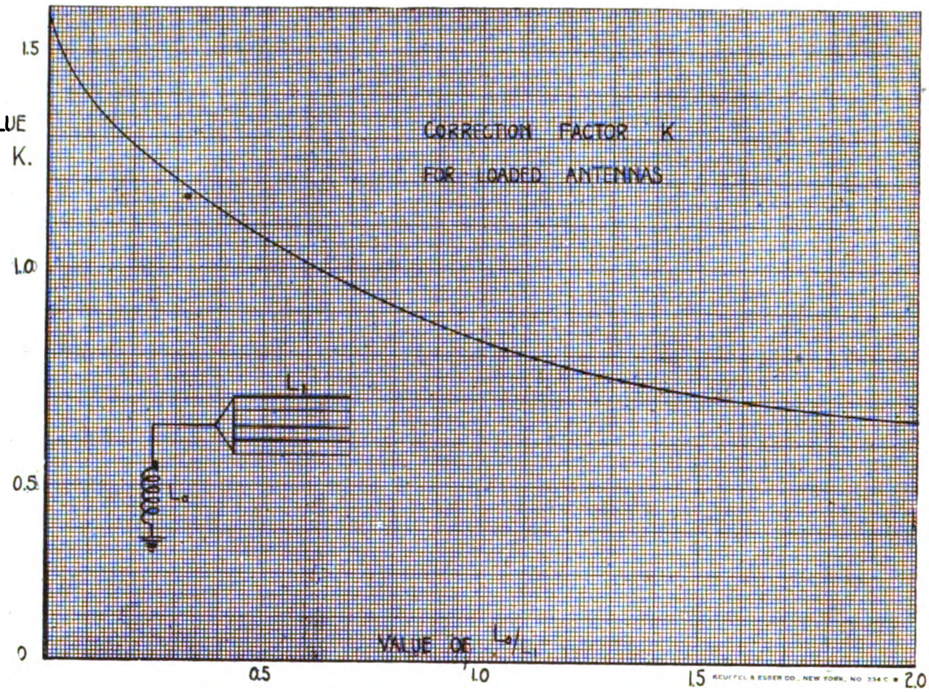


Fig. 8

$$i_2 = \sqrt{\frac{kW_1}{R_1 + R_2 + R_3}}$$

which is the same as equation (7).

The factor, k, involves the losses in the condenser, brushing and dielectric hysteresis losses, the losses in the conductors of the condenser circuit, the losses at the spark gap and the losses at the oscillation transformer. In ordinary spark sets and those using the nonsynchronous rotary gap, k may be in the neighborhood of 0.3 or 0.5.

Apart from the importance of selecting the proper wave length for a given distance, as discussed above, the proper proportioning of the aerial to the wave length used is so influential in its effect on the power radiated that it is remarkable that so little attention has been given to this feature in the construction of amateur stations. One frequently hears the amateur's query, "How many amperes do you radiate?" and the answer, "four amperes on 1 k.w.," or perhaps "three amperes on ½ k.w."; and these figures are then accepted *per se* as indicative of whether or not the station in question is an efficient one. *The antenna current mentioned by itself is absolutely no criterion of the effectiveness of one station as compared with another.* The writer knows of one station which radiates thirty-five amperes with 1 k.w., and yet has a range of less than 100 miles, while numerous other stations radiating only four or five amperes with the same power have a range of at least twice this. What is desired from a wireless station is the conversion of as much as possible of the primary transformer power into electromagnetic waves, that is into power radiated from the aerial.

Now the power radiated in this way is:

$$P = i^2 R_1 \text{ watts}$$

and the radiation resistance R_1, as has been shown, depends on the height of the aerial, the wave length, and on the shape of the current distribution along it; that is, the form factor. Moreover, as shown by equation (7), and stated in italics, the antenna current itself is limited by the effective resistance (including that due to radiation) of the antenna. Thus, in speaking of the radiation efficiency of a station it is not sufficient to give only the current in the aerial, but the radiation resistance must also be stated if a complete criterion is desired.

Substituting the value of i_2 given by equation (7) in the equation for the power radiated we find:

$$P = \frac{k W_1 R_1}{R_2 + R_3 + R_1} \qquad \text{.............(8)}$$

From this it appears that the radiation resistance R_1 should be as large as possible while the resistance of the earth connection and the wires R_2 and R_3 should be kept very small. If R_2 and R_3 could be made negligibly small then all wave length that can be effectively radiated corresponds to the fundamental of the given aerial. For the particular case of the amateur station, where the wave length must be very short, it is therefore obvious that a wave length very close to the fundamental should be used, since this means maximum antenna dimensions and hence maximum radiation. For these reasons it is of the utmost importance to be able to determine very exactly the maximum dimensions of the antenna which will permit the use of the given short wave.

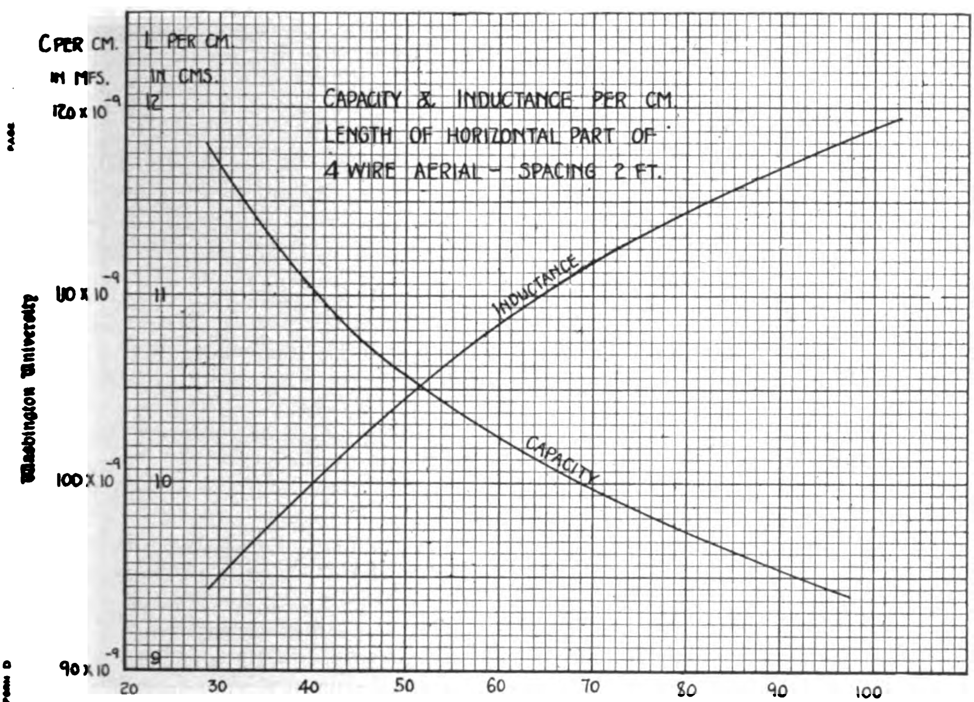


Fig. 9

the power supplied to the aerial would be radiated and the efficiency would be maximum.

Natural Wave Lengths of Aerials—From the above considerations it will now be evident that the wave length is a most important factor affecting the range of a station. It is also clear that in a superficial way it is desirable to use high aerials with high form factors, and short wave lengths, since all these make for a large value of power radiated. Of course, for a given aerial the shortest

The writer has already presented* curves and tables based on the formulae of Dr. Louis Cohen, which give the approximate values of capacity and inductance and natural wave lengths of amateur antennas. These were not highly satisfactory, for while they furnished an indication of the magnitude of the quantities involved, yet the average accuracy was not greater than some 20 per cent. Within the past three years, however, additional data and formulae have ap-

* A. S. Blatterman, Electrician and Mechanic, Sept., 1913.

peared* through which it is possible to calculate very accurately the natural wave length of a given aerial, and thus predetermine to a nicety the maximum possible dimensions thereof.

It is well known that when inductance and capacity in a circuit are lumped, or localized, respectively in a coil and in a condenser, the circuit can be put in oscillation, and the frequency of the oscillations is:

$$n = \frac{1}{2\pi\sqrt{LC}}$$

The wave-length

$$\lambda = 2\pi \times 3 \times 10^8 \sqrt{LC}$$

where L and C represent the total inductance and capacity, in henries and farads respectively.

In an antenna, however, the inductance and capacity are not concentrated, but are distributed throughout the system, and the total inductance and capacity of the system cannot, in general, be used in the above formula to compute the frequency. In this simple case the formula becomes:

$$n = \frac{1}{4\sqrt{LC}}$$

The wave-length:

$$\lambda = 4 \times 3 \times 10^8 \sqrt{LC}$$

Now in an actual antenna we have a loading coil or at least the secondary of an oscillation transformer at the base. This constitutes a considerable localized inductance which must be combined with the distributed antenna inductance in determining the frequency of the system. Under these conditions the frequency lies somewhere between the values given by the above two formulas being $\frac{1}{4}\sqrt{LC}$ when the loading inductance is zero and approaching $\frac{1}{2}\pi\sqrt{LC}$ when this inductance is so large that the antenna inductance is negligible in comparison.

We can therefore write the equation for the frequency of such a system as follows:

$$n = \frac{K}{2\pi\sqrt{LC}} \quad \ldots\ldots\ldots\ldots\ldots (9)$$

The wave-length:

$$\lambda = \frac{2\pi}{K} \times 3 \times 10^8 \sqrt{LC} \quad \ldots\ldots (10)$$

* G. W. Howe, Electrician, August and September, 1914.
L. Cohen, Electrical World, January 30, 1915.
Puchstein, Electrical World, January 15, 1916.

where K varies from 0 to $\pi/2$ and depends on the ratio of the coil inductance L_0 to the antenna inductance L.

The curve (Figure 8) gives the values of K for different values of the ratio L_0/R from 0 to 20.

Let the inductance of the loading coil have the same value as that of the antenna. Then $L_0/L = i$, and from Figure 8 the value of K is 0.82. Using this value

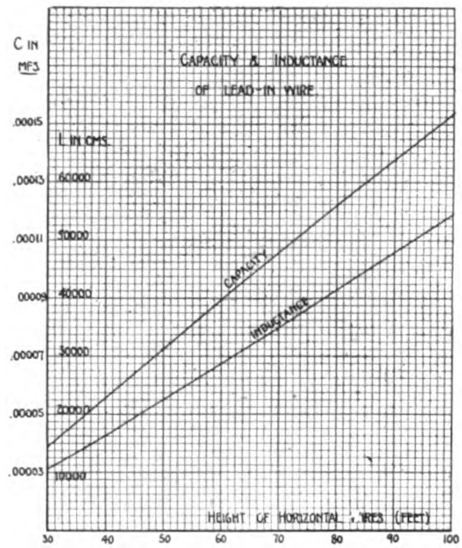


Fig. 10

of K in equation (9), there is obtained for the free frequency of the system

$$n = \frac{0.82}{2\pi\sqrt{LC}}$$

and for the natural wave-length:

$$\lambda = \frac{2\pi}{0.82}\sqrt{LC} \times 3 \times 10^8$$

Assume the following values for the inductance and capacity of the antenna.

$L = 20{,}000$ cms. $= 20{,}000/10^9$ henries.
$C = 0.0005$ mf. $= 0.0005/10^6$ farads.

Then

$$\lambda = \frac{2\pi}{0.82} \times \frac{3-10^8}{10^7}\sqrt{2000 \times 0.0005}$$

$= 230$ meters.

If the inductance and capacity of the system had been considered localized, the wave-length would have been:

$$\lambda = 2\pi \times 3 \times 10^8 \sqrt{(L_0 + L)\,C}$$
$$= 267 \text{ meters.}$$

which is in error about 16 per cent.

As a check on the results obtained by the use of the curve (Figure 8), consider the extreme cast $L_0/L = O$; that is, no loading coil, a simple antenna. In this case $K = \pi/2 = 1.57$.
Then

$$n = \frac{\frac{\pi}{2}}{2\pi\sqrt{LC}} = \frac{1}{4\sqrt{LC}}$$

which is the formula to be expected when the capacity and inductance are distributed.

We are thus forcibly impressed with the necessity of being able to calculate the inductance and capacity of the aerial, as well as the inductance of the coil at the base of it.

Figure 9 gives the capacity and inductance per cm. length of the horizontal part of four wire aerials at different heights. The wires are assumed to be No. 14 gauge and spaced 2 feet apart. Thus, for an aerial of four wires spaced 2 feet part, which is 80 feet long and a certain height above ground, the capacity and inductance of the horizontal part would be determined by reading from Figure 9 the values of C and L per cm. length corresponding to the given height and then multiplying each of these by the length of wires in cms., in this case, $80 \times 30.5 = 2240$ cms.

To these resulting values must be added the capacity and inductance of the lead-in, in order to determine the total inductance and capacity of the system.

The two curves of Figure 10 enable one to determine the inductance and capacity of the lead-in wire. These curves are plotted for a lead-in composed of four No. 14 wires twisted together, leading down from the aerial and terminating 10 feet from the ground. Abscissas are not the length of the lead-in but are the heights from earth to the horizontal wires forming the antenna top.

If the antenna is of the inverted L type the foregoing statements need no modification. However, when the antenna is of the T type with lead-in at the center, then from the point where the lead-in joins the flat-top there are two inductances and two capacities in parallel, these being the two halves of the flat-top is, by this process, reduced ductance of the flat-top is half that of either of its two branches, or, in other words, it is ¼ the inductance of the total length of flat-top; the equivalent capacity is equal to the actual capacity of the whole flat-top.

Roughly, therefore, the wave-length of an inverted L aerial is not materially changed by adding another piece to that already existing and extending in the opposite direction so as to form a T. This is because the inductance of the flat-top. Thus, the equivalent inone-half while the capacity is doubled, leaving the product LC unchanged. This is only approximately realized, however, since the capacity and inductance of the lead-in, especially in small aerials, is a considerable fraction of the total inductance and capacity and therefore doubling the capacity and halving the inductance of the flat-top does not exactly result in the same value of the total product LC.

Editor's Note—In the November issue will be published a complete set of curves indicating the fundamental wave-lengths of 4-wire aerials of various dimensions, supplemented by an additional set showing the wave-length of aerials with a given amount of inductance inserted at the base.

To be continued

REWARD FOR OPERATOR OF SAN MELITO

Owen Chick, Marconi operator on the tanker San Melito, which was attacked by a German submarine while en route from Great Britain to Mexico, and escaped by means of the skill and bravery of the ship's company, was among those who were accorded recognition for heroism. Chick said in a report to the English Marconi Company:

"I was very agreeably surprised when asked to accept, in addition to a check, a beautifully executed model in silver of an early type of U boat mounted on an ebony base, bearing the inscription: 'Mr. O. Chick, wireless operator, presented by the Eagle Oil Transport Co. and the Anglo-Mexican Petroleum Products Co. as a memento of the escape of the s. s. San Melito from a German submarine after being shelled for forty minutes August 21, 1913.'"

The Korea's Last Trans-Pacific Voyage

By David Mann Taylor

Marconi Operator

The shore is gone! O'er restless sea,
One last look far away;
We meet, dear friends, where joy ne'er ends,
Good-bye! 'Tis Sailing Day.

AMID screeching salutes and a hearty God-speed from five hundred throats, the Pacific Mail steamship Korea, greyhound of the Pacific, with the veteran Captain, A. W. Nelson, on the bridge, left San Francisco, at noon on July 3, 1915, on her 20,000 mile journey.

The scene will long be remembered. It was such a day as only California can give us; not too warm; just golden. As the ship swung away from the dock, bedecked from stem to stern with bunting, confetti and vari-colored paper ribbons, her deck-rails crowded with passengers waving handkerchiefs and wafting good-bye kisses to dear ones ashore, the Constabulary Band was playing alternately with our own Filipino stringed orchestra. A program of all the snappy American music of the day ended with the "Star Spangled Banner" and "America," at which time we all gravely saluted the flag, which was then dipped with a salute from our siren. All our officers were in full dress uniforms and the sight was inspiring. Many a tear dimmed eye I saw as I looked down upon the scene.

We steamed slowly from the dock to the main channel, thence across the beautiful bay toward the Golden Gate, passing the greatest Exposition ever held in the world. Off the Marina were anchored the battleships Maryland, Colorado and West Virginia, the Torpedo Flotilla, with the tenders Cheyenne and Iris and supply ship Jason, all of which dipped their flags in salute and ran up the signal "bon-voyage, safe return," which was answered from our bridge with "thank you." Many of the passengers lining the deck-rails at the time stood at attention, with bared heads as the salutes were exchanged.

We proceeded to sea, after exchanging salutes with the lightship and pilot boat. The big Pacific was calm and the beautiful clear blue sky, dotted here and there with fleecy little clouds, made it possible for us all to watch the fast disappearing land for quite some time.

After passing the Farallones, the last bit of America we were to see for sixty-five days, one and all retired to their rooms to dress for dinner, for the first evening meal on board is not unlike a debutante's "coming out" dinner, when everyone's curiosity is aroused and all strive to look their prettiest and best, especially the gentler sex, which was well represented.

At this time in the Marconi cabin we were keeping a close watch upon the doings upon the atmospherical stage, and it was the scene of great activity. Many messages were transmitted and many replies received. After clearing our own traffic to San Francisco, we watched patiently and assisted other ships that had traffic but at the time were out of range of the coast station. Constant communication was maintained throughout the entire voyage. Press dispatches were received from San Francisco, Honolulu, Choshi, Japan, and Shanghai, China, and our newspaper was published twice daily. Our average communication was 3,000 miles.

After steaming six days across the beautiful sunshine belt of the Pacific during which time there was nothing to break up the serenity of the fleecy little clouds that accompanied us, we picked up Diamond Head, the first point of land sighted by vessels bound to Honolulu. Those whose destination was Honolulu were loath to leave. For those glorious days had been a succession of deck games, dances, card parties, musicales and theatricals.

As we left the quarantine and proceeded to the Honolulu docks, we were besieged by dark-skinned native swimmers, diving for coins. These boys proved to be quite adept in the art and rarely missed any coins thrown to them. The rivalry was intense and their efforts energetic, each dive being accompanied by shrieks of laughter, the successful swimmer rising to the surface with the coin in his hand, immediately transferring it to his mouth for safe keeping. All the way up the channel and until the vessel was made fast to the pier, we were accompanied by the amusing divers.

We arrived at Honolulu at eight in the morning of July 9, and left at five o'clock that afternoon for Yokohama, Japan, our next port of call.

After leaving Honolulu our big swimming tank was placed in position on the forward deck, to the delight of our many passengers. The tank, promptly christened the "Korea's Bathing Beach," was crowded with a happy throng each dav of the remainder of the voyage.

The trip of ten days from Honolulu to Yokohama passed altogether too quickly. The weather continued delightful. The Pacific was as peaceful as a small inland lake.

We arrived at Yokohama, Japan, at 9:30 in the morning of July 20th. Here, many tourists' parties left us for their tours of the land of the Rising Sun. The supreme pinnacle of Japan, the peak of Fujiyama, the Sacred Mountain, rises in full view as the steamer enters Yokohama. In a moment the spirit of Japan is made manifest; you have the feeling of being carried from one world to another. Though Yokohama is quite a progressive and cosmopolitan city, one in which can be found all the modern luxuries and comforts of the present day, they are enjoyed among people who live in exquisite paper houses, who wear neither hats nor leather shoes, and who dress in kimonos unchanged in fashion for centuries—people who seem to go at life back end forwards, yet withal have evolved an artistic culture that has influenced the West.

We had been, a few days before our arrival at Yokohama, happily surprised to learn by wireless that the Oriental Palace Hotel management had made arrangements to give a dinner-dansant in our honor. By wireless also came the information that a company of Russian artists had been engaged to give a varied programme of entertainment immediately after dinner.

The dinner took place at eight in the evening of our arrival. Through the courtesy of Captain Nelson, our Filipino stringed orchestra was in attendance, and played with fine animation a selection of the latest American music, much to the delight of the guests. For the first time, public rendition was made of the new Korea waltz, "Yankee Swanson," written on shipboard by Dr. Tietze, in honor of our Commander, author of the story "Yankee Swanson," which is in reality a sketch of his own life.

At ten o'clock the following morning

The supreme pinnacle of Japan, the peak of Fujiyama, the Sacred Mountain, rises in full view as the steamer enters Yokohama we left for Kobe, Japan, our next port of call, arriving there at noon on July 22nd. We spent three days amid this city's great industrial activities.

A few hours after we left Kobe, we passed into the world-famed Inland Sea of Japan, one of the most beautiful bodies of water in the world, linking the Pacific Ocean with the Yellow Sea. The opportunity of passing through this wonderful stretch of water should never be missed. Here the greatness of Nature's handicraft is supplemented on all sides by the expert horticultural and gardening activities of the little Japanese. The opal-hued sea is dotted here and there with pretty little islands, thousands of them. The ship passed through the narrow channels, at times so close that one could almost step across from the deck to the fairyland islands, on which men and women hard at work occasionally stopped and waved to us. The surface of the magic sea reflected all the delicate colors of an Oriental opal, and it seemed to be set in a framework of brilliant emeralds formed of the dainty green covering of the mountainous mainland and the myriad of mystic islands, between which we passed the whole day.

After passing through the Inland Sea of Japan, we entered the Straits of Shimonoseki and passed into the Yellow Sea, skirting the coast of Kyushu, the southern island of Japan, southward to Nagasaki. We arrived at Nagasaki at 3 P. M., on July 26th. At this port is located the largest coaling station in Japan, and here also may be found the largest tortoise shell factories in the world, and the famous Tategami dry dock, carved out of solid rock at a cost of a million dollars.

Upon entering Nagasaki, the ship was piloted through a maze of narrow passages; up a crooked path, as it were, to our anchorage. In passing through this channel a striking panoramic view of the famed handicraft of the Japanese farmer is unfolded; upon the sloping hillsides are to be seen the finely cultivated truck gardens, so arranged as to make use of every possible bit of land for cultivation. These gardens are laid out in terraces, and graphically illustrate the ingenuity of the Japanese farmer, who has so little ground to cultivate in this section.

Upon arrival here steamers are met by a fleet of coal *sampans* (barges), each manned by a crew of Japanese men and women, some with little babies tied upon their backs, much like the papoose of the American Indian. The women and children work just the same as the men. They are very sturdy and never seem to be discouraged no matter what the weather conditions may be; at times they work all day and night, with only a short stop to take a little nourishment of rice and fish.

Almost before the ship was made fast to the coal buoy, the *sampans* were alongside our vessel and the agile little Japanese had begun the work of rigging the scaffolding around the ship, using ropes, poles and planks, in such a manner that they provided substantial stairways, just like so many little flights of stairs, all around the sides of the ship. Upon each step stood two workers passing the small baskets up, hand over hand, until they reached the deck, from whence they were emptied into the bunker hatches.

Each basket will average from thirty to forty pounds in weight, but these little people not only handle them with astonishing rapidity, but are quite happy in their work. On one occasion, as the baskets were being passed up very rapidly, one little woman caught a basket carrying a lump of coal that was heavier than her strength could manage and she dropped it back into the *sampan*. She began to giggle—they invariably giggle when anything happens—and the giggle rippled all the way down the line. No angry protest was heard from the foreman; it was just a joke on her and the work continued merrily on.

On this trip we spent some twelve hours taking on our supply of coal and left on July 27th, for Manila. We were right in the midst of the Typhoon Zone at the height of the typhoon season. The typhoon is the bugbear of seamen and travelers whose business calls them to this part of the globe during July and August, and the weather signals, reports and storm warnings sent out from the various observatories were watched by all with keen interest and anxiety.

A typhoon is the worst kind of a storm; it comes in the form of extreme heavy gales of wind, ranging from eighty-five to 125 miles per hour, accompanied by heavy rains and high mountainous seas.

After leaving Japan, we received daily weather reports, sent broadcast by wireless to ships at sea. This weather service, rendered free by most of the Government wireless stations throughout the Orient, is practically the same as that maintained by the United States Government radio stations.

For several days previous to our arrival in the Typhoon Zone, typhoons had been reported and observed from various weather observatories and warnings broadcasted to all ships at sea.

Less than four hours after leaving Nagasaki, south bound, our first storm warning was received, reporting a typhoon moving in a northwesterly direction. We were then steaming southwest The following morning I received a long report, containing explicit information as to the whereabouts of the storm. Captain Nelson, our commander, immediately ordered our course changed, more to the southeastward and away from the coast of Formosa. According to our position and course, and that reported of the typhoon, we were bound to meet and clash if we continued, and we were only saved the unpleasantness of passing through a typhoon, accompanied by its probabilities of and dangers of the encounter through the timely reception of explicit information, conveyed by wireless.

The change in our course was approximately 220 miles, which was overcome, to some extent, by steaming behind the typhoon and cutting across to Northern Luzon, thence southward to Manila. The distance covered by our ship was approximately the same, but we steamed 220 miles away from the Formosan Coast, in which direction the typhoon was directly headed, escaping its fury and experiencing nothing but a heavy sea, aftermath of the cyclonic storm which had just passed.

This typhoon, which was one of the most severe storms experienced in many years, swept over Shanghai, July 28, and continued up the China coast, doing heavy damage The North China Daily News reported the wind velocity the greatest recorded since 1879. Shanghai

An illustration of the writer's observation that, though Yokohama is quite a progressive city, one in which can be found all the modern luxuries and comforts of the present day, they are enjoyed among people who live in exquisite paper houses, who wear neither hats nor leather shoes, and who dress in kimonos unchanged in fashion for centuries suffered the most; the Bund and Public Gardens were seriously damaged and many deaths were reported. The value of Marconi wireless equipment aboard all vessels was again demonstrated; without the aid of the wireless storm warnings our ship would have continued on, in its regular course, unmindful of the approaching dangers and would have clashed with the typhoon between nine and ten in the evening of July 28th. The consensus of opinion among the officers of the ship was that we had escaped a situation that may have been disastrous to the ship and the lives of those on board. Many voluntary expressions showed it was also a great relief to the passengers, many of whom had traveled through the Typhoon Zone at this time of the year before, to know that with the aid of Marconi wireless we were able to keep in constant communication and at all times were aware of the progress of the storm, enabling the commander and his officers to navigate the vessel in a safe manner. A feeling of perfect security was evidenced by the passengers upon receipt of the news that we had escaped the wrath of the heaviest typhoon of the season, in fact, the heaviest in thirty-five years.

After four days' steaming time we arrived at Manila. Here we discharged our remaining passengers and cargo, and immediately began to load a general cargo for Shanghai and America.

We left promptly at 10 A. M., on August 2, for the fifty run over to Hong Kong, at which port we arrived at five in the morning of August 4.

Hong Kong, as many of us suppose, is not a city; but an island lying off the coast of Kwang-Tung Province, South China. It stands on the fringe of the vast Chinese Empire, a gathering place of all sorts and conditions of men. Victoria, the city, is located upon the slopes of the island, and in general it is spoken of as Hong Kong. It is the clearing house of the world's commerce to and from the Far East, therefore one of the busiest harbors in the world. Ships of various nations are continually coming and going to all quarters of the globe. The island of Hong Kong belongs to Great Britain, having been ceded by China in the early 40's; here is located one of the largest naval stations in the Far East. Owing to the war, our Marconi cabin was sealed and the aerials lowered under the supervision of a British naval officer, leaving us free to indulge in sightseeing. We were glad of the opportunity, even though we had been here before, and for eight days we enjoyed many little jaunts around this quaint, picturesque island.

On August 11, we steamed from Hong Kong for Shanghai, beginning the first leg of our homeward bound voyage. During the entire outward bound voyage we had heard many rumors that the Pacific Mail Steamship Company was to discontinue the trans-Pacific service. Not much credit was given to these rumors, however, as we had heard similar reports for quite some time. When we arrived at Woosung, three days later, we heard that our ships were sold, but we were unable to obtain any definite confirmation until our arrival at Nagasaki at 6 P. M., on August 16th. Here we learned our fate. A cablegram was received by the commander, giving explicit information and details regarding the future movements of the ship and its crew. It was then learned that the Big Four, the steamers Mongolia, Manchuria, Siberia, Korea and the China had been sold to the Atlantic Transport Company and that these ships were to be turned over to their new owners at San Francisco and sent back to England, thereafter to be engaged in the trans-Atlantic trade.

When this news reached officers and crew they were very glum. Much speculation was indulged in and many "pleasantries" were exchanged. Dr. Jackson, our ship's surgeon, portrayed our feelings very well that night at Nagasaki in a poem which he composed and titled: "Korean Lament."

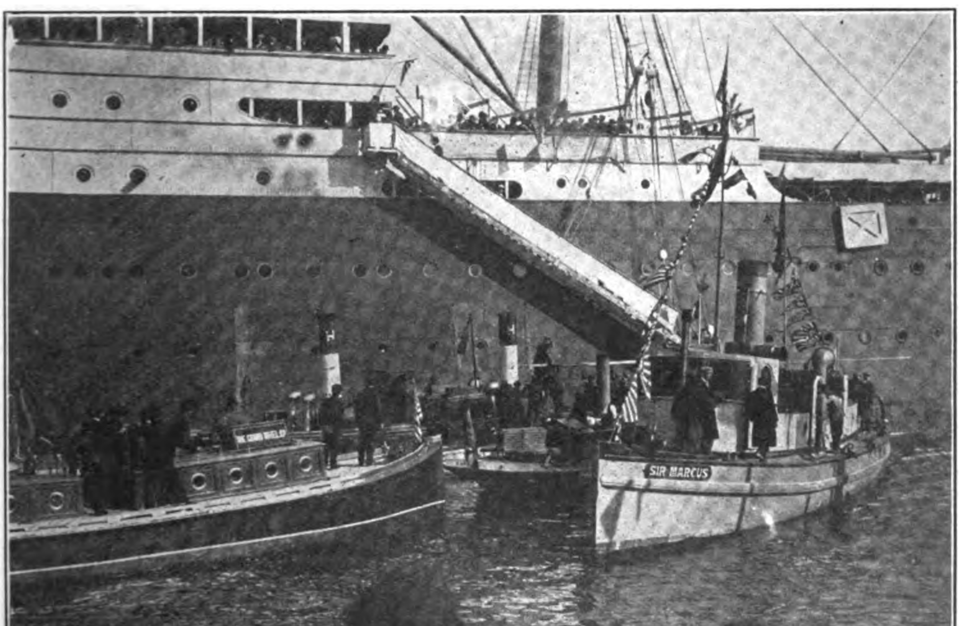
From thence onward our trip home through Japan was one long good-bye—"Sayonara," as they say in Japanese. Rumors of the removal of the American flag from the Pacific had filtered through Japan; but the catastrophe had been unbelievable. The Korea was the first steamer to have authentic information. We learned then that, commercially, the withdrawal of the Pacific Mail fleet from the Orient would be a heavy blow to Japan, as much money had been spent by American travelers and Yankee officers and seamen passing through the Island Empire. It was with a feeling of deep regret that Japan said farewell to the American flag.

The day of our departure dawned bright and sunshiny. Hours before our sailing time the beautiful harbor of Yokohama presented a fair and busy scene. Activity was everywhere. The barbor was crowded with many ships of various nations. *Sampans* propelled by one long oar, darted hither and thither, carrying Japanese sightseers aboard our ship for a last "Look see" and to say good-bye to their American friends. Merchants and their families, bringing with them small tokens of friendship—the little "Cumshaw" so affectionately remembered by us all—showed us with convincing sincerity how loath they were to see us go.

The hour of our departure drew near all too soon. Finally all our passengers were aboard and our visitors were beginning to leave the ship; the crowded decks were lined with returning tourists, intermingled with many Japanese in quaint costumes, their many-hued kimonos contrasting vividly with the more sombre American dress.

Promptly at 3:30 P. M. we were clear of the buoy. As the ship turned around and headed for the breakwater, there began the noisiest and most heartrending blowing of whistles I have ever heard; the steam salutes were forced until they sounded like shrieks and moanings. It was Yokohama's good-bye to the American flag, and it seemed to wail, "Come back, come back." Many a tear stained face I saw as I looked down upon the crowded decks, and through the glasses I could see that our friends and associates in the small boats felt as we did; it seemed to be the breaking of strong ties of friendship, that may or may not be renewed at some later time.

Several of the steam launches accompanied us out into the bay and two of the Pacific Mail Company's launches, crowded to the rails with officials and members of the Yokohama staff, ran alongside for five miles. With our siren



The harbor of Yokohama will still continue to present a fair and busy scene no doubt, but it was with a feeling of deep regret that Japan said farewell to the American flag. When the Korea left, hundreds of Japanese merchants came aboard for a last "look see" and to say good-bye to their American friends and steam whistles continuously blowing in answer to the salutes of the launches, we steamed slowly out to sea, dipping our flag in farewell as the launches turned around for their return run to the harbor.

In the Marconi cabin we were kept very busy with good-bye messages. All the way to Honolulu, the Japanese operators on various liners and at the coastal stations of Choshi and Otchishi, saluted us every night with: "Good wishes and hurry back."

* * * *

In the four years during which I had frequently visited Japan I had formed many friendships among the telegraph fraternity of the Island Empire. Many a happy hour I had spent in Japanese telegraph offices and radio-telegraph stations, and these reminiscences came crowding upon me. So much was I affected at severing my ties with the sons of Nippon that I wrote the following poem, as my "Good-bye" to Japan:

"SAYONARA"—GOOD-BYE

I can see the cherry blossoms,
As they bloom in Old Japan,
Falling pink and white about her;
Little maid of Yoko-San.
I can see the gold of sunrise
And the silver of the moon;
And the twinkling lights of sampans,
On the dusk of the lagoon.
I can feel the warmth of summer,
And the drowsy stir of air;
And the slender little fingers,
Strumming softly to me there;
And the world's a flood of sweetness,
When you play your samisen.
Sayonara—O my Hana!
I will dream of you again.

I can see you as I used to,
With the lotus in your hair,
Piled up smooth and dark and shining;
And the robes you used to wear,
Gay like wings of birds and beetles,
Sweet perfumed and flowing free;
And the long, light, sliding windows,
Where we leaned and watched the sea.
I can feel your soft caresses,
Blossoms of the East they seemed,
Fluttering down so warm and gentle,
Like dream kisses I have dreamed.
Oh! The world's a flood of sweetness,
When you play your samisen.
Sayonara—O my Hana!
I will come to you again.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS
Supplying the Current for a Vacuum Valve

ASK any amateur who is not using a vacuum valve detector what the chief difficulty is and in nine cases out of ten he replies it is lack of funds. He feels that he cannot afford to buy a vacuum valve and keep it supplied with electricity.

Being in the same boat with the majority of amateurs, I decided the best thing for me to do was to buy a separate valve, which several concerns are now selling, and make the storage battery and the high voltage battery myself.

I shall try to describe briefly the results of my work.

The low voltage filament battery consists of two cells for a four-volt battery and three cells for a six-volt battery. The unit I constructed was of six volts capacity, but any number of cells can be made to deliver any value of voltage. The important thing to remember is that a storage battery of the lead type delivers two volts on closed circuit.

The capacity of the small battery such as I constructed was about twenty ampere hours, and I think that this is sufficient for the requirements of the average amateur station.

There are two negative and one positive plate per cell. These plates have the same dimensions, but, of course, the negatives differ in construction from the positives.

From the drawings (Fig. 1) the size of the plates is given as 5 inches by 6 inches. This gives a capacity of twenty ampere hours for each positive plate in each cell. It is permissible to put in, say, two positive and three negative plates of this size, thus obtaining a capacity of forty ampere hours, but I think for the best service the smaller one will suit best because it is easier to charge.

The material from which the plates are made is ¼-inch lead. Each plate is 5 inches by 6 inches with a lug, ½ inch by 2 inches. The plates are drilled with ½-inch holes, as shown in the drawing, and each hole is countersunk on each side. These holes are to hold the active material.

After three plates have been made for each cell the positive plate of each is placed on a piece of heavy glass and the holes are filled up with a mixture of red lead (lead oxide, which may be obtained from most drug stores), and sulphuric acid. Dilute the acid to about 1 — 10 or 1 — 15 with water. Mix with a copper or iron spoon. Copper is best because it does not react with sulphuric acid.

Do not be sparing with the red lead, but fill the whole plate, or grid, up full.

The next thing to do is to fill up the negative plate with litharge, which is a spongy variety of metallic lead. Then the litharge is mixed in the same way as the red lead was, that is, with sulphuric acid.

When all the plates are filled up, either litharge or oxide, they should be piled up on one another, with several thicknesses of cardboard between and subjected to great pressure, such as is obtained from a vise. The cardboard is used to separate the plates so they won't stick together when taken out. The pressure will pack the active material better and prolong the life of the battery very much. They should be kept in the vise or under pressure of some great weight until they dry considerably.

After two negative plates and one positive plate have been made for each cell, they are ready to be assembled in the battery.

The two negative plates of each cell are connected as shown in the drawing. The separate cells are connected in series, that is, a positive plate to a negative plate, etc. They should be connected by heavy lead strips, as the wire will burn out quickly if the cell is shorted, which, by the way, is the worst thing you can do to make its life short.

When the cells are all connected, fill each jar with a solution of sulphuric acid by bulk four parts of water to one of acid, and whose final specific gravity is 1260° by hydrometer. Never

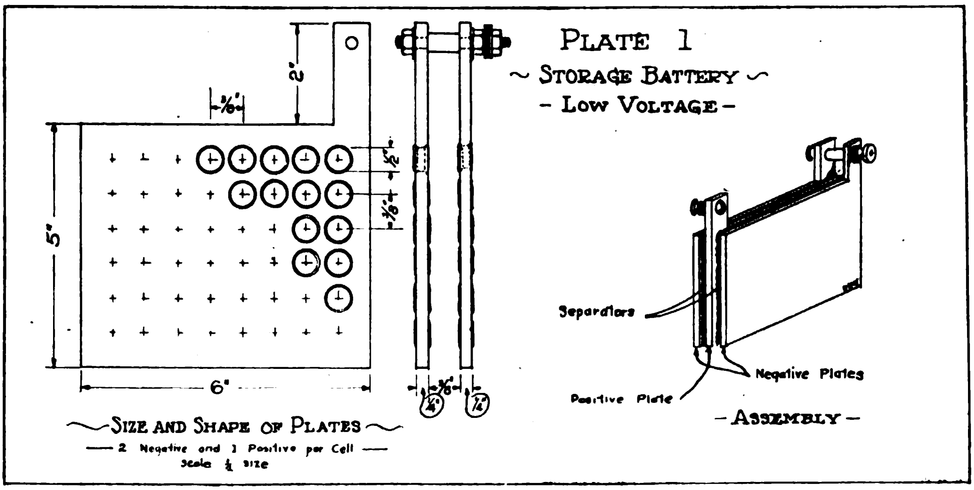


Fig. 1, First Prize Article

Glass jars are best suited to the use of the amateur as they cost less than rubber and never leak. Glass jars, measuring inside 6 inches by 6 inches by 1 inch, are just the right size.

Assemble the battery by putting two negatives around a positive plate, as shown in the drawing, and separated by wooden separators, which can be obtained from the Electric Storage Battery Company, Philadelphia, Pa. (Catalogue number 1420, cost per separator 4c.). These separators are just the right size and are specially treated wood. In the three element cell two are necessary so if you wish to make a six-volt battery, with two negatives and one positive plate, six separators will be necessary.

mix the solution by adding water to acid as the acid will be scattered all over and is liable to cause serious burns, but add acid to water. The mixture will get quite warm and should be allowed to cool before adding to cell. Always mix in a glass or earthen bowl.

A hydrometer is not absolutely necessary, but I certainly advise the purchasing of one, as it tells accurately the condition of each cell.

When the acid has been cooled, pour into the cells until about ½ inch over tops of plates.

The cell is now ready to charge, and the method used will be described later.

This battery should never be

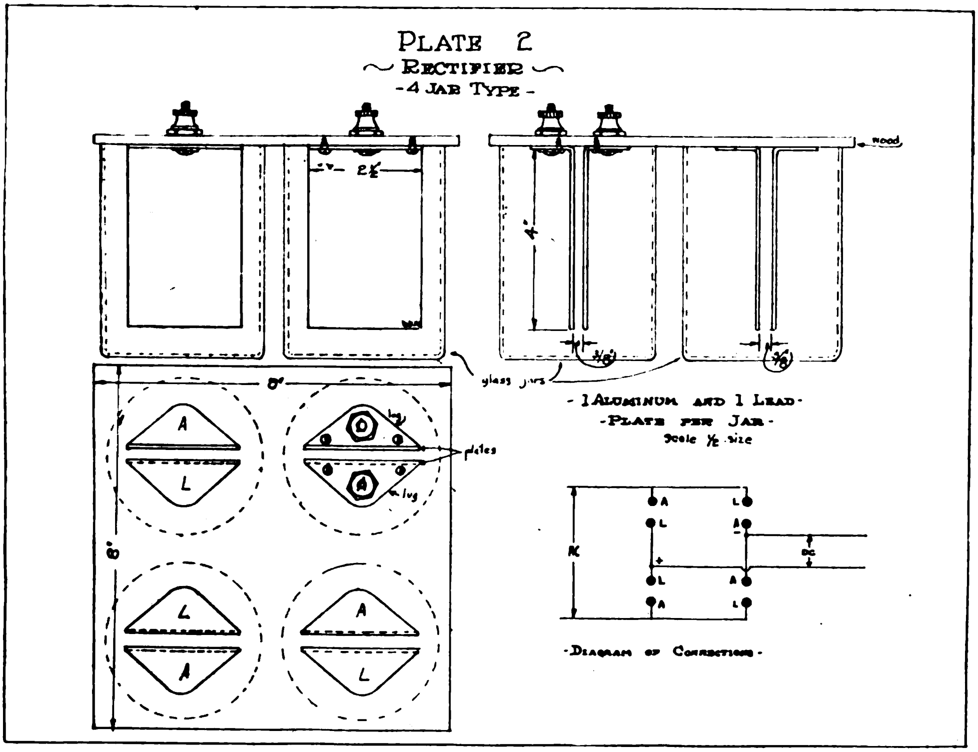


Fig. 2, First Prize Article

charged with more then 2-3 of an ampere and ten volts of the six-volt size. Too great a charging current will cause the active material to drop out of the plates and cause trouble.

Since the capacity is twenty ampere hours, current of two amperes for ten hours will charge the battery nicely. From my experience, I advise charging with two amperes until cells begin to gas, which will be in about eight hours; finish charging at one ampere for four hours. This gives a total of twenty ampere hours.

Always connect the positive pole of the charging current to the positive pole of the battery. To find the positive pole immerse the wires in a solution of salt water The most bubbles will come from the positive pole when the current is turned on. Few will come from the negative. Also the negative, after a few minutes' immersion, will become dirty in color, while the positive will be bright copper, if copper wires are used.

The specific gravity of the liquid when fully charged should be somewhere between 1280° and 1300°. One storage battery manufacturer says 1300°, and another says 1280°, so to be safe I shall call it 1290°.

Never add acid to the cell to make the specific gravity come up. If the gravity is right in the beginning it will be right at the end of the charge. Always use distilled or rain water to mix the electrolyte and only add pure water to jars when liquid evaporates, as the acid always remains unless spilled.

Always charge the battery once every six weeks whether it has been used or not. This will always keep it in good condition. Never allow the voltage of a single cell to drop below 1.8 volts. This corresponds to a specific gravity reading of 1,150° and the battery should be immediately recharged when found to be weak.

Never discharge a battery at more than 5 amperes. Although the battery will deliver about seventy-five amperes on short circuit, it is very harmful and five amperes is a safe discharge rate.

Never test the battery with an ammeter. This is a dead short circuit and will not only burn out the ammeter, but cause damage to the plates. Always test with a voltmeter and never test on open circuit. The voltage on open circuit is about 2.5 volts and is no indication whatever. Test the battery with a voltmeter when the battery is working, say, when it is connected to the filament of a vacuum valve. The voltage if in charged condition is near 2.2.

It is well to clean the jar of sediment that will collect in the bottom after the battery has been in use, in order to prevent short circuiting of the plates internally. This should be done every six or eight months.

Never allow any foreign substance to get into the jars as metals cause rapid deterioration of the plates.

Last but not least, use good judgment about the battery and you will get good service from it but always keep it well fed (charged). As a horse can do more work when fed well, so can a storage battery, and either must be fed whether working or not.

After I had completed my battery, my next thought was, how can I keep the battery charged without financial backing? True enough I had alternating current in the house, but I required direct current to charge a storage battery, so I made up my mind to make a rectifier. The description of the one I made follows:

As a single-jar electrolytic type uses only one-half of every cycle, it is very wasteful. The four-jar type is more efficient as it uses both sides of the cycle, and I decided on this type. Although no electrolytic rectifier is very efficient, it may be expected that this rectifier will deliver about 50 per cent. of the current put in. I have seen demonstrated a rectifier giving 60 per cent. efficiency, but I don't believe I have ever heard of one giving more.

The first thing to do is to procure four jars, such as the kind used in a crow-

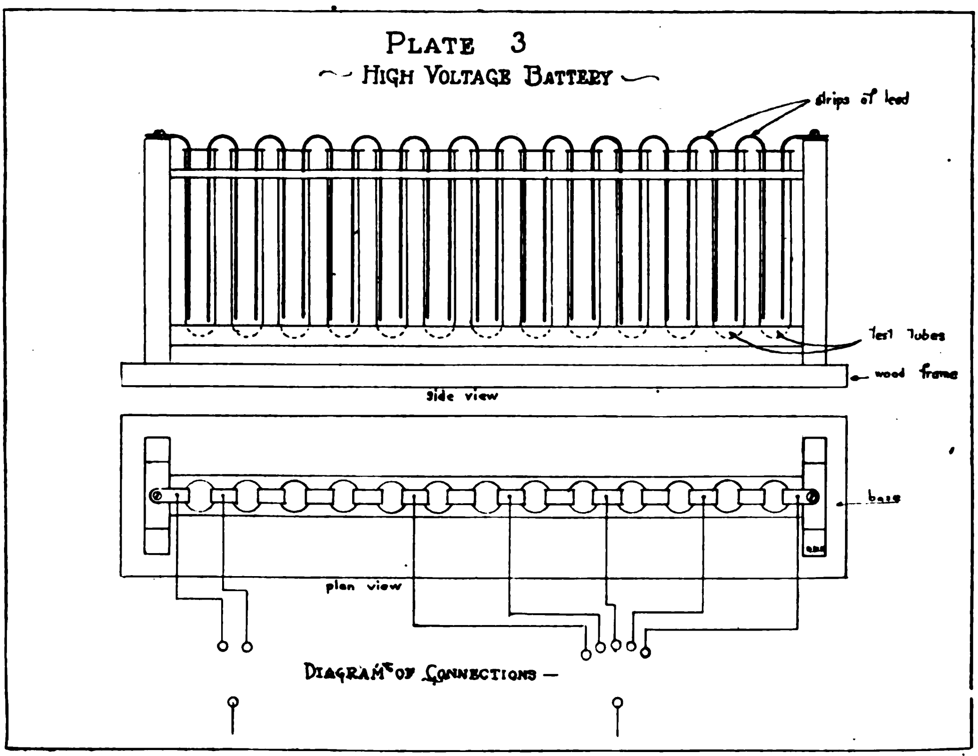


Fig. 3, First Prize Article

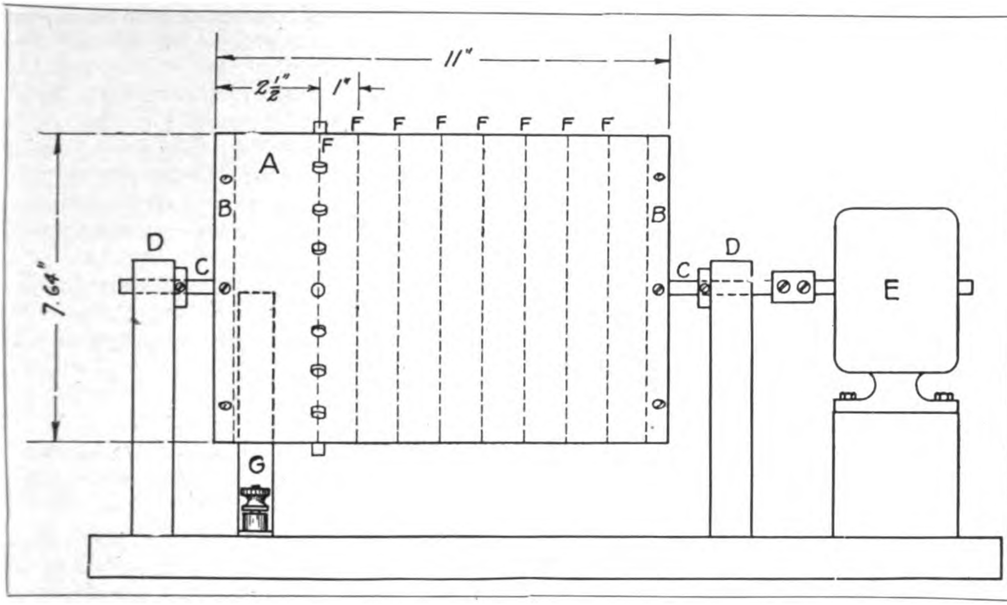


Fig. 1, Second Prize Article

foot battery. Four fruit jars may be used by cutting off the tops. This is best done by wrapping a string around the jar where it is desired to cut, soaking the string in gasoline and igniting. When the gasoline is burned up, plunge in cold water and a smooth cut is left.

I shall not give any dimensions as there is no definite capacity required as there was in the storage battery. However, I will give the size of the plates, etc., used in the rectifier I made.

A wooden top is made as shown in the drawing, to which all the plates were screwed. The size of the top was 8 inches square by ¼ of an inch thick. The plates attached were of ⅛-inch material, 2½ inches wide and 4 inches long, with a large lug as shown. There is a lead plate and an aluminum plate in each jar, both identical as far as size is concerned. The plates are spaced ⅜ of an inch apart for best results. A binding post is put through each plate to allow for connecting on top.

The diagram of these connections is given. Of course the supply of alternating current must be cut down. The best way is to use a step-down transformer, but in case none is to be had, a lamp bank will prove second best. In order to charge the storage cell at two amperes, two amperes must be taken from the rectifier, and since the rectifier will be about 50 per cent. efficient four amperes must be given to it on the A. C. side. Therefor four 32-candle-power carbon filament lamps will be necessary, all connected in multiple and the bank in series with the rectifier and the mains.

I have found that this arrangement only increases the cost in current for the whole house about 20c or 25c. each month, which is very reasonable, especially in the West, where the charging plants charge you 50c for just such a battery as I have described.

In order to use the rectifier the jars must be filled with a saturated solution of ammonium phosphate. Sodium phosphate will work, but the ammonium is cheaper.

When the rectifier is delivering current a film of gas collects on the aluminum plates and prevents passage of the current when the alternation is flowing into the aluminum plate. This acts as a valve and sends the current in one direction only.

It will be well to drill a hole in the wooden top over each jar to enable easier filling of solution. The rectifier will deliver more current with different levels of solution in each cell, and while the rectifier is working, a syringe may be inserted to either take out or put in the solution. With an ammeter in series with the battery the right amount of solution may be found.

A wooden tray should be made to hold the jars. If convenient a metal tray can be made into which cold water may be run to keep the jars cool, as under a current of four amperes the jars will heat up and the efficiency will drop considerably.

There is now but one missing piece of equipment to operate the vacuum valve, and that is the high voltage battery. There are several different types of batteries: the ordinary flash light variety, the voltaic pile, and the storage type that I will describe and which proved highly satisfactory.

To operate the valve the operator should have a source of E. M. F. up to fifty or sixty volts. Bearing in mind that the storage cell can be relied upon to give two volts, it is evident that from twenty-five to thirty cells are required.

Buy from a chemical supply house the required number of small test tubes, about 3/4 of an inch in diameter by 6 inches long. These will cost about 4c apiece. Make a wooden frame to hold the tubes as shown in the drawing (Fig. 3). Put strips of lead into each tube as shown and fill the tubes with sulphuric acid, the same as was put in the low voltage battery. The battery is now ready to charge.

It won't make any difference which is the negative or positive terminal the first time the battery is charged. Only at subsequent chargings be sure to charge the same way as at first. As a reminder, the positive pole may be painted red, the customary way of distinguishing it.

Since it is necessary to use a charging voltage of greater E. M. F. than that of the combined voltage of the battery, it will be necessary to divide the battery into groups of five or six cells each.

When the battery is first made, the plates must be formed into active material by the charging method, as it would be impractical to fill the plates in the way which was done in the case of the low voltage battery. But the method of forming the plates is easy, as the capacity is so low that with a charing current of two amperes, the charge is complete in fifteen minutes or less. The capacity is about 1/4 ampere hour, and it is possible to take about 1/2 ampere from such a cell, but for only six or seven minutes, depending upon the size of the plates.

The low capacity of this battery is not a disadvantage, as the current drawn from a high voltage battery is rather low when connected to a valve.

The same care should be taken of this battery as of the low voltage, but of course the plates are not as easily ruined by neglect.

Walter N. Maynes, *California.*

SECOND PRIZE, FIVE DOLLARS
A Simple Method for Constructing a Wireless Organ

From time to time articles have appeared on the design of experimental radio apparatus capable of producing music, but practically all of these de-

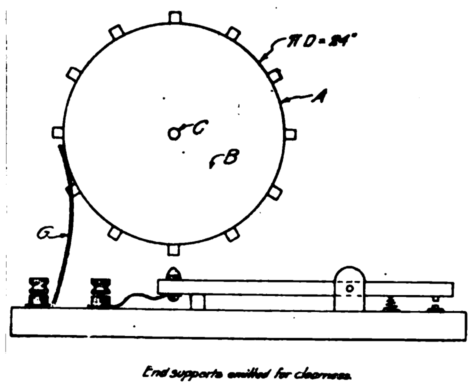


Fig. 2, Second Prize Article

signs involved the use of spark-coil sets so that their range was limited to a few miles, or the apparatus was so complicated as to be beyond the mechanical ability of the average experimenter. This is an interesting field for experimentation, and although the application of such apparatus is necessarily limited, the experimenter will be well repaid for his efforts in constructing a set in accordance with the instructions to follow. The writer has called his apparatus a wireless organ rather than a wireless piano for the reason that the notes are sustained as long as the keys are depressed.

Apparatus involving tuned interrupt-

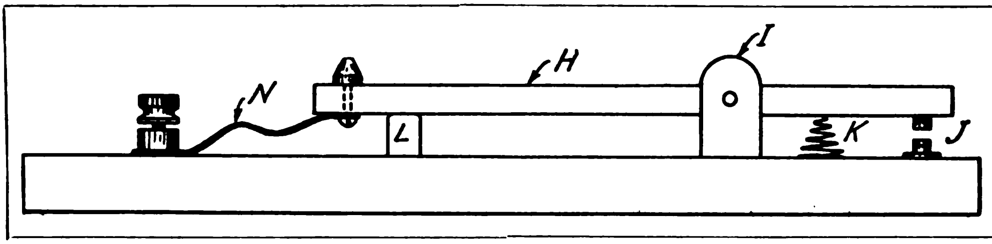


Fig. 3, Second Prize Article

ers, condensers of various capacity, or a collection of various sized rotaries is extremely complicated both in construction and operation. After considerable experimenting with systems using duplicate rotary gaps driven by counter-shafting at various speeds, also multiple gaps with a varying number of electrodes driven from a common shaft, the writer hit upon the simple method herein described. Many of the dimensions are purposely eliminated and the experimenter can fix them to suit his convenience. For the purpose of simplicity, only eight notes, comprising the major scale of C, are described. If the constructor desires he can enlarge upon this to any desired extent, providing an increased number of notes, and by reference to a physics textbook can figure out the required frequency for the various chromatics, which will be found quite an asset.

Figures 1 and 2 illustrate side and end views of the apparatus, respectively, the keys being omitted from Figure 1 and the end supports from Figure 2, for the sake of clearness. The eight notes are produced by a series of eight rotary spark gaps, mounted on a common drum. This drum, A, is made of heavy sheet zinc, 11 inches long, and exactly 24 inches in circumference. What is familiarly known as a "tin-can joint" is employed, as shown in Figure 6, after which the seam should be soldered. Two heads, B, are turned from ½-inch Bakelite, to which the drum is secured with small screws. These heads provide good insulation between the shaft and drum, and the former therefore may be directly coupled to the motor E. Suitable bearings for the drum-shaft are provided, as shown at D. The gaps themselves are formed by screwing brass switch-points to the zinc drum, as shown. The number of points varies for each note. These points may be procured cheaply in various sizes, but this design contemplates the use of points ¼ of an inch in diameter, 5/16 of an inch high, fitted with a threaded shank and nut. Eight circles are inscribed on the zinc drum, 1 inch apart, the first circle being 2½ inches from one end. It is on these circles that the points are to be mounted. These circles are indicated by the dotted lines, F, in Figure 1.

Now as to the required number of points to produce the various notes. It will readily be apparent that it is of no consequence what the lowest or highest note may be, but it is essential to obtain the proper intervals. The rest may be left to adjustment of the motor speed. "Middle C" on the piano vibrates at the rate of 256 vibrations per second, and we may take this as our starting point.

TABLE I

If C is 256 vibrations per second, then D is 288 vibrations per second, E 320 vibrations per second, F 341.3 vibrations per second, G 384 vibrations per second, A 426.7 vibrations per second, B 480 vibrations per second, and high C 512 vibrations per second.

TABLE II

If we call middle C (256) 1, and express the other figures in terms of improper fractions and find the least common denominator, we find that at any given speed, twenty-four points will be required for C, twenty-seven points for D, thirty points for E, thirty-two points for F, thirty-six points for G, 40 points for A, forty-five points for B, and forty-eight points for high C.

The required number of points for each note, as shown in Table II, are now fixed on the various circles, F, inscribed on the drum, A. Holes in the zinc should be drilled, not punched, as accuracy is necessary here, and the points fastened with a nut screwed on from inside. One head should be left off until this operation is completed.

G, in Figures 1 and 2, designates a phosphor-brone spring which conducts the high-frequency current to the drum. No detailed explanation is necessary.

We will now turn our attention to the keys, which are eight in number ⅞ of an inch wide, 1 inch thick, 10 inches long, of good dry hardwood. The purpose of these keys is twofold—to present a stationary electrode to the proper set of rotating points, and to make the primary circuit at the same time. The builder will note that unlike most rotary gap practice, but one sparking place is provided, the phosphor-bronze spring, G, making constant contact with the drum. In Figures 3 and 4, H represents the keys, pivoted on the common shaft, I, at a point 6½ inches from one end. One-half inch from the short end a series of contacts, J, are provided to make the primary transformer circuit. The stationary contacts are mounted on a copper strip fixed to the base, and the contacts on the keys are connected in series by short lengths of flexible conductor. The contacts are so adjusted as to provide a movement of ¼ inch. Small spiral springs, K, serve to keep the rear of the keys down on the strip L when not depressed. One-half inch from the rear end of the keys, and 6 inches from the pivot, stationary electrodes are provided. It is between these points and the rotary points that sparking takes place. These points may conveniently be made from the same type of switchpoints as the rotary points, but filed to a wedge shape as shown. Three inches behind the keys, a strap of copper, M, is run; and from this leads of thin flexible sheet copper ½ inch wide, N, are run to the electrodes on the rear of each key.

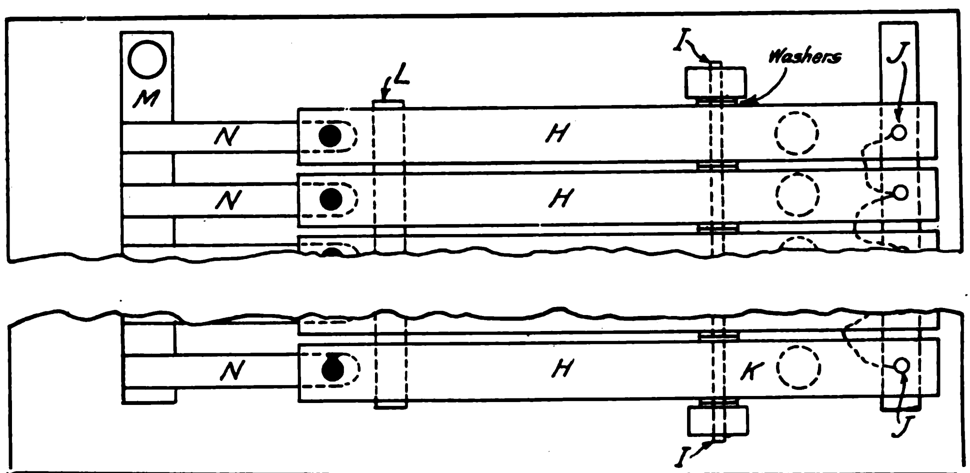


Fig. 4, Second Prize Article

A sparking length of about ⅛ inch will probably be found most suitable. The zinc drum should therefore be mounted at such a height that the outside ends of the sparking points clear the ends of the stationary electrodes, when in normal position, by ⅝ of an inch. The operation will not be self-evident. When any particular key is depressed (which takes the front end of key through an arc of ¼ of an inch), the rear end rises, carrying its stationary electrode through an arc of ½ inch and presenting it at a distance of ⅛ inch from the proper circle of gap points at the same instant that the circuit into the transformer primary is made. Thus it will be seen that no sparking will take place except from the particular gap desired, and the primary circuit will be interrupted whenever a stationary electrode is not elevated to the proper sparking distance.

The hookup is as shown in Figure 5. The regular transformer, condenser and oscillation transformer may be used, and the design therefore permits the use of a full kilowatt if desired. A rheostat, R in

Figure 5, arranged to be operated by the foot or knee, will be found quite serviceable as a "swell," as used in organ playing. If over ½ kw. is employed, it may be found desirable to use light contacts at J and make use of a

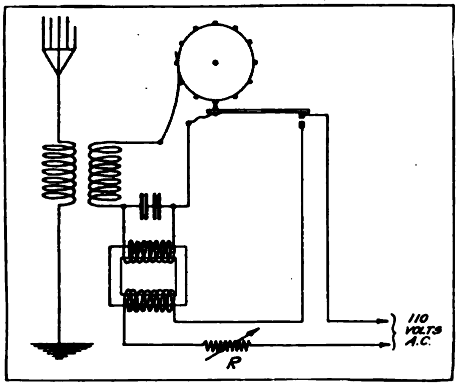


Fig. 5, Second Prize Article

magnetic key to break the primary current.

There are several familiar melodies which may be played on this one octave, among them being "Home, Sweet Home," "River Shannon," "Good Night, Ladies," "Lightly Row," etc. With a few additional notes at each end of this scale, and a few chromatics, its "repertoire" may be greatly increased. It will be found interesting and instructive, and the constructor will find a deal of pleasure when, after his friend signs off with a commonplace "GN," he can "turn on the music" and give him "Home, Sweet Home."

The wireless piano provides a large and interesting field for amateur experimentation. Three octaves are available between the spark frequencies of 200 and 1600 but the mechanical difficulties increase rapidly. Two drums similar to the one herein described, each carrying an octave, could be made to provide an uninterrupted run of two octaves by gearing one up to exactly twice the speed of the other. However, on a given condenser, a transformer draws its maximum current over a narrow band of discharge frequencies only, and if this plan were utilized for two or three octaves, it is likely there would be considerable difference in the strength of the notes at the extremes of the scales, so that separate circuits for each octave, operating on the most suitable voltage, would probably be desirable.

K. B. Warner, *Illinois.*

THIRD PRIZE, THREE DOLLARS

A New Type of Panel Receiving Set

The set about to be described is of a type little used by amateurs but one which I have found far superior to the usual receiving transformer type. Two of its notable advantages are the absence of all sliding contacts and the capacity for indefinitely fine and sharp tuning.

The set consists of two variometers, two rotary variable condensers, a stopping condenser, a horizontal ball and socket detector and aerial, ground and receiver binding posts. The variometers and condensers are mounted in the panel (Figure 1) and are operated by the knobs on the front of the panel. The variometers are mounted in opposite corners to cut out mutual inductance between them as far as possible and the fixed condenser is mounted against the

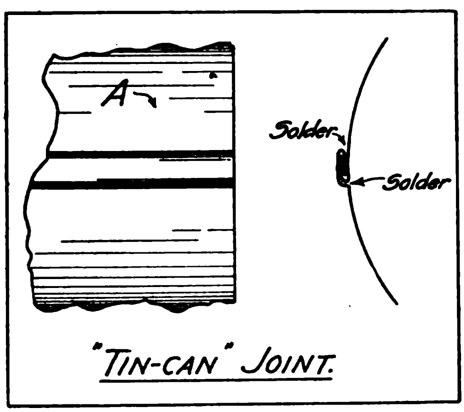


Fig. 6, Second Prize Article

right hand side of the panel. The detector is at the right of the panel.

The front of the panel is of ¼ inch fibre, one foot square; the manipulating knobs are ¼ inch fibre or hard rubber, 2 inches in diameter. They are tapped nearly through for 8-32 and the 8-32 rods are locked in place by nuts. The pointers work over aluminum protractors 4 inches in diameter. The sides and back of the panel and the detector base are made of 3/8 inch quartered oak, that on the sides and on the detector base being 6 inches wide, and also a piece running up and down midway between the two sides. This piece will have to be gouged out to take the variometers. The back pieces should be set flush with the sides.

The variometers are alike and are constructed as is shown in Figure 2. Two thin pasteboard cylinders 1½ inches wide, one 5½ inches in diameter, the other 5 inches in diameter, are wound closely with No. 26 B. & S. Gauge S. C. C. copper wire except for a space of ¼ inch left in the middle.

Care should be taken to have the same length of wire on each coil. The coils should then be thoroughly shellaced. The 5½-inch coil should then be fastened in place with the winding horizontal so that the middle of the nearest part is directly behind a hole in the front, 3⅛ inches from the nearest sides. The coil should be fastened by small screws through ¼-inch middle space to the front, side and middle partition. A brass rod is passed through the hole in the front of the panel and then through holes in the ¼-inch middle strip of both cylinders and is passed through them again on the opposite side, so that they turn symmetrically on the rod as is shown in Figure 2.

A knob and pointer are attached to the front end of the knob and the inner winding is locked to the rod by nuts as shown. Fibre washers are used to keep the correct distance between the coils. Four pieces of tire tape should be put on each coil to hold the windings and connections. Connection between the coils should be made by a flexible connection as shown in A. The variometer should be so adjusted that when the pointer reads 0° the movable coil is inside the fixed coil with its winding in the opposite direction; at 180° the windings should be in the same direction.

The variometer is continuously variable, for its magnetic opposition and attraction, which determines its wavelength, is continuously variable. (Note: The book, "How to Conduct a Radio Club," shows several other types of variometers which may be used equally well.)

The parts of the condensers, which are also alike, may be bought and put together or they may be made. Twenty-five stationary plates of No. 24 aluminum are needed. They should be cut in the form of a right triangle, 3 inches on each leg, and a semicircle ¾ of an inch in diameter, should be cut out in the middle of the hypotenuse; a hole should be bored in each angle 3⅝ inches from the middle point of the hypotenuse, as shown in Figure 3 B. The twenty-four movable plates are of No. 24 aluminum in the form of a semicircle 2¾ inches in diameter with a lug projecting from its center with a diameter of ½ inch. The plates are fastened to the front and to a

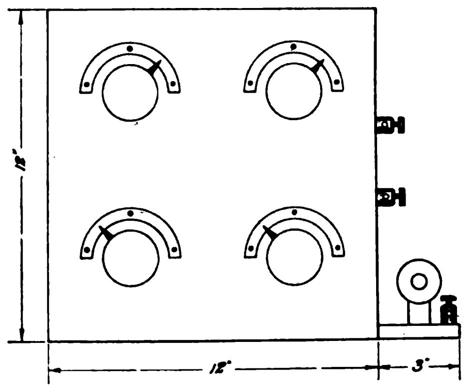


Fig. 1, Third Prize Article

fibre block, the movable plates being attached to the knob on front. The plates are separated by ⅛ inch brass washers, as shown in Figure 3 A.

The detector consists of a ½-inch octagonal brass pillar, 1⅝ inches high, on which is mounted the mineral cup and an 8-32 brass rod with a spring on one end so as to touch the mineral. This is accomplished by a ball and socket device with a tension spring and a knob to adjust it as shown in Figure 4. Note that both knobs extend in front of the base which is ¼ of an inch back from the front of the panel; this allows easy manipulation. This detector is intended for use with ferron, silicon, galena or perikon. I have found ferron the best, the only good kind being that which comes in very large crystals and has some surfaces that look like tin foil when broken. That from Colorado is probably the best. Three binding posts should be placed beside the detector so that the "phones" may be connected either across the detector or the condenser. The aerial and ground binding posts are on the right side of the panel.

The hook-up is shown in Figure 5. The first variometer is the primary of the receiving transformer, the second variometer is the secondary, and they are statically coupled by the variable condenser between them. This set can be made for about five dollars and is superior to many much higher priced sets.

CARLISLE M. ASHLEY,
District of Columbia.

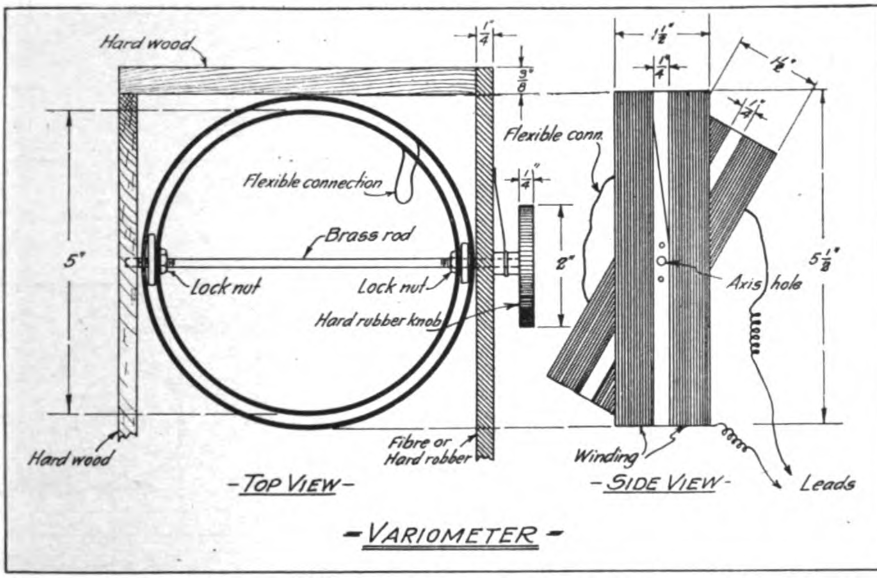


Fig. 2, Third Prize Article.

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Shock Absorbing Base for the Rotary Spark Gap

The operator who has experienced the annoying vibration arising from a rotary spark gap motor that does not run true in its bearings, will appreciate this simple arrangement for the absorption of the shock from the motor. For efficient radiation on a short wave it is essential to group the transmitting instruments closely together and thus reduce the total length of connections in the primary circuit. The rotary spark is usually placed somewhat apart from the other apparatus, particularly the receiving tuner, to prevent vibration from being transmitted through the wireless table. This is a weak point in the transmitting unit. The use of such a shock absorber as is described here permits the rotary gap to be grouped with the other apparatus and absorbs the noise and vibration.

Figure 1 is a cross section of the absorbing base, showing the motor secured thereto, and Figure 2 is a top view. Figure 3 is a detail of the spring element.

Referring to Figure 1: A designates the main base, preferably of yellow poplar 1 inch thick. It is cut out about 3½ inches each way larger than the spark gap base. The supplemental base, B, is 5/16 of an inch thick and 2½ inches larger each way than the spark gap base. Base B is positioned parallel to base A by means of bolts, D, rigidly secured to base A by lock nuts, E and F, and is spaced therefrom by springs, C, disposed on the bolts between the bases. The holes, M, drilled in the corners of each base are 5/16 of an inch in diameter, as indicated in Figure 2. They are drilled ⅝ of an inch from each edge of base B and ⅞ of an inch from each edge of base A, in the respective corners.

The bolts, D, are ¼ of an inch in diameter and 3 inches long, so that base B is capable of reciprocating upon them. The springs, C, are formed from No. 18

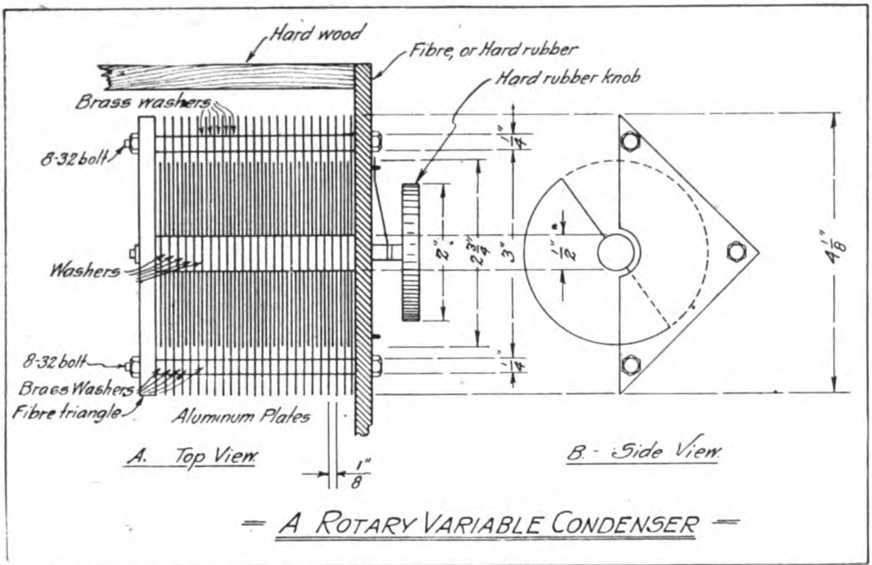


Fig. 3, Third Prize Article

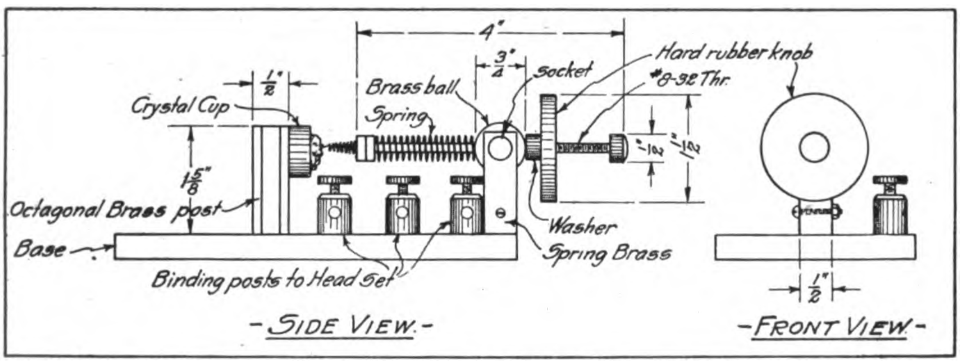


Fig. 4, Third Prize Article

or 16 spring wire, according to the weight of the motor they must support. They are 3 inches long and ½ inch in diameter. The springs positioned on the bolts between the nuts E and washers H resist the weight of the spark gap secured to base B.

Such arrangement will effectively prevent any shocks from motor, K, being transmitted to the apparatus mounted on the same table with the spark gap. The absorber, which is neither expensive nor bulky, is recommended for this and similar purposes.

J. B. Brady, *District of Columbia.*

HONORARY MENTION

Long Distance Communication and the Work of 5BV

I have read the articles by Messrs Weiss, Mathews and West and Chandler on long distance amateur communication. The work that these amateurs are and have been doing for the past winter is not at all out of the ordinary, to judge by what is being done by a great number of amateurs all over the country. I have conclusive information at hand that the amateur "PWR" at Cresco, Iowa, is being copied from Denver to Vineland, N. J., and south to the Gulf.

I copied 9EE last year nearly every time he sent. He is located in Indianapolis, and at the time I wrote him he was using ¾ k.w. and radiating 2 and ½ amperes. 9UC at Somerset, Ky., has been copied at Niagara Falls and also at Springfield, Mass. I have heard him talking to 4AA at Athens, Ga., who has a ¼ k.w. set and who has ben copied at Lima at 8AEZ. Also 9UC has worked with 9HQ at Stoughton, Wis. 5BJ has worked with North Dakota Agricultural School and I could read him, when he was using 200 meters, with the telephones two feet from the table.

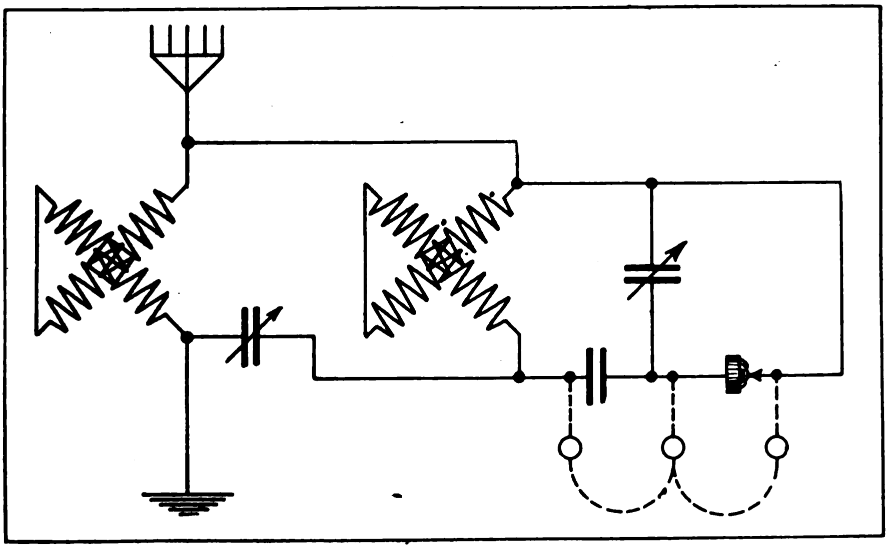


Fig. 5, Third Prize Article

With moderate interference I have heard the following amateurs nearly every time that they have worked for the last two years: 9XK, 9IT, 9ABD, 4AT, 4AA, 9LT, 5AD, 8DZ, 4AF, 4CL, 5DU, 9BW, 5AA, 9IC, 9EE, 8PP, 9JF, 9FY, 8TI, 9JB, PWR, 9IO, 9LM, 5ZA, 5ZC, 5ZI, 9YD, 9XT, 9XE, 9ZA, 8CX, 8XA, 9YK, 5ZB, 5ZQ and a number of others. I use only a single vacuum valve with a poor pair of 2,000-ohm phones and an aerial 38 feet high and 90 feet long. In conclusion I will say that I have never heard a single station in the daytime earlier than five o'clock in the afternoon, although I am able at night quite often to hear them two and three feet from the phones. In summer practically all the fellows down here have to close down on account of QRN. I have not heard a single commercial station on 600 meters nor anyone below that for the last month as the QRN simply kills all the short wave stations with a single vacuum valve as a detector.

JOHN M. CLAYTON, *Arkansas.*

HONORARY MENTION

The Manufacture of Insulated Copper Wire

Let me advise the readers of THE WIRELESS AGE that double braid No. 14 wire is no longer manufactured. Under the most recent edition of the National Code of Electrical Instructors, double braid wire in sizes smaller than No. 6 is not manufactured and single braid wire, in sizes larger than No. 7 has been discontinued. Of course this wire can be run off at special order, but as the entire matter is one of mechanical protection while pulling the wire through conduit, in order to prevent the carrying of double stock by contractors at considerable cost, duplication of jobbers' stocks of sizes, and to reduce the manufacturing cost, the Electrical Committee voted to change as above at the Revision Meeting in

New York City, March, 1915, and it became effective last autumn. Perhaps some readers believe that there is a necessity for double braid wire, but they should know that they cannot obtain it

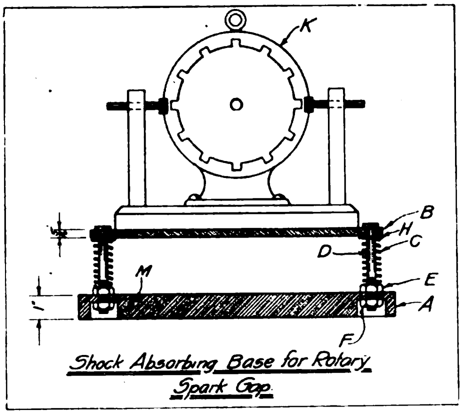


Fig. 1, Fourth Prize Article

in small sizes unless a bit of it happens to be left over in a dealer's stock.

Your readers should also understand that the rules of the National Electrical code are far broader in scope than those of the Underwriters' Association. Of course municipal regulations are always

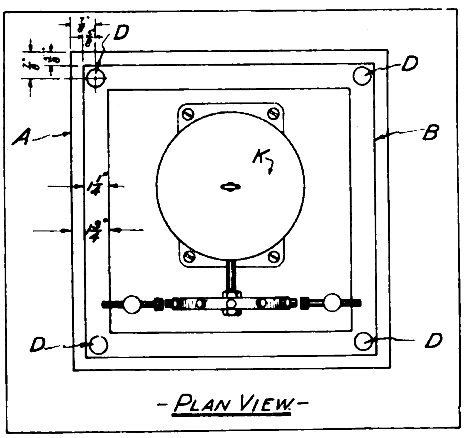


Fig. 2, Fourth Prize Article

paramount and they should be followed in radio installations.

WILLIAM LINCOLN SMITH,
Massachusetts.

HONORARY MENTION

Perhaps there is no surer method of stopping a rotary gap quickly, after the current has been broken, than by hand. But there is a certain amount of danger when one does that. For instance, he might catch his fingers between the stationary and movable electrodes, or re-

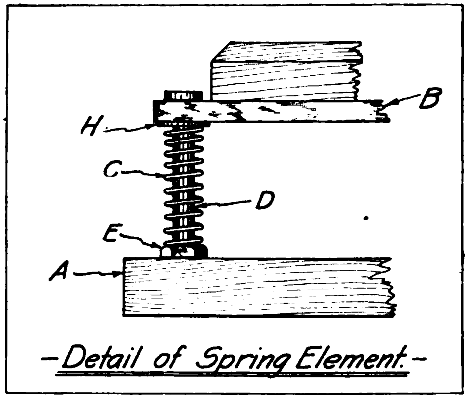
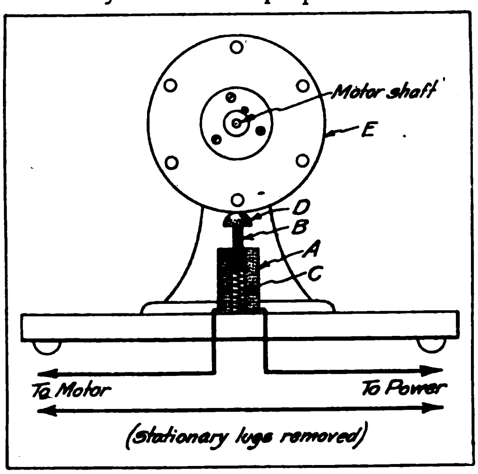


Fig. 3, Fourth Prize Article

ceive several thousand volts from the secondary of his step-up transformer.



Drawing, Honorary Mention Article,
R. A. Wilkins

The auto-magnetic clutch that I am about to describe, does away with these dangers, and therefore is invaluable to the amateurs.

The first thing to take into consideration is the magnet, A, shown in the accompanying drawing, which is obtained from any four-ohm telegraph sounder. The core is removed and an iron core, B, one-half the length of the magnet, and a trifle smaller in diameter, so it can slide with freedom in and out of the coil, is made. One end of this core or armature is fitted with a soft-rubber tip, D, to act as a brake against the rotor, E. The spring, C, is made of phosphor-bronze, the tension depending, of course, upon

(Continued on page 74)

Emergency Repairs At Sea

Overcoming Remarkable Conditions on the Pennsylvania in a Typhoon

THE ingenuity and resourcefulness of wireless men in the face of apparently hopeless difficulty, is sometimes severely tested. Deep-sea service in winter usually provides at least one opportunity for the man at the key to demonstrate his ability to make a cabin full of waterlogged apparatus awake and talk over a thousand miles of gale swept ocean, my experience on the steamship Pennsylvania being an example of the difficulties in which an operator sometimes finds himself.

The Pennsylvania is neither new nor large, so when we were hit by a terrific typhoon some 700 miles out of Yokohama, the seas began to smash our deckworks in an alarming manner. Usually when a ship runs into bad weather, some one of the passengers or crew will say he has known worse before, but in this storm no one on board had seen anything to compare with it. At times the whole after part of the vessel, including the wheel house on deck, was buried under green water; a huge wave came on board, broke every door in its path, ripped off the cover of No. 1 hatch and wrenched the funnel loose from its stays. Both the bridge pilot-house and the wireless room were stove in. Below, the cargo of liquid asphaltum broke loose, and, running into the engine room, threatened to put the motive power of the ship completely out of commission.

In the midst of this tumult, all hands were puzzled by the smell of acid and the entry of large streams of oil into the saloon. I guessed the source of the trouble as we had a glass plate condenser on deck, and the planking was anything but watertight. The oil on the floor, together with the heavy roll, made navigation in the saloon almost impossible, but presently when we heard the motor in the wireless cabin running, I managed to crawl up on my hands and knees, fearing that someone had gone crazy and was trying to operate the set. When I finally arrived, it was impossible to open the door against the wind till a momentary lull enabled me to force my way inside.

The place was full of water, the set a wreck. On the floor the transformer coil, two pairs of phones, accumulators, the condenser and all the cells were adrift in a slush of broken glass. Although the service switch was up and the starter "off," the motor was running slowly with the salt water making the connections. I had to think for a little how to stop it, and finally decided to wrench off the wiring. Meanwhile, with all the heavy equipment and the broken glass smashing about the cabin with the heavy roll, I had to look sharp to keep out of the way. As the rolling became wilder, I fled the place and reported the conditions to the Captain, who had squeezed between the stove-in bridge and the pilot house to keep from being blown overboard.

"Leave everything and go below," he ordered. "We can do nothing now but save the ship."

Next day the weather was fine though the sea was terrific. The Captain took a look at wreckage in the radio room. It seemed hopeless, he thought, but he urged me to make a big effort to get through to Chosi—the Japanese station at Hondo—as he expected important orders from the owners. Everything and everybody on the ship were at my disposal. Assisted by the ship's carpenter I went to work at nine in the morning, but the floor was so slippery that we made very little progress till the thoughtful mate sent up a bucket full of sand We then got the transformer into its case and made fast, removed the auxiliary and accumulators entirely, and set the condenser upright. The spare plates kept on the floor were intact, but so soaked with acid that the tinfoil was peeling off most of them. The container was cracked and we tried to repair it with asbestos paste donated by the engineers.

By one o'clock we had rigged up some sort of a condenser with twenty-four plates and set out to dry the rest of the equipment.

The rheostats had to be taken down, dried and oiled with insulative oil. The starter and transformer also had to be oiled. We spent two solid hours on the motor. First the brushes came off, then we oiled the inside as well as possible without taking out the armature, which would have required too much time. At eight o'clock (no time for dinner), I tried it out. The first thing to go was the generator rheostat. We repaired it, but it went again. I made a resistance by winding some twenty feet of iron wire on a pencil and after a good deal of experimenting managed to make it work, although the motor ran unsteadily and sparked furiously.

I started again at nine o'clock, and called Chosi. No answer. When I tried again the starter burned out in two places. Again the asbestos paste proved invaluable, but the release magnet now refused to hold. We hooked it up with wire hooks. Once more we tried to start the motor, but this time the field rheostat went on a strike. After we had mended that the apparatus operated, but the generator rings were arcing across the dividing rings while the brush holders were leaking into the frame. We remedied these defects and tried again. It was now midnight. I called CQ for a long time but received no answer—I had forgotten that the phones had been in acid and water all day before. Although I dried them out in the steam oven they were as wet as ever again in ten minutes, so I tried cleaning them while warm with gasoline. Still I could hear nothing. The aerial was intact—I tried the tuner with the battery but found it dead. By two in the morning I succeeded in getting it dry and listened. I heard NNG and my spirits rose. When I tried to call him, however, away went the condenser, shot to pieces. We rigged it up again, but the motor brushes were shorting through the frame.

I turned in for a nap at half past four and went at the task again at six. Every seam in the cabin was open, the roof sprung and the set as wet as ever. By noon we thought everything was in working order, but when I started up again all the current went to ground through the soaked insulation. All that day we worked on the motor and wiring, and about eight at night picked up NNG, the U. S. S. Proteus, bound for Nagasaki, to which I gave my MSG. Chosi got us however, and I worked with him direct.

When I began operating next day the condenser let go again. As my patience was now exhausted, I discarded it for a tentative air condenser of sixteen plates in series multiple, separated by chips or broken glass and braced by two supports from the floor. This kept us going till our arrival in Yokohama, where we bought a few necessities and steamed to Hong Kong. The carpenter made a serviceable frame for the condenser plates and everything went well till our arrival at San Francisco. We had worked 1,200 miles with the Empress of Japan, 850 miles with Chosi, 1,400 with San Francisco at night, and 247 miles with the same station at ten in the morning.

Such difficulties are, fortunately, unusual, but they demonstrate the surprising endurance of good wireless equipment, and the necessity of a thorough training in the theory as well as the practice of radio telegraphy to enable an operator, without technical assistance, to patch up a jury set when the seas have worked havoc with the regular equipment.

A wireless station is being built at the refinery of the Magnolia Petroleum Company at Beaumont, Texas. Construction of the tower was completed about June 1. The wireless instruments will be installed in the company's telegraph office at the refinery and three radio operators will be employed each working eight hours a day. The purpose of the station, General Manager Plumly states, is to keep in touch with vessels coming to and leaving the port of Beaumont.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Sunoil	Sun Company	KWP
J. W. Van Dyke	Atlantic Refining Co.	KHR
H. C. Folger	Atlantic Refining Co.	KHS
Henry R. Mallory	Mallory Steamship Co.	(Not assigned)

WORK OF THE WAVE-LENGTH COMMITTEE

It is likely that the recommendations of the Committee on Wave-Length Regulation of the Institute of Radio Engineers will be submitted to the next International Radio Telegraph Convention. This is among the most important activities of the Institute, the Committee having been appointed to carefully study the existing conditions and suggest such improvements as are deemed advisable. The members of the Committee are as follows: R. F. W. Alexanderson, Edwin H. Armstrong, Louis W. Austin, H. Boehme, William H. G. Bullard, George S. Davis, Leo deForest, Melville Eastham, Lloyd Espenchied, Leonard Fuller, Alfred N. Goldsmith, John L. Hogan, Jr., Frederick A. Kolster, Ralph H. Langley, Fritz Lowenstein, Emil E. Mayer, Greenleaf W. Pickard, Samuel Reber, David Sarnoff, Frederick Simpson, T. Lincoln Townsend, Roy A. Weagant, Arthur C. Webster and Leonard D. Wildman.

NAVAL SERVICE ANNOUNCEMENT

The following is from a circular from the United States Director of Naval Communications:

Hereafter the Naval Radio Service will be known as the "Naval Communication Service." Charges on all traffic exchanged between other systems (radio, telegraph, and cable) and radio stations (ship and shore) operated by the Navy will be accounted for by the Naval Communication Service. In addition to his other duties, the Director, Naval Communications, will perform the duties formerly assigned to the Superintendent, Naval Radio Service. Correspondence relating to the Naval Communication Service should be addressed to Director, Naval Communications, Radio, Va.

Remittances should be made payable to Naval Communication Service. If used, money orders should be drawn on Postmaster, Washington, D. C.

THE INSTITUTE CHANGES ITS MEETING PLACE

The first meeting of the Institute of Radio Engineers after the summer vacation season was held on the evening of September 6th in the Engineering Societies building, New York City. Two papers, one entitled "A Brief Technical Description of the New San Diego, Pearl Harbor and Cavite High-Power Naval Stations," and the other "A Few Experiments with Ground Antennas" were presented by Leonard F. Fuller. Professor Charles A. Culver presented a paper on "Notes on Radiation from Horizontal Antennas."

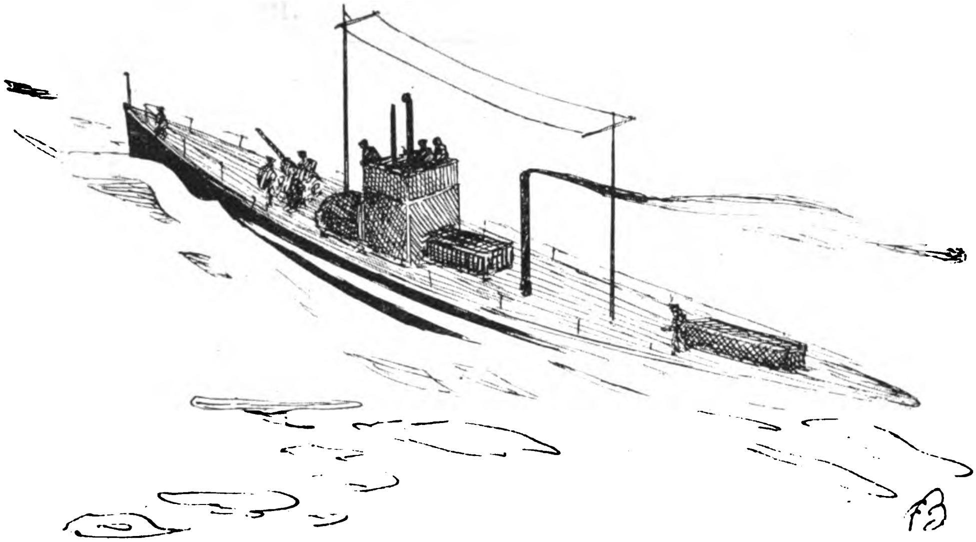
Meetings of the Institute will be held in the future in the Engineering Societies building instead of at Fayerweather Hall, Columbia University, where they have been held in the past. This change was due to the increased interest shown in the art by electrical engineers and the fact that the Engineering Societies building is more centrally located than Fayerweather Hall.

THE SHARE MARKET

New York, September 8.

The market has been dull because of the vacation season, and there has been comparatively little dealing in Marconi shares, but traders look for activity in the near future. Bid and asked quotations today:

American, 3¼-3⅝; Canadian, 2-2⅜; English, common, 14-17½; English, preferred, 13-16½.



U-Boat Attacks and Wireless Calls

Some Exploits of Marconi Men in the War Zone

ONE of the most remarkable instances of a fight on the part of a skipper, whose steamship was being shelled by a U-boat, was recorded in the experiences of the Anglo-Californian. The reliance of those on board the escaping craft was placed on their wireless apparatus, and the sequel showed that their faith in the Marconi service was not misplaced. The story came out when the British steamship Anglo-Californian steamed into Queenstown Harbor on the morning of July 5th, after having withstood an attack from a German submarine for four hours. The vessel had left Montreal for the British Isles on June 24th. The U-boat was sighted at eight o'clock in the morning of July 4th. Captain Parslow ordered full steam ahead, and wireless calls for aid were sent out. The U-boat on the surface proved to be far speedier than the steamer and rapidly overhauled her, meanwhile deluging her with shells.

One shot put the wireless apparatus on the Anglo-Californian out of action. Finding that he could not escape by running for it, Captain Parslow devoted his attention to maneuvering his ship so as to prevent the submarine from using her torpedoes effectively. He kept at his post on the bridge, coolly giving orders as the submarine circled around his craft. Finally Captain Parslow was killed by a shell. Just before that he had given orders to launch the boats, but this proved difficult while the vessel was under shell fire. Several men on board were struck down while working at the davits. Ultimately four boats were got overboard and were rowed away until they were picked up. The son of Captain Parslow, who was serving on board the ship as second mate, was standing by his father's side when the latter was killed. He seized the wheel and continued dodging the submarine. Meanwhile the wireless S O S call that had been sent out at the first alarm, brought British destroyers to the scene, whereupon the U-boat abandoned its attack and submerged.

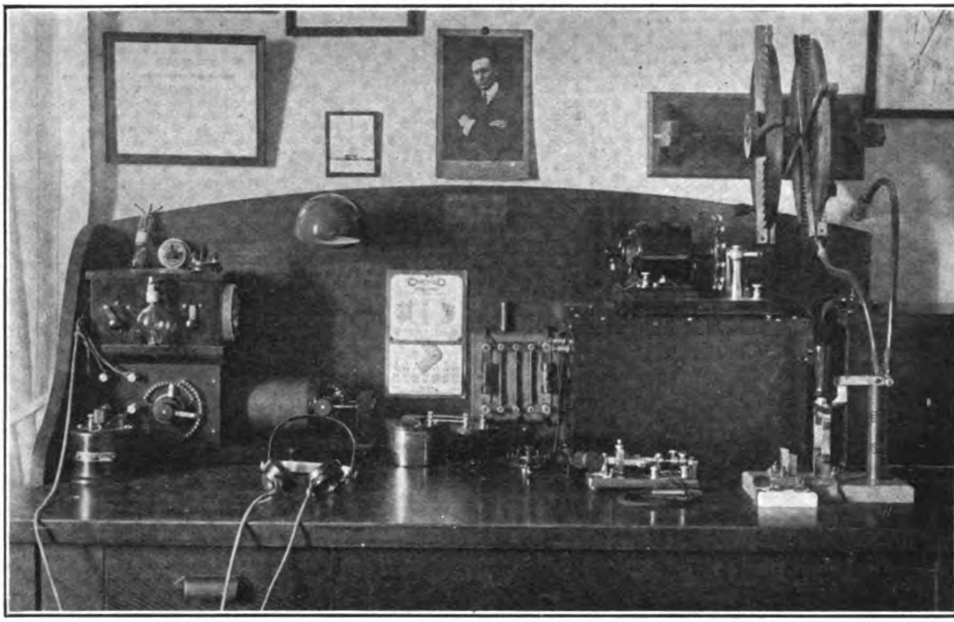
Not long ago, in the waters of the Mediterranean, the steamship Den of Crombie was sunk by a submarine. A time such as this, when the vessel in which you are journeying is about to be torpedoed, is not one which the average person would select in which to make sketches. This, however, suited the humor of Percival Denison, the Marconi operator on the Den of Crombie. So soon as the vessel had been held up by the enemy submarine, Denison noticed that the U-boat had a wireless equipment, and he forthwith made a rough sketch of it. When making away from the sinking vessel, the operator also sketched the scene behind him. In this wise afterward the Marconi man was enabled to give a detailed presentation of the aerial equipment. This, as he had observed it, consisted of a single telescopic steel mast, erected amidships, carrying at the top a permanently fixed spreader, the wires being secured to the deck. The most ingenious feature of the installation was the means for rapidly erecting and dismantling the aerial structure. The whole of the operation, he calculated, could be carried out after the order to submerge had been given and before the upper portions of the deck were awash.

In one of the first great tragedies involved in the torpedoing of an ocean liner, the saving of 140 lives was due solely to the promptitude of the Marconi wireless operator in sending out the S O S. The large African liner Falaba, bound outward, carrying a cargo and specie, with a crew of ninety and passengers to the number of 160, was in St. George's Channel at noon on Sunday, March 28, 1915, when those on board became aware that the vessel was being pursued by a submarine. The captain put forth all speed and tried to escape. The undersea boat, however, was one of the large and speedy types, and followed in the liner's wake with the swiftness of a greyhound. Within three-quarters of an hour after she had been sighted, she was within hailing distance of the ship. The first act of the commander of the submarine was to send up a rocket, and, following this signal, he ordered the captain of the Falaba to get his passengers into the boats, as he intended to sink the vessel.

In the meantime, when the undersea craft was first observed making after the vessel, the wireless operator on board was instructed by the chief officer to send out the S O S signal. In relating his experiences afterwards, the Marconi man said: "I sent the signal, giving our position, and it was answered from Land's End. In order to emphasize the urgency of the call, and anticipating what might happen, I added that our ship had been torpedoed and was sinking. I remained in the cabin for about six or seven minutes, and then the chief officer came to me and said that nothing further could be done, as the submarine had overhauled us. I managed to get into one of the boats, but almost as soon as it touched the water it began to sink, part of the side having been burst through. A passenger with a piece of rope held the crack together as well as he could, but the water poured in and soon we were up to our waists in water. Only the buoyancy of the lifeboat kept us from going under. There were sixteen of us, and two, a passenger and a member of the crew, were washed away."

The submarine had fired a torpedo before the work of removing passengers and crew into the lifeboats had been accomplished. The shot struck the vessel amidships and she immediately gave list to starboard and went down twenty-three minutes afterward. Of the 250 persons on board, only 140 were rescued, and of these eight died later from exposure.

In the meantime the S O S call had sped across the waters. The White Star liner Cymric, bound out from Liverpool, was only twenty miles away from the Falaba at the time. Captain F. E. Beadnell said that the wireless operator on his vessel picked up one of the distress calls sent out by the Falaba which read: "Submarine alongside. Am putting off passengers in boats." The captain was eager to steam full speed to the rescue of the African liner, but the British Admiralty instructions to all shipmasters forbade them to enter into the danger zone when the enemy's warships were near, so he was compelled to continue on his course. A little later the operator heard the answering calls to the S O S from British warships, and it was felt on board the Cymric that the passengers and crew of the Falaba would be rescued. As a matter of fact, however, the fishing boat Eileen Emma was the first to arrive on the scene and picked up nearly all of the 140 persons saved.



The equipment of Harry R. Lord at Cambridge Springs, Pa.

With the Amateurs

THE Radio Club of Westchester was recently organized at its headquarters, 2320 Newbold avenue, Bronx, New York City. The club meets weekly on Tuesday evenings. The more advanced members give lectures on radio subjects and code practice is held.

The transmitting set consists of a Packard ½ k.w. transformer, a sectional Murdock condenser, a rotary spark gap and an oscillation transformer. The receiving apparatus is of the loose coupled type.

The club would like to communicate with all amateurs and clubs within a fifty-mile radius. The call letters are 2EW.

The San Francisco Radio Club has undertaken the task of publishing an official account of the proceedings of the organization, under the title, "1916 Year-Book of the San Francisco Radio Club." It contains a record of what the club has accomplished, together with a list of members, notes on meetings, lectures, initiation fee and dues, and similar matter.

The booklet was made ready for distribution on September 7, copies to be supplied free of charge to those asking for them. A two cent postage stamp to cover mailing charges will be appreciated from all those who are anxious to obtain a copy of this publication.

The membership of the club is rapidly increasing; thirty-six members at present hold membership cards.

Names of newly elected officers are: president, H. W. Dickow; vice-president, D. B. McGown; secretary-treasurer, H. R. Lee; sergeant at arms, T. J. Ryan. The board of examining officers contains the names of L. O. Fassett and C. M. Heaney.

All correspondence should be addressed to the secretary-treasurer, 1580 Grove street, San Francisco, Cal.

Howard S. Pyle, 3329 37th avenue, Seattle, Wash., invites correspondence or personal calls from amateurs desiring to co-operate with him and the Puget Sound Radio Association to form an organization to cover the Northwest territory. Mr. Pyle makes a strong appeal to the fraternity of his vicinity, saying: "We want to affiliate with the N. A. W. A. and show the country that there are live amateurs away up here in the Puget Sound country, as well as around New York and the Middle West."

On June 12, a number of the amateur operators of South Jersey, headed by C. Waldo Batchelor, Wm. G. Phillips, Geo. E. Haldeman and Harry W. Densham, met and organized The South Jersey Radio Association, with headquarters at Collingswood, N. J.

The officers report that the association is already well under way and is affiliating with all the smaller clubs throughout the State with the object of forming a strong organization.

All organizations wishing to affiliate or become members of the South Jersey Radio Association, are invited to communicate with Harry W. Densham, secretary, Collingswood, N. J.

The radio station at the State University of Iowa (9-YA) will send general items of interest as QST press every Wednesday and Saturday night at 8:15 P. M., central time, during the school year. A wave-length of 500 meters and a rotary spark of medium tone will be used. R. C. Giese, operator, says to all amateurs: "Please drop us a note if you get our signature."

Deep regret has been expressed by the amateurs of Western New York over the death by drowning, on July 22, of R. H. Lilley, secretary of the Grape Belt Radio Association. Mr. Lilley was bathing in Lake Erie when the accident occurred and his body was brought to his late home in Westfield, N. Y. The vacancy occasioned by his untimely end has not been filled, Herbert A. Hiller, president, of Silver Creek, N. Y., having temporarily assumed the extra duties. It is expected that the position will be filled by election at the next meeting of the association.

Clayton S. Hunt, R. R. No. 12, Urbana, Ill., has recently been appointed district manager of the Central Radio Association, in place of Lauron A. Kern, of Mattoon, Ill., who resigned. Mr. Hunt trusts that he will hear from all interested amateurs at an early date.

The Port Morris Radio Club of New York, which was organized in June, 1916, would like to hear from amateurs in New York City. William K. Storrs is secretary and all amateurs interested are requested to communicate with him at 513 East 144th street, Bronx, N. Y.

Twenty-two young men possessed of a desire to assist one another in furthering their knowledge of wireless telegraphy, met at Fenske's Hall, Twenty-ninth and Clybourn streets, Milwaukee, recently to perfect a permanent organization.

Martin Hartman was named temporary chairman and Robert Mirgeler, temporary secretary. A committee, composed of Roman Engel, Clarence Bates, LeRoy Cleveland and Charles Seymour, was named to draft a constitution and by-laws to be presented at the next meeting in two weeks. Leonard Niessen and Robert Mirgeler were named on a committee to seek permanent quarters for the new club.

The society will be the first of its kind in Milwaukee and will have for its members all amateur operators who desire to join. There will be junior and senior classes, the latter offering assistance to the former. The club will have a permanent station at its headquarters.

Those at the meeting were: Frank Jutrash, Leonard P. Niessen, Louis Prahl, Winifred Zimmerman, Karl Frendenberg, Roman Engel, Clarence Bates, LeRoy Cleveland, Charles Seymour, R. E. DeLand, George Koresh, Reginald Hardy, Eugene Tuhtar, Charles Bishop, Stanley F. Poser, Moy B. Quong, Herbert Holz, Thomas A. Towle, George Stumpf, Elmer Kaufmann, Martin Hartman and Robert Mirgeler.

MARCONI IN NAVY

A Rome dispatch says that Guglielmo Marconi has been transferred from the engineer corps and appointed temporary captain of the navy.

Artillery Fire Directed From Aeroplanes By Wireless—Marconi

This Has Been Made Possible, Inventor Says, By Improvements in Aircraft

ON the whole, there have been no great war inventions that occur to me. Most of them have been minor ones, or applications of knowledge previously at our disposal, as in the case of poison gases, if these may be named at all. In my own field, there has been some advance in practical wireless, by which we are now able to direct the artillery fire of a ship by signals from an aeroplane. This has been made possible largely through big improvements in aircraft."

This was the statement made recently in Rome by Guglielmo Marconi in an interview regarding the European war.

"The big lesson in Europe has been one of organization, of the physical handling of big material problems by the armies. I doubt if any one before this war ever realized the meaning and value of railroad transportation on a large scale, as it is practised in the United States. Europe, too, has learned how to do big industrial jobs overnight, to assemble raw materials and turn out needed factory products.

"I refuse to play the prophet rôle, so I would rather not say how many of these war products will be of use to us when peace comes."

Since the beginning of the war Mr. Marconi has had unusual opportunities for observing the practical side of the war, having early put his scientific knowledge at the service of his country. As a Senator of the kingdom he has visited England, Belgium, France and other countries and introduced industrial and shipping reforms. In his capacity as military officer he has come into close relation with the army and the navy and given the benefit of his science and business organization knowledge to munition factories.

He has also perfected the army and navy wireless systems, and is at present working on a signal system which, it is expected, will render far more difficult submarine warfare through the readier location and signalling of the presence of such craft. The details of this he was unable to furnish because of its immediate military importance. Incidentally the inventor referred to the position of the United States.

"I don't think the United States should ever fear any fatal, disastrous invasion," he said. "Her seas protect her too well. She is too mighty a country in population and force ever to be conquered. I doubt if, with reasonable precaution, even her coasts could be injured or landed upon. The experience of this war has shown how easy it is to protect a coast by submarine, even when the invader is a near neighbor. It is a rule that will work both ways. The United States would have vast difficulties in landing forces on foreign territory, say that of Europe. Neither England nor Germany has been able to get at each other, though relatively close."

As to the prospects of peace in Europe, Mr. Marconi said there are many people who believe the war—that is, actual hostilities—will be over by winter.

"To me," he said, "the saddest fact about this war is that so much energy has been used up which might have gone to a better purpose."

GERMAN STATIONS JAMMING

Since the beginning of the great allied offensive daily wireless battles have been occurring between rival radio stations in belligerent countries. A despatch from Lugano says that the Italians complain that their wireless messages are being blocked by the German stations, which fill the air with flashes to prevent the Italians from getting their news to the world.

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.

F. S. L., New Rochelle, N. Y., inquires:

Ques.—(1) Referring to the receiver described on page 82 of the book "How to Conduct a Radio Club," over what range of wave-lengths will a transformer secondary winding respond with the secondary loading coil eliminated? What is the longest and shortest possible wave-length adjustment?

Ans.—(1) With the loading coil out of the circuit the secondary winding will respond to wave-lengths inclusive of 3,700 meters and of course the minimum wave-length can be the lowest value desired; but unless the precaution is taken to fit the secondary winding with dead-end switches there will be considerable energy losses at the shorter range of wave-lengths at values lying between 200 and 1,000 meters.

Ques.—(2) Could variometers take the place of these two coils as efficiently? If so, what should be the dimensions?

Ans.—(2) Variometers of the rotary ball type by all means could not be used as it is not possible to construct one possessing sufficiently values of inductance for a circuit of this type. It would be possible to construct a variometer of the sliding tube type for this circuit, but the energy lost in the windings would be detrimental to the efficiency of the set.

Ques.—(3) What would be the dimensions for a receiving transformer if the secondary loading coil were eliminated and the remainder of the circuit given the same dimensions as is the book "How to Conduct a Radio Club"? Would the entire apparatus be adjustable to the same range of wave-lengths?

Ans.—(3) The dimensions of the secondary winding may remain as given provided a condenser of much larger capacity, say .001 microfarad, is used in shunt to the secondary winding. but the apparatus will not be as efficient as that constructed according to instructions given in "How to Conduct a Radio Club."

We note by your last query that you desire to construct a compact receiving set that will be responsive to wave-lengths up to 10,000 meters. This is possible by the use of multi-layered loading coils. Coils of this type are not feasible when the layers are wound closely together, but when they are separated by an air space of 1/4 or 1/2 inch, they are practical and will work as efficiently as single-layer windings. Multi-layered coils can be purchased from the Manhattan Electrical Supply Company, Park Place, New York City. They are conveniently fitted with multi-point switches for variation of the inductance values and are exceedingly compact for the value of inductance given.

* * *

E. R., Trinidad, Colo.:

We are not familiar with the circuits nor the possible wave-length adjustment of the time signal receiving set sold by a manufacturer referred to. An inquiry of this kind should be sent to the manufacturer direct who will undoubtedly be glad to give you the necessary information. In the book "How to Conduct a Radio Club" the dimensions and circuits of a receiving set particularly suitable for the reception of the Arlington time signals, are fully described.

Your aerial of the T type, 120 feet in length with a vertical height of 50 feet, has a fundamental wave-length of about 210 meters which is slightly in excess of the United States restrictions.

No. 4 enameled wire may be used for the windings of an inductively coupled receiving tuner and will give fair results, but owing to the thinness of the insulation there is considerable electrostatic capacity between adjacent turns; therefore coils wound with wire of this type may have a defined natural time period of vibration which, at certain wave-lengths, may occasion considerable energy losses. It is customary in commercial receiving tuners to use single or double silk covered wire.

It is not necessary to make contact with each individual turn of the secondary winding of the receiving tuner, provided it is fitted with a shunt variable condenser to give the necessary closeness of adjustment between the tops of the usual winding. If, however, a variable condenser is not supplied, it is of advantage to have the secondary winding closely adjustable.

* * *

D. P. D., Limon, Colo., asks concerning the dimensions of an aerial suitable for the reception of amateur signals, as well as the wave-lengths used at the larger commercial stations.

For all-round work we advise, if it is possible to erect one, an aerial of the T type, which, for the reception of amateur signals, should be 110 feet in length and about 50 feet in height, provided the flat top portion consists of 4 wires spaced 2½ or 3 feet apart. An aerial of this type will permit the reception of waves at 200 meters and will be almost equally efficient on the longer wave-lengths, such as 600, 1,000 and 2,500 meters.

D. P. D. also desires to know the possible range of his receiving set with a crystaloi detector and other equipment of the usual amateur design. It is difficult to state definitely how far he would be able to receive, but if he is familiar with the Continental telegraph code and can copy radio signals at a speed of from fifteen to twenty-five words per minute, he should be able to determine for himself just how far the set will work. During the night hours it may be possible to receive signals from the Gulf of Mexico or possibly from the Pacific Coast, but in the daytime about the best that can be expected is the reception of signals from local stations. It is sometimes difficult in a mountainous region to receive signals from a considerable distance, because in traveling through the Rocky Mountains, wireless waves are required to take a rather hazardous journey and a good deal of the energy may be lost en route.

Our inquirer is still puzzled on the subject of receiving tuners and desires to know if a 2-slide tuner, having a possible range of 790 meters, is more efficient for the reception of amateur signals than inductively-coupled receiving tuner primarily built for the wave-length of 2,500 meters. Undoubtedly the two-slide tuning coil will give the best results because when the inductance values of it are adjusted to 200 meters the dead-end effect will not be so great as in the receiving tuner built for the longer range of wave-lengths. In the ordinary circumstance, a simple two-slide tuning coil will give just as good results in the reception of amateur signals as a more expensively constructed loose coupler.

In his fourth query the correspondent requests a diagram of connections for an inductively coupled receiving tuner and also for a double slide tuning coil. So many diagrams of this sort have appeared in past issues of The Wireless Age, particularly in the July, 1916, issue, that it seems unnecessary to repeat them here, and the book, "How to Conduct a Radio Club," has innumerable diagrams suitable for all conditions and types of radio telegraph receiving apparatus.

The inquirer closes his communication by asking the type of telephones used by the Navy Yard wireless operators. The latest installations in the United States Navy are supplied with the Baldwin telephones, which are especially constructed for wireless telegraph work, and are from eight to ten times as sensitive as the ordinary telephone receiver. A prominent feature of this particular type of telephone is the use of a micanite diaphragm, which in turn is actuated by an armature placed close to the magnets.

* * *

A. A. P., Santa Maria, Cal., desires to know whether glass or air is the better di-electric for a high potential condenser. He says that some experimenters assert that there are considerable hysteresis losses in a glass plate condenser.

The hysteresis loss in glass condensers is quite appreciable, but not enough to interfere with the practical working of the set. An air condenser, using the air at ordinary atmospheric pressure, is rather expensive and requires considerable space to erect, because the plates must be sufficiently separated to prevent sparking between them when the secondary winding of the high potential transformer is connected. A type of air condenser employing air at a pressure of 250 pounds between plates is manufactured, but the construction is beyond the resources of the average amateur experimenter and it would be better to resort to the ordinary glass condenser. Care, however, should be taken to secure a grade of glass free from mineral properties and notably free from lead.

This experimenter possesses an eight-wire aerial, 100 feet in length, and desires to know the inductance, capacity and wave-length, but as he has not stated the distance above the earth, we cannot reply. Ordinarily, however, an aerial of these dimensions, spaced about sixty feet above the surface of the earth, has a fundamental wave-length of 300 meters, and is highly suitable for the reception of signals at commercial wave-lengths.

* * *

A. A. P. requests the dimensions for a 3,000-meter loose coupler. This subject has been discussed so many times in the Queries Answered department that it seems unnecessary to go over it again. In the book "How to Conduct a Radio Club" the dimensions are given for a receiving tuner that will respond to wave-lengths of 3,000 meters and a complete diagram for the connection to an oscillating vacuum valve is published.

The correspondent desires to know if this tuner is used for the reception of amateur signals whether it will be as efficient as another tuner especially constructed for 200 meters. Unless the precaution to fit the tuner with dead-end switches is taken, it will not be as efficient as one built expressly for the wave-length of 200 meters. A tuner of the latter type is fully described in the last chapter of the book "How to Conduct a Radio Club," and under test has proved very efficient on the amateur wave-length of 200 meters. Receiving sets of this type will shortly be placed on sale by the Marconi Publishing Corporation and should prove of interest to experimenters who heretofore have not been able to purchase one of this type. The constructor should not be alarmed at the diminutive proportions of a 200-meter tuner because a coupler built for this value of wave-length has very few turns of wire in both the primary and secondary windings.

* * *

S. H. M., Richmond Hill, N. Y.:

The call letters of amateur stations and their locations are fully given in the book entitled "Radio Stations of the United States" on sale by the Government Printing Office, Washington, D. C.

* * *

M. N. P., Elsinore, Cal., has a one-inch spark coil and is apprehensive that it will be burnt out when operated in connection with an electrolytic interrupter on 110 volts direct current. He need, however, have no fear of this if the interrupter is constructed for variation of the current flow. In certain types of electrolytic interrupters means are provided whereby the distance to which the platinum electrode is dipped into solution may be closely regulated and in consequence the current flow can usually be cut down to a safe value for the primary winding. Generally an inquiry addressed to the manufacturer of the interrupter will reveal whether or not it is suited for a small spark coil.

* * *

U. F., Louisville, Ky., inquires:

Ques.—(1) What are the dimensions of a condenser to be used with a Thordarson ½ k.w. transformer, an oscillation transformer and a rotary gap as described in the book "How to Conduct a Radio Club," so as to comply with the government regulations? The aerial is to be 50 feet in length and 40 feet in height.

Ans.—(1) The subject is gone into so exhaustively in the book "How to Conduct a Radio Club" that it seems unnecessary to go over it again in these columns. The book states specifically that the condenser can in no case exceed the value of .01 microfarad and if one of these dimensions is employed the connecting leads to the primary winding of the oscillation transformer and the rotary spark gap must be exceedingly short. It is the custom at the majority of amateur stations to use a condenser of .008 microfarad. A single plate of glass, 14 by 14 inches, covered with foil, 12 by 12 inches, with an average thickness of ⅛th of an inch, will have a capacitance of .002 microfarad and four of these plates connected in parallel will give the required value, .008 microfarad. The oscillation transformer described in the book has the correct dimensions for this antenna system and the emitted wave will be near to the value of 200 meters.

Ques.—(2) I have a loose coupler, the dimensions of the primary being 7½ inches in length by 3½ inches in diameter, wound with No. 24 single cotton covered wire. The secondary winding is 7 inches in length, 3 inches in diameter, wound with No. 30 single silk covered wire. What is the longest wave-length to which this apparatus will respond when connected to a single wire aerial 175 feet in length and 30 feet in height?

Ans.—(2) The fundamental wave-length of this antenna system is about 300 meters and if a condenser of small capacitance is connected in shunt to the secondary winding the apparatus is adjustable to wave-lengths of 3,000 meters.

* * *

W. H. M., Seaford, Del., describes an elaborate umbrella aerial that is supported by a gas pipe mast. The mast is set in a cement base and he wishes to know if it will have sufficient insulation to permit the mast to be used as a portion of the antenna system. He also desires to know the natural wave-length of the antenna and asks whether the ribs of the umbrella should be evenly spaced and of the same length.

We have no knowledge of the formula by which the fundamental wave-length of an umbrella aerial can be determined accurately; consequently, it would be better to purchase a wave-meter and measure the natural period of the antenna circuit. Cement has not sufficient insulation for the potentials of a wireless telegraph aerial; it is customary to support a mast on glass blocks or heavy porcelain bushings, the mast being held in position by the guys alone.

We should prefer to have the ribs of the umbrella evenly spaced and of the same length as it is generally considered best to have the transmitting aerial of uniform construction throughout.

* * *

J. J. S., Jr., Tampa, Fla., requests data for the construction of a 1 k.w. 500 cycle rotary quenched transmitting set, but these cannot be given in the space at our disposal in this department and could only be obtained at a considerable expense from the engineering department of a commercial wireless telegraph company. J. J. S. also wants to know the kilowatt rating of the apparatus designed by A. E. Henninger in the February, 1916, issue of THE WIRELESS AGE. This set will consume about 1 k.w., but is not primarily a 500-cycle set. It was designed to give a spark frequency of about the equivalent of a 500-cycle set, although the apparatus is not supplied with 500-cycle alternating current.

The correspondent's further inquiry regarding the range of a receiving station cannot be accurately answered, as one who is familiar with the telegraph code should be able to determine for himself the possible range of the apparatus. The matter is discussed in the book "How to Conduct a Radio Club."

* * *

F. W. S., Omaha, Neb.:

Any type of transmitting apparatus where the condenser is charged with alternating current does not generate undamped oscillations. If, however, the arc gap shown in your diagram was supplied with direct current at 1,500 volts, sustained oscillations would be generated and accordingly flow in the antenna circuit.

A telephone transmitter highly suitable for radio telephone work was described on page 22 of the July, 1916, issue of The Wireless Age. We do not know of any manufacturer who makes a specialty of microphone transmitters suitable for wireless telephone work.

The condenser for your high potential transformer may have a capacitance of .008 microfarad. If your 8-inch by 10-inch glass plates are covered with foil 6 inches by 8 inches each plate will have a capacitance of approximately .00066 microfarad and consequently twelve plates connected in parallel will give about the desired capacity.

* * *

J. N. J., Union, Ore.:

Your aerial has a fundamental wave-length of about 237 meters and when connected to the receiving apparatus you describe should permit the reception of night signals of from 600 to 1,000 miles. The daylight range is problematical, depending upon local conditions.

There is little difference in the results obtained between a two-wire and a four-wire aerial. A four-wire aerial has a smaller value of resistance and when the span of the flat top portion is short, it may be of value to use a great number of wires. However, when the flat top portion is at least 60 feet in length almost identical results are obtained with either aerial. (?)

* * *

H. P. S., Lynn, Mass.:

The apparatus described in the February issue of the monthly service bulletin of the National Amateur Wireless Association is probably more sensitive than that described on page 82 of "How to Conduct a Radio Club." It is difficult to place apparatus of this type in a receiving cabinet of small dimensions, but you should be able to arrange such a design after careful consideration of the operation of the set. You can decrease the dimensions of the receiving cabinet by using multi-layered coils for the grid and wind circuits of the oscillating vacuum valve. Coils of this type constructed ready for use are now on sale by the Manhattan Electrical Supply Company, New York City. The telephones with the micanite diaphragms can also be purchased at the same address.

For a cabinet receiving set on the order of that described on page 82 in the book "How to Conduct a Radio Club," it is suggested that one of the cabinets contain the oscillating vacuum valve, the high potential battery, the necessary telephone connections, the grid condenser and the condenser for the wing circuit. The second cabinet may have the primary and secondary windings of the inductively-coupled receiving tuner and the aerial tuning inductance. The third cabinet may contain the loading coils of the wing and grid circuits. It will not matter if they are placed in slight inductive relation. In fact, if the coils are placed within an inch of one another, the oscillation transformer L5 and L6 may be dispensed with.

* * *

N. A. J., Trenton, N. J.:

Ans.—(1) You will not be able to make use of the full power of a 2 k.w. closed core transformer at your transmitting station if your station is to be operated at a wave-length of 200 meters. About the best you can do is to consume between one-half and one-quarter kilowatt if the frequency of the current supply is 60 cycles. Previous issues of The Wireless Age have contained a number of articles on the construction of high potential transformers and you are advised to procure these issues and duplicate the designs given therein. The average amateur experimenter secures the best results with an open core transformer rather than one of the closed core type. The design for a transformer of this construction is fully described in the book "How to Conduct a Radio Club."

Ans.—(2) A magnetic leakage gap is merely a tongue of iron which extends from one side of the core to the opposite side, there being a break at the center of about one-fourth of an inch over which the magnetic lines of force pass. The open core transformer naturally possesses the requisite amount of magnetic leakage, and no special construction is therefore required.

Ans.—(4) The range of the transmitting apparatus operated at the wave-length of 200 meters depends largely upon local conditions, and, of course, upon the over-all efficiency of the set. Amateurs frequently do from 40 to 100 miles during daylight hours and 500 to 800 miles after dark. But to obtain similar results a sensitive receiving set must be employed at the receiving station. The aerial you describe has a fundamental wave-length of close to 400 meters and, to be operated at the restricted wave-length of 200 meters, the flat top portion must be reduced to 60 or 70 feet in length.

* * *

A. B., New York, inquires:

Ques.—(1) What is the best form of aerial for long distance receiving to erect on a space limited to fifty by forty feet, using masts if necessary.

Ans.—(1) Knowledge of local conditions would aid us in giving advice, but we cannot see how you can do better than to erect an ordinary flat top aerial of inverted L type with six wires spaced about three feet apart. The higher you can swing this aerial the better will be the results obtained, but, of course, the proposition is one that you can best decide for yourself.

Ques.—(2) Approximately what would be the wave-length of the aerial that I could erect in this space?

Ans.—(2) It depends on the height to which the flat top portion is placed. Probably about 250 meters.

* * *

W. P., of Brooklyn, writes that he has installed ½ kw., sixty-cycle transmitting set with which he secures a very heavy spark, but amateur stations within a quarter of a mile claim that his signals are not readable. He sends us a diagram of connections which we find to be correct in every respect, but we believe that the trouble lies in the lack of resonance between the primary and secondary windings of the oscillation transformer. It may be that the circuits are not in tune. Consequently a small hot wire ammeter or a small bulb lamp shunted by a turn of wire should be inserted in the antenna circuit and certain adjustments made of the inductance in the primary and secondary windings until a brilliant glow of the lamp is secured. Ordinarily a two-volt battery lamp will suffice for the purpose, and will indicate conditions of resonance. If, after this experiment has been gone through, improvement does not result we have no additional advice to offer with the exception that there may be a poor earth connection. If possible, the lead from the transmitting apparatus should be connected to the street side of the water mains and in any event care should be taken to see that there are no high resistance joints between the oscillation transformer and the earth or between it and the antenna proper.

W. P. also says that he rewired his receiving apparatus and the connectors thereto with much heavier wire than used formerly, and immediately upon doing this the signals from other stations weakened. He urges us to believe that the decrease is due to the solder used in the connecting lugs, but we advise that this cannot possibly be so. If the connecting wires are well soldered into the lugs it should have no effect on the strength of signals. It may be that with this rearrangement of the wiring some portion of the circuit has become actually interrupted. If so a telephone test circuit should be applied to the various windings of the apparatus to determine if they are electrically closed.

The receiving apparatus described on page 71 of the first edition of the book, "How to Conduct a Radio Club," is applicable to the reception of amateur signals, provided the primary and secondary windings are constructed so as to have sufficiently low values of inductance for the wave-length of 200 meters. A receiving tuner designed particularly for the wave-length of 200 meters is described in the last chapter of that edition.

* * *

F. S., Parkersburg, W. Va.:

It is evident from your fifth query that you already possess a copy of the book, "How to Conduct a Radio Club," and if you will read this publication carefully you will find complete answers to every question in your communication. A plate of glass, 8 inches by 10 inches, covered with a foil 6 inches by 8 inches, has a capacitance of approximately .00066 microfarad, and twelve plates connected in parallel give the value of .08 microfarad, which is quite correct for the Thorardsen 1 kw. transformer. The dimensions for an oscillation transformer are given in "How to Conduct a Radio Club," and also a method of applying the tinfoil to the glass plates. Vacuum valve detectors can be purchased from any of the advertisers listed in this magazine.

* * *

R. B., Omaha, Neb.:

The April, May, June and July issues of THE WIRELES AGE contained complete answers to all the queries in your recent communication. A table of the natural wave-length of four-wire flat top aerials up to 150 feet in length is given in the book, "How to Conduct a Radio Club."

The loose coupler you have mentioned is evidently designed for reception of long wave-lengths and the primary winding should be covered with No. 24 single silk covered wire and the secondary winding with No. 32 single silk covered. If the secondary winding is shunted by small variable condenser, it wil respond to the wave-length of about 8 000 meters. See the article on "How to Conduct a Radio Club" in the July, 1916, issue of THE WIRELESS AGE for a diagram of connections applicable to this apparatus.

* * *

T. R., Jr., New York City:

The receiving apparatus described in the October, 1915, issue of THE WIRELESS AGE, by A. C. Burroway, will easily respond to a wave-length of 2,500 meters and will give good results at that wave-length when connected to an aerial with a flat top portion at least 150 feet in length.

* * *

J. P., Ridgewod, Brooklyn, N. Y.:

We have carefully scrutinized the diagram of connections accompanying your query and find no error therein, but just why you are not able to receive signals is another matter. Your tuner is correctly designed for the wave-length of 600 meters, but not so well adapted for the reception of the time signals at 2,500 meters. You require a secondary winding of increased length for the best results. Be sure and connect the positive pole of your high potential battery to the plate, R, of the vacuum valve. Also connect the top terminal of your secondary winding to the negative side of the land filament.

Your aerial has a fundamental wave-length of about 200 meters. From the last five articles on "How to Conduct a Radio Club" appearing in THE WIRELESS AGE you should have no difficulty in the selection of a receiving tuner that will fulfill your requirements. You must first decide for yourself, however, the range of wave-lengths over which it is to respond and whether the complete equipment is to be used for the reception of damped or undamped oscillations. After having made this decision you can then select from these previous articles a receiving tuner that will give the maximum response.

* * *

A. G., Tampa, Fla., inquires:

Ques.—(1) What is the capacitance of a condenser utilizing glass plate 10 inches by 14 inches, with an average thickness of 3/32 of an inch, coated on both sides with tinfoil, 8 inches by 12 inches? What is the capacitance per single plate?

Ans.—(1) With glass of ordinary texture the capacitance per plate is approximately .0013 microfarad.

Ques.—(2) Will the capacity of this condenser be changed if it is immersed in oil?

Ans.—(2) Not if the plates are stacked and pressed closely together so that there is no oil intervening between them. However, if the dielectric is oil as well as air, the capacitance will vary according to the dielectric constant of the particular grade of oil used.

Ques.—(3) What is the wave-length of the Sayville, Tuckerton, Arlington and Nauen high-power stations?

Ans.—(2) Sayville, 9,400 meters; Tuckerton, 7,400 meters; Arlington, 6,000 to 7,000 meters; Nauen, 9,400 meters.

Ques.—(4) When can these stations be heard?

Ans.—(4) At intervals throughout the day and night. Tuckerton and Sayville can be heard from 7:00 p. m. to 12:00 p. m., Eastern standard time regularly.

The dimensions of the inductively-coupled receiving tuner you furnished us are not complete enough for making calculations, but off hand we could say that the possible wave-length adjustment is about 2,000 meters, and that also the mutual inductance between the primary and secondary windings is not sufficient for the best efficiency if the primary and secondary circuits are loaded to a longer wave-length by means of loading coils. You had better see previous issues of The Wireless Age and the book, "How to Conduct a Radio Club" for the dimensions and diagram of connections for a long distance receiving apparatus.

The Arlington station sends out time signals at 10:00 p. m., Eastern standard time.

* * *

R. H. L., Baltimore, Md., inquires:

Ques.—(1) What is the capacity in microfarads and the natural wave-length of an inverted L antenna consisting of two wires, 100 feet in length, placed four feet apart? The height is 50 feet and the lead-in is 30 feet in length.

Ans.—(1) The fundamental wave-length is approximately 281 meters, the capacitance .000395 microfarad and the inductance about 63,000 centimeters.

Ques.—(2) What is the maximum possible wave-length adjustment with this antenna connected to the following described apparatus:

The primary loading coil is 15 inches by 3 inches, wound with No. 24 single silk covered wire.

The loose coupler has a primary winding 5 inches in diameter and 7 inches in length, wound with No. 22 single cotton covered wire.

The secondary winding is 7 inches in length and 4½ inches diameter, wound with No. 30 single cotton covered wire.

A variable condenser of .007 microfarad is connected in shunt to the secondary winding.

Will I require additional inductance in the secondary circuit to place the primary and secondary windings in resonance?

Ans.—(2) With a complete loading coil and primary winding of the receiving transformer connected in series with the antenna system, the upper wave-length adjustment is 3,900 meters and with the full value of capacity in shunt with the secondary winding using the entire inductance the maximum adjustment is 4,620 meters. You thus see that to place these two circuits in resonance at the longer wave-length will require a loading coil in series with the antenna circuit of increased dimensions; but keep before you the fact that there are no spark circuits in operation at a wave-length of this value.

Ques.—(3) Can all types of wireless telephone systems be heard on ordinary receiving apparatus with crystalline detectors?

Ans.—(3) Yes, provided the receiving tuner is constructed to permit resonance with the transmitting station.

Ques.—(4) What flux density is used in designing the cross sectional area of a transformer core?

Ans.—(4) The actual density varies with the frequency. At the frequency of 25 cycles from 60,000 to 90,000 lines are allowed per square inch; for 60 cycles 40,000 to 50,000 lines per square inch; for 120 cycles, 30,000 to 50,000 lines per square inch; for 500 cycles, 5,000 to 10,000 lines per square inch.

From one to three dry cells are used with a carborundum crystal, but usually only one is required.

Your aerial, sixty feet in height, thirty-eight feet in length, consisting of two wires, spaced three feet apart, has a fundamental wave-length of approximately 178 meters.

* * *

A. B. R., Stuttgart, Ark., writes us as follows:

My station is practically inoperative during the summer months and my troubles are not those of the usual amateur station, namely, poor connections, faulty instruments, or poor earth connection. I believe there must be some condition external to my station which is causing this, but so far I have not been able to solve the problem. I have a complete set of apparatus, including a vacuum valve detector, inductively-coupled receiving tuner and an antenna 100 feet in length and 72 feet in height at one end, and 45 feet in height at the other end. I experience this trouble principally between the months of May and September, and I should like to have you give me some advice.

Ans.—(1) There is nothing wrong with your apparatus nor your station as a whole. The fact is, that long distance receiving work in the United States, particularly from spark stations operating at wave-lengths between 600 and 2500 meters, is only possible during the winter months of the year, that is, from September to May, but from May to September it is rather doubtful whether or not long distance stations can be received. Occasionally on cold evenings during the summer months, signals are readable from ships a considerable distance at sea, but not ordinarily. Consequently there is nothing you can do except to wait until the favorable months arrive, in the meantime satisfying yourself by communicating with local amateur stations. About September 15th, or possibly later, you will find that during the night hours you will be able to receive signals from far distant stations, and the condition that allows this to take place is not entirely attributable to conditions of heat or cold. It seems to be more a matter of seasons than one of temperature.

R. B. H., Allentown, Pa., inquires:

Ques.—(1) When using my transmitting apparatus there is an extremely loud noise in my head telephones. Can this be overcome and how?

Ans.—(1) If found to be caused by electrostatic induction from your transmitting apparatus, it can be overcome by disconecting the terminals of the telephone cords from the receiving apparatus during the sending period and may be eliminated by placing a small switch acros the telephone binding posts during the period of transmission. You might separate your transmitting apparatus by several feet from your receiving equipment. It may be that you do not disconnect the earth wire from the receiving apparatus during the period of transmission; if this is not done you should construct an aerial switch immediately that will permit it.

* * *

C. E. G., Bryan, Texas., inquires:

Ques.—(1) Will an E. I. Company ½ kw. transformer send as far as a closed core transformer with the same power?

Ans.—(1) Yes.

Ques—(2) How far should a ½ kw. coil send on a 200-meter wave?

Ans.—(2) About twenty miles.

Ques.—(3) How many plates of glass, 8 inches by 10 inches, should I use for condensers for this coil?

Ans.—(3) Eight plates connected in parallel.

Ques.—(4) How far should I be able to receive with the usual amateur receiving apparatus connected to an antenna 74 feet in length and 45 feet in height?

Ans.—(4) From 40 to 100 miles in daylight and from 100 to 500 miles after dark.

Ques.—(5) What is the wave-length of the aerial referred to in the fourth query?

Ans.—(5) About 195 meters.

* * *

C. H., Spencer, N. Y., inquires:

Ques.—(1) What is the wave-length of my aerial, which is 75 feet in length and 35 feet in height? It is composed of 4 wires, spaced 3 feet apart. The lead-in is 35 feet in length and the ground lead 17 feet in lenigth.

Ans.—(1) About 210 meters.

Ques.—(2) Is it necessary to insulate the layers of wire on the secondary winding of a 3-inch spark coil, and if so what material is used? The data for this coil are taken from the book, "How to Conduct a Radio Club."

Ans.—(2) Adjacent layers should be insulated by a good grade of paraffine paper or preferably by very thin Empire cloth.

Ques.—(3) What size condenser should I use with this coil to keep the wave-length within 200 meters?

Ans.—(3) A suitable condenser is completely described on page 28, Figure 9, of the book, "How to Conduct a Radio Club."

Ques.—(4) What is the approximate transmitting range of this coil using a suitable helix, spark gap and condenser?

Ans.—(4) From 10 to 40 miles, depending upon the type of receiving apparatus used at the receiving station. With crystalline detectors 15 to 20 miles has been covered with a similar coil.

Ques.—(5) Is the oscillation transformer more suitable than the ordinary single coil helix?

Ans.—(5) Not necessarily, but it permits the coupling between the primary and secondary windings to be more easily regulated than with the ordinary helix.

* * *

G. C. R., Richmond, Va.:

We do not know what stations were engaged in the wireless telephone conversation which you heard, but there are several experimental radio telephone stations in daily operating at Schenectady, N. Y., and also at Pittsfield, Mass. The United States Navy has been engaged in numerous wireless telephone tests, and it may be that the conversation which you heard emanated from some of their equipments.

* * *

E. F. Champaign, Ill., desires to know if two undamped receiving sets, like those described in the book, "How to Conduct a Radio Club," will interfere with one another owing to the fact that such receiving sets actually radiate undamped energy. In the problem given us these stations are located half a mile apart. These equipments will not interfere ordinarily with one another if the two antenna circuits have different degrees of damping, but we cannot make a definite statement on the subject. It is a fact that apparatus of this type does radiate undamped energy and has been used by several experimenters for wireless telephone conversations up to a distance of 1½ miles.

It does not seem necessary for us to take up the matter of the taps on the loading coils of the wing and grid circuits of the diagram published on page 82 of the book, "How to Conduct a Radio Club," because the majority of amateurs know that in any wireless telegraph receiving circuit it is desirable to have close variation of the inductance value. The experimenter may have just as many taps as he desires. For the longer range of wave-lengths, however, no taps are required on either the loading coil in the detector circuit or the one in the wing circuit. They are used at their full value.

* * *

W. C. H., Wind Rock, Tenn., inquires:

Ques.—(1) Please advise if the vacuum valve amplifier described on pages 77 and 78 in the book, "How to Conduct a Radio Club," can be used to amplify undamped signals received with the "beat" receiver described on page 82 of the book? If so, how?

Ans.—(1) The connection is feasible and will give the desired result, provided the one to one transformer, P, Figure 55, is connected in series with the head telephones and the battery, B-2, of Figure 62 on page 82 of the Radio Club Book. The connections from the auto transformer are then extended to the grid and filament of the second vacuum valve and so on. Some experimenters prefer a one to one transformer having a primary and a secondary winding and in certain stations, a step-up ratio of turns is employed. The secondary winding is then given double the number of turns in the primary winding. Inductively-coupled transformers of this type can be purchased from the Manhattan Electrical Supply Company, New York City.

Ques.—(2) Approximately what is the wave-length of a single wire aerial, 700 feet in length, 55 feet in height with an 80 foot lead-in and a 10 foot group wire?

Ans.—(2) The fundamental wave-length of this aerial is close to 1,100 meters.

Ques.—(3) By the use of two wires spaced 12 feet apart in this aerial will the strength of the received signals be increased materially?

Ans.—(3) Possibly a slight increase in the strength of signals may be experienced, but perhaps not sufficient to warrant the expense of the wire.

* * *

F. E. M., Troy, N. Y., inquires:

Ques.—(1) Will you please publish a formula to calculate the condenser capacity of a wireless telegraph set when the wave-length, spark frequency, secondary voltage and power input to the transformer are known.

Ans.—(1) These various quantities are related to one another in the following ratio, namely:

$$C = \frac{W}{V^2 N}$$

Where C = Capacity condenser in microfarads.

W = Watts delivered by secondary winding.

N = Cycle frequency of current supply.

This formula must be considerably modified for practical work, but is of sufficient importance for guidance in elementary design.

Ques.—(2) I have a 60 cycle 1 k.w. transformer, which, when used on forty cycles A. C., draws practically 2 k.w. Operated at the wave-length of 300 meters and connected with a rotary gap giving about 480 spark discharges per second, what is the required capacity for the condenser and how many 8 by 10 plates, coated on each side, with tinfoil 6 by 8 inches, are required?

Ans.—(2) You will probably not be allowed to operate this station at a wave-length above 200 meters and consequently the capacitance of the condenser should lie between .008 microfarad and .01 microfarad. Each plate of glass of the condenser you have described will have a capacitance of about .00066 microfarad and in consequence twelve plates connected in parallel will give the required value.

Ques.—(3) If I increase the speed of a non-synchronous rotary gap so as to produce about 800 spark discharges per second instead of 480 discharges, will a condenser of smaller capacity be required?

Ans.—(3) Yes, the capacity of this condenser must then be reduced. Ordinarily a non-synchronous rotary gap does not function well at spark frequencies in excess of 400 sparks.

From and For Those Who Help Themselves

(*Continued from page 58.*)

the weight of the motor's armature and the rotary disk. For example, if the rotor and armature were heavier, the rubber tip, D, would have to make a firmer contact against E. The position of the clutch and the connections may be seen from the cut. It is plain to see that when the current is made, the tip, D, is drawn away from E, and when it is broken, C forces D against E, automatically stopping it.

R. A. Wilkins, *California.*

FIVE-CENT CRYSTAL HOLDER

After experimenting with all kinds of detector cups I hit upon the plan of using an ordinary helix clip for holding the crystal. These clips can be purchased for five cents and any size or shape of crystal can be clamped in any position instantly. The end opposite the jaws should be flattened out and soldered to a support which can be arranged to suit conditions. B. A. Noe, *Indiana.*

National Amateur Wireless Association

OFFICERS OF THE ASSOCIATION.

PRESIDENT, Guglielmo Marconi.

NATIONAL ADVISORY BOARD OF VICE PRESIDENTS

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Lieut.-Col. Samuel Reber, Signal Officer, U. S. Army.

E. E. Bucher, Instructing Engineer, Marconi Wireless Telegraph Company.

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ACTING PRESIDENT,
J. Andrew White,
Editor, THE WIRELESS AGE.

MANAGING SECRETARY,
Clayton E. Clayton,
450 4th Avenue, New York.

A national organization of wireless amateurs was announced in the October, 1915, number of THE WIRELESS AGE. Further details of the organization are given in an address made by J. Andrew White, which was published in the November WIRELESS AGE. Reprint copies sent upon request.

MEMBERS' EQUIPMENT.

1st. CERTIFICATE OF MEMBERSHIP.

The handsomely steel-engraved Certificate, with shadow background half-tone, is sealed and signed by Officers, with the endorsement of Senatore Marconi, as President. Every member will want to frame and place it alongside of his Government License certificate, two documents establishing status as wireless amateurs.

2nd. AERIAL PENNANT.

The 36 inch aerial pennant, painted in four colors on scarlet felt, will stand long service at your aerial mast head. Every member will be proud of the National Insignia flying from his aerial.

3rd. MEMBERSHIP PIN.

The National Amateur Wireless Association Pin in gold and enamel is the National emblem of the Association. The design shown on the preceding page can but faintly describe its handsome appearance in three colors and gold. The pin has a special patented hub and shank which permits it being securely fastened on the coat lapel or on the vest without turning upside down.

4th. LIST OF RADIO STATIONS OF THE WORLD.

Revised Edition just published. See advertisement. Regular 50c edition.

5th. HOW TO PASS U. S. GOVERNMENT WIRELESS LICENSE EXAMINATIONS.

Regular 50c edition of this popular book. Members who already have a copy, see concessions below.

6th. HOW TO CONDUCT A RADIO CLUB.

This splendid book, which has been months in preparation and incorporates portions of articles running under the same title in THE WIRELESS AGE, is re-written to cover every new development, and with a large proportion of new matter. It is the foundation stone of the National Amateur Wireless Association activities. Price of this book 50c.

7th. MONTHLY BULLETIN SERVICE.

It is intended to make the monthly bulletin service for members of the National Amateur Wireless Association one of the most important features of the Association. This bulletin is to be used in connection with "List of Radio Stations of the World" described above. It will carry all additions (both amateur and commercial) to "List of Radio Stations of the U. S.", issued by the Bureau of Navigation, U. S. Department of Commerce, and secured for members at 18c a copy. The Government list is issued only once a year. The Association Bulletin will keep both lists up to date for you month by month, and in addition, will carry other special and invaluable Association features not obtainable elsewhere

8th. ONE YEAR'S SUBSCRIPTION TO THE WIRELESS AGE.

THE WIRELESS AGE is the Official Organ of the National Amateur Wireless Association and will contain full reports of wireless amateur activities, both national and local. It is planned to give published recognition to individual amateur achievement.

CONCESSIONS:

Those who, *during the past six months,* have become subscribers to THE WIRELESS AGE, or have renewed their subscription, or have purchased any portion of the Membership Equipment, may consider such payment as partial payment of Membership Application as given below. If you have paid for a subscription to THE WIRELESS AGE which includes books which are not a part of the Membership Equipment, then you may credit $1.25 of the remittance as partial payment on the Membership. For example, you may have remitted $2.25 for the combination offer of the 1915 Year Book with one year's subscription to THE WIRELESS AGE. In this combination, the price of both the book and the subscription was reduced, to make the special offer; therefore, you may be credited only with that part of the payment which went to the magazine—that is, $1.25. *Coupon subscribers receive no credit for trial orders.* Subscribers to THE WIRELESS AGE who *began or renewed more than six months ago,* will secure through Membership dues a renewal for another year; and their subscriptions will be extended for one year from the time the present subscription expires.

INITIATION FEE

An initiation fee of $1.00 is required of all new members to pay for the initial membership equipment, consisting of Nos. 1, 2, 3, 4, and 5.

ANNUAL DUES

The annual dues are to be not more than $2.00. For this, all members are to receive:

1st. The Monthly Bulletin Service.

2nd. THE WIRELESS AGE for one year.

3rd. How to Conduct a Radio Club or equivalent.

4th. 10% discount on any book on wireless published, and other features to be announced later.

SPECIAL NOTICE REGARDING CORRESPONDENCE.

As the National Amateur Wireless Association is in no sense a money making enterprise, and as the nominal dues will cover a very small amount of handling expense, it is desired that the correspondence be limited to only the most essential necessities. A cordial invitation is extended to all club officials to write on matters pertaining to organization. This invitation also includes those who are interested in starting new clubs.

Charters—Out of the amount paid by each member for annual dues, it is purposed to allow organizations that have become part of the National Amateur Wireless Association a rebate of 50 cents out of each $3.00 for their own treasury—a fund to take care of local expenses. Please note that this is a rebate, not a deduction. In order to qualify for recognition as a unit in the National Amateur Wireless Association, a club must have at least five active members and at least one-quarter of its total membership become members of the National Amateur Wireless Association. Clubs securing a charter will have representation in the National Council; this means that they elect their own delegate and thus secure a voice in the management of the Association and in the planning of its future development and activities.

Clayton E. Clayton, Managing Secretary,
450 4th Ave., New York.

Checks and money orders should be made payable to: Natl. Amateur Wireless Assn.

APPLICATION FOR MEMBERSHIP.

Clayton E. Clayton, Managing Secretary,

NATIONAL AMATEUR WIRELESS ASSOCIATION, Date...............

450 4th Avenue, New York City.

As I desire to receive full recognition as an amateur wireless worker of the United States, I ask the privilege of enrollment as a Member in the National Amateur Wireless Association and request that you send me the complete Members' Equipment for which I enclose herewith remittance of $1.00 Initiation Fee, covering Initial Equipment, and $2.00 for First Annual Dues—or $3.00 in all. Option.*

I trust that you will act upon my application promptly and forward the equipment to me at the earliest possible date.

My qualifications for membership are given in blank spaces below.

Signature .... Age............

Street Address ....

Town and State..

Please credit me with $........ paid for......................

* Option.

In the event that an applicant is unable to send the entire amount of the membership dues with this application, the figure $8.00 may be crossed out and $1.00 written in its place. This will be considered an agreement on the part of the applicant accepted for Membership that the balance of dues ($2.00) will be paid at the rate of 50c per month for the next four months, at which time pin, pennant and Certificate of Membership will be issued. The other equipment will be sent at once.

FILL IN ANSWERS TO THESE QUESTIONS.

1—Have you a Government License (give number.........) or do you purpose applying for one?..

2—If you are under 21 years of age, give names of two adults for references as to character.

Reference...

Reference...

3—If you are a member of any Local, State or Interstate wireless club or association, give its name, and name of Secretary with address.

....

4—Are you now a subscriber to THE WIRELESS AGE?........................

5—If you already have any books included in the equipment, state which ones.........

....

National Amateur Wireless Association

A Directing Organization Dedicated to the Promotion of Radio Communication

Call Letters 9PY
S. W. PIERSON
Carrollton, Illinois

GUGLIELMO MARCONI, President

Reduced fac-simile of letter head.

For Clubs and Members of National Amateur Wireless Association

The following list of items of optional equipment is listed at cost price in order to give members and clubs of the Association every material advantage in the way of a complete equipment that may be desired. Prices include transportation charges to 5th Parcels Post Zone. Postage extra to 6th, 7th and 8th Zones.

LETTER HEADS AND ENVELOPES:

100 National Association Letter heads with imprint of member at left hand side, as illustrated above 75c

Without member's imprint........ 35c

100 Envelopes with imprint...... 65c

Special prices on 1000 *Letter Heads to Clubs.*

MESSAGE BLANKS:

Pads of 50.................... 10c

STATION LOG BOOK:

A record book in which to keep track of all your operations and communications, in paper........ 15c

in cloth 30c

RADIO STATIONS OF THE U. S.:

Call list issued by the U. S. Department of Commerce, postpaid.. 18c

PHOTOGRAPHS AND PICTURES:

Photographs of important stations, such as Arlington, Sayville, etc., 9" x 12", each $1.00

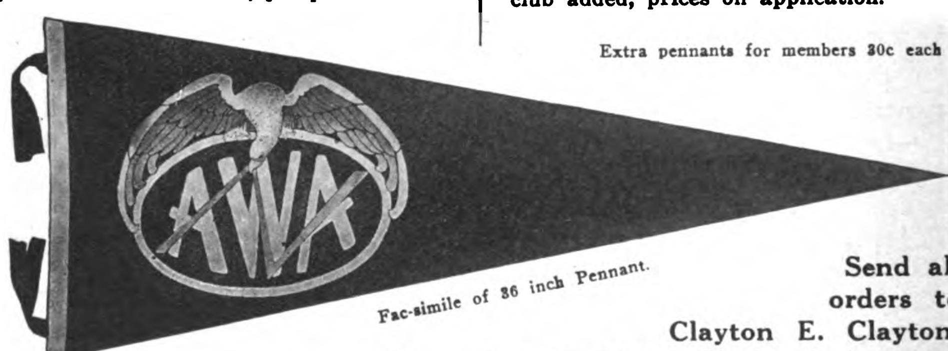
Half-tone picture of G. Marconi, suitable for framing 10c

SOLID GOLD BUTTONS, 14 Karat N. A. W. A. emblem............$1.75

WIRELESS MAP OF THE WORLD in colors 50c

1916 YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, published at $1.50, special to members and clubs (1915 Ed. 75c).. $1.35

CLUB PENNANTS: Made of first quality wool bunting, letters and emblem sewed on with cut outs in color and name of club added, prices on application.



Extra pennants for members 30c each

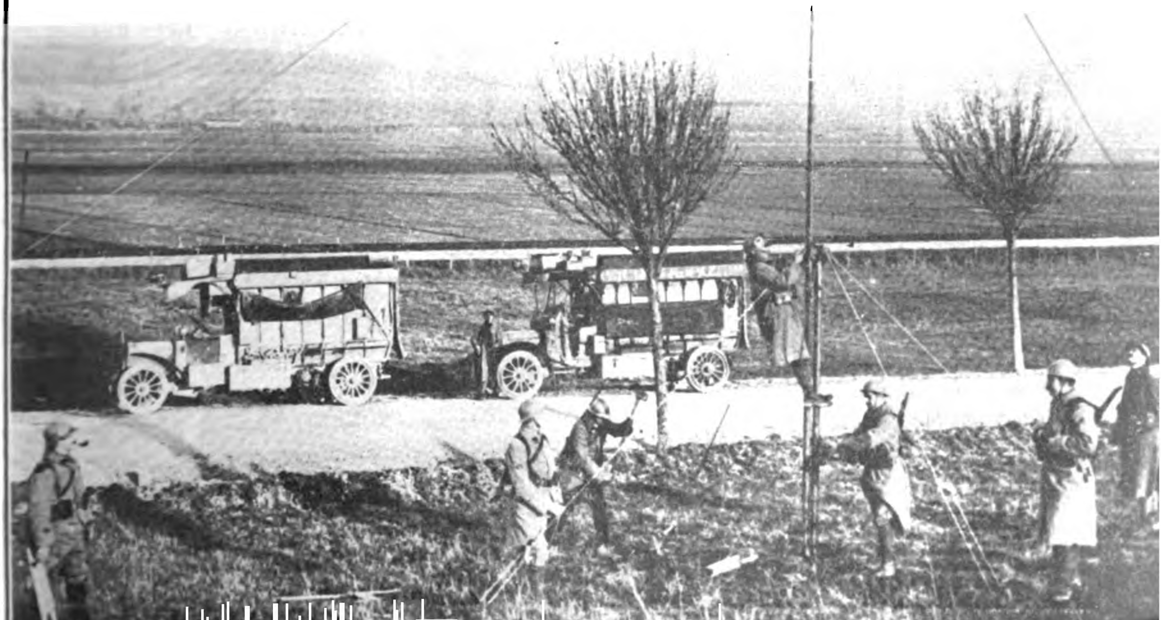
Fac-simile of 36 inch Pennant.

Send all orders to Clayton E. Clayton, Managing Secretary, National Amateur Wireless Association, 450 Fourth Ave., N. Y. City.

Price 15 Cents November, 1916

THE WIRELESS AGE

A FRENCH FIELD WIRELESS STATION IN USE IN THE WAR



THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

NOVEMBER, 1916

Nation Wide Relay for N. A. W. A. Members

Under Direction of National Chief of Relay Communications Members are to Send Messages Broadcast from President Wilson as a Preparedness Test

MEMBERS of the National Amateur Wireless Association are to take the lead in a nation-wide preparedness test to be held on October 25, 26, and 27. Under the leadership of W. H. Kirwan (9XE) of Rock Island, Ill., who has been appointed National Chief of Relay Communications of the N. A. W. A., the amateurs will be organized into a relay chain to broadcast throughout the country messages from President Wilson. The great organization of licensed amateur stations under N. A. W. A. control will be placed at the disposal of the National Chief of Relay Communications and selections will be made from the list to establish relay points.

The entire country will be divided into circles whose diameter will be the sending radius of the stations officially appointed, the circles overlapping and connecting up all the strategic points. The messages will be received in each city and town, whereupon each operator will file a copy of the message with the postmaster and receive a receipt which will insure him credit for the work.

The national relay chief's preliminary announcement to members states:

"Aside from the novelty of the thing, the plan has many advantages. I have served in the navy, and I am a strong believer in preparedness.

"The sending of the president's messages will serve to get every amateur station in the country tuned up and ready for work. Many of them are ready now.

"Think what an advantage it would be in case of invasion to have all of these stations ready to receive the first word of the intent.

"The diameter of each of the circles into which I have divided the entire United States is the sending range of the sender. Every circle overlaps, and the best station has been picked out as the most strategic point. In time of need, messages could be delivered to either the mayor of each town or the nearest fort.

"Among the stations which have been enlisted in the president's campaign work, are the big stations at the Illinois Watch Co., Springfield, Ill., Cornell, Harvard, the Georgia School of Technology at Atlanta, Iowa State University, Ames College, Washington University at St. Louis, University of North Dakota, University of Michigan, Catholic College at Corteau, La., and the University of Pittsburgh.

"Pittsburgh will work its new 5 k. w. set donated recently by Andrew Carnegie. Arrangements have also been made through this station and others for sending out during the winter Thanksgiving and New Year greetings from the city officials of Davenport to those all over the country."

Full details of the plan will appear in the forthcoming issue of the Association's Monthly Service Bulletin. Meanwhile, members whose stations have not yet been listed as relay points, may communicate with the New York headquarters of the N. A. W. A. or direct with the National Chief of Relay Communications, 508 Best Building, Rock Island, Ill., giving full particulars of equipment and other qualifications.

TALK OF WIRELESS AT TELEGRAPHERS' REUNION

MEN prominent in various walks of life attended the thirty-fifth annual reunion of the Old Time Telegraphers and Historical Association and the fifty-fifth anniversary of the Society of the United States Military Telegraph Corps at the Hotel Astor on September 26th, 27th and 28th. Letters of regret from Andrew Carnegie, president of the Old Time Telegraphers and Historical Association; Theodore N. Vail, Edward Lind Morse, Thomas A. Edison and others were read at the banquet which was held on the evening of September 28th. Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, a vice-president of the Old Time Telegraphers and Historical Association and chairman of the Committee on Banquet, was unable to be present, having sailed for England on September 1st.

John Bottomley, vice-president and secretary and treasurer of the Marconi Company, was among the speakers at the banquet, at which Melville E. Stone acted as toastmaster. Mr. Bottomley related the early history of wireless and called attention to the fact that Great Britain had recently passed a law requiring every vessel of 3,000 tons burden or over to carry a full radio equipment.

"It is estimated that in Great Britain alone nearly 2,000 ships not now equipped will in future carry wireless installations," said Mr. Bottomley. "Similar laws, or, at any rate, regulations, have been passed in Italy, and, it is believed, will be passed by all other nations."

In regard to modern developments in wireless, Mr. Bottomley said: "High-power stations have been erected in America, England, Italy, and Germany, and daily communication is had between San Francisco and Hawaii, Nova Scotia and England, New York and Germany; in fact, the wireless system has been the only one open for communication with the German Empire since very shortly after the outbreak of the present war.

"In addition to the communications above mentioned, which are being actually carried on today, tests are being made between the Marconi station near Honolulu, Hawaii, and the Japanese Government station at Funabashi, near Tokio. Test signals have been heard and messages passed between them, but, at the present moment, the stations are not yet ready for commercial business. In the immediate future, however, the United States will undoubtedly be linked up with the Orient by means of the Marconi wireless.

"Reference might also be made to the high-power stations which have been recently erected by the Marconi Company at Belmar and New Brunswick, these being duplex sending and receiving stations for the purpose of communicating with England, and also the high-power stations at Chatham and Marion, Mass., which have been erected for the purpose of communicating with Norway. These stations were ready for business at the opening of the great war, but as the corresponding foreign stations have been kept in use by the respective governments, no actual business has yet been accomplished. Extensive tests are now in progress, and as a result I may safely say that as soon as matters quiet down on the other side, communication both with England and Norway will be opened up with the general public in the regular commercial way."

David Homer Bates, who as a telegrapher sat at the side of Abraham Lincoln to receive the news of the battle of Bull Run, referred to wireless in his address delivered on the first day of the reunion.

"What is the meaning of our reunion?" he said. "Is it not that we may renew old friendships of our early days, make new ones, recount the marvelous achievements of the telegraph and its blood sister, the Marconi wireless, and its first cousin, the telephone, and get a new grip on life?"

Those attending the reunion journeyed to the Edison laboratory at West Orange, N. J., on September 27th, where Mr. Edison addressed them by telegraph.

Lee Lemon, superintendent of the Trans-Oceanic Division of the Marconi Wireless Telegraph Company of America, and William E. Vansize, patent attorney of the company, attended events incidental to the reunion.

Court Awards Vacuum Valve Decision to Marconi

Controversy Over Fleming Valve and de Forest Audion Decided by Judge Mayer and de Forest Declared an Infringer

THE contention of the Marconi Wireless Telegraph Company of America that the deForest Radio Telephone and Telegraph Company had infringed its rights to the sole use and ownership of the patent covering the Fleming detector was sustained on September 20 in an opinion written by Judge Julius M. Mayer of the Federal District Court, of New York.

Judge Mayer's opinion made clear at the outset the court's conception of theory versus fact.

"Whatever differences may exist between men of science," it read, "in respect of the theories by which they account for the movement and action of the unseen forces about which so much has been testified and argued in this case, the solution of the points of the controversy with a single exception is not difficult. This, because courts, in an art of this kind, place their decisions upon things demonstrable and cannot speculate as to theories in regard to which there is not a common agreement among recognized authorities."

It then pointed out that in endeavoring to resist the Marconi attack, the deForest interests had proceeded on the theory that beginning with his parent patent No. 979275 antedating Fleming, deForest gradually developed his conception until finally it found practical exemplification in the two so-called three electrode "Audion" devices as to which plaintiff had confessed judgment. "In line with this plan of defense," notes the opinion, "defendants have elaborately built up an unsteady theoretical structure and upon this have superimposed an observatory from which they can see in the mind's eye only that which they call 'Audion' action."

The Judge then considered the vacuum valves as detectors, and the various forms of receiving devices which preceded them. "As the practical radio art developed, there was a constant effort to improve the detector in three directions; first and most important, in sensitiveness to received signals; secondly, in reliability, and thirdly, in ease of manipulation by the receiving operator.

"There were many types of detectors prior to Fleming, the most useful of which were known as the coherer, the microphone, the magnetic, the electrolytic and the crystal.

"Some detectors, such as that of Hertz and the hot wire barreter of Fessenden, were never of any commercial utility and may be disregarded.

"The crystal detector, particularly because of ruggedness of material, is still in extensive use but, as is generally accepted and was fully demonstrated in the court room, it is somewhat unsatisfactory by the reason of the necessity of taking time to feel around, as it were, sometimes for a sensitive point and sometimes for the best point on the crystal and the liability that such a point may be destroyed or its sensitiveness impaired by a strong incoming signal, by static or by the local sending station.

Fleming Used Incandescent Lamp First

"These criticisms or defects of one kind or another in the detectors prior to Fleming—or since, for that matter—will be fully appreciated when it is realized that efficiency in this art consists in attaining accuracy and quickness in reception of signals as well as distance, whether the radio message is across the ocean from one merchant to another, from a vessel in distress calling for help from land or sea, or from a naval officer to the ships under his command.

"With the state of the art as briefly outlined, *supra,* John Ambrose Fleming disclosed the incandescent lamp detector. While the United States patent application was filed April 19, 1905, the effective date is that of the British specification filed November 16, 1904.

"Fleming is a British scientist of the highest standing and, as appears from his patent and his papers read before learned societies, is and long has been recognized as a man of major accomplishments with the ability to make clear what he intends to convey.

"Stripped of technical phraseology, what Fleming did was to take the well known Edison hot and cold electrode incandescent electric lamp and use it for a detector of radio signals. No one had disclosed nor even intimated the possibility of this use of a device then long known in another art. Cohering filings, magnets, electrolytes and sensitive crystals, *at that time,* failed to give any hint of the utility in this art of the Edison lamp."

Clearly a Valuable Invention

The opinion then discusses the theoretical considerations which led to Fleming's conclusions respecting the invention's utility as a detector, summarizing as follows:

"Whether right or wrong in his theory, the result of Fleming's invention was to give the art a new valuable and easily obtainable detector, which has gone into important commercial use. This Fleming detector is highly sensitive, quickly adjusted by an operator of even inferior skill and only momentarily disturbed by static or strong signals. The thoroughness and earnestness of this litigation is its most significant testimonial. Nothing in the prior art urged by defendants in negation of invention calls for extended discussion. The Tesla patent (No. 645,-576) and the Fessenden patents (Nos. 706,742; 706,743 and 706,744) were far removed from the incandescent lamp and were commercially useless; and, nothing could be learned for this purpose from the Valbreuze and Zehnder tubes.

"Rectifiers of low frequency oscillations, such as those of Wehnelt and Cooper-Hewitt, taught nothing. These are rectifiers for commercial power frequencies and it was not common knowledge, as of Fleming's date, that rectifiers of low frequency oscillations would rectify radio waves nor is it a fact that all rectifiers of low frequencies are likewise rectifiers of radio high frequencies.

"In the absence of a well accepted theory of operation which needed merely some physical embodiment and, in the absence also in the art of the physical device itself, at a time when men of great skill were constantly endeavoring to bring forth an advance in this branch of the art, the contribution of Fleming was clearly invention and is entitled to liberal interpretation and consideration—unless impeded by deForest."

In relation to the application for the parent patent of deForest No. 979,275, of November 4, 1904, it was decided by Judge Mayer that "nowhere is there a suggestion of an incandescent electrode. On the contrary, in the specification and the drawings it is entirely apparent that deForest pointed out only what the layman understands as heating gas." A review of the claim made is followed by this conclusion: "Translated into plain English, this meant, "I will try to make the gas conductive between two electrodes by heating it to the dissociating point."

"It was attempted to read incandescence into the specification or rather to infer much that later knowledge has taught, but incandescence had long been a word of art and Fleming had no trouble in using it either in his specification or his Royal Society paper. Why not deForest? Merely because the incandescent lamp detector was the farthest from his thoughts."

Entitled To Use Local Battery

In considering what Judge Mayer termed, "the only substantial question in the case—the infringement claimed against defendants," the opinion cites the claims of the Fleming patent: a broad claim for the incandescent lamp as a radio detector and another covering its application to a radio system; *i. e.,* a local circuit containing means for detecting a continuous (direct) current such as a telephone or galvanometer and means of impressing high frequency oscillations on the detector, such as the secondary of the oscillation transformer.

"Fleming's theory, as has already been stated, was that of rectification," the decision notes, "while defendants account for the action of their 'Audion' on the theory that it is a telephone relay or, in other words, that its products are alternating currents of 'Audio' frequency and of the local energy and not of the 'input' energy.

"As a result of these differences, the effect and relation of the local battery was one of the sharply contested points in controversy.

"It was satisfactorily proved that for some reason not yet understood, incandescent lamps possess idiosyncrasies of operation, as demonstrated by a batch of a dozen lamps of identical dimensions made of identical stock, pumped at the same time for a vacuum and sealed at the same time.

"Of these, some worked best at the negative end; *i. e.*, without a battery, some with a small amount of battery, some with a battery equal to the battery for lighting the filament and some with a battery in addition to that used for lighting the filament.

"While, with care and time, lamps could be selected which would work best without a local battery, such a course would obviously be foolish commercially and unnecessary, when a simple and well known means could be employed to utilize all the lamps, whatever their idiosyncrasies. This means was a local battery, and a potentiometer, whereby a varying local potential may be applied to the lamps. The potentiometer is a resistance connected across the lighting battery of the detector so that any fraction of the lighting battery may be tapped off and applied to the local circuit. The local battery is used to bring the lamp detector to the sensitive point of its characteristic curve and the potentiometer is the simple and effective device which, varying the local battery, accomplishes this task.

"Nearly all prior art detectors were used in this way—the coherer of Marconi and Lodge; the microphone of Hughes and Branley; the electrolytic of Fessenden, Vreeland and others and the crystal of Bose.

"The use of the local battery to locate the sensitive point on the characteristic curve, was well known and accepted as of Fleming's time and, as appears by his 1905 lecture, was fully understood by him.

"Plaintiff is undoubtedly entitled to use the Fleming detector with a well known instrumentality and, therefore, to employ the variable local battery; for practically all the prior art detectors required local batteries to locate the operating points. Plaintiff is likewise entitled to use the Fleming device in the ordinary detector circuits of the prior art. The circuits of the Marconi patent No. 627,650 are the specific circuits which plaintiff has used and the modern operative Fleming device has simply been substituted for the coherer in old and familiar circuits."

De Forest Experiments Followed Fleming Articles

Several pages in the opinion are devoted to comparison of the P. N. Type Audion deForest Detector with the Fleming valve detector and it is noted that both sides agreed the deForest two-element and three-element bulbs operate on the same principle. It is also, in Judge Mayer's opinion, "established with reasonable certainty" that the deForest device, in order to operate, must have a heated electrode connected to the negative terminal of the local battery. Reviewing the theory that the local battery changes the mode of operation of the incandescent lamp from rectifier to relay, Judge Mayer observed that in many experiments and much testimony it had not been satisfactorily demonstrated. The opinion continues:

"In order to reconcile the explanation of the action of the deForest grid detector with the language of deForest's earlier patents so as to work out the idea that deForest's two and three electrode detectors were simply the logical development of an original thought, Pickard advanced the theory that the action of the deForest grid was by ionization by impact and, therefore, that it was necessary to have a local battery to impel electrons at a high speed on their journey of succeeding collisions.

"But this theory is shattered or at least impaired by the tests which showed that when ionization by impact occurred the detector showed a blue glow and stopped operation. If anything was shown in this regard it was rather, as plaintiff contends, that the device operates in spite of and not because of ionization by impact."

In awarding the decision to the Marconi Company the opinion observes:

"Within the limits of an opinion it is, of course, impossible to analyze at length a mass of experiments, tests and theses and an infinity of detail necessarily involved in the testimony of experts in an art of this kind; but * * * * * * the physical facts all support plaintiff's claims.

"Here, as is so often the case in law suits, resort is had to the story of events and the outcroppings of human nature.

"DeForest had long been proceeding on a theory different from that of Fleming. Having read Fleming's article, he began to experiment with the incandescent lamp. He probably doubted its efficacy at first but within a very short space of time—perhaps a week, perhaps a month—he changed his mind and, discovering that Fleming was right, wrote his solicitor, after he had filed his application for No. 824,637 that the 'new receiver is the best yet.' Thereafter, he used the language of the incandescent lamp and in an address on October 20, 1906, before the American Institute of Electrical Engineers, really described fundamentally the Fleming lamp detector although using phraseology which has since become Audion vocabulary. Thus, the physical ocular fact is that in the alleged infringing P. N. device, the Fleming detector and not the Bunsen burner is used and the broad Claim No. 1 of the Fleming patent is infringed, precisely the same as if a patented crystal has been placed in some old or new type of circuit with a local battery—such, for instance, as the Weagant and Armstrong circuits."

Many Sets Ordered from American Marconi Co.

THE rapidly increasing importance of wireless telegraphy in war time is illustrated in the announcement made recently by the Marconi Wireless Telegraph Company of America that an order had been received from the English Marconi Company, asking for urgent delivery of 250 wireless sets of the cargo vessel type. These equipments are of American design and similar to those recently ordered from the American Marconi Company by Belgium and Italy.

It is announced also that the United States Navy has just ordered two direction finders for installation on the U. S. S. Pennsylvania and the U. S. S. Birmingham. This apparatus is used as a wireless compass in determining the direction and latitude and longitude of wireless stations, also as detector of the approach of vessels in fog. A high-power wireless telegraph set has also been ordered by the Navy for a shore station, and four special type receiving sets are under construction, together with twenty-nine transformers for high-power equipments.

Additional wireless telegraph equipment required under the new Navy program includes seventy-five aeroplane sets and ninety small powered equipments. Orders will soon be placed, it is understood, for 126 receiving sets for long and short distance work and forty additional sending and receiving equipments of varying ranges.

The United States Signal Corps has given the Marconi Company orders to assemble at its factory ten 2 k. w. radio tractor equipments. The tractors will include complete sending, receiving, aerial and counterpoise devices.

An order has also been received from the Italian Marconi Company calling for delivery of fifty sets of ¼ k. w. power.

The Raid of the U-53

Quick Response to Wireless Appeals of Six Ships Sunk by German Submarine off the New England Coast

WIRELESS telegraphy, conveying a message that the German submarine raider U-53 had sunk six steamships off the New England coast on October 9, brought the first news that underseas craft warfare had been brought to the shores of the United States. It was wireless also that started a flotilla of United States destroyers and the American-Hawaiian liner Kansan steaming full speed to the rescue of the passengers and seamen of the vessels torpedoed by the submarine. All of the 216 passengers and seamen on the sunken vessels were saved.

The U-53, after a short stay at Newport, left on October 7, having accomplished her ostensible mission of delivering a letter for Ambassador von Bernstorff. The first intimation that her visit to American waters was not entirely a peaceful one was contained in a wireless message from Captain Smith of the Kansan, asking why a German submarine had halted him on October 8 near the Nantucket Shoals lightship. Captain Smith, after stating his nationality, had been permitted to continue his voyage.

Then came other wireless messages telling of the attack on the British freighter West Point, the British freighter Strathdene, the Norwegian freighter Christian Knudsen, the British passenger liner Stephano, the Dutch freighter Bloomersdijk, and the British freighter Kingston. Following these messages, seventeen destroyers set out from Newport to the rescue. The Jarvis was the first boat to get away and the others followed. These were the Drayton, the Ericsson, the O'Brien, the Benham, the Cassin, the McCall, the Balch, the Porter, the Fanning, the Paulding, the Windlow, the Aylwin, the Cushing, the Cummings, the Conyngham and the Melville. Soon after the destroyers had left the bay a wireless came from the Nantucket Shoal Lightship saying that twenty of the crew from the Strathdean had been taken on board the lightship. Admiral Gleaves, who was keeping in touch with the fleet by wireless from the radio room of the flagship, directed the destroyer nearest the lightship to take those rescued on board and transfer them to the Melville. While the work of rescue was proceeding a series of messages from the commanders of the destroyers was received. In them was contained every incident and every bit of information that the commanders could obtain.

The first call sent by Oscar B. Hanson, Marconi operator on the liner Stephano, which was steaming from Newfoundland ports to New York, read as follows:

"S O S. Am being torpedoed. American passengers."

One of the destroyers flashed the following in reply:

"We are coming to your assistance."

Hanson said that he had received a wireless message previous to the torpedoeing of the Stephano, saying that the West Point had been attacked by a submarine. The Stephano's officers paid little attention to the message as the liner was steaming away from the position named as the scene of the disaster. Then another wireless was received, this message having been relayed from the West Point itself. Afterward came word from the Kansan to the effect that she intended to change her course and go to the aid of the West Point. Later, Hanson said, the Kansan was sighted by the Stephano and the latter was again asked if she were going to the aid of the West Point. A short time afterward the Stephano was attacked.

Marconi Operator Arthur Gray of the Christian Knudsen, in describing his experience to a correspondent in Newport, said:

"We heard the sound of firing some time before the submarine hove in sight,

(*Continued on page 97*)

DEATH OF GENERAL ZABRISKIE

Brigadier General Andrew C. Zabriskie, commanding the Junior American Guard, with which the National Amateur Wireless Association is affiliated in military signal corps work, died on September 15 at his country home, Blithewood, at Barrytown-on-Hudson. At the funeral services held in New York, the escort of honor was composed of members of the Junior American Guard, the 71st Regiment, N. G. N. Y., and the Veteran Corps of Artillery. The escort accompanied the funeral cortege to the grave at Woodlawn Cemetery and closed the services with a salute from the firing squad and the blowing of "Taps" from the bugle.

Among the officers accompanying the escort of honor were Major F. L. V. Hoppin, Adjutant General, First Brigade New York Militia; Major William H. Elliott, Adjutant General, Junior American Guard, and Major J. Andrew White, Chief Signal Officer.

General Zabriskie was born in New York City sixty-four years ago, and was a son of the late Christian A. Zabriskie and Mrs. Sarah J. Titus Zabriskie. He was a member of one of this country's oldest families, being a descendant of Albrecht Zaborowsky, who landed from the ship Fox in 1662. He was educated in private schools and was graduated from the School of Mines, Columbia University. He became a member of the Seventh Regiment, N. Y. N. G., in 1873. Afterward he served as inspector of rifle practice for the Seventy-first in which he was captain of Co. C. He resigned from the regiment in 1897. He took considerable interest in politics in Dutchess County, being a member of the Democratic State Executive Committee and chairman of the Dutchess County Board of Supervisors.

Mr. Zabriskie was well known in charitable work and was vice-president of the Hospital and House of Rest for Consumptives, a trustee of the Sheltering Arms and of the Parochial Fund of the Protestant Episcopal Church and president of the Board of Trustees of the Church of St. John the Evangelist, at Barrytown-on-Hudson. He was one of New York City's largest real estate owners, spending much of his time at his offices at No. 52 Beaver street, caring for his estate. He was a director of the Poughkeepsie Trust and the Bonner Brick Companies. For ten years he was president of the American Numismatic and Archæological Society. He was a member of the Union, Metropolitan, Army and Navy and other clubs.

Brig.-Gen. Andrew C. Zabriskie

CLUB GIVES LAWN FÊTE

The Mahoning Valley Radio League, Niles, Ohio, gave a lawn fête on August 5 for the purpose of raising funds for the purchase of instruments. A complete sending and receiving set was in operation and an undamped receptor of the "beat" circuit was also employed.

The Phantom Call

A Fiction Story

By Magda Leigh

IF you have never come into the fog off the California coast you don't know what fog is! Man, you can reach out and get solid handfuls of it! Well—almost!

And the s. s. Amador had had three steady days of it. Lord, but we were a restless lot! and we hugged the haze-filled warmth of the smoking-room and the cheer of its clinking glasses. If it hadn't been for the Purser, with his never-failing stock of yarns, I don't know what would have become of us.

But now, the Purser was busy. We were nearing the Golden Gate, and he had his manifests and other papers to get into shape. When we had tired of cards and the eternal war arguments, we found ourselves sadly missing our entertaining companion.

It just happened that I looked up in time to catch a peculiar little twinkle in the eyes of the ship's doctor—a dark, silent man, named Brooks, who invariably sat with us, listening to our chatter from his special corner of the settee, but saying little, if anything.

"If it's funny, for the love of heaven, tell it to us, Doctor!" I burst out. The eternal fog-whistle was beginning to wear on my nerves.

The ship's doctor looked over at me, mildly surprised, his brown eyes, however, still twinkling.

"If *what's* funny?" he asked, quietly.

"Whatever you're thinking of, that makes you laugh with your eyes!" I snapped in reply.

"I was thinking of humanity." He paused. Then he added, quizzically: "And as for that, I don't know that there's anything funnier than humanity—certainly there's nothing more interesting!"

We looked at him, speculatively. "In your business, you must have an almighty good chance to study it!" Van Norden exclaimed.

"Ha!" The brown eyes snapped. "Every case I have is a human document. And out here, at sea, I find my cases so much more interesting," he continued, thoughtfully. "There seems to be something, out here, that plays Merry Ned with most people's characters. The sea *humanizes* people. It makes 'em unfold, blossom, branch out. Where I, perhaps, touch only lightly on the personal end of a case, ashore, out here I have the full document from cover to cover, with preface, illustrations and appendices thrown in!"

"Good heavens!" Van Norden stared. "Do you mean to say you are an enthusiast over seafaring life?"

"Why not?" the Doctor smiled amiably. "I care for nothing so much as studying the human in the raw—and that's how I get him, out here!"

"How delightful!" Greene murmured, appreciatively. "We've heard the Skipper calling this a 'dog's life'; we've listened to the Chief's lament about the amount of coal this 'old hooker' consumes; we've condoled with the Mate because he swears he can't keep his paint clean, what with kids with pencils and men with penknives; and we've even sat up nights with Sparks, and helped him cuss static! At last," he grinned at us, "we meet that rare bird—a seafaring man who likes seafaring!"

We all laughed and turned to the doctor. There was, however, no answering smile. He was, for the moment serious.

"Static!" he murmured. "It's a queer, uncanny thing—static!" His voice dropped, as if he were talking to himself. "It's what finished young DeWitte—static that smashed his conscience with its phantom call. That was a human document worth reading!"

And then, to our utter amazement, he squared away and spun us the yarn.

Before I came over to this coast, I was on one of the big fruit steamers out of New York to Santa Marta—the s. s. Seramalac, a white beauty of a ship, known along South street as the "Rose of the Fleet."

I had been on her only two trips when the events of which I shall tell you occurred.

I don't mingle much with the crew, as a rule, and never know much about it unless something special is called to my attention. Sometimes, though, one is unable to keep clear of gossip, and it was on my first trip that I heard various snatches of the ship's talk about Philip DeWitte, our senior wireless man.

DeWitte interested me, as soon as ever I first saw him. I took to spending a goodish bit of time with him, up in his lofty wireless quarters. One could run up, unobserved, and spend many quiet, uninterrupted moments, smoking and listening to the big, singing spark. It was a good spot for man-sized talk.

DeWitte was almost as new to the ship as I was. He had made only one trip previous to my arrival. But most of the officers knew him, as he had been junior operator at the big Santa Marta wireless station, for three years, and used to come over aboard ship, when she was in port, to pilfer the latest magazines and newspapers.

You know, every ship is a little village unto itself. And it has its village gossip. There being so many men in the crew—and only one or two women—why, the lord have mercy upon the souls of all stewardesses!

The Seramalac carried two stewardesses: Mrs. Dunphy, a dear old soul who had been with the company since the year Noah launched his ark; and a little, slender, dark-eyed beauty known as —well, we'll call her "Miss Chase."

Any port steward who ships a woman as pretty as Aileen Chase ought to be sacked for incompetency—or locked up for madness!

Aileen Chase had joined the Seramalac a trip before DeWitte. They tell me there was hysteria among the crew that trip—every man-jack falling over himself to make friends with the Little Stewardess. And she would have none of their friendliness. A curt "Good morning!" was the extent of her cordiality.

But when DeWitte joined the Seramalac it was different. DeWitte had evidently known Miss Chase before, and they were seen talking together, many a time, serious of face and tone. Of course, tongues began to wag. But neither Miss Chase nor DeWitte paid the slightest attention to this. They went about their duties, quietly and unobtrusively.

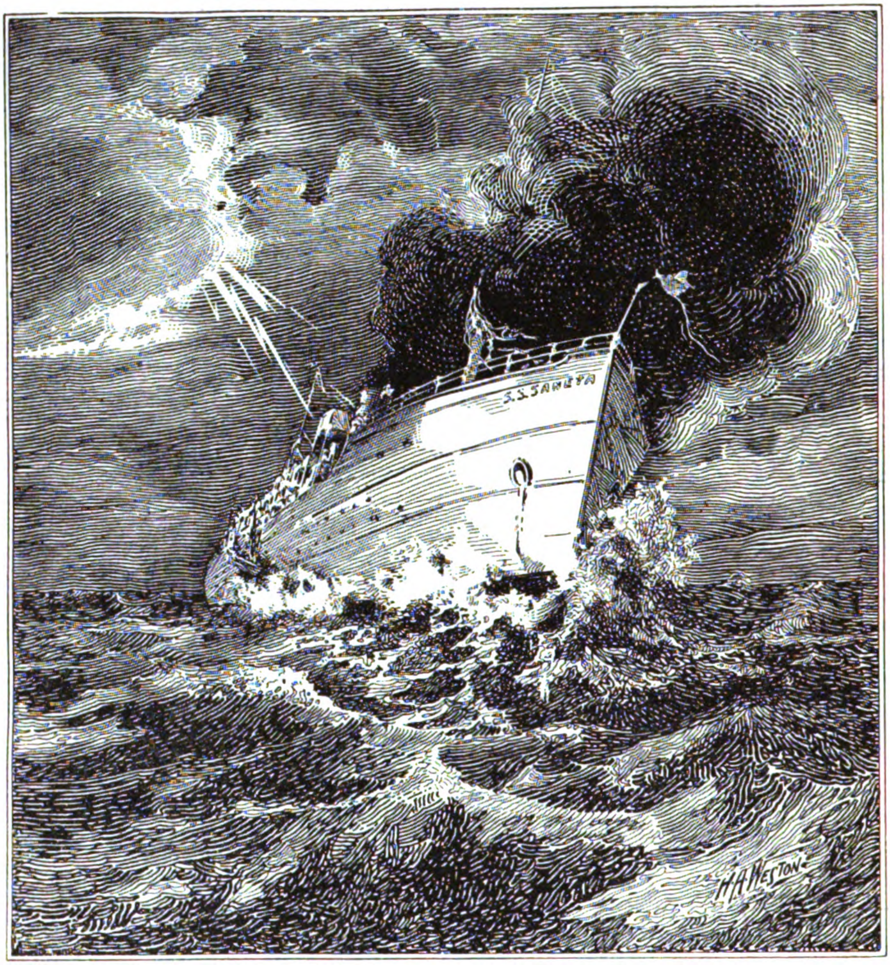
The trip I joined the Seramalac was a bad 'un! It was hurricane season, however, so this was not unexpected.

We hadn't been more than a day out, when gossip began to reach me about DeWitte and his former senior at Santa Marta, Bob Wilkins. Wilkins, it seemed, was now on the s. s. Saneta, one of the 5,000-ton ships belonging to our company, running out of New Orleans. No one knew why the Santa Marta station had changed operators, but gossip had it that DeWitte and—oh, the usual, eternal triangle business! Anyway, there was little friendship left between the two men, and the New York office had been wise enough to put them on different runs.

The Seramalac touched at Jamaica, Panama, Cartagena, Puerto Columbia and Santa Marta—returning over the same route. It was a fine trip of about twenty-two days. The Saneta called at Panama, too, so that once in a while the two ships stood a chance of meeting in port, though that happened but once in a blue moon. They were in wireless communication a good deal, though, and down in the Caribbean, where their courses finally converged, they were even within sight of each other at times.

We had unusually fine weather, I remember, that first trip, until we were well into the Caribbean. And then the big sparks from our stations at Swan Island, Cape San Antonio, Bocas del Toro, Limon and Santa Marta snapped out a circle of warnings. There was a hurricane chasing its tail around 'way down in the direction of Colon, and we were heading for it. Then Saneta, northbound, was heading for it, too.

As our junior wireless man had had a touch of fever, since we left Kings-



The poor old Sancta had been quite given up. Not a sign of her had been found by any of the many ships sailing over her course. Her name was struck off the list of the company's fleet, and the Hydrographic Bulletin gave notice that her wireless letters, "KDK," had been rescinded ton, DeWitte was standing an extra watch or so. I left the hospital steward (yes, we carried them on the Seramalac) on watch, and made my way up to the Wireless Room from the Dispensary, for a look-see at the Junior, who had refused to go out of his own quarters. His fever was higher than it should have been, so I told DeWitte he'd have the honor of nursing the wireless through the storm.

"We pass the Saneta, soon," he answered, wearily, "and that means extra close attention, in case she has any messages for the Skipper."

I knew I should be needed below, so bade him a good-night, and made my way back to the Dispensary.

Lord! What a night! The Seramalac, with all the strength of her 9,000 tons, fought sea and gale for hours. There isn't any need for me to describe a hurricane to you gentlemen. You've all been through them. They're—well, they're hell let loose!

The women passengers kept a host of us busy, for most of them were hysterical with fear, as well as deathly seasick. Several times during the night I was working with Miss Chase. I noticed a peculiar expression in her eyes—an expression of most dreadful anxiety. I wondered if she were worrying about DeWitte, up in his storm-beaten quarters, or whether she was just plain scared. I'd find her looking over her shoulder toward the port hole of whatever room we were in, with a strangely shrinking manner. I made up my mind she'd have to be talked out of that state, pronto, for those crazy women needed to see faces filled with confidence about them or there would be panic. Hurricanes try the stanchest of souls!

As we were passing along an alley, going from one room to another, I turned to her and said:

"There isn't any cause for fear, Miss Chase. The Seramalac is a staunch ship and has gone through worse gales than this. Think of the Saneta just now—only a little over half as big as the Seramalac!"

And then I stopped, for the woman turned deathly white and clutched my arm, staring into my face with eyes of horror.

"The Saneta—! Is she—is she—in this?"

"Why, yes," I answered, puzzled by her manner. "She's not very far from us, if she's on her course."

Her eyes closed sharply and she swayed. I put my hand out and steadied her. Frankly, I could have shaken her. I suppose we seafaring men become rather brutal toward seafaring women. We think they should have no emotions—they should become mere serving machines.

Miss Chase's next question came with an apparent effort.

"Who is on watch in the wireless room?"

"DeWitte," I answered, shortly. "Craig is ill."

She looked up at me as if she wished to say something, but her lips moved soundlessly. I saw her shake her head slowly, from side to side, and noticed that her shoulders drooped as if I had placed a too-heavy burden upon them.

But we were needed, and I took her firmly by the arm and guided her to the room where one of our patients lay suffering.

When we had made the rounds, once, I turned to the Little Stewardess and spoke sharply.

"This is an all-night job for us. You've got to brace up or you'll cave in. Now, I want you to come to the Dispensary and get something. Your nerves are not in shape for this kind of a night, at all."

She followed me meekly enough, the two of us staggering and stumbling to the rolling and pitching of the big, storm-driven ship.

It was morning before I could get a chance to run up and see Craig again, and I wondered how DeWitte had stood the dreadful siege of an all-night watch, in that weather.

I entered the wireless room and then came to an abrupt pause. I had expected to find DeWitte badly used up, but I had not expected to find him like he was. The man was a ghost. His face was white and drawn hideously, and his hands, fumbling with the key, were trembling like a drunkard's.

"Here, man!" I said quickly. "You're all in! This is a deuce of a mess you're in! Can't you quit now and turn in for a spell?"

He looked at me out of dull eyes. "I'm trying to raise the Saneta," he answered, and his voice was like a drunkard's, too.

"But I'll report to the Skipper that you're not in condition to work any more. His messages can wait."

DeWitte's eyes closed, wearily. "You don't understand," he answered. "I can't raise her. She—she hasn't replied. I've been sending and sending her call letters —KDK—KDK! She doesn't answer!"

Perhaps I was just tired myself, with the night's strain. Or perhaps I am naturally slow. It took me several minutes to grasp what DeWitte meant. Then I shook him by the shoulder.

"You mean——"

He sprang up from his chair with such a wild look in his eyes that he startled me. "I tell you, they don't answer!" he said, hoarsely. Then he sank down again, burying his face against his arms, and I heard him sob: "Oh, God!"

It wasn't altogether shipshape for me to do, but I went and found the Old Man. I reported to him that DeWitte had gone as far as he could, without a rest. He'd either turn in—or break down. But the Skipper was in a great state over the Saneta, and couldn't see how DeWitte could be spared, unless Craig could stand his watch. This was out of the question, and I told the Skipper so, in a few words. His answer was brief. DeWitte must keep on trying to raise the Saneta. She must be heard from. She was within easy radio-communication at the beginning of the hurricane—she should answer—she must answer.

I took DeWitte a good stiff drink with my own hands, and stood over him while he gulped it down. And then I left him, sending his eternal call of "KDK! KDK!"

At noon, that day, I learned from one of our officers that all the shore stations were calling the Saneta, but that there was no answer. We had passed the position where we should have met the other ship, and by wireless orders from the offices in New York, we steamed around in a radius of some ten miles. There was no sign of the Saneta. And then, because we had passengers, perishable cargo, and other reasons for haste, we gave up the search and made for Limon.

Fortunately, at Limon, another of our Company's ships was in port. We borrowed one of her wireless men in exchange for Craig, so the latter could be taken back north as speedily as possible. We needed someone on the Seramalac to relieve DeWitte. The man was a wreck. To tell the truth, I was afraid he was going off his chump. His eyes had a wild look in them, and he wouldn't go below for his meals. Insisted upon staying in the wireless room, where he would watch the new junior, Shaw, in his every move. Once when I was up there talking to him on the way home, Shaw, listening in, shoved one side of his phones up, so he could hear our conversation. This is a little, amazing trick of wireless men: listening to the human voice with one ear, and to a wireless voice with the other. Suddenly, Shaw turned and jammed the receivers close over his ears, and DeWitte sprang to his side, asking in a choked voice:

"Who is it, Shaw? Who is it?" shaking the other, as he did not at once answer.

And it struck me, as I watched him, that we were just in the position where we had been, the night of the hurricane, when he must have been listening in for the Saneta.

Until we passed north of the Greater Antilles and were well on our way toward New York, DeWitte acted like this. That he had been profoundly affected by the loss of the Saneta—and lost she was, for there was never a sign of her, no, not even a bit of wreckage!—was not to be wondered at. After all, he and Wilkins might have had a tiff, but they had been pals, inseparable partners down in the big station at Santa Marta for three long years. And the crew of the Seramalac, to a man, took pains not to mention the lost ship before DeWitte. His feelings were too deep.

But if a change had come over DeWitte, what shall I say of Aileen Chase? The day after the hurricane, I had been sent for in a rush to see the Little Stewardess. She had fainted away at the lunch table and lay unconscious in her bunk, where the Chief Steward had had her carried.

"She went smash on the table!" Mrs. Dunphy told me, in a flurry, as I worked over the ghastly woman. "We were talking about the storm, and the Steward was telling us about the Saneta being lost or whatever's become of her, when Miss Chase just gave a queer little sort of choke and fell forward on the table."

I made no answer. I was too busy, both mentally and physically. As I said before, I may be slow in getting things through my head, but it didn't take me so very long to recall the look on Miss Chase's face, the night before, when she asked if the Saneta were out there in the storm. What was there in this woman's interest in the Saneta?

When I saw that she was regaining consciousness, I found an excuse to send Mrs. Dunphy on an errand to the Dispensary. I wished to be alone with Miss Chase for a moment.

As she opened her eyes, she started weakly upright, with a low cry of fear —or horror—or anguish.

"Lie still," I commanded. "You are not to move, yet."

Recognition came into her eyes, as she looked up at me, and she clutched my arm tightly.

"The Saneta?" she gasped. "Have they heard from her, yet?"

"No," I answered, quietly, watching her face. "DeWitte has been calling all morning. But she doesn't answer."

And then, in the same tone DeWitte had used, she moaned: "Oh, God!"

I determined to solve what was now a riddle to me, and so spoke, as gently as I could, to the white-lipped woman.

"Had you friends on the Saneta?" I asked. "You were anxious about her, last night, I remember. Is there someone on her that you know?"

Miss Chase started up at me, wide-eyed, and I saw that her breast was heaving.

"No!" she answered, and I thought the one word strangely fierce. "No—I had no friends on her!"

And then she lay quiet and white, letting me chafe her cold hands.

Lord, that trip north! It was a horror! Between Miss Chase and DeWitte, I thought I might as well start a private insane asylum as soon as we reached port! A happy pair to doctor! I should have loathed it, had there not been enough psychology beneath it all to stimulate my interest. There was a mystery, somewhere, that I meant to fathom.

When we again sailed from New York, the poor old Saneta had been quite given up. Not a sign of her had been found by any of the many ships sailing over her course. That she had been lost in the hurricane was beyond a doubt. Her name was struck off the list of the company's fleet, and the Hydrographic Bulletin gave notice that her wireless letters, "KDK," had been rescinded.

Among other things connected with Miss Chase and DeWitte, I noticed a decided change in their manner toward each other, upon our next voyage. DeWitte did not seek out the pretty stewardess, as he had formerly, and her bearing toward him was one which simply whetted my curiosity about her. She would stand and stare at him whenever they were near each other, and there was a peculiar questioning in her eyes. Once I ran into them, in a secluded corner of the promenade deck, and was in time to see her little hands clench at her sides and her eyes look into his with an expression of anguish.

Things went more or less smoothly, however, until we left Kingston and started south for Limon. Then DeWitte began to act strangely. Restive? Good Lord! That man was never still! I don't know when he sat down—when he slept —when he stopped moving from one place to another—but never far from the wireless room. Sometimes he'd stand and look out toward the horizon, sweeping the sea through a pair of glasses, as if seeking, seeking, seeking something he could never find. There was something on DeWitte's mind—something heavy—and I realized that if he didn't get rid of it, *wikiwiki*, there'd be a mental smash.

We were nearing that same latitude in which the Saneta had been lost, when Shaw came to me and drew me into conversation. He began rather awkwardly, and I could see with half an eye that he'd something he wished to ask, so I led him on. Finally, he blurted it out.

"Say, Doc, is DeWitte quite right? Isn't there something loose in his upper story?"

I spoke slowly and carefully, weighing each word.

"That's a funny one," I said. "Why should he be anything but quite right?"

The junior operator shot a resentful glance at me.

"If you had to work with him, you wouldn't ask!" he snorted. "He says the darndest things every once in a while."

"What, for instance?"

"Oh, he's always bothering me about listening in. Says if he ever finds me asleep on watch, he'll brain me. As if I didn't know my duty as well as he does! And he keeps saying: 'If you ever hear a ship calling S O S, let me know, old man. Never let a ship call S O S without my knowing.' I guess I am as capable of answering a distress signal as he is!" And then Shaw paused and looked searchingly at me. "Sometimes," he said, slowly, "I wonder if old DeWitte was asleep, the night of that hurricane, and if the Saneta's S O S didn't pass him by!"

I looked right back into Shaw's eyes, I can tell you, and didn't speak in a very friendly tone.

"I wouldn't wonder any such thing as that to anyone else, if I were you, Sparks," I answered. "In the first place, no man could have slept through that hurricane. It was—a hellion. In the second place, how do you know the Saneta ever sent a distress signal? It was never picked up."

"I don't. I know no one ever heard it," he replied, sullenly. "But what's wireless for, if not for that?"

"The matter of the Saneta has been given a good deal of serious consideration, young man," was my answer. "And the consensus of opinion is that the ship sunk before a call could be sent."

The next time I saw Shaw was when he walked into the Dispensary and came over to me, white of face.

"You better go up and pay a call on your friend, DeWitte," he said, and his voice was actually shaking.

"What's the matter?" I asked.

"He's got 'em," was the laconic reply. "He insists he hears a ship calling S O S, and then swears she signs off KDK. Those were the call letters of the Saneta, if you remember. They've been rescinded. There aren't any such call letters on any ship, right now."

I studied him a moment. Then I asked: "Have you listened in, as you call it? What do you make it out that DeWitte hears?"

"Static!" was the scornful sniff. "Just pure, unadulterated static. It's fierce. I never heard it so bad, before."

So I climbed up two decks to the wireless room, and entered as nonchalantly as could, under the circumstances.

I confess I was shocked. DeWitte's face was gray; his lips blue. His hand, on the key, shook like a palsied thing.

He turned as he saw me and snatched the phones off his ears. Springing from his seat, he clutched my shoulders and peered into my eyes.

"Doc!" His voice was almost a sob. "Doc! For God's sake, sit down there and listen to that thing! Tell me if I'm crazy—or if that isn't the Saneta calling—calling!"

I patted him soothingly on the shoulder. Gad! He was in a bad way!

"My dear man," I answered gently, "how would I know? I can't understand wireless."

He paused and stared closer at me, for a moment. Then his eyes brightened.

"I can teach you, in just a minute, what her calls letters sound like—that and the S O S. Please, Doc!" He was in such a state that I decided to humor him. So I sat down beside him and, with a little buzzer affair, he taught me the sounds of the dots and dashes that made up the letters "K D K," and "S O S." When I knew them so I could slowly spell them on the buzzer, he attached an extra pair of phones to the wireless set and bade me listen in, with him.

Of course, another person's emotions are bound to influence you to a certain degree. As I sat there, bent forward listening, I was conscious of a sort of subdued excitement in my own mind—a sympathetic response to DeWitte's anxiety.

And by Jove! Just because I was trying so hard to hear these letters I had so laboriously learned, out of that queer, crackling sputtering in my ears, it seemed to me I *did* make them out.

Something in my face must have given me away. I must have nodded my head—or my eyes must have shown some sign of acquiescence. For DeWitte, who had been watching me like an eagle, sprang suddenly from his chair, tore the phones from his ears, and gave a terrible cry.

"I knew it! It's Bob!" he screamed. "It's Bob! He's come back. I knew he would! I knew he'd turn on me, some day, and get me! He knew she was here with me, as stewardess! And when I wouldn't answer his S O S—I knew he'd come back and get me for that! God! God! They'll all hear him, now—they'll all hear him! And he'll tell them that I heard him that night, and wouldn't answer him, because I was mad for Aileen and wanted him out of the way. He'll tell them—he'll tell them—" and then he fell, crashing against the settee, as he went down to the deck.

The doctor paused and looked around at us, soberly.

"Of course, it was only static. His conscience was what had come back and was telling on him. But it didn't matter. DeWitte was dead of heart failure when we got him to the Dispensary."

He paused and lit a cigarette.

Van Norden leaned toward him. "The woman, Doc?" he asked. "What became of her?"

"What could you expect?" the Doctor answered. "That fool, Shaw, had told her about DeWitte's imagining he heard a ship calling, and she (probably suspicious of the truth from the beginning) had stolen up to the boat deck. She was just outside the wireless room door when DeWitte broke down. The Mate found her crouched there, half-fainting, and took her along the deck to a quiet spot where he could calm her."

"But what a strange ending——" Van insisted, as the Doctor paused.

"She became the Mate's wife, after about three months. They both joined the hospital corps in Europe, after the war broke out, and they are today giving their all—somewhere in France."

"But what a strange ending——" Van began.

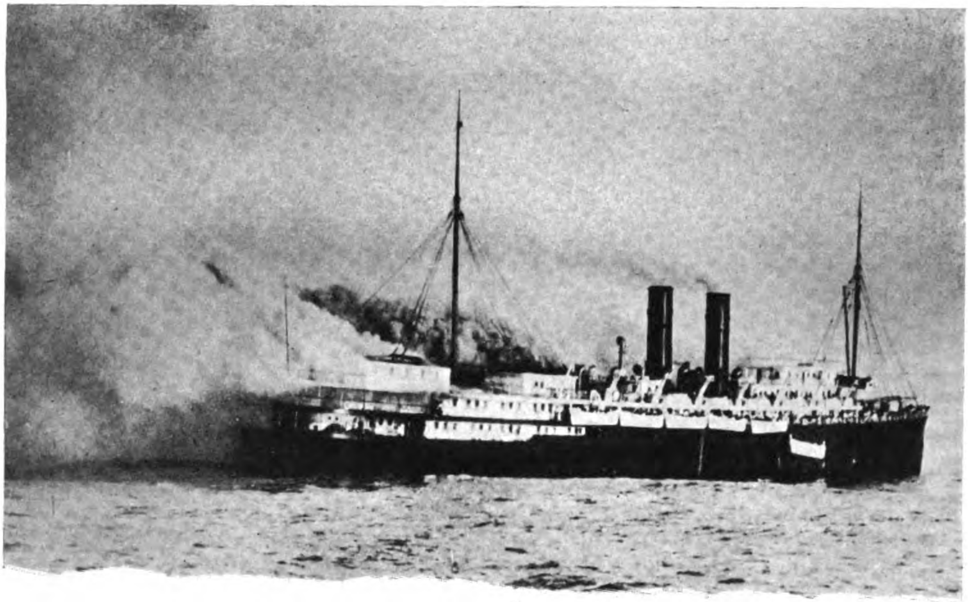
"No!" the Doctor's quiet voice interrupted. "It is quite in order. Aileen Chase felt that she was as guilty as DeWitte, since it was his madness for her that caused him to disregard that call for help. Therefore, when the Mate asked her to be his wife, she agreed only on condition that he should allow her to go to the front and do as much toward saving life, as possible. You see," he added, after a pause, "as I said in the beginning; there's nothing more interesting than—people."

NEW RECORD FOR AEROPLANE TRANSMISSION

A new record for flashing wireless messages from an aeroplane in flight was established by Captain Clarence Culver, of the signal corps aviation school, of the United States army, when he succeeded in keeping in constant communication with San Diego while on a reconnaissance flight to Santa Monica and return, a total one way distance of 114 miles, in an aeroplane.

Captain Culver ascended from the military aerodrome in a Martin Tractor, No. 50, piloted by Sergeant William Ocker. He flew at an even height of a mile and a half, sending messages every three minutes to Lieutenant W. A. Robertson, who handled the receiving instruments of a private station.

Captain Culver's feat was accomplished with a radio set designed by himself. The power for the transmission set is derived from a generator placed on the lower wing section of the aeroplane and driven by a two blade propeller. Aerial wires hung from the fuselage, with an insulated counterpoise hung from the wings to the tail of the aeroplane, complete the set, which weighs less than forty pounds.



The steamship Congress burning off Coos Bay, Ore.

How the Congress' People Escaped the Flames

A Disaster of the Pacific Marked by a Race Against Time and a Severe Test of the Wireless

ANOTHER disaster of the Pacific Coast in which wireless was employed to save human lives has been recorded. This instance of the value of the art occurred when fire was discovered in the hold of the Congress, largest of the Pacific Steamship Company's fleet, off Coos Bay, Ore., on September 14. The situation was full of peril. Land was a considerable distance away, the flames were making headway rapidly and there was no ship in sight to aid the 233 passengers and crew of 175. There was a chance that the vessel might reach shore safely, however. Therefore, Captain Cousins, the commander of the Congress, ordered the prow of the vessel headed for the coast, toward which she sped, while her wireless, in charge of R. H. Brower, first Marconi operator, and C. A. Lindh, his assistant, flashed the S O S broadcast. These appeals were not without result and when the decks of the Congress was scorching, her people choking in the smoke, and she was about to be completely enveloped in flames, rescue ships arrived and saved every one on the doomed craft.

The Congress, bound from San Francisco to Seattle, had reached a point approximately 200 miles north of Eureka, Cal., when the ship's barber saw smoke coming up through the floor of his shop. This was about three o'clock. An investigation was made of the hold under the shop, but the smoke was so dense that it was impossible to locate exactly the source of the fire. In this extremity Captain Cousins turned to the wireless and directed Operator Brower to send out the S O S.

Tests showed, however, that the fire had cut off the power of the main set and Brower employed the auxiliary equipment to flash the appeal. The call was answered by the Marconi station at Eureka. Five minutes afterward the Naval Station at Cape Blanco "came in" and the burning ship's position was given as eight miles off Coos Bay. The message to Cape Blanco produced quick results for at ten minutes to four o'clock that station informed the Congress that tugs and a life saving crew were on their way to the distressed ship. The Marconi station at Marshfield, Ore., then called and reported that the steamers Tilamook and A. M. Simpson were on their way to the assistance of the Congress.

Meanwhile the Congress had been racing toward shore and when two miles off Coos Bay bar her people took to the lifeboats. The dredge Michie—one of the rescue craft—was already on the scene and the vessels dispatched from Marshfield were standing by also. Hardly had the rescued folk left the Congress than she flared up like a torch and the flames spread from stem to stern, marking in spectacular fashion her final end.

THE STRANDING OF THE BAY STATE AND THE SUMMONING OF RESCUE VESSELS

The steamship Bay State, groping her way through a dense fog early in the morning of September 23rd, piled up on the ledges off McKenny's Point, Cape Elizabeth, Me. There was fear for a time regarding the safety of her 250 passengers, for a great hole had been torn in her bottom and the water rushed into the hold in torrents. The force of the collision worked damage to the wireless set, throwing the condenser top off the condenser case, and breaking the tabs off the condenser plates. Marconi Operator A. R. Gardner quickly repaired the equipment, however, and within three minutes after the Bay State had struck he was in communication with the Cape Elizabeth Naval Station. As a result the revenue cutter Ossippe and the tugs Portland, Cumberland and Scandinavia were rushed to the wreck and, aided by the life saving crew of the Two Light Station, rescued those on the stranded ship.

When the revenue cutter and the tugs arrived lines were run from the Portland to the Bay State with the object of hauling the steamship off into the deep water. The hawser parted, however, and the Bay State apparently settled farther on the ledges. Plans were then made to transfer the stranded ship's people to other craft. In order to effect the transfer rope ladders were lowered over the side at the gangways and one by one those aboard the Bay State made their way into small boats and thence to the rescue vessels.

WIRELESS IN SUBMAR NE RAIDS OFF THE NEW ENGLAND COAST

(*Continued from page* 86)

but we had no idea what it all meant. By the time we had discovered that a submarine was operating in our vicinity it was too late to escape. When we came on the scene of action the underseas boat was engaged with the Stephano. While the passengers and crew of the Stephano were disembarking, the U-boat ran alongside the Knudsen and ordered us to steam over nearer the Stephano.

"While the submarine was alongside the Knudsen waiting for the Captain to take his papers aboard one of the United States destroyers came in view. Almost immediately the submarine disappeared beneath the water and remained there until the destroyer came near enough to be recognized as a neutral vessel, when she immediately came to the surface and continued her work.

"We were told to pack up our belongings and leave the ship, which we at once began to do. We had plenty of time to get off while the submarine was disposing of the other vessel. We had rowed some distance away before the submarine fired on the Knudsen."

Odds and Ends for the Amateur Station

By Elmer E. Bucher

THE design of the principal parts of a wireless equipment for a complete amateur station is a matter of common knowledge among radio experimenters, but some mechanical and electrical details frequently undergo neglect or are not well understood. A piece of equipment often misunderstood is the protective condenser.

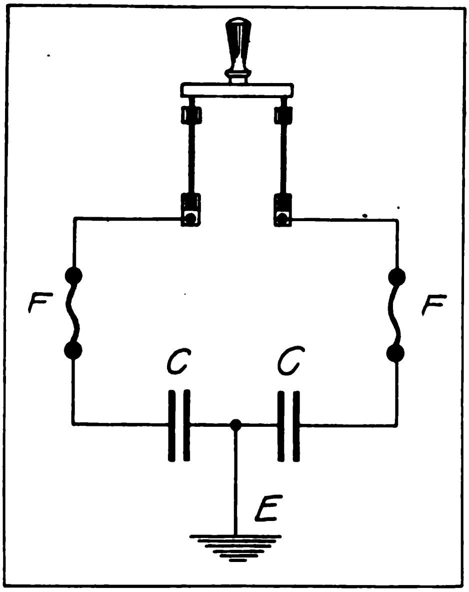


Fig. 1

Protective Devices.—Primarily the protective condenser was intended to protect power circuits, house lighting circuits, the windings of motor-generators, etc., from the induced potentials of a local wireless transmitter, because it is a well known fact that a conductor lying parallel to a transmitting aerial will absorb a certain amount of energy. Hence it is desirable in so far as possible to run low potential power mains at a right angle to the aerial wires, thus reducing the effects to a minimum.

The most effective protective device is that indicated in Figure 1, where two condensers of two microfarads capacity each are connected in series, the terminals being connected to the power mains and the center point connected to earth. Should the condensers by chance be punctured, due to an extra high potential discharge, the power lines would be short-circuited with corresponding effects. Therefore, to prevent disaster to the circuits, the fuses F, F, of 1 ampere capacity are connected in series.

A second method for protection of circuits is the use of a carbon or graphite rod having a value of 1,000 to 10,000 ohms. These rods are shunted across the power circuits and connected to earth at the center point. Static charges accumulating on the power circuits are thus neutralized and led to earth.

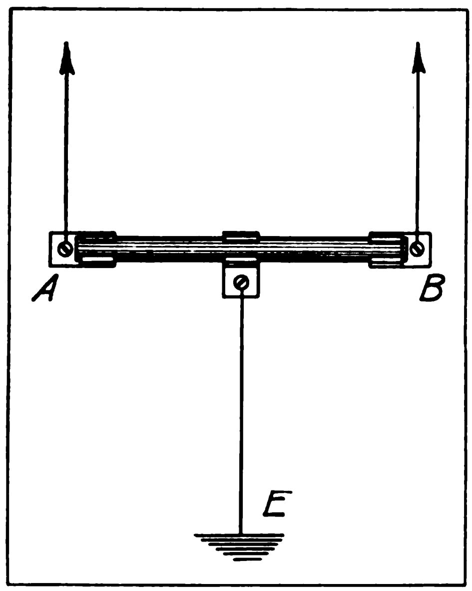


Fig. 2

In some radio stations, a condenser or a protective rod is connected from the frame of the motor-generator to the windings, thus preventing a large difference of potential being set up between them. In amateur stations where the power leads enter the house through the basement and the radio apparatus is located on a.. upper floor, a set of these protective devices should be connected across the primary terminals of the transformer and a second set near to the basement meter.

High-Frequency Choking Coils.—It is often desirable to protect the secondary windings of a high potential transformer from the high frequency oscillations released by the condenser during discharge. This is particularly important for a home-made transformer where the constructor lacks the facilities for properly insulating the windings. Should the spark gap be opened to abnormal length, the current of radio frequency may break down the insulation of the secondary pancakes and thus render the transformer inoperative.

Protective choke coils are represented at N, N, and they may be constructed in a simple manner. A spiral winding of annunciator wire with outside diameter of 6 inches may be made on any convenient insulating base, or if preferred a single tube 4 inches in length, 4 inches in diameter, may be wound with a single layer in the usual manner. These coils may be constructed with or without an iron core, but they will be effective in either manner.

The function of the reactance coil or regulator is frequently not thoroughly understood. It is often employed in the primary winding of poorly designed transformers to prevent an abnormal consumption of current. It is of value, however, in any transformer winding where the power input is to be reduced by steps.

A reactance regulator may take the designs indicated in Figure 4A or 4B. In the former a straight iron core has two or three layers of wire of suitable current carrying capacity, the turns of which are equally divided between the taps of a ten-point switch, or we may use the design in Figure 4B where two coils of fixed inductance are connected in series and a "U" shaped iron core inserted. Then, by drawing the core in and out of the windings, the self-inductance can be varied over considerable range and the power input accordingly increased or decreased.

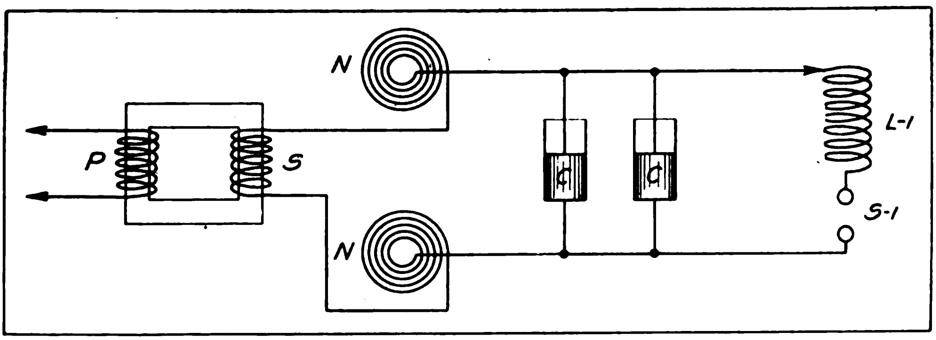


Fig. 3

For the average amateur transformers having an input of ½ k. w., the core for the design (Figure 4A) may be 14 inches in length, 2 inches in diameter, wound with three complete layers of No. 14 D. C. C. wire, with tappings brought out at certain intervals.

The core for the design (Figure 4B) should be laminated, *i. e.*, constructed of thin sheets of iron stocked up and assembled as the core of the usual type of transformer. The core for both windings A and B may be 1½ inches square, 8 inches in length, with a cross bar or yoke 7 inches in length. Two layers of No. 12 wire are now wound on each leg. The precaution should be taken to place the turns on each leg in the opposite direction.

It is of course understood in either type that the windings are insulated from the core by means of two or three layers of Empire cloth. The actual dimensions of these coils and the number of turns will probably not apply to all types of amateur transformers, but a few trial experiments with each will reveal a winding of the correct proportion for a

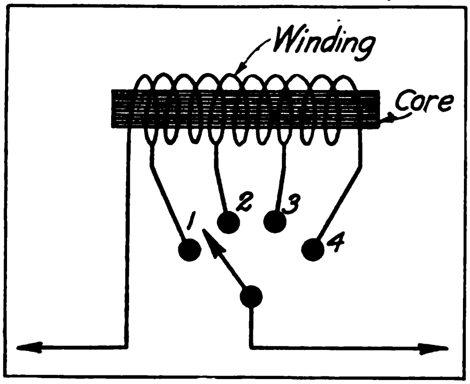


Fig. 4-a

given radio set. Should the reactance regulator show signs of overheating it may be immersed in a small tank of insulating oil.

Radiation Indicator.—An indicator for determining conditions of resonance between the condenser and aerial circuits of a radio station is an absolute necessity. The amateur market is not well supplied with a cheap and efficient aerial ammeter and consequently many experi-

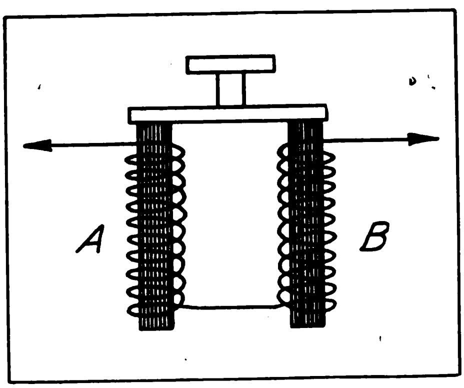


Fig. 4-b

menters prefer to construct this device themselves.

The simplest device for this purpose is that indicated in Figure 5, wherein a two or four-volt battery lamp, L, is connected in series with the aerial system through the binding posts, A and B. The lamp is shunted by the loop of wire, W, bent in a semi-circle over which slides the variable contact, C. The dimensions of the loop vary according to the current flowing in the aerial system; its diameter may have to be increased or decreased accordingly, but a few trial experiments will quickly reveal the correct position so that the lamp will not burn out when complete resonance is established.

The better method for obtaining resonance is to set the inductance of the

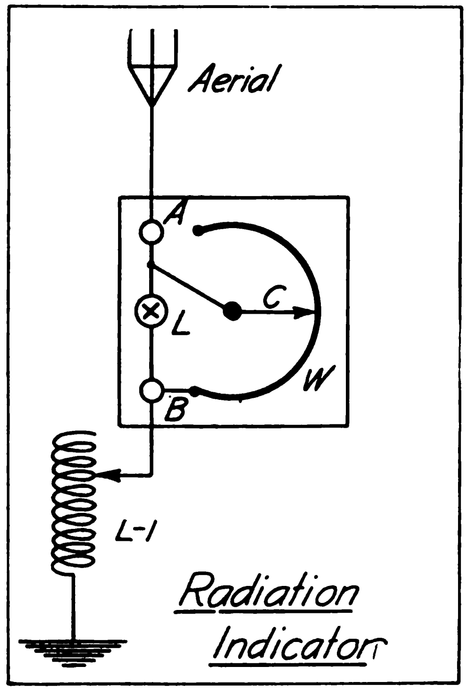


Fig. 5

closed circuit at some fixed point and follow it by altering the inductance in the aerial circuit until a brilliant glow is secured.

An Aerial Ammeter.—The experimenter preferring a hot wire aerial ammeter that can be calibrated by comparison with a meter of standard construction should note carefully the diagram in Figure 6. The instrument shown therein will measure at the full scale position, 0.1 ampere, and by placing several additional wires in parallel to it, the range may be increased to any desired value. Between the copper bars, B-1 and B-2,

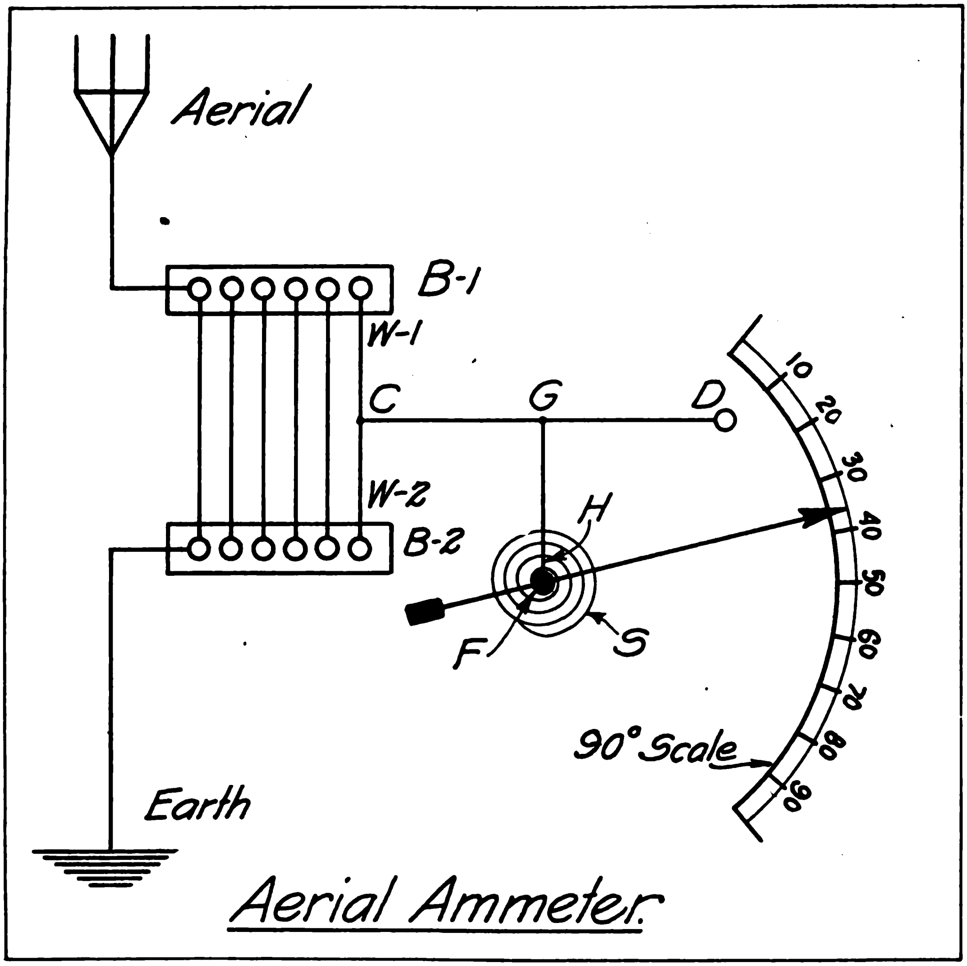


Fig. 6

is stretched a piece of Therlo resistance wire, 4 inches in length and .003 inch in diameter having approximately a resistance of 9.5 ohms. C, D, is a piece of silk fibre about 3 inches in length, while G, H, is another piece 2 inches in length. The latter thread is attached to C, D, and wound around the shaft, F, which is preferably supported by jewelled bearings. Without the tension of the small hair spring, S, the pointer would fly to the full scale position, but the force exerted by G, H, holds it to the zero position. Then when current is caused to flow through the W-1, W-2, the wire expands, releasing the back tension of the spring, and the pointer accordingly moves across the scale.

To take care of larger values of aerial current, four to six Therlo wires should be placed in parallel, from bar to bar, until the correct current carrying capacity is secured. The pointer may be made of a light piece of straw attached to the shaft by a bit of *beeswax*.

A small counterweight, A, should be attached to the opposite end of the pointer to give the correct balance.

Aerial Outgoing Insulator.—An aerial insulator for bringing the aerial leads through the roof of a building or the side of the house must be carefully constructed to prevent leakage of water. An insulator of elaborate construction is beyond the means of many amateurs and therefore the type shown in the drawing may be substituted. A hard rubber tube at least 16 inches in length with a hole

⅜ of an inch to ½ inch in diameter is clamped to the roof by means of the wooden blocks, B, B, drawn together by

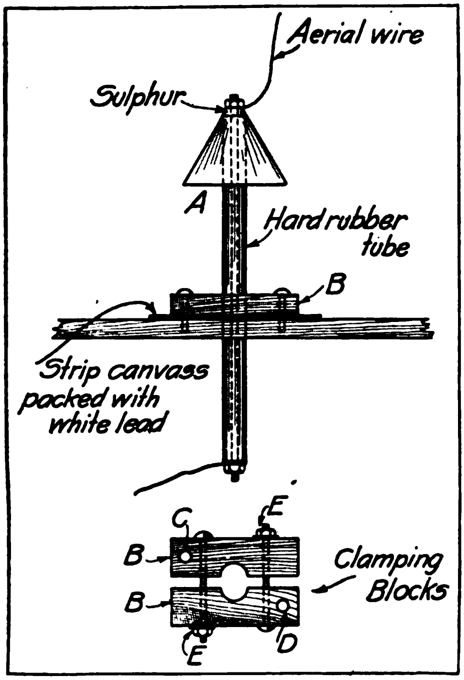


Fig. 7

the bolts, E, F. The fit of the tube should be snug when the bolts are tightly drawn. A second set of bolts are inserted at C, D and the blocks thereby drawn to the base board.

To make the joint water tight a strip of canvas slightly larger than the blocks has a hole the size of the tube cut in the center, after which it is thoroughly smeared with white lead. The bolts are

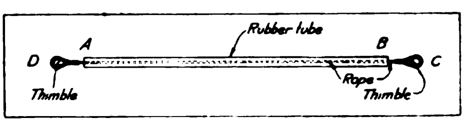


Fig. 8

then placed at C, D, and the blocks drawn to the roof. If allowed to dry, a water tight joint will result, provided the strain of the leadings is removed by appropriate guys.

The wire extending through the insulator should be at least No. 6 D. B. R. C. stranded conductor, which may be made water tight by surrounding it with melted sulphur. A certain quantity of sulphur should be heated in a pan until it runs freely; the bottom of the insulator is then stuffed up with waste and the sulphur poured from the top until the insulator is completely filled. When dry the sulphur hardens and possesses the requisite insulating qualities.

A cone shaped metal can may be attached to the top to prevent leakage of the high voltage current during a rain storm, but it is not absolutely essential.

Antenna Insulators.—In a somewhat similar manner we may construct insula-

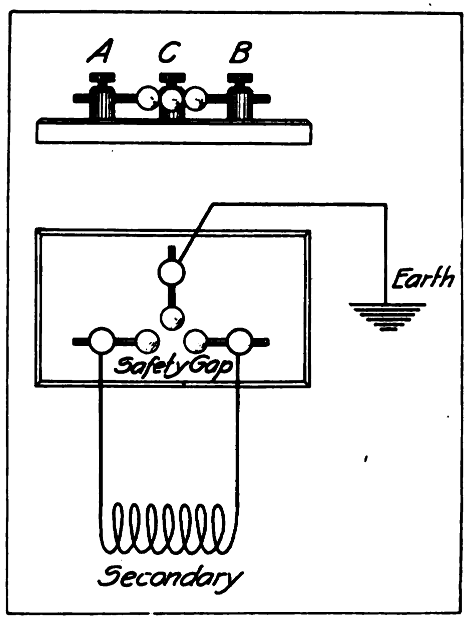


Fig. 9.

tors for aerial wires. A thin hard rubber tube about 12 inches in length may have extended through it a piece of ⅜-inch diameter marlin rope which in turn is served about heart shaped thimbles, as at C and D. The tube should be large enough to permit a small air space between the rope and the walls, around which is poured a quantity of melted sulphur. When dry the sulphur usually soaks into the rope sufficiently to make a water tight joint, after which the insulators may be attached to the spreaders for support of the wires.

(*Continued on page 118*)

Bridging Distance in 3,000,000 Square Miles of Jungle

How the Great Network of Wireless Stations in Brazil Serves That Country

By J. L. Barttro

TRUE though trite is the statement that wireless is playing a most important part in the extension of civilization. And perhaps the widespread influence of the radio is nowhere more in evidence then in Brazil where the art draws closer together the various points in the country's three million square miles. Up to a few years ago many parts of this jungle-covered section were almost unknown to the rest of the world. Now a great network of wireless stations transmitting business, thoughts and laws to the farthermost sections, makes this vast territory thoroughly alive.

If you will take an atlas in hand you will be able to follow to better advantage the progress of the wireless as I learned it while employed in radio in Brazil. Beginning at Para, at the mouth of the Amazon, radio stations have been erected as far as the Pacific coast, with installations at Manaos, Santarem, Iquitos, Quito, Lima, Porto Velho, Senna Madureira, Rio Branco, Cruzeiro de Sul and Xapury. For your information it may be well to state that Porto Velho, or, wirelessly speaking, PV, is at San Antonio Falls, 700 miles up the Madeira River, and the balance of the southern stations are in the Acre rubber district, located between the Purus River and the Madeira.

Messages from the government officials in Rio de Janeiro are transmitted to their subordinates along the western border in large volume. This is especially true of the wireless and of the relay from Para on, 2,500 to 3,000 words being the average traffic business transacted in four hours from that place to Senna each morning. After making the river trip from Para to Porto Velho, which takes two long, hot, tiresome weeks, or the month's journey from Para to Senna up the smaller rivers, one is particularly impressed with the speed and ease of communication effected by wireless. As for Rio Branco and Cruzeiro, it is fatiguing even to think of the time and unpleasant features involved in a trip to them. Mail does not arrive with the morning sun in these places. But the morning messenger does bring the telegrams to the subprefect in his little thatched office in the rubber wilds.

And in many novel ways does the radio serve the government officials stationed at isolated posts. If someone in officialdom has a birthday fifty long Portuguese words of esteem and best wishes wing their swift, silent way from and into the depths of the wilds. A marriage may take place in Manaos. Immediately the jungle stations are notified of the event and from them come congratulations and expressions of good will. If a law is passed at the capital affecting a tiny spot in near oblivion, the wireless is resorted to and two days later the act, word for word, is in the hands of the proper officials.

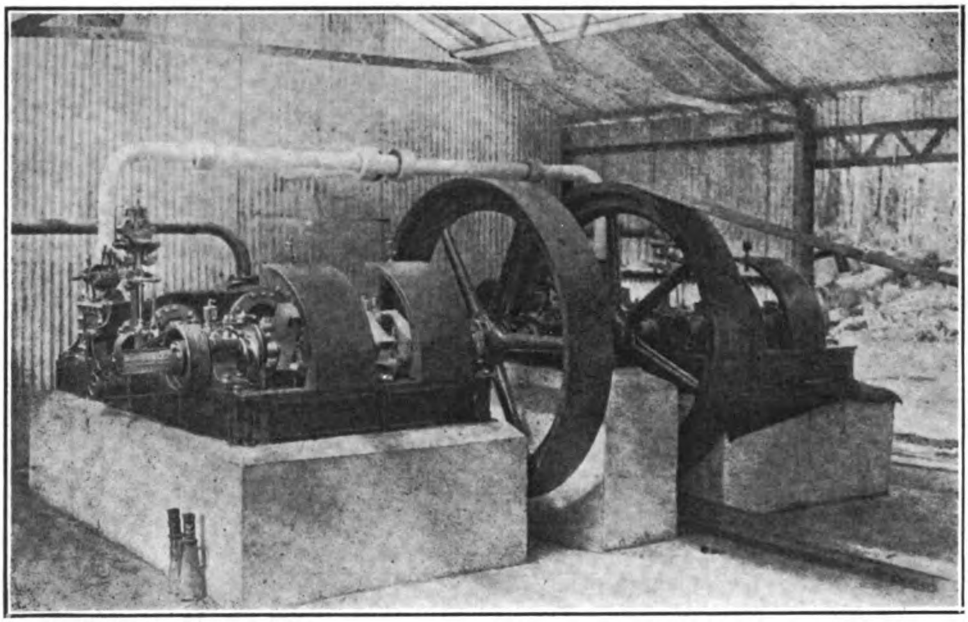
When the soldiers and police begin a quarrel in which shooting, rioting and arson are mixed indiscriminately, "Sparks" chuckles, pounds the report of the unpleasantness out on the "mill" and speculates regarding the next government staff. Chuckles? Certainly! For these are noisy, but usually bloodless revolutions.

So the game—for game it is—goes on. Little jungle railroads, steamboat lines of which folk outside of Brazil never hear and new business offices in the rubber districts, spring up like settlements in the early days of the West in the United States. Adventures thrilling and gruesome in the jungle; tales of death by the dread disease beriberi; little incidents of the wilds, crudely told, but containing all the elements of life in the raw. These are the tales that come into the head phones of the wireless man in Brazil.

Static prevails from twelve to eighteen hours a day. The period free from this condition is from six o'clock in the morning until noon, during which time the heavy traffic is dealt with, from sixty to seventy thousand words in a month of twenty-six working days being handled.

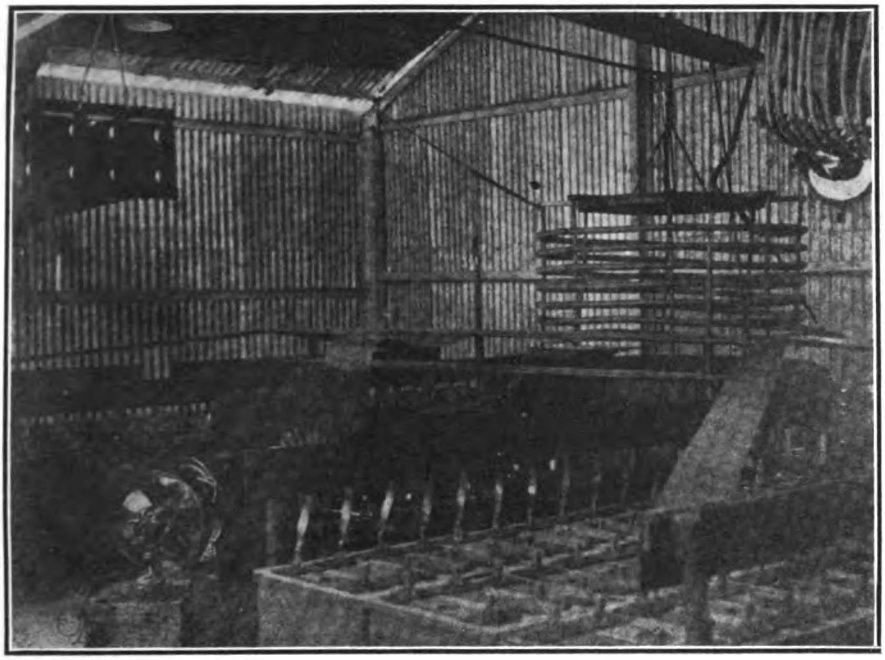
The stations at Manaos and Porto Velho are of 150 k. w. maximum capacity, but only require about one-fifth of this in clear weather. The sets are worked with Morse wire keys which control a double make and break relay system at a speed of twenty-five to thirty words a minute. Most of the messages are copied on typewriters, the signals coming in with a loud ringing note like those of the old Cape Cod station. Before the introduction of the typewriting machines it was difficult to average more than 600 words an hour. The typewriter record is between five and six thousand words of Portuguese and code in a six-hour trick. Portuguese words, it should be understood, generally have nine letters each. The record referred to was made with two operators, working three-hour tricks, at each of the two stations employed.

The stations are equipped with 200-foot aerial masts and special type tuners with a balanced carborundum set, the latter being the handiwork of a Marconi engineer. As a result excellent receiving records have been made by these stations. Clifden was heard one night and signals were regularly received from Arlington.



The engine room at Porto Vehlo, a Marconi station located at San Antonio Falls, Brazil, 700 miles up the Madeira River, a two weeks' journey from Para

Working in the Manaos and Porto Velho stations has considerable interest and the experiments carried on at one time were even more interesting than the work. There was for example, the task of assisting the Brazil-Bolivia Survey Commission in determining local longitude. The operators' part in the work consisted in sending time signals so that accurate observation as to chronometer variations could be obtained. The longitude of Porto Velho was determined within a few hundred feet and with this as a base, members of the survey party start-



The condenser room of the 150 k.w. station at Manaos, from whence the survey party of the Brazil-Bolivia Commission received its longitude signals on a portable set erected each night in the depths of the jungle

ed for the depths of the jungle, carrying a portable wireless set. Every night the aerial of the latter was swung from high trees and the operators listened in for PV time signals, noted their variations and then shot the stars.

The obstacles to be overcome were not inconsiderable and the work could only be carried on during the dry season. During the rainy period of the year large clouds are almost constantly in the sky and drops of water the size of marbles descend to the ground. The storms are often accompanied by destructive high winds, lightning and thunder, all work being brought to a halt while they last. The Madeira rises steadily as the rain falls, reaching at times a height of from fifty to sixty feet above low water, and inundating many thousands of miles of the surrounding lowlands. Nature plays strange pranks following these deluges. One of the most striking was remarked by a member of the surveying party who told of a river flowing in the opposite direction from its original course, 200 miles from its position on the map.

I have attempted in this article to convey a rough idea of the work of a wireless man in a country where comparatively little is known regarding the details of his duties. If the word picture I have set down is alluring to some let me remind them that reading about this tropical land is more fascinating than the reality of living in its jungles, fighting sand flies and mosquitoes and waiting for the seemingly never-ending rainfall to cease.

Long Distance Transmission on Low Power and Short Wave-Lengths

By A. S. Blatterman, B.Sc.

PART III (Conclusion)

TABLE 1 has been worked out to give the total inductance and capacity, including the lead-in, of four-wire inverted L aerials of different heights and lengths.

Table 2 gives the same data for T aerials.

Figure 11 gives the natural wave-lengths of inverted L antennas with no inductance at the base, consisting of four wires spaced 2 feet apart, for heights varying from 30 feet to 100 feet and lengths from 30 feet to 130 feet.

Figure 12 is similar to Figure 11 except that it refers to T aerials. It will be noticed that doubling the length of the flat-top of an L aerial in forming a T aerial does change the wave-length somewhat.

These curves take into proper account the distributed character of the inductance and capacity of the aerials, and are considerably more accurate* than the values given in the author's 1913 paper.

Figures 13 and 14 give the natural wave-lengths of L and T aerials respectively when a coil with an inductance of 10,000 cms. is placed in the antenna near its base. This coil is supposed to be the secondary of the oscillation transformer. These curves were calculated by means of formula 10 and the curve of Figure 9. (See the October issue.)

Inductance of Coil at Base.—The inductance of the secondary of the oscillation transformer can be calculated by means of the following formulae and table:

$$L = 4 \pi r n^2 \left\{ 2.3 \left(1 + \frac{3 b^2 + c^2}{96 r^2} \right) \log_{10} \frac{8 r}{\sqrt{b^2 + C^2}} - y_1 + \frac{b^2}{16 r^2} y_2 \right\} \quad \ldots\ldots\ldots\ldots (11)$$

where the dimensions b, c and r are as shown in Figure 15-a, and y_1 and y_2 are read from the table.

b/c or c/b	y_1	y_2
0.00	0.50000	0.1250
.05	.54899	.1269
.10	.59243	.1325
.15	.63102	.1418
.20	.66520	.1548
.25	.69532	.1714
.30	.72172	.1916
.35	.74469	.2152
.40	.76454	.2423
.45	.78154	.2728
.50	.79600	.3066

This formula must be corrected in the present instance to take account of the actual distribution of the current over only a part of the cross-section bc. For a first approximation, when the conductor is of taped shape section and the distance between the turns is the same as the width of tape, this correction will be

$$\Delta L = 4 \pi \left(0.6949 \sum_1^{n} r' - 0.1285 \sum_1^{n-1} r' \right)$$

where r′ is the mean radius of a turn. $\sum_1^{n} r'$ means the sum of the radii of all the turns. $\sum_1^{n-1} r'$ means the sum of the radii of all except the outside turn

* These curves have been at least partly checked by actual measurements on antennas.

The actual inductance is that calculated by formula (11) plus the correction Δ L. These formulae are equally applicable to either the pancake spiral type of coil or to the cylindrical helix.

TABLE 1
TOTAL CAPACITY AND INDUCTANCE OF 4-WIRE AERIALS, INVERTED L
HORIZONTAL LENGTHS

	40 ft.		60 ft.		80 ft.		100 ft.		120 ft.	
H ft.	C mf.	L cm	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.
30	.000186	22430	.000252	28230	.000334	34010	.000395	39770	.000456	45610
40	.000190	28900	.000258	35000	.000324	41100	.000392	47200	.000459	53310
60	.000213	42180	.000276	48800	.000337	55460	.000400	62090	.000463	68700
80	.000241	55410	.000300	62400	.000360	69320	.000418	76300	.000478	83300
100	.000268	69000	.000325	76260	.000382	83500	.000439	90750	.000496	98020

TABLE 2
TOTAL CAPACITY AND INDUCTANCE OF 4-WIRE T AERIALS WITH LEAD IN TAKEN FROM CENTER
HORIZONTAL LENGTHS

	60 ft.		80 ft		100 ft.		120 ft.		140 ft.	
H ft.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.
30	.000252	15050	.000334	16530	.000395	18000	.000456	19480	.000555	20950
40	.000258	21000	.000324	22580	.000392	24150	.000459	25740	.000528	27820
60	.000276	33790	.000337	35460	.000400	37150	.000463	38820	.000522	40500
80	.000300	46530	.000360	48330	.000418	49850	.000478	51870	.000538	53630
100	.000325	59870	.000382	61690	.000439	63430	.000496	65340	.000553	67180

	160 ft.		180 ft.		200 ft.		240 ft.	
H ft.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.	C mf.	L cm.
30	.000629	22430	.000702	23900	.000775	25380	.000928	28330
40	.000599	28900	.000664	30500	.000731	32050	.000867	34720
60	.000584	42180	.000645	43860	.000706	45550	.000830	48890
80	.000597	55880	.000654	57190	.000713	58950	.000831	62490
100	.000610	69000	.000667	70840	.000724	72680	.000838	76310

Corona Loss from the Antenna.—There is another very important, though seldom considered, factor relating to the overall effectiveness of the transmitter. This is the loss through "corona," or brush discharge from the antenna.

When a wire is charged to a high potential of the order of 100,000 volts, there is a leak of energy into the surrounding air, and if the potential exceeds a certain value, "the visual critical value," this leak is accompanied by a visible halo-like glow on the surface of the conductors. The loss due to this leakage of energy into the air is practically negligible below what is called the "disruptive critical voltage." The "disruptive critical voltage," or the voltage at which loss begins, is lower than the "visual critical voltage," or the voltage at which blue glow first appears. It is wrong, therefore, to assume, as is often done, that because an antenna does not appear luminous after dark, there is no corona loss. This loss may be a considerable fraction of the total aerial energy and still not produce the blue glow.

In another paper* the writer has developed formulas for calculating approximately the probable corona loss from antennas. These formulas are here summarized for convenience. They are:

$$P = \frac{265N}{10^{18}\delta}\sqrt{\frac{d}{h}}\left(\frac{V}{2} - V_0\right)^2 \quad \ldots.(12)$$

Where:

P = power in watts lost from one wire per ft. length of the portion whose potential is above the disruptive critical value (=x).

N = spark frequency.

δ = log. decrement of antenna per half period.

h = height of antenna in inches.

d = diameter of wire in inches.

V = max. voltage on aerial at free end.

V_0 = disruptive critical voltage.

$$= 74{,}000 \ d \log_{10} \frac{4h}{d} \quad \ldots\ldots\ldots(13)$$

The maximum antenna voltage V can be calculated by the formula:

$$V = \frac{26 \ I}{C}\sqrt{\frac{\lambda\delta}{N}} \quad \ldots\ldots\ldots\ldots (14)$$

Where:

I = current in aerial at base (measured by a hot-wire ammeter).

C = capacity of aerial in microfarads.

λ = wave-length.

In Figure 15, the disruptive critical voltage is represented by the dashed line

* A. S. Blatterman, The WIRELESS AGE, July, 1916.

V_0. The actual antenna voltage is represented by the dotted line with maximum voltage V at the end. The corona loss only occurs over the length X, which is the length wherein the antenna voltage exceeds the value V_0. To calculate this length, X, from which power is lost, for an inverted L antenna, we have the following formula:

$$X = L\left(1 - \frac{2}{\pi} \times \text{angle whose sine is } \frac{2V_0}{V}\right)$$

$$V^1 = (1 + 0.267/\sqrt{0.064})\ \log_{10} 240 \times 12/0.064 = 45{,}000 \text{ volts.}$$

whereas loss of power through corona begins at 21,900 volts.

The curves of Figure 17 have been calculated from these formulae. They show the loss in watts due to brush discharge as a function of antenna current for various sizes of antennas. In all these curves the wave-length is assumed to be 200 meters, the antenna decrement 0.1 per half period, which is the legal limit, and the spark frequency 600 per second. Also the antennae all have a

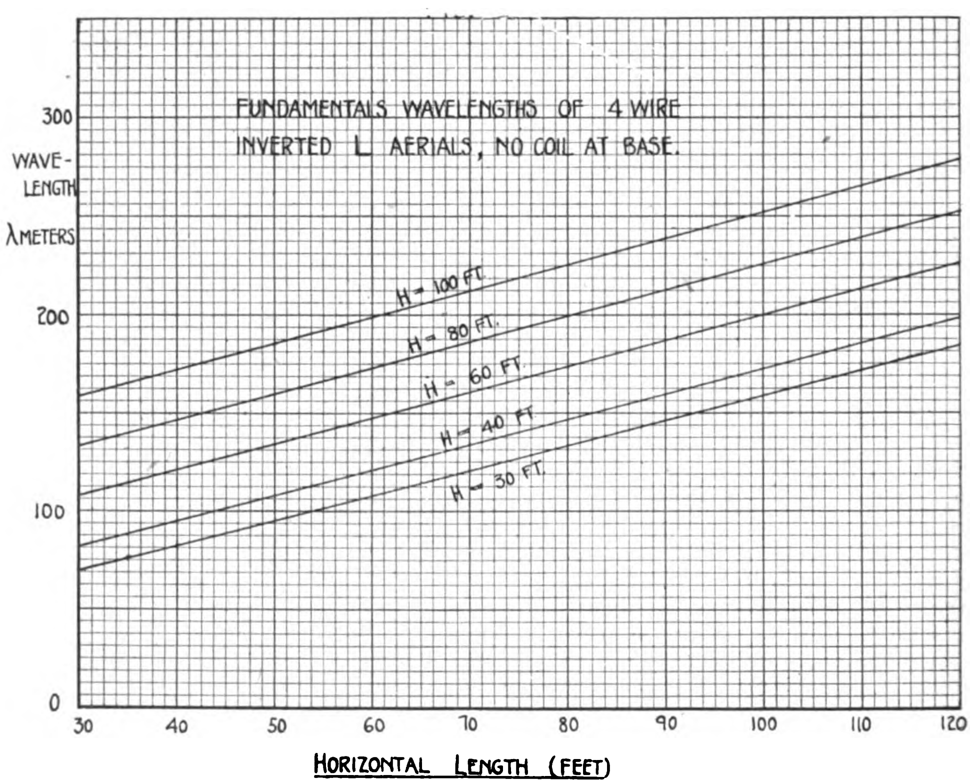


Fig. 11

For a T aerial power is lost from twice this length. (See Fig. 16).

The voltage at which brush discharge first begins to show as a blue glow is approximately:

$V^1 = (1 + 0.267/\sqrt{d})\ V_0$ ....(16)

which shows that for small wires the visual voltage is very much greater than the voltage at which loss begins. Thus, a No. 14 wire 60 ft. from earth will begin to glow at a potential of

coil of 10,000 cms. inductance at the base for coupling, and are of the four, No. 14 wire inverted L type discussed above.

The formulae and curves show that in order to reduce the corona loss from the antenna it is necessary to use high spark frequencies, short wave-lengths, low decrements, large wires and large capacity, that is, low antennae.

Extraordinary Distances and Freak Transmission.—We have considered so

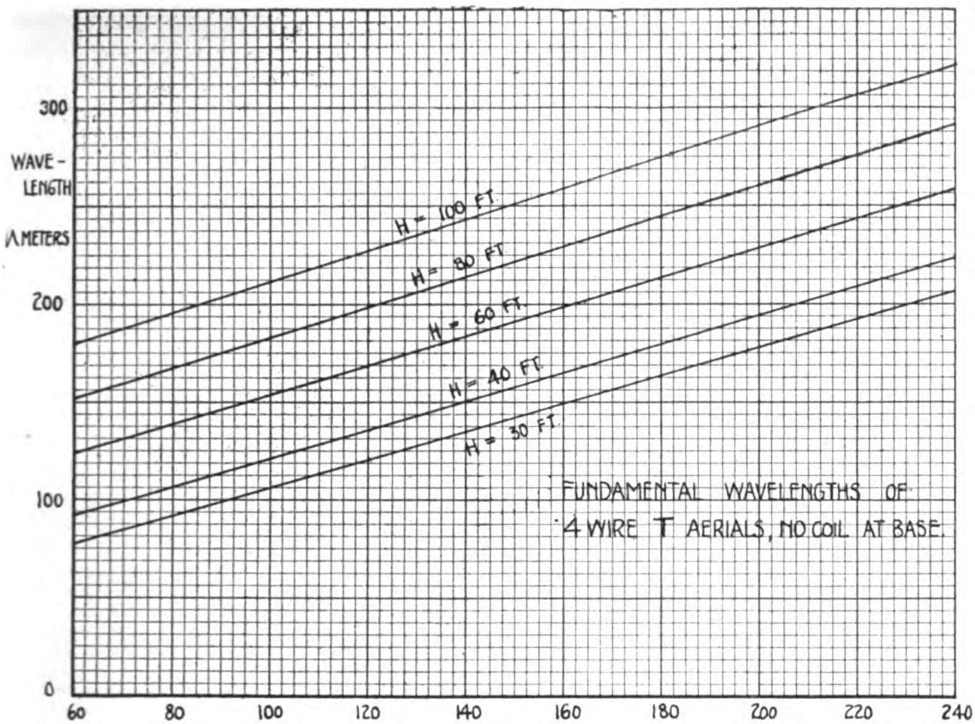


Fig. 12

far only the possibilities of continuous transmission on a regular schedule according to well defined combinations of such important factors as the wave-length, the antenna proportions and the aerial current. The distances involved herein may be considered as the normal ranges of land stations in the twilight hours near sunset and sunrise.

It is well known that after sundown the range of a station, particularly with short wave-lengths, may be considerably greater than it is at any other time. Also it is a very common observation among operators that signals vary in a most erratic way after dark, at times permitting communication over very long distances, and then suddenly reducing the strength of signals to a value almost as low as the regular day strength. The writer has lately been engaged in experiments* carried on between Washington University in St. Louis and the University of North Dakota, which were designed to study the variations in nocturnal transmission, and based largely on these tests, the following facts and theory are presented as tentative explanations of some of the phenomena commonly encountered.

There seem to be two kinds of fluctuations in nocturnal overland transmission. The first is a rapid fading, and the second is a slow swinging in signal strength. The first may be due to changes in the nature of interference effects. These could be local at the sender or at the receiver, or they might be caused by rather sharp surfaces of discontinuity almost anywhere between the stations.

The second or slower effect may be due to refracting masses of moving ionized air in the path of transmission, producing at times a lens-like concentration and at other times a dispersive effect.

The interference theory is generally regarded as the more tenable.

Let A, in Figure 18, represent a transmitting station sending to a receiving station at B. We can represent, conventionally, the waves traveling out from A along the surface of the earth, by the

* A. H. Taylor and A. S. Blatterman, "Proc. Inst. Rad. Eng." Apr. 1916.

solid wavy curve X-X. This is the direct wave. Suppose that there exists somewhere between the stations a rather sharply defined surface of electrical discontinuity, such as a floating ionized cloud-bank. Such a surface will reflect waves striking it. If this reflecting cloud-bank moves into a certain position, such as C, then waves radiated from the sending station will be reflected from it and return to earth as shown by the dashed line, Y-Y. It is seen that for this particular position of the reflecting surface, C, the reflected wave returns to earth in exact phase opposition to the direct wave, X-X, and thus causes a weakening of the signals at the receiver, B.

If, now, the reflecting surface moves to the position, D, then at the point where the reflected wave returns to earth it is in phase with the direct wave and hence re-enforces it. In this case, therefore, the signals at B are improved.

Thus, shifting reflecting surfaces, probably moved by air currents, cause alternate strengthening and weakening of signals; and, of course, it is entirely possible that favorable reflection of this kind might take place from several of these surfaces at the same time, thus permitting transmission for a short time over comparatively great distances.

This also explains the frequently observed fact that signals from one station gradually grow stronger while those of another fade out.

Superposed upon these transient fading effects there is another quite general and slowly changing set of conditions which is manifestedly the generally improving transmission toward midnight. Curves obtained during the tests cited showing the variation of signal strength during the night have the general appearance of that shown in Figure 19.

Soon after sunset the strength of signals increases very noticeably, and though it varies a great deal during the night, in accordance with the fading effects just discussed, the transmission, as a whole, improves up to a little after the solar

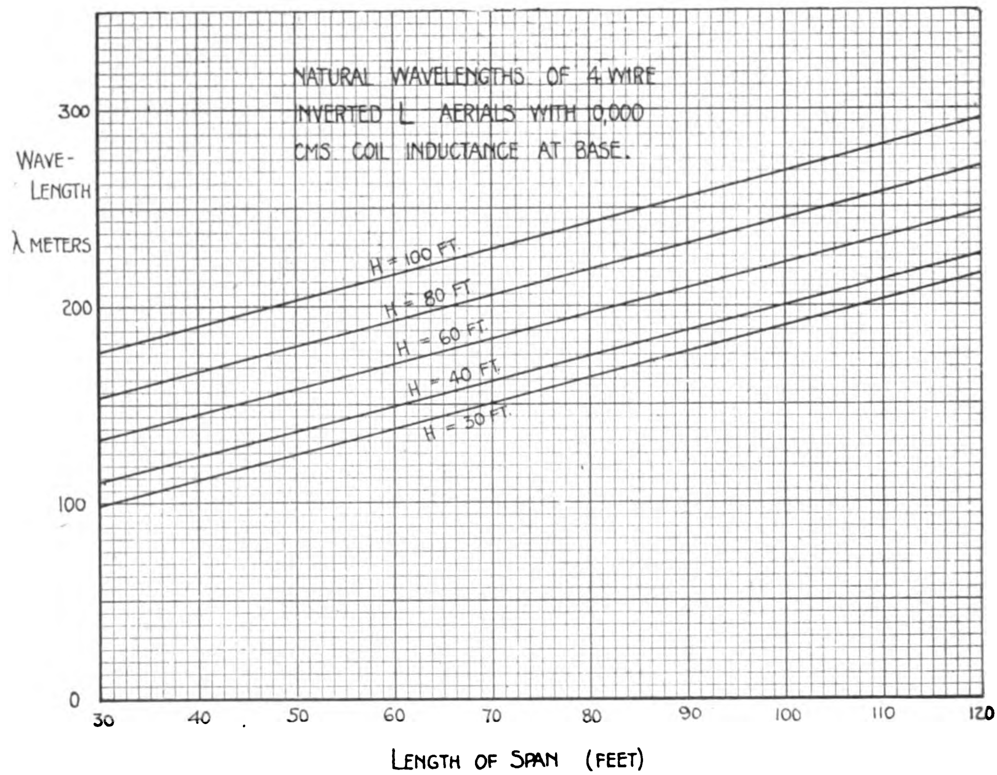


Fig. 13

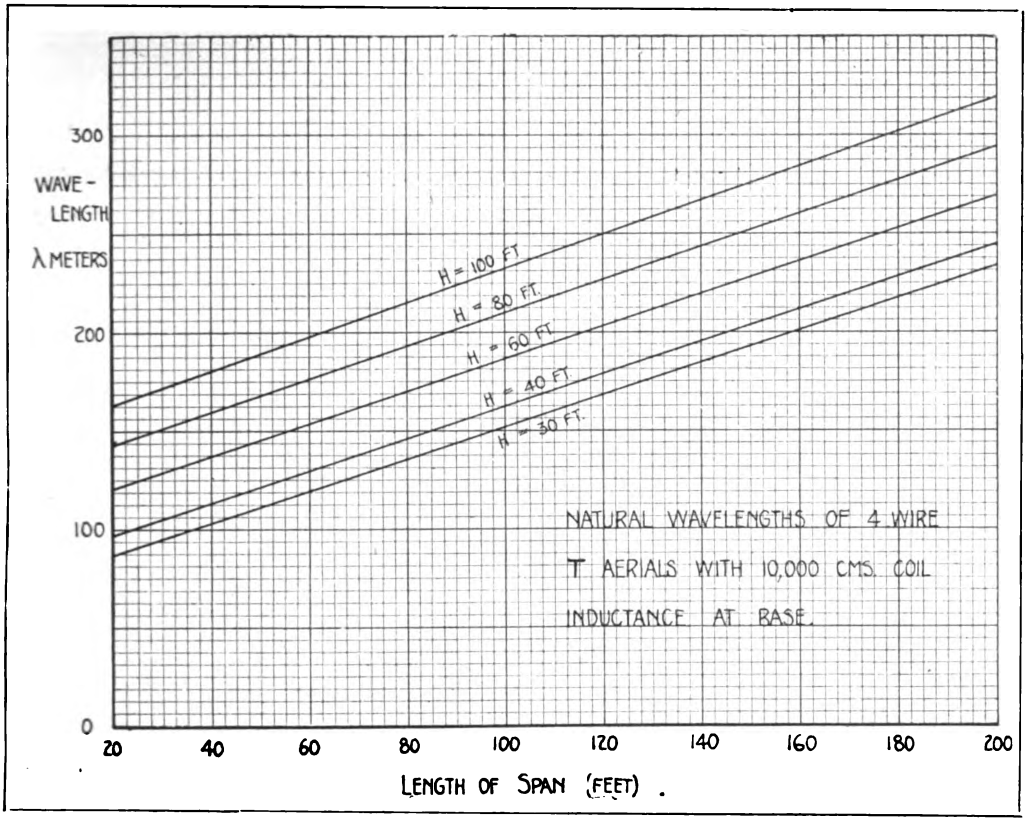


Fig. 14

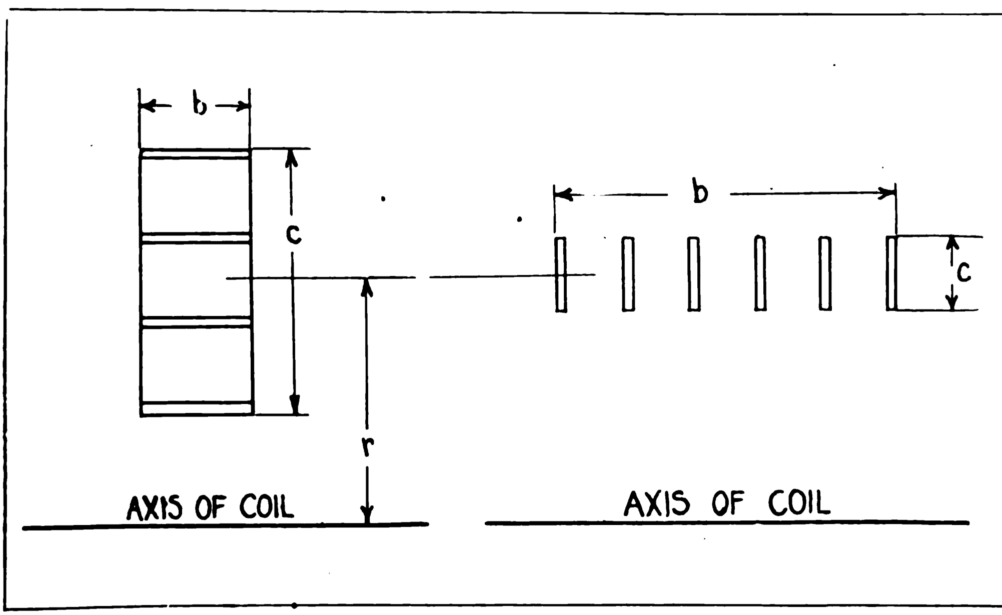


Fig. 15-a

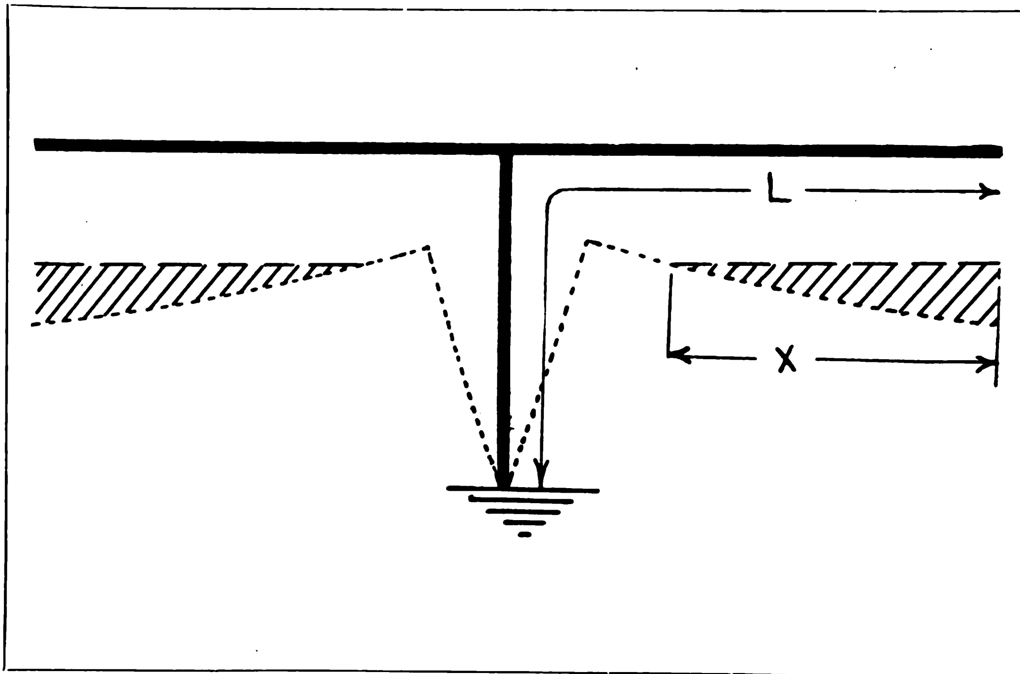

L
X

Fig. 16

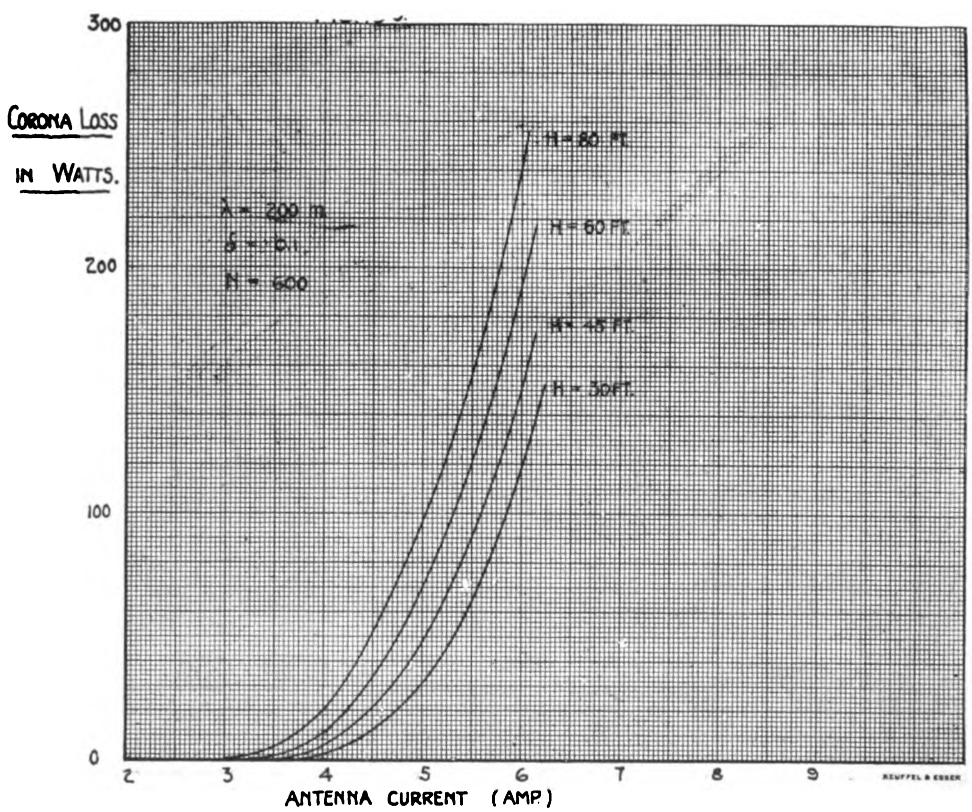

Corona Loss in Watts.
300
200
100
0
λ = 200 m.
δ = 0.1
N = 600
H = 80 FT.
H = 60 FT.
H = 45 FT.
H = 30 FT.
2
3
4
5
6
7
8
9
Antenna Current (Amp.)

Fig. 17

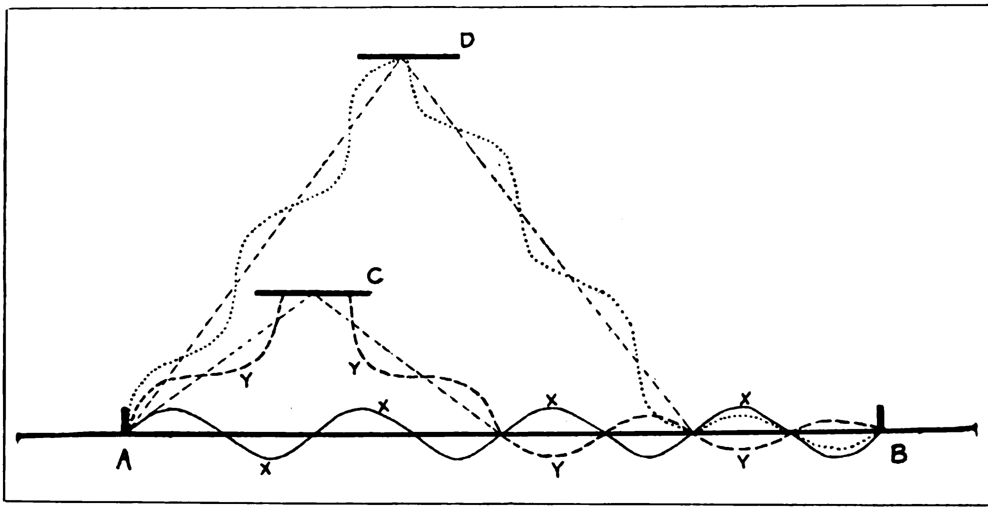


Fig. 18

midnight when it again falls off with the approach of sunrise. The dotted lines of Figure 18 show the fading effects. The solid line shows the general trend of transmission; this is an average curve drawn through the observed points. It is to be especially noticed that the best time of night is not midway between sundown and sunup, but is usually about an hour later than this—about one or two o'clock in the winter at the latitude of St. Louis.

One very likely explanation of the better transmission at night rests upon the fact that during the day the ultra-violet rays of sunlight render the upper layers of the earth's atmosphere conducting by splitting up the air molecules into positive and negative ions. This causes energy to be abstracted from the waves and dispersed upward into the higher strata of space, thus weakening received signals. At night, however, there are no ultra-violet rays to produce ionization. The homogeneous atmosphere then takes on the property of a perfect insulator and the waves travel with very little absorption and dispersion.

The ions, which render the air conducting (especially at high levels) during the daytime, do not, however, disappear at once with the setting of the sun, but it takes an appreciable time—several hours—for them to completely dissolve or disperse. This results in gradually improving transmission conditions after nightfall, as shown in Figure 18. The improvement is not an abrupt one. It is only toward the middle of the long winter nights that all of the ions have had time to disappear; and at this time one wave is as good as another as far as the absorption is concerned because all waves are then unabsorbed. Our tests support this unabsorbed transmission hypothesis near midnight.* It is likely that in summer, when the nights are compartively short, there is not sufficient time for the ionization of the preceding day to entire-

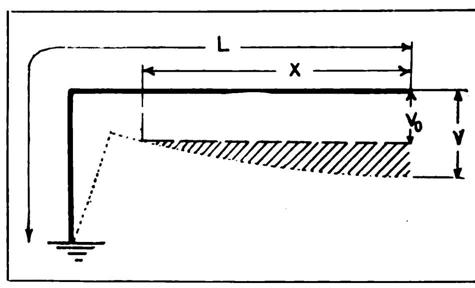


Fig. 15

ly disappear before that of the next day's sun is felt, and therefore, even at midnight there is considerable ionization and absorption of the waves. It is well known that transmission is much better on winter nights than it is in summer.

If the above theory is correct it is therefore not at all the surprising fact many have thought for amateur transmitters to send 1,000 miles at one or two o'clock on a winter night. If we go back for a moment to the Austin transmission

* Proceedings Institute Radio Engineers, l. c.

formula discussed in Part 1 of this paper, and put into it the condition that the waves travel without absorption, then instead of the absorption factor 0.0762 we have to use 0. The formula then becomes:

$$I_r = \frac{635\ I_s\ h_1\ h_2}{\lambda d} \quad \ldots\ldots\ldots\ldots\ (17)$$

Solving this for distance:

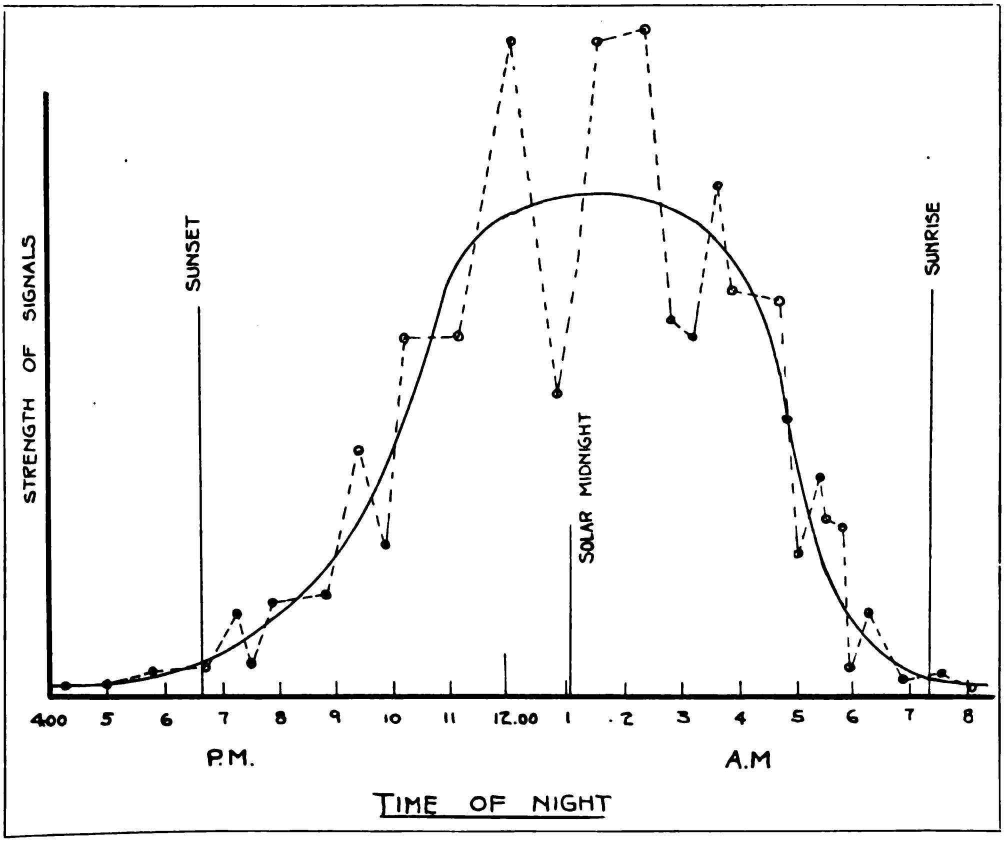


Fig. 19

$$d = \frac{635\ I_s\ h_1\ h_2}{\lambda\ I_r} \quad \ldots\ldots\ldots\ldots\ (18)$$

This is a midnight, winter transmission formula.

As an example, let $h_1 = h_2 = 50$ ft., $\lambda = 200$ m., $I_s = 4$ amps., and $I_r = 40$ microamps., which corresponds to good readable signals. Then,

$$d = \frac{635 \times 4 \times 2500}{200 \times 40} = 800 \text{ miles.}$$

We thus have a range of 800 miles, barring the effects of reflection and consequent fading, etc., discussed in the foregoing; and there is no wonder attached to regular communication between two such stations during the middle of a winter night.

It has been shown that when absorption exists, that is, particularly during the late afternoon and early winter evenings, the usual transmission formula given by Austin applies to amateur stations, and at those times it is very important to properly proportion the antenna to the wave-length, the distance and the aerial current. When the proper combination and proportion of these quantities are obtained, considerable distances, of the order of 200 to 300 miles, are quite feasable and can be consistently covered with 200 meter wave-lengths. A number of amateurs have apparently hit upon the proper adjustments through chance, and to less fortunate co-workers the results obtained seem startling.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Cauto	New York & Cuba Mail S. S. Co.	K W F
Panuco	New York & Cuba Mail S. S. Co.	K W M
Kuskokwin River	Westward Navigation Co.	W L K
Jos. R. Parrott	Florida East Coast Ry. Co.	K J P
Maryland	Crew Levick Co.	K I N
San Rossore	Furness Withy & Co.	I O A (temporary)
Oregon	Wilson Bros. & Co.	(Unassigned)
Idaho	Wilson Bros. & Co.	(Unassigned)
Wm. Rockefeller	Standard Oil Co. of New Jersey	K W O

THE SHARE MARKET

New York, October 6.

There has been little change in the market as regards American Marconi shares. Traders have remarked on the fact that the stock is not higher in view of the activities of the American Marconi Company, calling attention to the fact that it has recently received large orders from abroad for wireless sets as well as from the United States Navy. They are optimistic, however, and look for better prices in the future.

Bid and asked quotations today:

American, 3⅜—3⅝; Canadian, 1¾—2¼; English, common, 14—17½; English, preferred, 13—16½.

SAN DIEGO STATION COMPLETED

The third of five wireless links in the United States Navy's chain extending from Washington, D. C., to Cavite, P. I., via the Panama Canal, has recently been completed at San Diego, Cal. San Diego's link consists of three towers, each 600 feet high. They will connect with the two stations already in working order at Arlington,Va., near Washington, and in the Canal Zone, halfway between the canal's Atlantic and Pacific terminals, and with the proposed station at Pearl Harbor, Honolulu. The Honolulu station will connect the Philippines with the United States.

It has been announced that the formal opening of the station at San Diego will take place later, possibly not before December 1. A force of twenty operators will be on duty at the station. The equipment provides for the reception and dispatch of messages at the same time. Lieutenant J. M. Ashley of the Navy will be in command at San Diego.

REDUCTION IN ALASKAN RATES

The Marconi Wireless Telegraph Company of America made a substantial reduction in its telegraph rates in the Northwest beginning October 1st. The rate previously charged for messages from Seattle, Wash., and Astoria, Ore., to Juneau and Ketchikan, Alaska, was $1.25 for ten words and twelve cents for each additional word. The new rate is $1 for ten words and ten cents for each additional word. The company opened its Alaskan chain of stations a little more than a year ago.

SHOPPING BY WIRELESS

The wife of the Colombian minister of the United States, traveling on one of the fruit liners on her way to New York, lost her hat overboard, relates a newspaper. She immediately went shopping by wireless and ordered a hat in New York, acquainting her husband with the transaction. He was in New York and when the steamer reached port he met his wife at the dock and handed her the hat she had purchased in such an uncommon way.

Experiments With an Indoor Aerial

By W. G. Cady

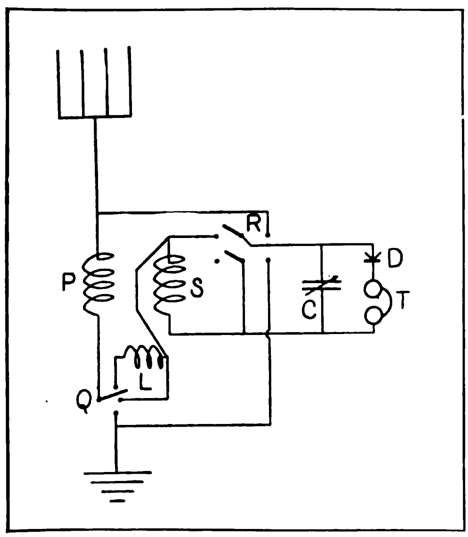
THE opinion seems to be commonly held that an indoor aerial is practically useless for receiving, except over short distances. It may be encouraging to some readers who have no outdoor aerial to know what can be accomplished indoors under fairly favorable conditions. The indoor aerial has the advantages of being cheap and safe, free from danger of lightning, and outside the pale of insurance regulations.

The house in Middletown, Conn., where these tests were carried out, is a wooden frame dwelling with a shingle roof, standing near the top of a slope. Many trees and electric wires are in the neighborhood, and close to the house are several trees that tower high above the roof. The antenna is of the umbrella type, and is tacked to the rafters of a loft over the attic. The floor of the loft measures about 21 by 26 feet. From the central point overhead, about 35 feet from the ground, half-a-dozen wires, from 8 to 15 feet in length, run off at a slant in various directions. One of the wires is continued down through the floor to the second story of the house, where the receiving apparatus is located.

Electric light conduits and telephone wires in the attic pass a few feet from the aerial wires. A switch at the receiving apparatus disconnects the latter from the aerial, when the station is idle. This is partly to protect the detector from static, partly because during a thunder storm the roof is perhaps less likely to be struck by lightning if the wires immediately under the shingles are not grounded.

From the station, the ground wire runs to the kitchen immediately below, where it is connected to the water pipes. All aerial wires are well soldered together. They consist of old electric light wire about size 14, held down with double-pointed tacks. This sort of insulation would not do, of course, for transmitting, unless it were planned simply to send for a short distance by means of a buzzer.

The apparatus consists normally of a home-made receiving transformer of 1,000 meters maximum wave-length, Blitzen condenser, Western Electric 1,500-ohm receivers, and Crystaloi detector. Galena and ferron detectors have also been successfully used, while a Baldwin 'phone responded audibly to N A A when held a foot from the ear.



For receiving at a wave-length above 1,000 meters, primary and secondary coils of the transformer are connected in series and the detector circuit is connected across the two. This is a simple and effective way of greatly extending the wave-length of any receiving transformer. The connections are as shown in the accompanying drawing, in which P is the primary and S the secondary of the transformer, D and T the detector and 'phone, respectively. When the D.P.D.T. switch, R, is to the left, primary and secondary are separate, and each plays its usual part. When R is closed to the right, primary and secondary are in series, and the connections are similar to those of a single-slide tuner. Whenever R is to the left, the 3-way key, Q, must be in its lowest position, *i. e.*, with antenna grounded through coil P. When R is to right, Q is set at its middle point, except for very long waves, when it is set at the highest point, thus throwing the loading coil, L, into the circuit. L may, of course, be omitted.

When P and S are in series, the wave-length can be altered by varying the number of turns of either coil or by varying the coupling. It is important to make sure that the current circulates through both cells in the same direction, making practically a two-layer coil out of the combination. The distributed capacity added to the circuit by this arrangement is too small to cause trouble.

By slight further complication it would be possible to make the system equivalent to a two-or three-slide tuner, but I have not found this necessary. This form of connection is useful for picking up stations of all wave-lengths, as it is only necessary for one adjustment to be made at a time.

When the coils are close-coupled, with all turns in series (coil L not being used), resonance with the 2,500-meter signals from N A A is attained when a small fraction of the capacity of the condenser is in parallel.

By using with any receiving transformer the connections shown in the drawing, the range of received wave-lengths can be increased four-fold. Of course signals are not as loud, nor is the range as long, as if an inductively coupled tuner of large size were used, still the results are surprisingly satisfactory. The principal limitation is, that it is not easy to tune out interference.

In addition to hearing N A A day and night at all seasons, it is generally easy at the station here described to read stations on the Atlantic Coast and many amateurs within a radius of fifty miles.

If the roof is wet with rain, signals are dimmer. It might be expected that when the roof was wet and hence more conductive, the capacity of the aerial and therefore the wave-length would be increased, but I have not found this to be the case.

By means of a wave-meter the natural wave-length of the aerial was found to be about 140 meters, and its capacity 0.0003 microfarad. These values are remarkably large, considering the dimensions of the aerial. This is doubtless due to the grounded conducting material in the house.

Few amateurs realize how simple a tuner is needed for receiving such long waves as those from W C C or N A A, if one possesses a good detector and receiver. For example, the writer has sometimes removed the receiving transformer entirely, and in place of it connected between antenna and ground three coils in series, each coil being nothing more than a closely wound "hank" of magnet wire about six inches in diameter. Such coils can be wound in a few minutes around a tin can or even around the spread fingers of one hand. No attempt at winding regular layers is necessary—in fact, the capacity of the coil is less if the winding is done at random. After winding, the coils are slipped off, the turns bunched together, and wrapped with a little string or tape to keep from spreading.

The coils mentioned had about forty, fifty, and seventy turns, respectively, of Size 18 wire. For most stations, two coils of 150 turns each are recommended. In parallel with these coils, between antenna and ground, the detector and phone are connected in series. The phone may, of course, have a fixed condenser in parallel with it. As is well known, the self-inductance of a closely wound coil varies with the square of the number of turns. Hence when two similar coils are laid on the table, one on top of the other, so that the current traverses each in the same direction, the self-inductance is nearly four times that of either alone; if now one coil is simply turned over, the self-inductance becomes a small fraction of that of either one. Thus by leaving one coil on the table, and moving the other about or turning it over, the system can be tuned continuously over a very wide range of wave-lengths.

With the three coils used by the writer, results were similar. Unfortunately the lowest wave-length that can be depended on is about 1,000 meters, owing to the comparatively large distributed capacity of the coils, but from 2,000 meters up, this crude arrangement gives results which in loudness are not so very inferior to those from an expensive tuner. Trouble from interference is also not as great as might be expected, especially if large wire is used and all connections are perfect. Flexible leads of lamp-cord should be used to connect the coils in series.

Middletown is about 300 miles from Arlington, yet time signals, news, and weather reports are very easy to copy, using the indoor aerial, with the simple apparatus described. No variable condenser is necessary if the coils have enough turns. Of course, the coils must be kept at a distance of some inches from masses of metal.

I have occasionally found the system to be in resonance with 600-meter stations, when the antenna system was tuned to five or seven times this wave-length. This is because an odd harmonic of the fundamental oscillation of this complex system of self-inductances and distributed capacities may happen to be especially prominent.

ODDS AND ENDS

(Continued from page 102.)

Safety Gap for High Potential Transformer.—During the adjustment of the rotary spark gap, the secondary winding of the high potential transformer should be protected by a safety gap.

The design in Figure 9 is applicable. Two brass rods ¼ inch in diameter have balls ½ inch in diameter mounted on the end. A third ball is placed in the center and thoroughly connected to earth. The actual distance between A and B (Figure 9) depends upon the potential of the transformer, but ordinarily the spacing is no more than ½ inch between the three electrodes. Then, if the spark gap proper of the closed circuit is widened to abnormal length, a discharge takes place from A to C, B to C, thereby protecting the windings.

Crystalline Detectors.—Sensitive crystals may be protected from dust or dampness by placing a few drops of oil on the used surface. This will not interfere with the action of the detector, but will prevent it becoming inoperative under the conditions.

Several inquiries have been made regarding the leak resistance for the vacuum valves.

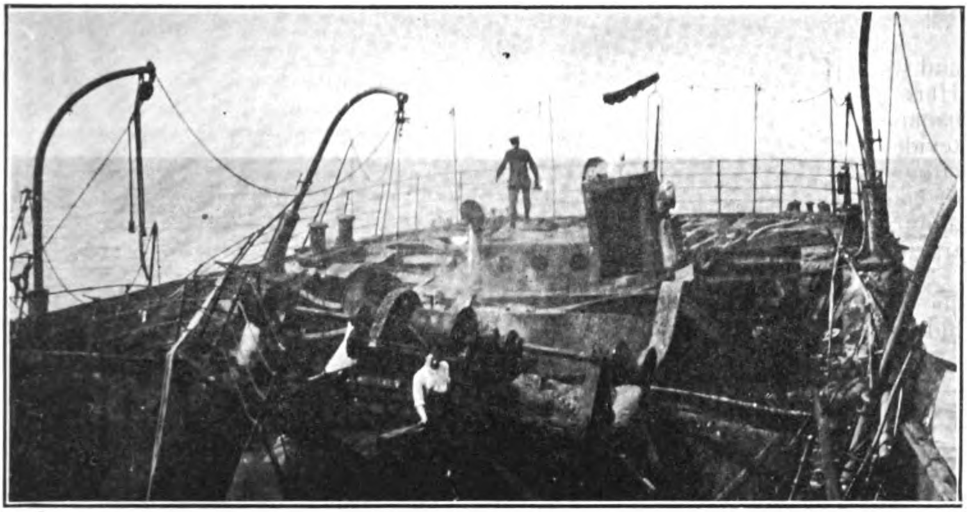
The static leak between the grid and filament of the vacuum valve has a resistance value lying between 500,000 and 2,000,000 ohms. A strip of paper placed underneath two binding posts and a lead pencil line drawn between them will give about the required value. The paper and the pencil line should be about 2 inches in length.

A PRIEST WHO MADE A NAME IN WIRELESS

The death of the Rev. Father Archibald John Shaw, scientist and artist, in Melbourne on August 28th, marked the passing of an interesting figure in wireless in Australia. Just previous to his death he had completed the contract for the sale of the plant of the Shaw Wireless, Ltd., to the Australian Navy Department for $275,000, of which he was to receive half for his share.

Father Shaw was born near Wagga about forty-four years ago, and did not enter the priesthood till he had gone through a training which laid the foundation of his recent success. As a young man he was employed for some time at Sydney, as a telegraph operator.

Eight or nine years ago the telegraph operator found the priest again. At the time of his death he had a number of wireless patents and a powerful plant. The first company was the Maritime Wireless Shaw System, Ltd., and with new capital and new business it became the Shaw Wireless, Ltd.



After the explosion

The Seventy-Seventh Voyage of the Tennyson

As recorded by Reginald Merry, wireless operator

IT was a gloomy outlook for the ship's company of the s.s. Tennyson when they were informed that the vessel was scheduled to steam from New York for the tropics on December 24—the day before Christmas. In port only a few days after a tedious voyage of four months, we had been looking forward with considerable pleasure to spending the holiday season ashore. So it was with somewhat heavy hearts that we watched the receding sky line of the city as the Tennyson steamed through the Narrows and left Sandy Hook astern, well under way for Santos, our port of destination—5,000 miles distant.

Christmas day dawned cheerless and cloudy, with a strong wind whipping the waters into formidable looking waves. The wind increased in force as the day wore on and late in the afternoon the ship was rolling and pitching as if she might at any moment turn over and hurl us into the sea. Old sailors said that they had never before seen the gale equalled in fury. One wave reached such a height that it knocked the bottom out of the crow's nest, carried away one of the sky lights on the boat deck and moved a life-boat out of its chocks. Weird beyond conception were the tricks played by the gale. Terrific gusts, shrieking like thousands of demons, would seize the ship in their grasp, apparently seeking to rival the force of the gale. Then, above the roaring of the blow, could be heard the plaintive wail of the steamship's whistle as the wind seized the wire cord that controlled it.

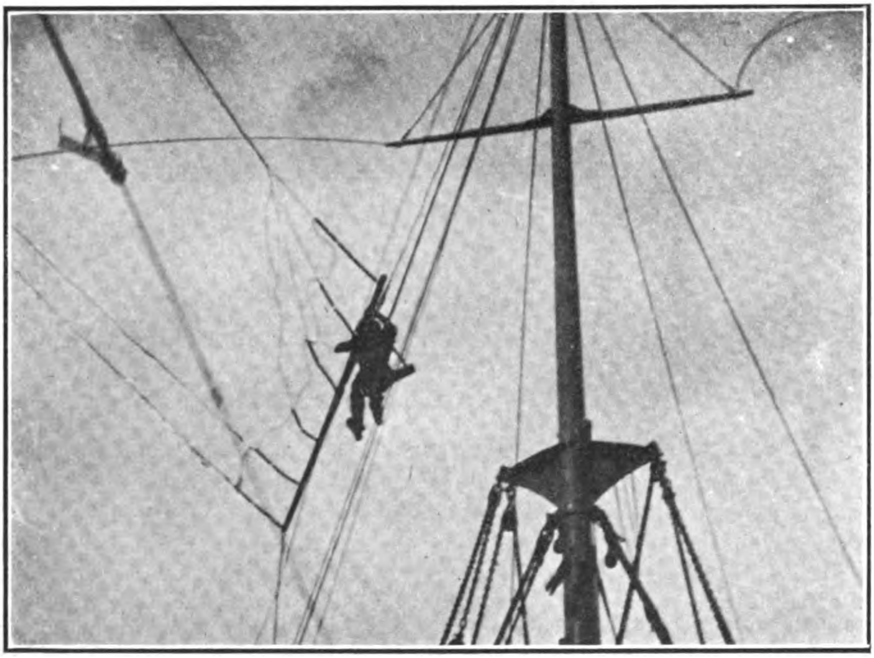
These weather conditions prevailed for four days and of course we of the wireless cabin momentarily expected to hear of ships in distress. Therefore, we were not surprised when the Thessaloniki on December 27 sent out calls for aid, saying that she was sinking. We were not near enough to be of aid, but we heard other vessels answering her appeals.

The storm at an end, our voyage proceeded, for a time, with nothing but pleasant incidents to mark its course, and we arrived at Santos on January 15. Here the Tennyson was loaded with bananas, leaving in the evening for Montevideo, where she docked four days later. At Buenos Aires, our next port of call, we loaded a cargo of quebracho, a gum-like substance used for dyeing, extracted from a tree in the Argentine.

Eight days later saw us safely anchored in Bahia Bay. Here we loaded hides and sixteen cases described as "photographic samples." The latter looked harmless enough but—however, I'll go on with my story.

The unexpected occurred five days after we had left Bahia for Trinidad, our next port of call. I was asleep in my bunk at fifteen minutes after four o'clock in the morning when an explosion so terrific that it can only be likened to the simultaneous discharge of a hundred cannon, shook the vessel and made her seem about to leap out of the water Slipping hurriedly into my clothes, I rushed to the deck. Here an indescribeable scene of havoc met my eyes. The entire after end of the ship had been blown away and the decks twisted about as though they were playthings in the hands of a giant. A solid steel girder, which probably weighed a quarter of a ton, had been blown over the mainmast and crashed through the boat deck. But most alarming of all was the sight of the flames started by the explosion which, it was afterwards determined, was due to a bomb in the hatch where the "photographic samples" had been placed.

Of the eight men sleeping aft only five escaped death. One of the survivors—the ship's carpenter—obtained an axe as soon as he had made his escape and groped his way back through the flames and smoke to rescue another member of the crew who was hemmed in his room. The carpenter succeeded in smashing two deck planks over the room of the imprisoned man and then, exhausted by his efforts and partly overcome by the flames and smoke, he abandoned his attempt.



Repairing the aerial

The wireless had not escaped damage, the antenna having been torn from the mast and hurled to the deck, a tangled, twisted heap. It was a situation that called for quick action, so we obtained two wires and ran them up to the signal arm on the foremast and down to the cabin. The dynamo continued to operate and, having obtained the ship's position, we flashed the S O S, but without avail.

The crew had been playing the water from the fire hose on the flames and this was not without its effect. Another encouraging sign was also discovered in the fact that the ship was not leaking, and hope began to be entertained that the vessel could be saved. By noon time the flames were so well under control that it was possible for members of the crew to make their way aft. The engines were still in good order, although the steering gear had been considerably damaged, and, a jury rudder having been rigged up, it was decided to navigate the vessel at half speed, toward Maranhao, 180 miles away.

We were without an adequate chart of the coast toward which we were headed, but the weather conditions were favorable and the vessel made steady progress. However, as we neared the coast a storm blew up and the Tennyson, too badly crippled to combat it, ran her nose into a sand bank. She was released without great difficulty from this predicament, however, and steered to a safe anchorage.

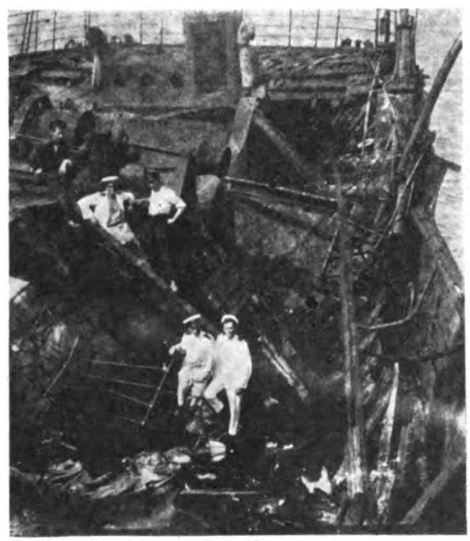
The next morning a pilot boarded the vessel and we arrived in due time at Maranhao. There were no facilities here to make repairs to the Tennyson, however, and consequently she steamed for Para, still using the jury rudder. Calm weather prevailed during the trip and for this I was thankful as we had rigged up a two-wire aerial which I was fearful would be displaced in the event of a storm.

At Para the cargo and wreckage was removed from the ship and then it was towed to a small place called Val-de-Caes, where the work of patching up the Tennyson began.

Here we remained for seven weeks. At length the Tennyson steamed back to Para to load what remained of her cargo. At Para we rigged another two-wire aerial from the foremast, and, as the mainmast was missing, we ran it to a spreader on a flag staff on the poop.

April 26 was a red letter day for us, for on that date we steamed for New York, via Barbados. The Tennyson had been only two days out of Para, however, when the carpenter was stricken with illness and it was feared that he had yellow fever. At Barbados a physician came aboard, but he was unable to determine the exact nature of the carpenter's illness. Three other physicians were no more successful and they ordered that he be taken to the quarantine hospital on Pelican Island where he died. Following his death, the captain of the Tennyson was directed to bury the carpenter's body five miles out at sea.

These incidents of course resulted in delay in getting again started on our voyage for New York. In fact many of us believed that the carpenter's death was due to some contagious disease and we were prepared to become reconciled to a quarantine. Great was our surprise



Havoc was on all sides

therefore in the afternoon following the burial to be informed that the carpenter had died from acute meningitis and that the Tennyson was free to leave port. The crew needed no urging to make haste in their preparations for departure and at midnight the vessel was showing her heels to Barbados.

As if to make up for previous neglect, good fortune smiled radiantly on the Tennyson during the last leg of her voyage. Excellent weather prevailed and the vessel made a speedy trip to Sandy Hook. A short time afterward saw us at Quarantine and with the high tide we went to dock. In this manner was the seventy-seventh voyage of the Tennyson ended.

Photo Electric Phenomena*

By Dr. J. A. Fleming, F. R. S.

THE Phenomena of Light and Electricity are so closely connected that we may truthfully say the study of both is embraced within the confines of a single branch of science.

The term photoelectricity is, however, restricted to the description of a particular effect—viz., the power of light of certain kinds to cause an electric discharge or leakage of electricity from many substances, or under some conditions to produce an electric charge, or electromotive force or ionization.

The starting point for this subject is found in an observation Hertz made in the course of his celebrated researches on the production of electric waves, in which he noticed that the discharge in the form of an electric spark between two balls is facilitated when light from another spark falls upon them.

This effect can be shown by a special form of apparatus devised by the writer. It consists of two upright strips of wood carrying copper strips which are connected at two places by a pair of spark balls, adjustable as to distance. The lower pair of balls are inclosed in a glass box, whilst the upper pair are exposed in the air. The copper strips are connected to the inner and outer coatings of a pair of Leyden jars, and these again to an induction coil. When the coil is in action, electric sparks jump across between the balls. We can then adjust the two spark lengths so that the sparks always take place between the two bottom balls in the glass box, because these balls are a little closer than the upper pair. If we now illuminate the upper balls by the light from an electric arc, or a piece of burning magnesium wire, or the light from another electric spark between zinc balls, or else points of Invar, which is a nickel-iron alloy, we see that the sparks discharge at once takes place between the upper balls. This effect is not due to the visible or eye-affecting light, because the interposition of a sheet of glass or mica stops the effect. On the other hand, a sheet of transparent quartz does not. Hence we infer that the action is due to the ultra-violet rays in the light, or those of very short wave-length. The material of which the spark balls acted upon are made does not seem to have much influence. Experiment also shows that the chief part of the effect is due to the action of the ultra-violet light on the negative spark ball.

These observations were made by Hertz in 1887, and immediately suggested lines of research to others. Hallwachs soon afterwards discovered that the same kind of light could discharge electricity from a negatively electrified zinc plate.

If a plate of zinc, or better, magnesium which has been recently well polished with emery paper, is placed on an insulating stand connected with a gold leaf electroscope, and a charge of negative electricity given to it, it is found that the charge rapidly disappears if the plate is exposed to the light of an arc lamp. The experiment succeeds better if an uninsulated brass grid or plate of coarse gauze is placed between the plate and the light. If the plate is oxidized or tarnished, or has been long exposed to the air since polishing, then the discharge of negative electricity from it proceeds much more slowly. If the plate is positively electrified, the discharge does not take place, or but very slightly.

We may show the experiments in another way. If we insulate a piece of brass gauze and connect it to an electroscope and charge it with positive electricity, then, if the insulation is good, there should be no leakage. If then we

* From "The Year Book of Wireless Telegraphy and Telephony, 1916."

hold near to the gauze a polished plate of zinc, magnesium or aluminum which is uninsulated, we find that no discharging effect takes place until light from an arc lamp or other source of ultra-violet light illuminates the polished plate, and then the positive electricity of the electroscope is discharged.

These experiments may be modified by employing a very sensitive galvanometer in place of an electroscope. If we connect to the negative terminals of a high potential battery a polished zinc plate, and to the positive terminal a piece of metal gauze, and insert in the circuit a galvanometer, and then bring the gauze near to the zinc plate, we find no current as long as the zinc plate is not illuminated. If, however, a strong light, rich in ultra-violet rays, is thrown through the gauze on to the zinc plate, the galvanometer at once gives indications of an electric current which is called a photoelectric current.

Light Effects Escape of Electrons

The consideration of all these effects shows that there is a leakage of negative electricity from negatively electrified bodies when they are exposed to light, chiefly ultra-violet light. In modern terminology we say that light falling on certain substances causes an escape of electrons from them.

Many things affect this photoelectric discharge.

First, the nature of the body itself. Some are highly photoelectric, such as zinc, magnesium, potassium, sodium, rubidium. Broadly speaking, the most oxidizable metals are most photoelectric, and the photoelectric order is very roughly that of the electro-chemical series, the most electropositive being the most photoelectric.

Secondly, the physical nature of the surface, whether polished or tarnished, smooth or rough, has a great deal of influence, and,

Thirdly, the nature of the atmosphere or surrounding gas.

A convenient method of exhibiting these facts and testing various substances is by an apparatus as follows:—It consists of a box within which is contained a series of spark gaps between Invar points. The ultra-violet light radiated passes out of an aperture covered with a thin transparent quartz disc and passes down a tube and falls upon a disc of the substance under test. Around the outside of the tube, but so protected as not to be affected directly by the light, is an insulated metal ring which is connected to an electroscope. This ring is given a charge of positive electricity. When the spark light shines on the disc under test, it liberates from it negative electrons. This discharge passes through the air and discharges the positively charged metal ring. By observing the time taken for the electroscope to be discharged we can compare various substances, solid, liquid or in powder, with each other with regard to their photoelectric activity in air. The results, however, of such observations in air must be interpreted with caution. It must be noted in the first place that the radiation most effective in the case of one metal or subtsance is not so in another, and, moreover, the nature of the surrounding atmosphere affects the result. Also, we have to take into account a very noticeable effect which is commonly called *photoelectric fatigue*. It is found that the sensitiveness of a freshly cleaned surface of metal rapidly decreases if the metal is left exposed to the air. It has been found that this depends much on the size of the vessel in which the substance is kept. In the open air photoelectric fatigue progresses most rapidly, but less so if the body is kept in a closed chamber. The term "fatigue" is not very appropriate, because the photoelectric sensitiveness is not recovered on resting.

Photoelectric Deterioration

Elster and Geitel found that a freshly polished zinc surface lost half its photoelectric sensitiveness in five minutes. Hoor noticed that for freshly cleaned metals, zinc, copper and brass, the activity was reduced one-tenth of its initial value by exposure for forty-eight hours to the air. The effect, however, is not due or wholly due to oxidation of the surface, because it takes place in hydrogen as well as in air. Again, it takes place in the case of such insulating materials as sulphur, shellac and paraffin, which are not oxidizable. It would be more apropriate to call this falling-off the *photoelectric deterioration.*

The reasons for this photoelectric deterioration have not yet been fully ascertained, but as far as the evidence goes, it seems to be due to a peculiar condition of the gaseous layer adhering to the surface of bodies. It is suspected that in some cases it is due to the formation of a film of hydrogen peroxide, which is extremely absorbent of ultra-violet light, and this again may be due to the action of the ultra-violet light on aqueous vapor in the air, or moisture condensed upon the surface, according to the chemical equation $2H_2O = H_2O_2 + H_2$.

Experiments seem to prove that pure clean metal surfaces in a very high vacuum show no photoelectric fatigue.

How to Obtain Consistent Results

Accordingly, experimentalists sooner or later realized that consistent results can only be obtained when we experiment with freshly prepared surfaces in a very high vacuum. This, however, introduces great experimental difficulties, and it is necessary to devise methods for distilling or preparing the metal or other substance in the vacuous tube. Some years ago the writer described methods for doing this in the case of the liquid potassium sodium alloy, which is very highly photoelectric, and, moreover, sensitive to ordinary visible light. Small lumps of potassium and sodium are placed in a glass tube, the weights being in atomic ratio—viz., about 2 to 1. When this is melted in vacuo it produces a liquid alloy resembling mercury, which can be tilted off from the solid dross or oxide. If such liquid alloy is placed in a clean part of the exhausted tube provided with an electric connection, consisting of a platinum wire sealed through the glass, and if there is a clean platinum plate, also with an external electrode placed over and near to the alloy surface, we can observe the following facts:

First, the alloy surface rapidly discharges negative electricity when light from an arc lamp falls upon it. Also when illuminated the alloy discharges positive electricity from the platinum plate, provided the alloy is kept connected to the earth. Most remarkable of all is the fact that the alloy when illuminated actually generates an electric current. If we connect a sensitive galvanometer to the alloy and to the platinum plate, then in darkness there is no electric current; but when a bright light falls on the alloy surface the galvanometer indicates a current, and this current is in the opposite direction to that which would flow under the volta contact potential difference. That is to say, the negative electricity comes out from the terminal connected to the platinum plate and flows through the galvanometer back to the terminal connected to the alloy. This proves that light causes an emission of negative electrons from the alloy surface, which has an electromotive force greater than the contact E. M. F. due to platinum and potassium.

The strength of the photoelectric current varies with the color of the light thrown upon it—that is, with the wavelength. Elster and Geitel found that this negative leak is greater for potassium than for sodium, provided we employ white or blue light, but for yellow light sodium is more photoelectric than potassium, and rubidium is vastly greater than either of them, both for white and for yellow light.

Photoelectric Metals

The writer showed that several such photoelectric cells could be joined in series to make a photoelectric battery. If it were possible to obtain the rare metal rubidium in large quantities, it would be possible to construct a rubidium photoelectric battery of a large number of cells, which would create a considerable electric current merely by illuminating the rubidium surface. It is needless to say that the energy represented by this current would be drawn from the light energy.

We may next pass on to notice some curious and interesting facts with regard to the photoelectric properties of various classes of substances, solid and liquid.

It has been mentioned that the most photoelectric metals are the electropositive ones, rubidium, potassium, sodium, magnesium, zinc, aluminum, etc. The least sensitive are the electronegative and non-oxidizable metals, platinum, gold, silver, palladium. Metals such as copper, iron, and nickel occupy an intermediate position.

There are, however, many compounds of metals and non-metals which are highly photoelectric, such as the sulphides and iodides, especially the sulphides. These sulphides may be roughly arranged in the following order, the most photoelectric standing first:—Sulphide of lead, copper, manganese, silver, tin, iron, chromium, bismuth, nickel, antimony, zinc, cadmium, cobalt, and molybdenum. The native sulphide of lead called galena and the native double sulphide of copper and iron, called chalcopyrites or copper pyrites, are markedly photoelectric; whilst the native sulphide of molybdenum, called molybdenite, is very insensitive.

Photoelectric Effects

Again, the phosphorescent sulphides of barium, calcium and the alkaline earths are very photoelectric. Flourspar, which is a fluoride of calcium, is also photoelectric; and silver iodide is said to be remarkably photoelectric under ultra-violet light.

Another important class of substances which exhibit photoelectric qualities are the aniline dyes. Not only is anthracene photoelectric, but also eosin, fluorescine, fushin; and aniline green and violet are very sensitive in the solid as well as in solutions.

There is a certain conection, in fact, between fluorescence, phosphorescence, and photoelectric leak or discharge, and, broadly speaking, the fact that a substance is fluorescent is generally an indication that it is photoelectric and will lose negative electricity when illuminated by ultra-violet light.

With regard to liquids, many experimentalists agree that pure water shows no photoelectric effect when illuminated by the electric arc. Soapy water is intensely non-photoelectric, and even very sensitive materials, such as clean zinc, lose sensitiveness if smeared with soapy water.

Generally speaking, flourescent liquids are photoelectric, and I have noticed a marked leak of negative electricity from the surface of paraffin oil, which is well known to be flourescent.

The flourescence of a body is a property of it in virtue of which it has the power to create a change in refrangibility of light. It absorbs, say, ultra-violet or non-luminous light and radiates or emits violet or visible light. A typical instance of this is a solution of sulphate of quinine.

At this point we may with advantage consider in outline the explanations which have been offered to account for photoelectric effects.

According to modern views, we regard electricity as having an atomic structure, and the atoms of negative electricity, called electrons, are constituents of chemical atoms. All electric conduction and electric currents are considered to be due to a movement or drift of electrons in or between chemical atoms or molecules. All radiation is effected by oscillations of electrons, which create ether or electric waves when the velocity of the electron is being changed. Hence an electron radiates only when it is being accelerated. Again, the forces binding together atoms into molecules are electric forces due to electric charges. Hence we may classify the electrons in a certain manner depending on function. We have to consider the conduction electrons, the radiation electrons, and the valency electrons. This does not imply that the same electron may not function in all three ways. It is merely a classification for the sake of distinction.

Conduction Electrons

The conduction electrons may be regarded as the molecules of a kind of gas. They are assumed to be in rapid irregular movement, and, in good conductors, to be about as numerous as the chemical atoms. Their velocities are distributed according to the same law as those of gas molecules. These free electrons cannot, however, escape from the conductor, because if they did they would leave it positively electrified. In the next place we have those electrons the vibrations of which create the radiation or spectrum of the body when incandescent or luminiscent. Lastly, there are electrons more or less loosely attached to the atom, up to the number of eight, which by entrance to or exit from the atom give rise to the atomic electric charges proportional to the chemical valency, and so effect chemical combination.

The question then arises, to which of these classes do the electrons belong, the escape of which constitutes the photoelectric discharge? If light discharges negative electricity, this implies that light causes an escape of negative electrons. We then ask, what electrons are these, and how is this escape brought about?

Dealing first with the conduction electrons, it may be noticed that there is no good evidence that these are liberated in the photoelectric effect. If they were, one would think the body should become a worse conductor when illuminated. Since, however, in good conductors the conduction electrons are extremely numerous, probably about as numerous as the atoms, there might be a considerable loss of conduction electrons without sensible or measurable loss of conductivity. On the other hand, one well-known case in which light affects conductivity is that of selenium. The effect of light falling on it is to increase conductivity. Again, light is said to increase the conductivity of sodium vapor, and Arrhenius found that the haloid salts of silver increase in conductivity under the action of light.

Conductivity and Ultra-Violet Light

There is no well marked case of decrease in conductivity under the action of ultra-violet light. The author has found one interesting connection between photoelectric sensitiveness and conductivity. It is well known that the contact between certain pairs of substances has a unilateral conductivity. Thus the contact between zincite (native oxide of zinc) and chalcopyrite (copper pyrites) conducts negative electricity better when flowing from zincite to chalcopyrite across the junction than in the opposite direction. The same is true for a junction between molybdenite (native sulphide of molybdenum), and copper, also between plumbago (carbon) and galena (sulphide of lead). Again, a junction of tellurium and aluminum, silicon and steel, carbon and steel, and several other pairs of metals and non-metals, such as gold and iron pyrites (native persulphide of iron), have similar unilateral conductivity.

It has been found that almost without exception, of these pairs of substances which so act, one of them has great photoelectric sensitiveness and the other one small. The two materials which compose a rectifying contact always differ greatly in photoelectric sensitivity or power. The one which loses negative electricity most easily under the action of ultra-violet light is always the sulphide, or else the good metallic conductor. The largest negative current flows across the junction from the material of small photoelectric activity to the one of large activity. For example, chalcopyrite is vastly more photoelectrically sensitive than zincite, and the largest current flows across the junction when the zincite is the negative terminal or electrode, or is attached to the negative pole of the battery.

Sensitiveness Dependent on Molecular Grouping

Whatever may be the proper interpretation of these facts it appears clear that photoelectric sensitiveness is not an atomic property, but is a molecular one, and depends also on molecular grouping. Also we cannot trace any definite relation between this property and electric conductivity. Accordingly, we are obliged to assume that there are in connection with certain molecules or groupings of atoms certain electrons which can be set free by light of short wave-length.

The question then arises: How does the light act? Is it a simple resonance action in virtue of which the luminous vibrations work up these loosely attached electrons to such an amplitude that they break loose from their moorings and are shot off, just, for instance, as water waves might cause a boat to break loose and drive it away? If this were the case, it would seem most probable that the more intense the light—that is, the greater the amplitude and energy of the light waves—the more effective it would be, and the greater the velocity of the electron which is detached and flung out. Also it would appear likely that high temperature in a body, by increasing the electronic motion, should promote or increase photoelectric effects. But two very remarkable facts have been discovered which are quite inconsistent with this resonance theory. The first is that the maximum velocity with which the electron are shot off when the sensitive substance is exposed to light is independent of the temperature, as long as the body is not oxidized or otherwise altered by heating or cooling. Thus, for the noble metals it is invariable between a red heat and the temperature of liquid air.

The second fact is that this maximum electronic velocity is independent of the intensity of the incident light, and depends only on the frequency; but no electrons at all are liberated if the frequency falls below a certain value. There is a special velocity for each substance. For a given metal or substance the maximum velocity with which the electron is shot out increases with the frequency of the light, and the electronic energy is proportional to the excess of this frequency above a certain minimum, which must be exceeded in order that any photoelectric effect may take place at all.

Discussion of a Theory

It appears, therefore, that there is a certain energy required to get the electron away from its atom or to detach it from home; and that over and above this the energy absorbed is proportional to the frequency of the light and to a constant called Planck's constant. The difficulty which we are called upon to face in endeavoring to explain these facts by the ordinary undulatory theory is as follows: A molecule cannot absorb more radiant energy than falls on its surface or projected area. Now the cross section of a molecule is something of the order of 10^{-16} of a square centimetre. It is certain that light of suitable wave-length which falls on a photosensitive surface, giving to it per second energy equal to 1 erg per sq. centim., will produce a photoelectric effect. The liberation of 1 electron requires at least 10^{-12} erg. Hence the above illumination would have to fall for 1,000 seconds on each molecule to impart to it the necessary energy to expel an electron. It is, however, found that the photoelectric effect, if it takes place at all, happens instantly the illumination begins. The conclusion is inevitable that the ordinary undulatory theory, in which the light energy is assumed to be spread uniformly over the wave front cannot, taken by itself, adequately explain photoelectric effects.

It has been, therefore, necessary to introduce modifications. Sir Joseph Thomson has suggested that in the light wave the luminous energy is not distributed uniformly over the wave front, but is concentrated at certain points in it. This supposition is somewhat analogous to a view taken by Faraday in his "Thoughts on Ray Vibrations." On the other hand, we have more recently the hypothesis developed by Planck, Einstein and others, that radiation is not emitted continuously, but in gushes or bundles, which are, in effect, indivisible units of energy and all absorbed as a whole. These gushes of radiant energy are called *quanta,* and the size of these quanta is proportional to the light frequency and to a constant called Planck's constant. Our ordinary measure of radiation is therefore an average, and the maximum value at any moment may greatly exceed the average value. We may compare this view of radiation with the ordinary one by the illustration of carrying water in buckets, say, to put out a fire, as contrasted with pumping a steady stream of water through a hose. In the bucket-carrying process the water arrives in gushes or lots, but the average water delivered per hour is very much smaller than the maximum delivered at the moment when one bucketful is just being poured on the fire.

This view of the case gives to the radiant energy an atomic character, and we can speak of these quanta as atoms of energy.

Phenomena Not Fully Explained

In spite of the fact that this quantum theory helps us to explain very easily photoelectric effects, and also many other matters, such as the distribution of energy in the spectrum and some facts connected with the ionization of gases by ultra-violet light, yet this theory seems hopelessly irreconcilable with the fundamental facts of interference which must be primarily explained. The well-known fact that two rays of light can, under certain conditions, extinguish each other at a point in space is one of the chief truths of physical optics, and is at once explicable on theory of a wave motion. But it is not interpretable on any corpuscular theory of light or radiation. Hence, although this quantum theory of radiation has attracted much attention and exercised much ingenuity, it is probably correct to say that the leading physicists have felt it does not give us a final theory and that photoelectric phenomena are still not yet fully explained.

Case of Gases

We pass on then to consider photoelectric effects in the cases of gases, particularly the circumstances under which light of short wave-length can ionize gases or produce in them positively and negatively electrified particles.

If an electron or negative corpuscle is extracted from a chemical atom it leaves the atom positively electrified. If, on the other hand, a neutral atom takes up an electron it becomes negatively electrified. The extraction of an electron requires the expenditure of a certain energy, and the electron itself is a charge of negative electricity equal to 4.772×10^{-10} electrostatic unit or 16×10^{-20} Coulomb.

Hence we may represent the work required to extract an electron from an atom as proportional to a certain voltage called the ionizing voltage. This ionizing voltage multiplied by the electron charge gives the ionizing work, which last may be measured in ergs. The ionizing energy is of the order of one-billionth of an erg.

The ionizing voltage varies from about 2 to 12 volts for various atoms, being greater for electronegative atoms than electropositive ones. For gaseous oxygen the ionizing voltage is 9 volts, and the ionizing energy about 15 billionths of an erg.

Now experiment shows that ultra-violet light of very short wave-length can ionize gases, and it has also been proved that there is a connection between the length of the longest wave of light which can effect this ionization and the ionizing voltage. The product of this longest wave-length and the voltage is always a number near to 11,000 or 12,000, if the wave-length is measured in Angstrom units (A. U.).) Thus for sodium the ionizing voltage is 2.1 volts, and hence the maximum wave-length is 5,500 A. U.

Hence wave-lengths longer than this will not liberate negative electricity from sodium.

For oxygen, the ionizing voltage is 9, and hence wave-lengths longer than about 1,350 A. U. will not ionize oxygen. This wave-length is about 2 octaves higher up in the spectrum than ordinary blue-green light. It therefore requires ultraviolet light of very short wave-length to ionize gaseous oxygen. It is a difficult matter to prove experimentally the ionization of gases by ultra-violet light. The gas must be contained in some vessel, and have a window of some material transparent to light of very short wave-length. Glass is very opaque to this light, and even quartz does not transmit light of wave-length less than about 1,850 A. U. Almost the only substance available is fluorite (fluoride of calcium). We have to avoid spurious effects due to photoelectric action of the light on the walls of the vessel or upon dust particles in the gas. Nevertheless, by suitable precautions it can be shown that light of wave-length less than about 1,400 A. U. can ionize—that is, produce, positive and negative ions in a gas.

Sun Light and Atmospheric Gases

The question then arises whether the light of the sun thus ionizes the atmospheric gases. It has been shown by Huggins and by Cornu that the light which reaches the surface of the earth from sun and stars contains no wave-lengths shorter than about 2,950 A. U. The spectrum is terminated pretty sharply at that point.

Now the sun is a body at a very high temperature, and must certainly radiate light of very short wave-length. The absence of the very short wave-lengths from the light received at the surface of the earth seems therefore to prove that there is an absorption of ultra-violet light of very short wave-length in the upper levels of the atmosphere.

This light possibly ionizes these higher levels. Ionization in gases is proved by the gas acquiring electric conductivity. An un-ionized gas is a perfect non-conductor. It is found that air even near the sea level has always some small degree of electric conductivity. This, however, cannot be due to true ionization by solar light. It may be due to photoelectric action on dust particles or to radio-active matter in the sea or soil.

Strong Ionization In Upper Atmosphere Levels

There are well-known phenomena in connection with wireless telegraphy which seem to indicate the existence of somewhat strong ionization in the upper levels of our atmosphere which, in part at least, are due to ionization by solar light because they vary with day and night. Such, for instance, as the now well-known day and night effect on radio-telegraphy discovered by Senator Marconi in 1902, in virtue of which signals are in general received at greater distances by night than by day.

In addition to this there seems to be a more permanent ionization of the very high levels of the atmosphere which is not due to true light ionization, but possibly due to the projection of negatively electrified corpuscles from the sun propelled by light pressure and ionizing the upper layers of our atmosphere by impact.

The sun is an incandescent body, and the light-giving portion of the sun called the photosphere is probably in the main composed of carbon. Hence, like other incandescent bodies, such as the filament of an electric lamp, it projects from it electrons or atoms of negative electricity. These, as they pass outwards through the superimposed solar atmosphere, collect molecules round them and form small masses called negative ions.

It was shown by Clerk Maxwell that light or ethereal waves exercise a pressure upon bodies upon which they fall.

At the earth's surface the solar light pressure only amounts to 2.8 lbs. per square mile taken perpendicularly to the light rays. At the sun's surface, owing to the vastly greater intensity of the light, it amounts to no less than 58 tons per square mile. One cubic mile of sunlight near the sun's surface contains energy equal to 302,300 foot-tons, enough to throw twenty of H. M. S. Elizabeth's 15-inch shells over the top of Mont Blanc. Consider, then, a small particle of matter poised in space near the sun's surface. Gravity at that place is twenty-seven times greater than at the earth's surface. Hence the particle is pulled towards the sun with a force twenty-seven times greater than its weight on the earth. But the light-pressure is pushing it outwards. The gravitation pull varies as the mass or as the cube of the diameter, whereas the light-pressure varies as the surface or as the square of the diameter. Hence if the particle is made smaller the light-pressure decreases much less fast than the gravitation attraction, and for a certain diameter—viz., about 0.00013 cm. or 13,000, A. U., if the density of the material is equal to that of water—the push would just balance the pull. Suppose the particle made still smaller, then it can be shown that the light-pressure would not increase indefinitely relatively to the gravitation pull, but would come to a maximum for particles of unit density and of a diameter equal to 1,600 A. U. This is about twice the thickness of very thin gold leaf. For such a small particle the solar light-pressure near the sun's surface would be ten times greater than the solar gravitation, and the particle would be flung away from the sun with an acceleration to start with of about 2 kilometres per second. Hence it would cover the distance between the sun and the earth in a very few score hours, and would enter the earth's atmosphere, if it happened to hit it with an enormous velocity.

Transit Time From Sun to Earth

The writer has calculated for particles of three sizes what this time and velocity would be. Taking three sizes, viz., 1,600 A. U., 5,000 A. U., and 10,000 A. U., the first is about the wave-length of the shortest ultra-violet light easily made, the second that of the wave-length of blue-green light, and the third that of ultra-red or heat rays. The times of transit from sun to earth and final velocities are as follows:

Diameter of particle in Angström units.	Time of journey in hours from sun to earth.	Velocity on reaching earth in kilometres per second.
1,600	25	1,700
5,000	55	800
10,000	112	350

Hence the energy contained in quite a small quantity of this dust is enormous. If we suppose 1 kilogram = 2.2 lbs. of the dust of the above sizes to arrive at the earth's atmosphere, the energy it would bring with it would be as follows:

Diameter of particle.	Energy in horse-power hours per kilogram.
1,600 A. U.	540,000
5,000 " "	120,000
10,000 " "	45,000

Therefore as much of this dust as one could carry in one's pocket would convey to the earth enough energy to run one of our large battle cruisers at full speed for 18 hours!

This energy must expend itself in ionizing the upper layers of the earth's atmosphere, which consist principally of hydrogen and helium. Hence the outer layers of the atmosphere are probably in a state of strong permanent ionization.

We have then to recognize, roughly speaking, three layers in the earth's atmosphere, not, however, sharply delimited from each other, in which ionization occurs. In the upper or highest layers of the atmosphere there is strong permanent ionization with a predominance of negative ions. In the middle layer there is ionization, both positive and negative, due to solar ultra-violet light of short wave-length which is strong by day but weaker by night. In the lower layers near the earth there is weak ionization, chiefly due to radio-active matter in the soil or sea, or to photo-electric action on dust particles or ice particles in the air.

This permanent and varying ionization reveals itself by its action on the long electric waves used in wireless telegraphy and upon the stray waves produced by atmospheric electric discharges. This action seems based upon the variation in velocity produced on such electric waves when they pass from a strongly ionized to a weakly ionized region or *vice versa*.

Although it has not been proved experimentally that strongly ionized air has a less refractive index for long electric waves, yet it has been shown mathematically by Dr. W. H. Eccles that if the ions are a certain class of heavy ion the effect is equivalent to a reduction in refractive index of the medium. If this conclusion is valid, then it can be shown that if the bounding surface of the heavily ionized air is fairly well marked a ray of long wave-length radiation would suffer a rapid refraction when incident on the surface equivalent to reflection. Hence it may be concluded that there is on the underneath side of the heavily ionized atmospheric layer at great altitudes an effect equivalent to an *inverted mirage* by which electric rays sent upwards are bent down again.

If, however, the bounding surface of this heavily ionized layer is underlaid by other layers of gradually decreasing ionization, the reflective effect of the upper layer may be greatly diminished. In this manner it is possible to explain some of the curious variations in strength of radio-telegraphic signals at or about sunrise or sunset and the extension of range of freak signals at other times by the refraction or bending downwards of the electric rays.

We have thus good grounds for believing that atmospheric photoelectric effects play a very important part in long distance wireless telegraphy, but it will require many years of careful observation before all these phenomena are disentangled and explained.

INSTITUTE HEARS PAPER BY E. H. ARMSTRONG

At a meeting of the Institute of Radio Engineers, held on October 4th in the building of the American Institute of Electrical Engineers, New York City, Edwin H. Armstrong presented a paper on "The Heterodyne Theory of Amplification and Its Relation to the Oscillating Audion."

NAVY DEPARTMENT CALLS FOR EQUIPMENT

As a result of the Naval Appropriations Bill, recently approved by Congress, schedules have been issued by the United States Navy Department calling for considerable radio equipment of various sizes. It has been estimated that between $400,000 and $500,000 worth of business is involved.

With the Amateurs

The membership of the San Francisco Radio club has increased so rapidly that is has become necessary to vacate the former club room at 737 Shrader street and occupy a new meeting hall at 350 Frederick street.

The new club room is large enough to accommodate 100 persons, and it is expected that the membership will reach the hundred mark by the end of the year. Due to the enormous amount of correspondence to be carried out by Secretary H. R. Lee, an assistant secretary has been elected, E. W. Radford being the successful candidate.

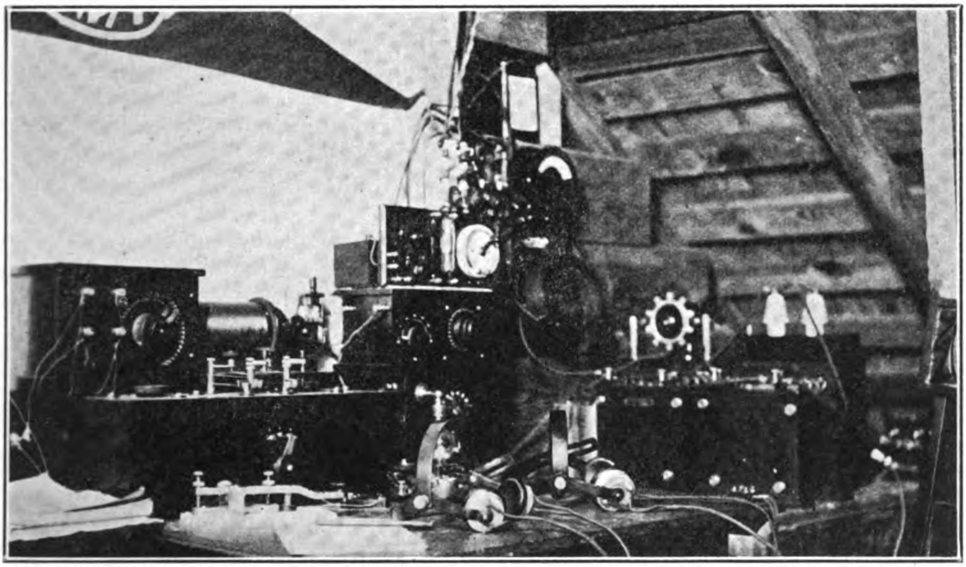
Plans for the installation of a modern radio station are under way and within due course of time the club room will be equipped with one of the best radio stations in the city.

The club is steadily growing in popularity, and approximately ten new members are admitted to the club monthly.

The first edition of the Year Book of the San Francisco Radio Club has been sent to hundreds of addresses. Available copies still on hand may be procured from the Secretary by sending a two cent stamp in order to lighten the mailing charges.

Among radio operators recently admitted to the club are H. R. Spraddo of the National Wireless Telephone Co.; F. L. Busch, radio operator at the Fort Winfield Scott station, and several former marine operators of the Marconi Wireless Telegraph Company of America.

Meetings are still held as usual, Friday evenings at 8 P. M. Notices and announcements, as well as application blanks, may be secured from the secretary, H. R. Lee, 1580 Grove street, San Francisco, Cal.



An amateur equipment located near where the troops are mobilized along the border, the station of D. H. Graham, of House, Texas

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The Roxborough, Philadelphia, Wireless Association was recently organized for the purpose of developing wireless telegraphy and telephony in the Twenty-first ward. The following officers have been elected for the coming year: President and treasurer, Ernest McGee, vice-president and secretary, Earl Henson;

The Association would like to hear from all amateurs in Philadelphia regarding the range of their stations so that it may communicate with them by wireless. Address all communications to the secretary at 6200 Ridge avenue.

The third annual convention of the Hawkeye Radio Association was held in Des Moines recently. Plans were made to enlarge the membership, to assist in the establishing of relay lines and to take up other matters.

The monthly Bulletin will be continued throughout the year as before. The Association was one of the first in the country to print such a Bulletin, and it has proved very valuable.

The following officers were elected:

President, D. R. Lewis, Eldora, Iowa; vice-president, H. K. Sels, Ames, Iowa; secretary-treasurer, J. W. Silcott, Brooklyn, Iowa; purchasing manager, A. B. Church, Ames, Iowa; relay manager, Ralph Batcher, Ames, Iowa.

The Association would be glad to get in touch with any amateurs in Iowa. The relay manager would like to hear from other state organizations in the Middle-West.

The Association held a wireless exhibit at the Iowa State Fair, the station attracting considerable attention. Messages were sent free of charge to many towns.

The most popular feature of the station was a high grade undamped wave receiving set. Arc stations could be heard at nearly all times and news reports were sent daily. Nearly $1,000 worth of apparatus was on display.

The Crescent Bay Radio Association has been formed in Santa Monica, Cal., with the following officers:

President and chief engineer, Thomas J. P. Shannon; first vice-president, George G. Cole; second vice-president, Herbert Bohme; third vice-president, and secretary-treasurer, Elmer Forsythe; general manager, Phillip Leigh; chief operator, Harold Bull.

The officers will act as a Board of Directors, the main office being at the home of the president, Thomas J. P. Shannon, 1148 Fifth street, Santa Monica. He has a ninety-six foot aerial pole and an excellent wireless telegraph outfit. All amateurs are requested to make application to the president. The call of the Association is 6QJ. Meetings of the Board of Directors will be held every two weeks.

The office is situated five blocks from the ocean and overlooks the great race course of the west, where the Vanderbilt cup and grand prize races are held. It is proposed to send out the position of each car to all amateurs and those who wish to copy, thereby giving them the first news of the races.

Following the plan which was adopted two years ago, the radio station operated by the Department of Physics of the Nebraska Wesleyan University will send out coded weather forecasts and a synopsis of current news on each week day at 8:55 A. M.

Coded forecasts will be repeated three times to give opportunity to copy correctly. Through the courtesy of Professor Loveland of the Weather Bureau at Lincoln, these forecasts are up to the minute as they are telephoned from his office immediately on receipt of the data from Chicago, and sent from the university station five minutes later.

Important war news follows the forecast, the latter being in plain English. Reports of athletic contests, debates and news of a similar nature will be sent out from time to time as announced in the morning. In general, base-ball and foot-ball are reported at 6 P. M., and basket-ball at 10 P. M.

Address all correspondence to J. C. Jensen, University place, Nebraska. Station call 9YD.

The weather forecast code for the University station is as follows:

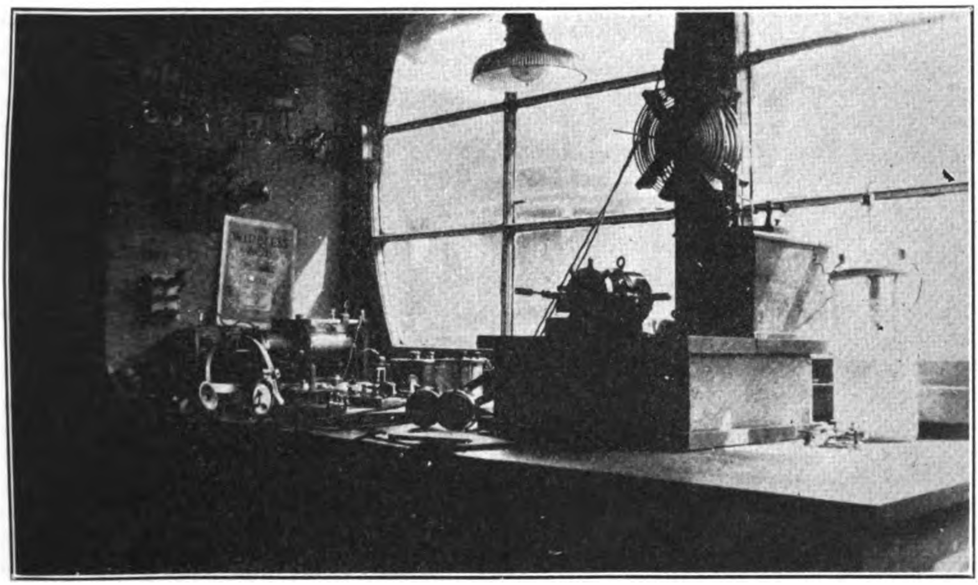
R = rain; Z = thunderstorms; H = hail; S = snow; W = wind; B = blizzard; C = cloudy; X = warmer; Y = colder; P = pressure; T = temperature; U = unsettled; F = fair; L = to-night; M = yesterday; N = to-day; O = to-morrow; Q = changing to; ? = probably; 1 = north; 2 = east; 3 = south; 4 = west, when following W. Thus P728T54W34.R2M.-

RQSN.FXO? would be interpreted as follows: Barometric pressure 728 mm.; temperature 54 degrees F.; wind southwest. Rain in eastern portion yesterday. Rain, changing to snow to-day. Probably fair and warmer to-morrow.

A movement is on foot to form a radio club in Port Richmond, Staten Island, N. Y. A meeting of amateurs interested in the project will be held on or about November 1 at the home of H. E. Ballentine, 17 Sharp avenue, Port Richmond.

The Suburban Radio Club of Washington, D. C., is carrying on a membership campaign as a result of which it hopes to secure almost every amateur wireless operator of the District of Columbia as a member. At the last meeting of the Club, the secretary was directed to notify every member by mail of meetings.

The Club is a chartered organization of the N. A. W. A. Amateurs wishing to join the Club should get in touch with Charles Longfellow, Jr., 5515 Potomac Avenue, N. W., Washington, D. C.



The sending and receiving equipment of Russell A. Neuman, of Springfield, Ill.

During the Kentucky State Fair held at Louisville from September 11 to 16 inclusive, the Louisville Radio Club gave a demonstration of wireless telegraphy. Space was given the club by a local newspaper and a 1 k. w. rotary gap set was installed. N. A. A. was heard and many amateur stations as well.

The exhibit brought six new members into the Club. The Club, which was formed last March, now has a membership of about forty-five, who own and operate eight licensed stations. The Club meets every first and third Thursday of each month, when its members read papers on the art.

An accompanying photograph shows the set of Russell A. Neuman of Springfield, Ill. The aerial is made up of three wires, 40 feet in length by 50 feet in height. The wires are placed one over the other. The receiving set consists of a Chambers loose-coupler, two variable condensers, one fixed and one loading coil. There are three detectors, one crystalori silicon, and two sets of Brandes 2,000-ohm phones. The sending set consists of a rotary and stationary spark gap, an interrupter, a glass plate condenser, key occulation transformer and a transformer coil. The call letter of this station is 9K1.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS
Advice Regarding the Construction of Antennae

The average amateur antenna is an unattractive piece of engineering. This is not surprising when we consider the amount of time that the experimenter spends in constructing it. It is usually put up in a great hurry, with little thought as to appearance, efficiency or insulation. Why not put a little more thought into designing an antenna? Sad to relate, the usual method of designing is to go on the roof and place the antenna where it will go up easiest; in most cases there is a new aerial on the roof every month, running in a different direction.

Some amateurs construct transmitting antenna with a flat top length of fifty feet, consisting of four wires with a spread of about six feet between the wires. Such an aerial is badly proportioned and usually the big spreader is bent into all sorts of queer shapes. Remember that it is not necessary to space wires more than 1/50 of the effective length of the wires. Such things as superfluous insulators in the flat top and in the guys and stays also make an antenna system less attractive.

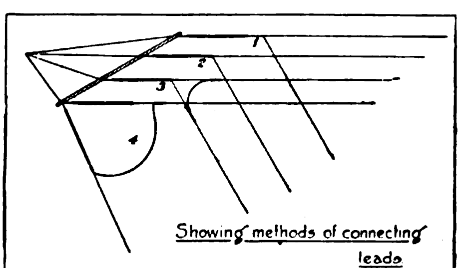


Fig. 1, First Prize Article

Referring to Figure 1. The method of insulating shown is used by many amateurs, and is also employed to a considerable extent by commercial companies. There is an insulator placed in each wire, but there are two objections to this system of insulating. First, it is costly. Secondly, it adds weight to the antenna.

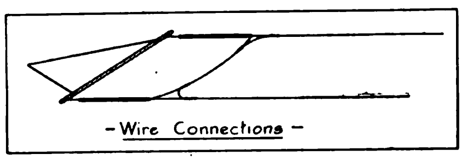


Fig. 2, First Prize Article

There are several methods of connecting leads to the antenna wires. The method shown at 1 in Figure 1 is usually employed by amateurs. The lead proper is connected directly to the aerial wire. It strains the antenna wire, makes a sharp turn, and is liable to break from twisting. It should not be used. Method No. 2 is better. Here the lead is connected to the wire at the eye in the insulator. Still the turn is too sharp. Connecting the lead and antenna wire by a loop, as in 3, remedies this and is good practice. No. 4 is an excellent method of connecting leads. It adds to the weight of the antenna as a whole, however. There is absolutely no strain on the antenna wire. The strain is on the spreader. It is neat in appearance and effective, if you have plenty of insulators.

In connecting the wires of the system be generous with the connecting lead, as in Figure 2. Allow it to sag slightly and always round off the turns as shown.

An amateur having a vertical antenna

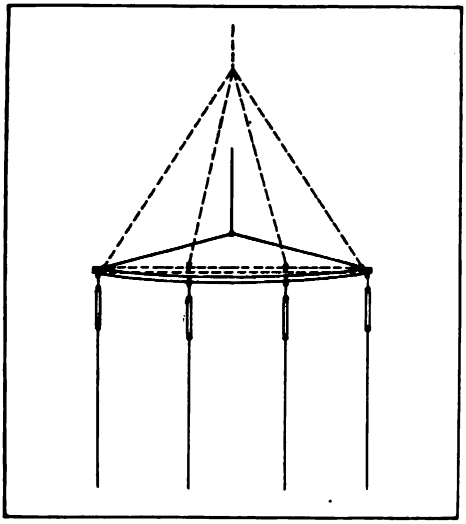


Fig. 3, First Prize Article

for transmitting produced the effect shown in Figure 3 when he used a 12-foot spreader. The spreader was always bent when the aerial was strained. A glance at his antenna showed that his halyards were too short. These supported the spreader only at the ends. Where a long spreader is used there should be a support from where each wire is fastened. Halyards should always be about as long as the spreader itself, both for looks and effectiveness in support. The dotted lines in Figure 3 show this. If this amateur needed every foot of length possible for effective length in his aerial he should have removed the individual wire insulators and used the system shown in Figure 4.

As every one knows, the vertical antenna is a very efficient type for transmitting. For the average amateur it is impracticable, however, as it requires a very high mast in order to make it of a desirable length. If you can construct a vertical aerial of from sixty to one hundred feet in length, do it, as increased efficiency will warrant the high mast. Use the construction shown in Figure 4 for the aerial. This is of navy type and adds considerable to the effective length. The greatest advantage of this system is that it can be better insulated and at less expense than where individual wire insulators are used. One good glazed insulator behind the halyard is more effective than a string of cheap ones in each wire. Again, the whole aerial is lighter and the strain of the leads is on the insulators and not on the individual wires. Remember that the leads should not be of higher resistance than all of the wires in the flat top combined. This is a very neat appearing aerial as well as less expensive than those of most experimenters.

In conclusion: Design your antenna, as well as your other apparatus. Know what you want before you start to construct it, and the labor you spend on it will be justified in a wireless outfit more attractive as well as more efficient.

Irving Farwell, *California.*

SECOND PRIZE, FIVE DOLLARS

A Design for a Non-Synchronous Rotary Quenched Gap

This article contains a description of a design for a non-synchronous rotary quenched gap.

My design is in brief as follows: An air tight, cast iron housing encloses two sparking electrodes, preferably of copper, one stationary, the other rotating. Each electrode has thirty-six radially cut teeth on the inside face. The stationary electrode is split equally in halves,

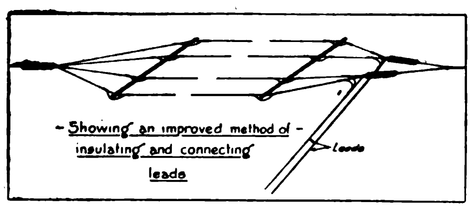


Fig. 4, First Prize Article

this being done to receive the charge from the condenser.

The rotating member is contained in two sets of S. K. F. self-aligning ball bearings which in turn are held in position by cast iron housing. This gap is designed for low potential transformers, and accordingly the electrodes should be about eight or ten thousandths of an inch apart, or according to the voltage of the

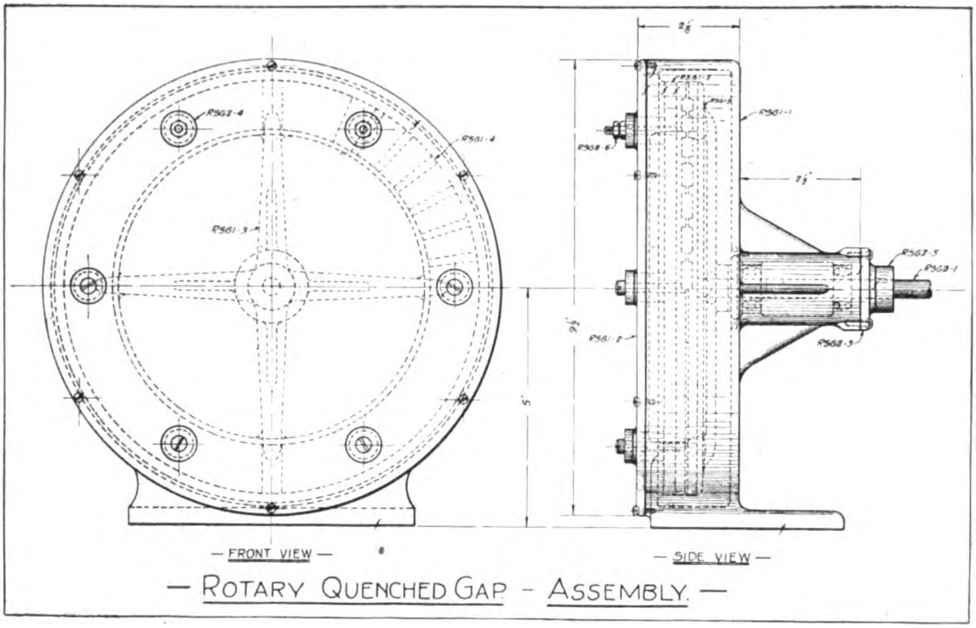


Fig. 1, Second Prize Article

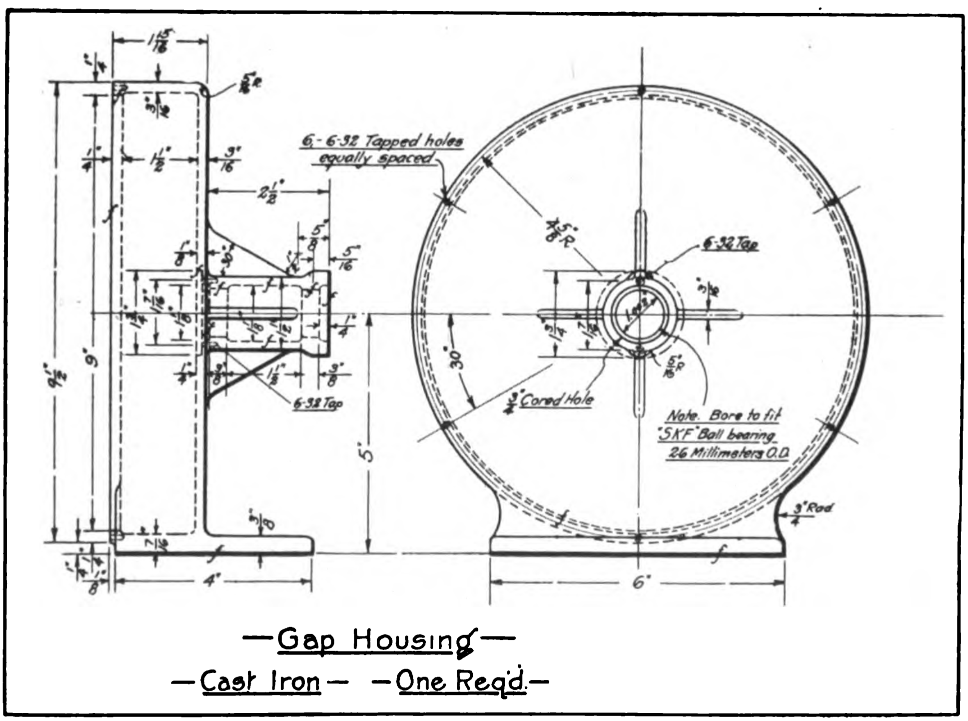


Fig. 2, Second Prize Article

transformer employed. The rotating electrode may be radially adjusted by means of the collar on the shaft. The gap should be revolved at 1,800 r.p,m, to give a spark frequency equivalent to a 500-cycle note.

Referring to the drawings:

Figure 2 shows a cast iron housing. No information is needed, as the drawing shows clearly what the necessary operations are. Care must be exercised in machining the spots which receive the ball bearings and should be finished to give a light force fit.

Figure 3 is the cap or the member which the stationary sparking electrode is mounted upon. In order to obtain an air-tight fit, care must be taken while machining the surface which fits into the housing. Note the hub which is used for convenience in turning. After the part is completely machined, the hub is cut off and the hole plugged with a piece of fiber.

Figure 4 is the wheel for the rotating electrode and is constructed of aluminum. Care must be taken while in the process of machining this part, the operator observing that he does not cut off the metal with a heavy chip, or otherwise the wheel will chatter and slip on the arbor.

Figure 5 shows the details of both the stationary electrode and the rotating electrode. The stationary electrode is split in halves after being mounted on the cap. These are made of copper preferably. After each one of these members is mounted on its respective part, it should be trued up very accurately.

Figure 6 shows the details of the insulation used to insulate stationary electrode from the cast iron cap.

Figure 7 shows the details of the rotating shaft and is made of machine steel. The short end of the shaft should be a driving fit into the aluminum wheel. In grinding the long end of the shaft the required fit should be so one could force the ball bearing on the shaft by the hand.

Figure 8 shows details of grease retainers, the ball bearings being immersed in the grease. Figure 10 shows the detail of the bushings used to insulate the bolts from the cast iron cap. Figure 11 is the adjustment collar on the rotating shaft. Figure 12 shows the details of the bolt used to make a connection with

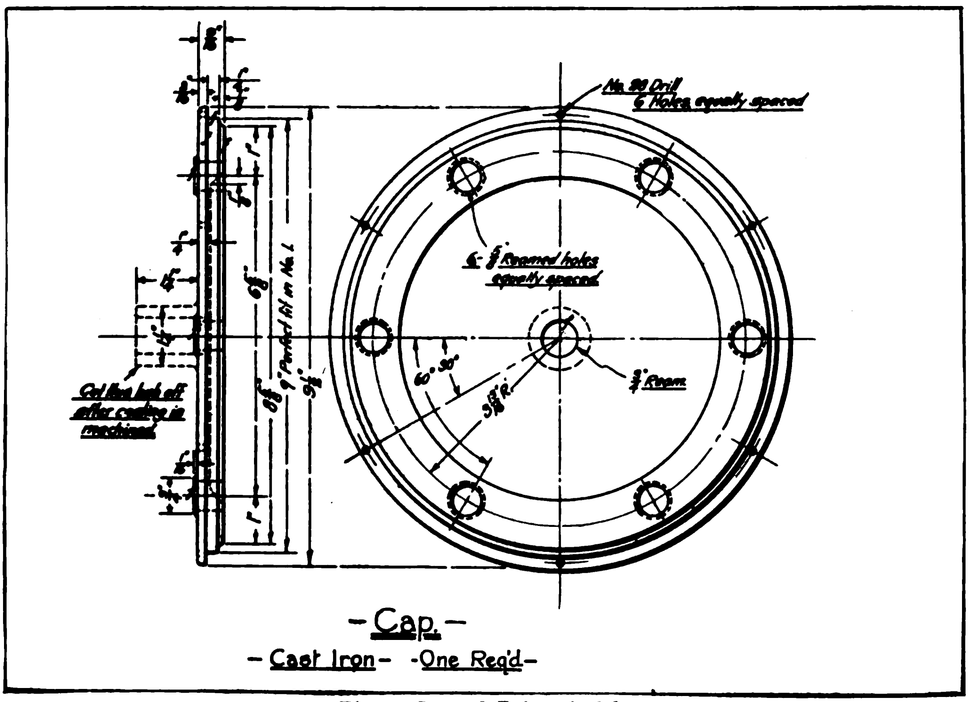


Fig. 3, Second Prize Article

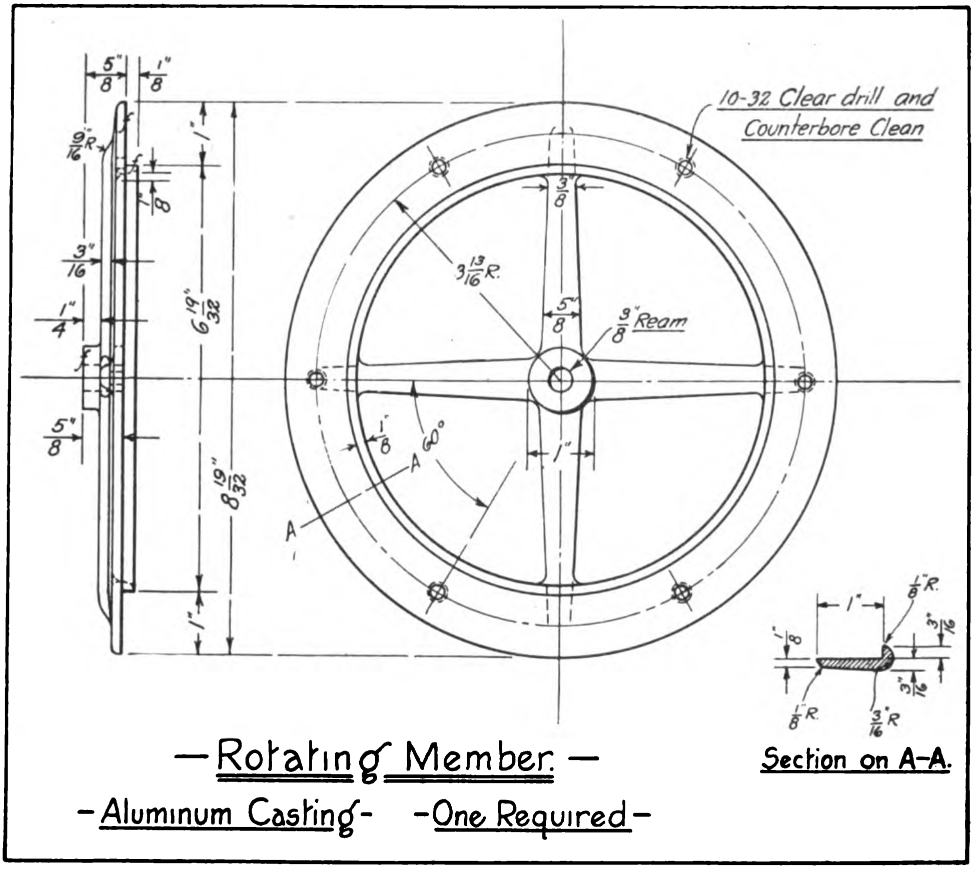


Fig. 4, Second Prize Article

each half of the stationary electrode. Regular 10-32 fillister head brass screws are used to fasten the copper electrodes to the cast iron cap.

If the amateur does not wish to equip his gap with ball bearings, he may use a bronze bearing in its place, but, of course, more motive power will be required than would be necessary if the ball bearings were used. In general, if he adheres strictly to the minute details, he will have when completed a well constructed gap capable of giving very efficient results.

This gap is intended to be used with transformers having secondary voltages of between 2,000 and 3,000 volts. It is suitable for transformers up to ½ k.w. capacity and is therefore highly recommended to the amateur field unlimited in respect to the wave-length employed.

A difficulty in the use of this gap for amateur work lies in the fact that a rather large condenser is required for the highest efficiency and usually the value of capacity is such that the wave-length of the condenser circuit is in excess of 200 meters. Good results, however, can be obtained with a condenser of .01 microfarad by very careful adjustment of all circuits. An oscillation transformer of the usual type will do for this equipment, but the pancake type is preferred or any type where the inductance is continuously variable.

Ralph Hoaglund, *Massachusetts.*

THIRD PRIZE, THREE DOLLARS
How to Make a Synchronous Rotary Gap and Circuit Interrupter

Knowing that many amateurs desire an efficient rotary gap for use in connection with a spark coil and furthermore that the main draw-back is the loss of so many sparks per second, I designed this little gap to meet their need. The instrument is built around any make of upright toy motor, preferably the Rex or the Voltamp.

Start by removing the shaft and threading it for a distance of ⅜ of an inch from each end with a 6-32 die. Figure 1 shows the circuit interrupter which is roughed from a piece of ¾-inch stock, the hole for the motor shaft being drilled in a lathe and tapped with a 6-32 tap before the machined section is removed. Having drilled and tapped the roughed-out interrupter, cut it off to length and insert the motor shaft. Next, place the shaft in the chuck and finish the interrupter to size. The contact breakers must be finished in this manner to insure the segments running true. Next, cut the segments with a fine hacksaw and after cutting small strips of mica about 1/16th by ⅛th of an inch, pack several in each slot, coating each with shellac before doing so. When dry, finish by filing the edge of the mica with a fine file, the shaft being placed in the chuck of the lathe. Next, plane the fibre rotor to size and drill and tap the holes indicated in Figure 4.

After replacing the shaft in the motor, attach the rotor and thread the brass rod comutator which goes opposite the motor shaft. Insert this rod and the two studs with their connecting wire and proceed with the stator. The strip in Figure 2 is cut to size and filed to a thickness of 1/32d of an inch for a distance of 3/16th of an inch from each end. The filing is done from one side on one end and from the other side on the opposite end to prevent a thick joint in the ring. After drilling at all the dotted lines bend at 45 degrees all solid lines and solder the joints. Next, construct the upright supports for the ring (Figure 3). The length of these pieces, as can be seen, depends upon the height of

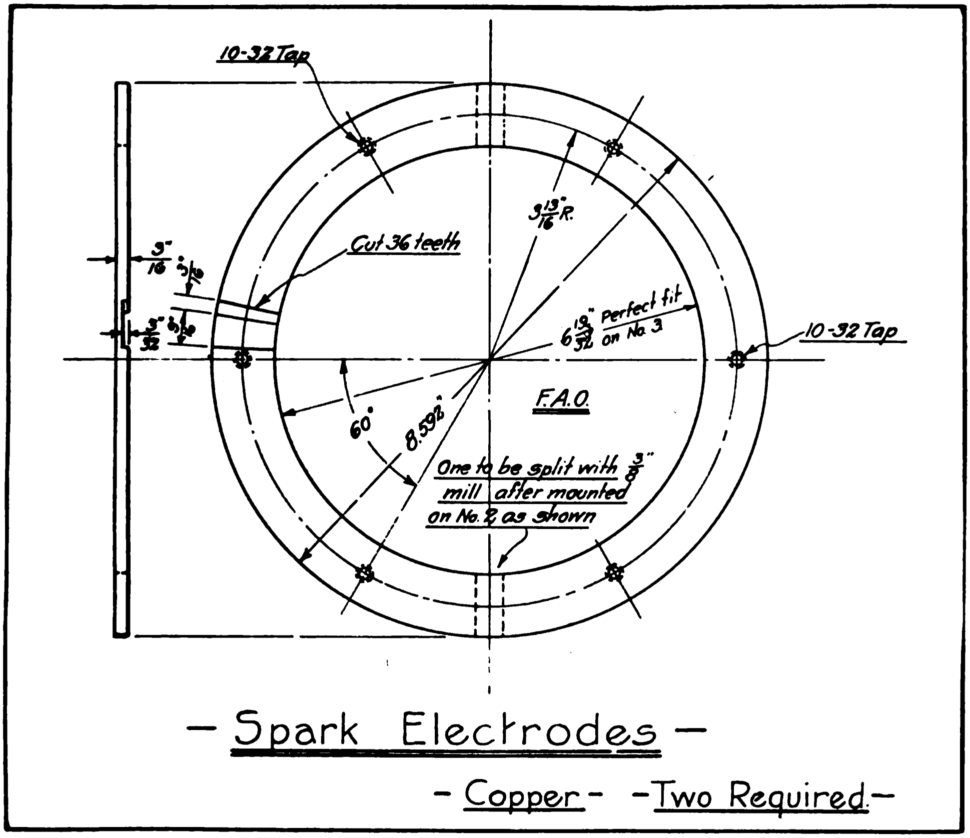


Fig. 5, Second Prize Article

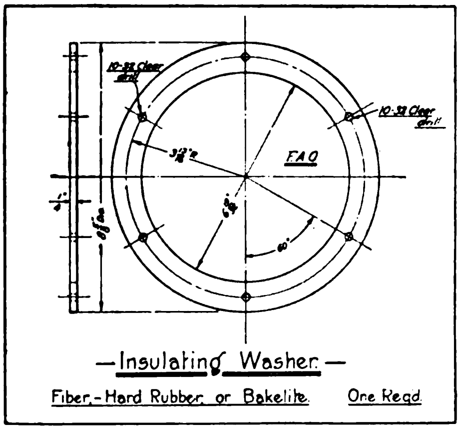


Fig. 6, Second Prize Article

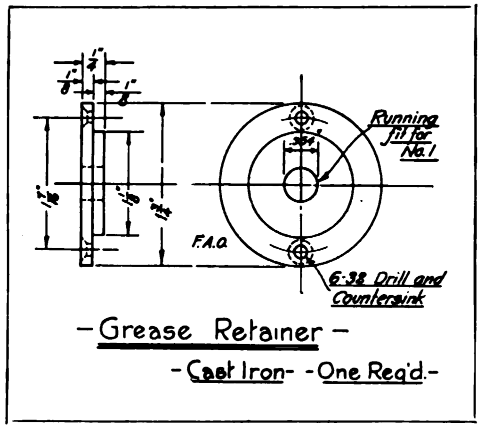


Fig. 8, Second Prize Article

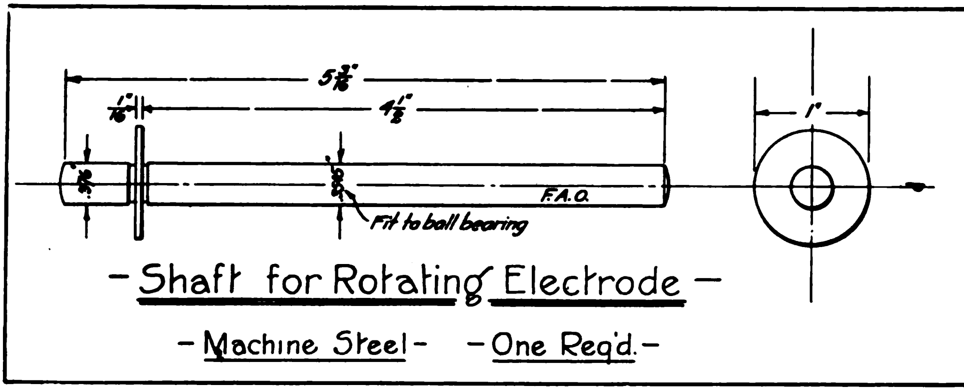


Fig. 7, Second Prize Article

the shaft above the base. Set up the stator and adjust the studs to a 1/16th-inch gap, then attach the two copper brushes shown in Figures 1 and 4. Connect as in Figure 5, using the motor frame for connection to the segmented circuit interrupter. Now, synchronize the gap by setting the circuit breaker so that the circuit is broken just when the studs of the rotor are opposite those of the stator.

With the same amount of care given in the construction of all good instruments, this gap will produce a clear note of high pitch having good carrying properties.

E. D. Hibbs, *Pennsylvania.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Satisfactory Switch That Is Simple in Construction

This is a description of a switch for use on radio instruments that very nearly approaches perfection, and leaves nothing to be desired.

The several features worthy of mention are as follows: Its construction is simple in the extreme; it has few parts and these are easily and quickly made; the tension of the switch blade upon the contacts is adjustable; the entire moving element can at any time be removed from the instrument upon which it is mounted without disturbing any connections whatever. Its action is smooth as velvet, never binds and is absolutely free from the great fault of most other switches, that is, there are no nuts or parts to work loose in operation, causing loose connections and necessitating the dismantling of the apparatus to tighten and adjust. This single feature alone offsets the disadvantage that it cannot be used when the contacts are a continuous circle and the switch blade must revolve continuously in one direction; however, this is

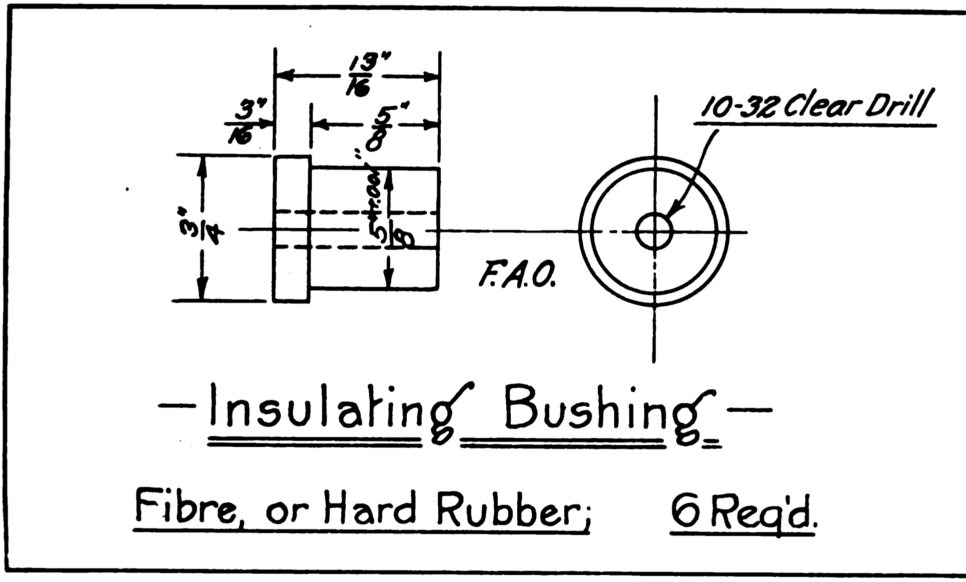


Fig. 10, Second Prize Article

seldom required, as the only advantage gained is (in this case), that the blade may be removed directly from the last contact on the first without revolving the switch back over the other contacts.

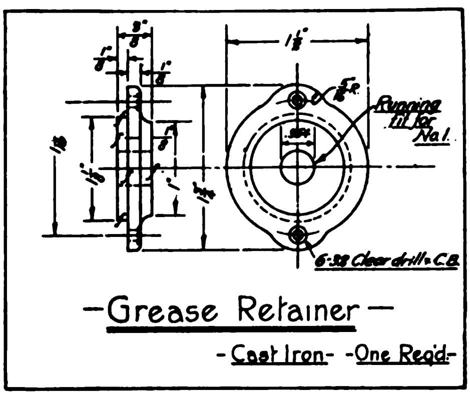


Fig. 9, Second Prize Article

The drawing shows a cross-section through the switch and makes its construction perfectly clear. A is the base of insulating material. B is a brass bushing threaded on the outside to take the lock-nut, C, by which it is fastened to the base, and also the thumbnut, D, which forms a binding post for attaching the connections. This bushing, B, is also drilled and tapped with a fine thread to accommodate the fine thread machine screw, E. Upon the machine screw, E, is placed the insulating knob, F, and the switch-blade, G, both of which are locked in place by the nut, H. The coil spring, I, is slipped over the machine screw, E, its purpose being to take up any play that may exist between the threads of stud E and the threads in the hole of bushing B.

The contact point, J, has its shank threaded and is held in place by locknut K, having thumbnut L to form a binding post for connections.

When the threads on stud E run about forty to the inch and the switch-blade, G, is reasonably flexible the vertical movement of the blade is hardly noticeable, and as far as operation of the switch is concerned, is practically nil.

A careful consideration of the construction will make its various features obvious.

J. A. Wever, *Maryland.*

HONORARY MENTION

A High Potential Condenser Suitable for Use of Amateurs

The condenser which I am about to describe is made by coating test tubes in-

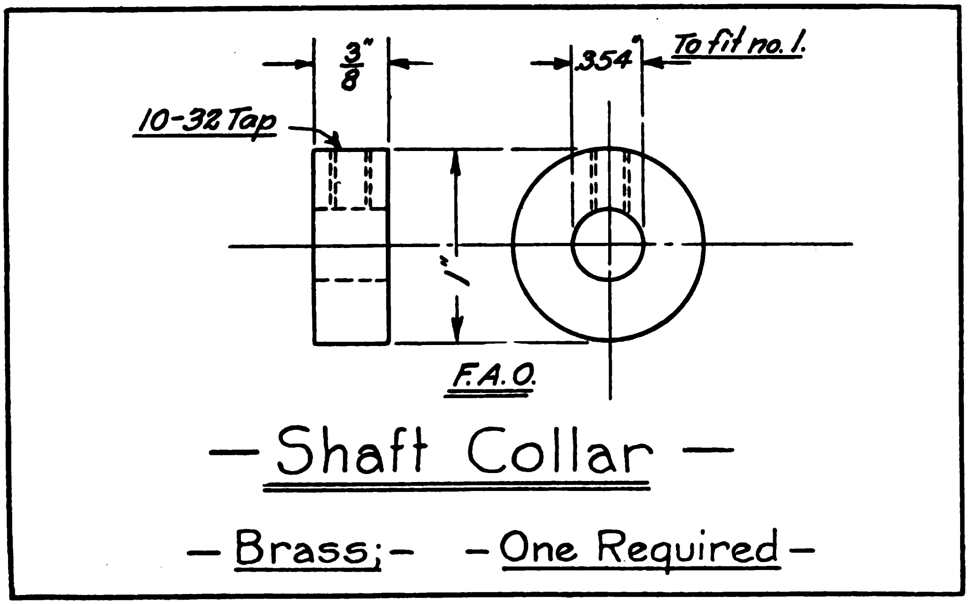


Fig. 11, Second Prize Article

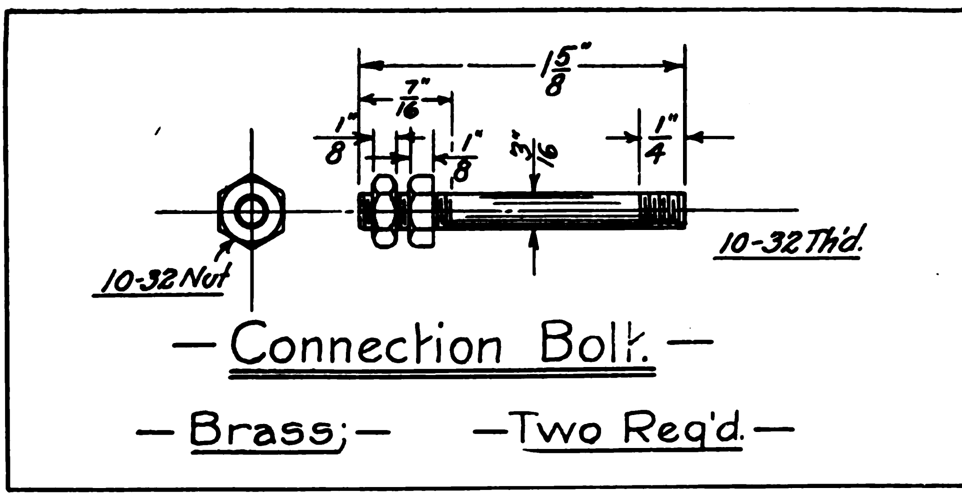


Fig. 12, Second Prize Article

side and out with tinfoil as illustrated in the accompanying drawing at A. I used 8-inch tubes. In order to coat the tube, first wrap a small stick with a couple layers of cloth as shown at B, and by means of this, smear shellac inside the tube. Have ready the inside foil, which should be about 6 inches in length and three and a half times the diameter of the tube in width. Wrap this foil loosely around another cloth-covered stick as shown at C and insert it into the tube. By this time the shellac will have become "sticky" and the foil will stick tight. The end of the foil should be about an inch and a half or two inches from the bottom of the tube before it is pushed against the side and stuck. It is then smoothed out by rolling the cloth covered stick over it a number of times.

The outer coating of foil is much easier to put on. The best way is to lay the foil

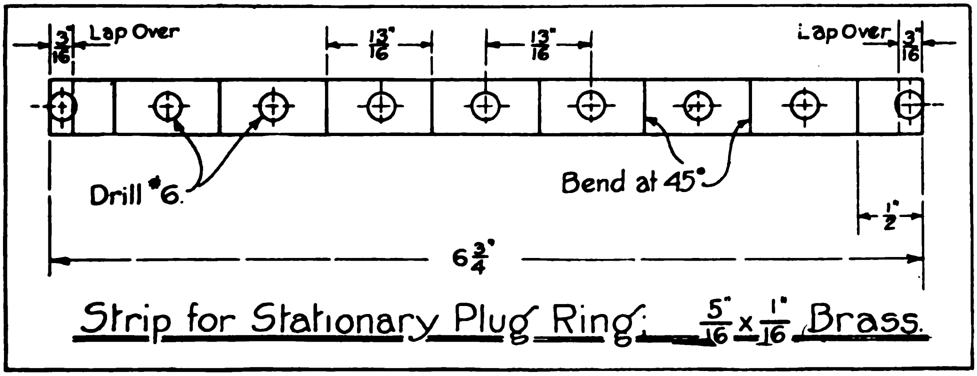


Fig. 2, Third Prize Article

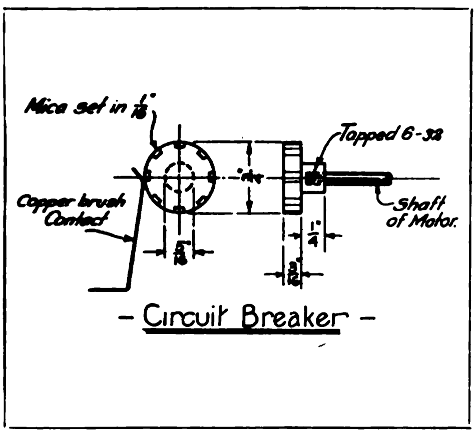


Fig. 1, Third Prize Article

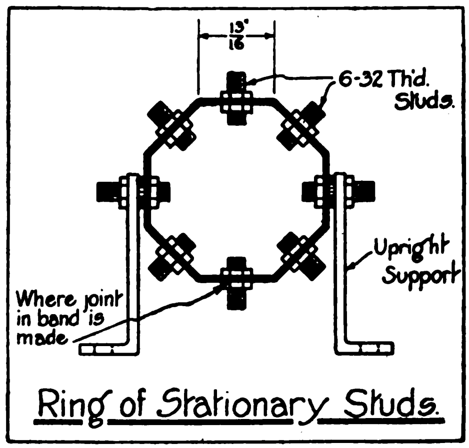


Fig. 3, Third Prize Article

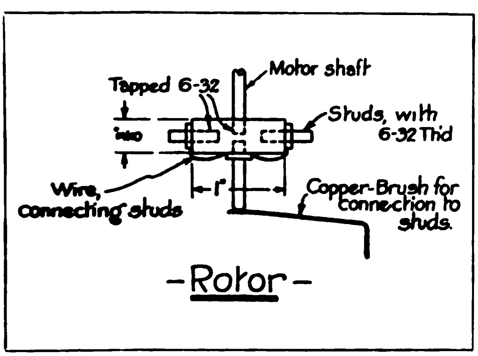


Fig. 4, Third Prize Article

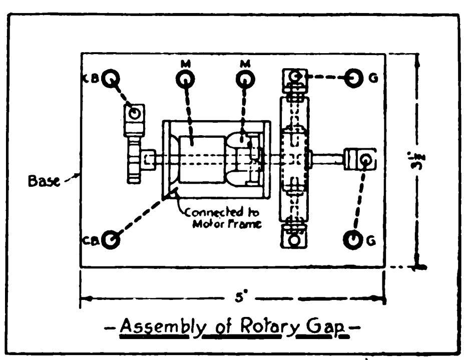
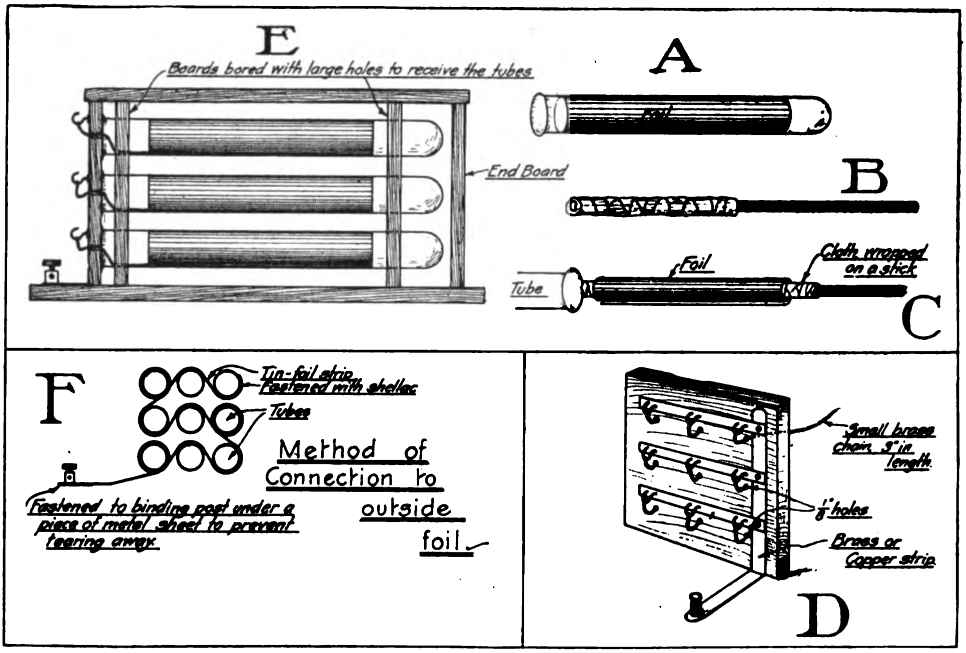
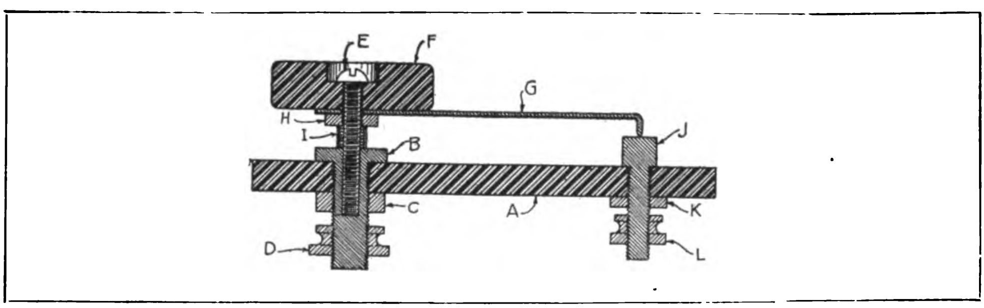


Fig. 5, Third Prize Article



Drawing, Honorary Mention Article, Joseph Dean



Drawing, Fourth Prize Article

out on a smooth board and roll the shellacked tube over it. Six or nine tubes are prepared in this way, depending upon the size of the condenser desired. A rack, as shown in the drawing, is then made. Boards x and y, at E are bored with holes large enough to receive the tubes easily and should be of very tough wood, so as not to split.

Connections to the condensers are made on the inside by chains, and on the outside by wrapping a long strip of foil around all of the tubes. This is fastened to a binding post by laying it under a small piece of sheet metal, so that when the post is turned down tight it will not tear the foil. The chains are hooked on to small hooks which are screwed through small holes in brass strips. These strips are then connected together and brought to a binding post.

The capacity may be varied by pulling out or inserting the chains.

JOSEPH M. DEAN, *Iowa.*

WIRELESS FOR SIGNAL CORPS

A "Must Have" book for every wireless amateur. See announcement, first two pages in this issue.

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. J. D., Sheboygan, Wis., writes as follows:

It will be of interest to your readers to know that the Naval station located at Lake Bluff, Ill., is fitted with a 5 k.w., 500-cycle quenched spark transmitting set as well as the 30 k.w. arc set. The spark set employs a wave-length of 1,000 meters and it is used for sending weather reports for the Great Lakes division daily.

This station may be heard almost any evening between 6:30 and 7:30 P. M., central time

* * *

A. R. M., Greenville, Pa., writes:

Ques.—(1) I constructed a wave-meter in accordance with the instructions given in the book "How to Conduct a Radio Club" and apparently during a test completely ruined my head telephones for any other purpose.

When I connect them to the wave-meter they crack and roar like heavy static discharges. I have examined them carefully for loose connections and find none. Is the fault due to a blunder of my own or should I expect such results every time I use the meter?

Ans.—(1) Apparently you have placed the wave-meter in too close inductive relation to the circuit under measurement and potentials of such value were induced in the wave-meter circuit as to burn the windings of the head telephones. Keep in mind that the telephones should be connected in series with the carborundum crystal, and if this precaution is taken, together with keeping the wave-meter at a sufficient distance from the transmitting set, no injury to the head telephones should result. You will probably find that the windings of the head telephones are badly burned.

* * *

N. C. B., Reno, Nev., inquires:

Ques.—(1) My wireless station is located in a power house and the antenna lies parallel to a 23,000-volt transmission line. The aerial wires and the transmission line are about the same height and, owing to induction, I cannot read amateur stations. I contemplate erecting a mast approximately 15 feet in height on the nearest end of the antenna to the line, so that it will lie at an angle of 45 degrees. Will this tend to decrease the interference from the high tension line?

Ans.—(1) The minimum of interference will be experienced when the receiving antenna is exactly at right angles to the transmission line and, even with this correction in the location of your antenna, you will probably experience the effects of induction. We know of no method by which it can be totally eliminated.

* * *

S. E., Portsmouth, Va., inquires:

Ques.—(1) In Figure 19-b, published on page 861 of the September, 1916, issue of The Wireless Age, are the two secondary coils for the transformer wound one upon the other, or at either end of the primary winding? Is the same size of wire used on all windings and are the secondary coils wound in the same or opposite directions?

Ans.—(1) The secondary coils for this transformer are on the inside and the outside of the primary winding. They are not wound on opposite ends. The same size wire is employed for all three of the windings and they are wound in the same direction.

Ques.—(2) Can stations that are completely inaudible when using a simple vacuum valve detector be heard with a vacuum valve amplifier? A statement has been made that the amplifier only makes audible signals that could already be heard with a single vacuum valve.

Ans.—(2) A properly constructed vacuum valve amplifier will make audible signals that cannot be heard with a single vacuum valve detector, but many of the amplifying circuits evolved do not possess this characteristic because they are not properly designed.

Ques.—(3) Can the various types of vacuum valve bulbs recently appearing on the market be used in the same circuit as the original type of vacuum valve?

Ans.—(3) Yes.

Ques.—(4) In your opinion, will the high voltage battery constructed of pieces of zinc, copper and blotting paper, stacked up in a pile described in a previous issue of The Wireless Age, function properly? Will I be able to obtain results from it?

Ans.—(4) The writer of the article assured us that this battery was continuously operative for the purpose desired.

E. C. J., Jr., Fairmount, W. Va., inquires:

Ques.—(1) What finish is generally used by amateurs on their receiving cabinets and wooden portions of the transmitting apparatus?

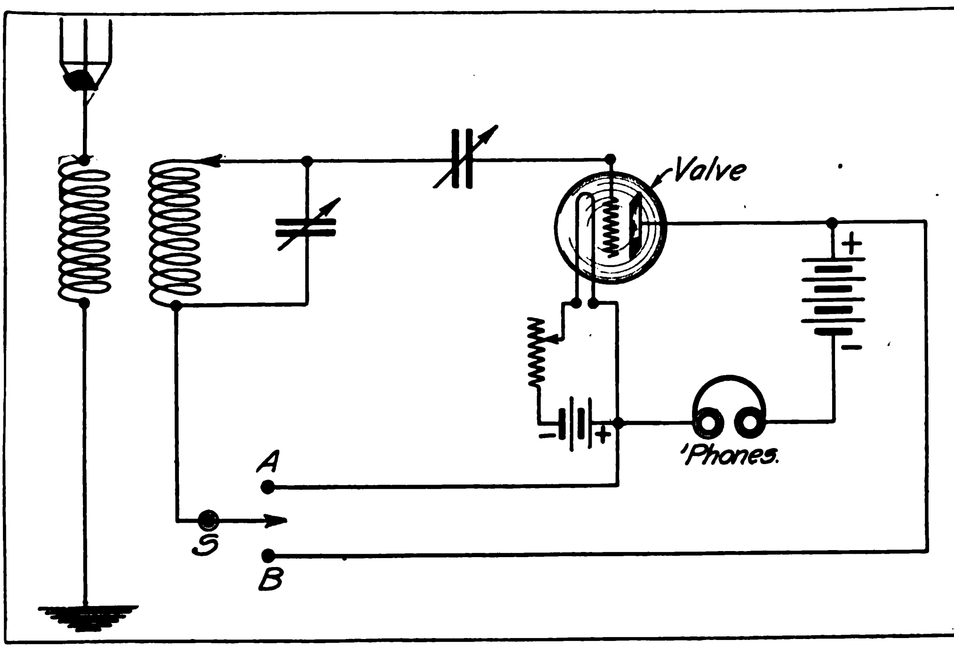
Ans.—(1) Mahogany stain has proved the most popular and seems to present the best appearance. You can purchase stain of any color from paint supply stores, which, when mixed with alcohol, will give the wood the desired tint. After two coats of the stain have been applied and allowed to dry pertectly, two or three coats of good varnish are put on for the final finish.

Ques.—(2) Please publish a diagram of connections for a loud speaking horn attached to a receiving set consisting of a receiving tuner, vacuum valve detector, fixed and variable condensers, etc. I should like a diagram for the apparatus like that described by Chris. K. Bowman in the June, 1915, issue of The Wireless Age.

Ans.—(2) A diagram of connections for the loud speaker is not necessary. It is simply connected in the circuit at the same point where the ordinary telephones are connected.

Ques.—(3) Can a vacuum valve be connected up to receive either continuous waves or spark signals by merely throwing a switch, or can both be received with the same connection? If so, how?

Ans.—(3) See the accompanying drawing. When the switch, S, is thrown to the point, B, the apparatus is responsive to continuous waves, but when thrown to the point, A, the circuit is correct for ordinary spark signals.



J. P., Sanford, Maine, inquires:

Ques.—(1)) Please publish a diagram of connections for a loose coupler, loading coil, fixed condenser, variable condenser, detector and head telephones.

Ans.—(1) So many diagrams of this character have appeared in previous issues of The Wireless Age, particularly in the series "How to Conduct a Radio Club" and also in the book "How to Conduct a Radio Club," now on sale by the Marconi Publishing Corporation that it seems unnecessary to redraw the diagram. The article on "How to Conduct a Radio Club," published in the September, 1916, issue of The Wireless Age, contains a diagram applicable to your requirements.

Ques.—(2) What detector is considered most sensitive?

Ans.—(2) The vacuum valve detector stands at the head of the list.

Ques.—(3) What is the highest wave-length employed by the wireless station at Portsmouth, N. H.?

Ans.—(3) 1,000 meters.

* * *

L. G. D., Keene, N. H., inquires:

Ques.—(1) I have a Marconi type D Tuner No. 224, which is fitted with a carborundum detector and connected to an aerial with a natural wave-length of 200 meters. Please tell me the names of the high-power stations which I should be able to hear with it.

Ans.—(1) If you will use the left-hand coil of this tuner as a loading inductance for the right-hand coil, your equipment should respond to the wave-length of Arlington when the latter is sending the time signals, namely, 2,500 meters.

Ques.—(2) Apparently this tuner was made to operate with a looped aerial and is said to be responsive with this adjustment to wave-lengths of 2,000 meters, but when used in the ordinary manner with a plain aerial, will respond to 4,000 meters. Which method would be the most efficient for all around work?

Ans.—(2) For the shorter range of wave-lengths practically equal results will be obtained with either the plain aerial or looped aerial, but for the longer wave-lengths, the plain aerial connection will give the best results.

Ques.—(3) Is it the custom to use looped aerials at the present time, and if so, how would you connect a four-wire aerial in this manner?

Ans.—(3) The use of the looped aerial has practically been discontinued, but should you desire to use this type, all wires should be connected together at the high potential end. Two wires should be connected together at the receiving station for one side of the loop and the remaining two wires for the opposite leg of the loop.

* * *

J. H., Jr., Evanston, Ills., inquires:

Ques.—(1) Please advise how to connect a Packard ½ k.w. transformer and a Wagner ½ k.w. transformer in series. The Packard transformer is rated at 13,200 volts for the secondary winding and the second transformer at 14,000 volts.

Ans.—(1) If these transformers were intended to be operated on 110-volt circuits, the primary windings should be connected in parallel and the secondary windings in series. The proper connection for the secondary terminals had best be determined by experiment, for if they are connected to oppose, the resultant voltage will be practically zero. The proper connection will give approximately 25,000 volts.

* * *

S. R., New York City, inquires:

Ques.—(1) Has a practical method for transmitting radio signals with a buzzer been found? If so, please publish a diagram of connections.

Ans.—(1) The buzzer has frequently been employed for short distance communication at wave-lengths up to 600 meters. There are several methods by which energy can thus be set up in the antenna circuit, one being to connect the earth and aerial connections across the contacts of the vibrator. Another method is to connect a small coil of inductance in series with the antenna circuit and then continue the circuit from a buzzer and battery through this coil. A change in the lines of force takes place in this coil during the operation of the buzzer which sets up a potential in the antenna circuit causing it to oscillate at its natural frequency. A diagram of connections is not required.

Ques.—(2) Can cerusite be employed in any type detector holder in the same manner as silicon or other crystals?

Ans.—(2) It may be mounted in the usual manner with Wood's metal or other soft metal.

Ques.—(3) Where can cerusite crystals be purchased?

Ans.—(3) From Eimer & Amend, 211 Third avenue, New York City.

* * *

J. B. C., Deering, N. D., inquires:

Ques.—(1) I am situated in a town where there is neither alternating nor direct current. I understand that alternating current is positively necessary for the operation of a closed core transformer. I have also been told that direct current generators only can be had in ½ k.w. and 1 k.w. sizes. In view of the fact that I expect to use either a ½ k.w. or a 1 k.w. transformer, what remedy can you suggest for my trouble?

Ans.—(1) Any reputable manufacturing concern will be able to supply you with a 1 k.w., 60 cycle or 120 cycle generator which can be operated by a gasolene engine. In view of the fact that you have neither alternating nor direct current, we advise the purchase of an alternating current transformer and generator, rather than a direct current generator and induction coil. The Crocker-Wheeler Company, Ampere, N. J., or the Robbins & Meyers Company, Springfield, Ohio, will be able to supply you with a generator of this description.

Ques.—(2) At what time does Arlington transmit on continuous waves and what is the wave-length employed?

Ans.—(2) The continuous wave set is used at irregular intervals throughout the twenty-four hours of the day and may be heard in the afternoon to good advantage, communicating with the Naval station at Darien and other high-power stations. The wave-length employed varies between 6,500 and 7,500 meters.

Ques.—(3) At the beginning of a schedule, Arlington makes use of the letters "Q. S. T." What is the meaning of this signal?

Ans.—(3) This is an international abbreviation and is the "general call for all stations."

Ques.—(4) How many watts does the average ½-inch spark coil consume and is a license required in case it is used in a radio telegraph set?

Ans.—(4) The average coil of this type consumes approximately forty watts and if your station is so situated that the signals from it are apt to be heard beyond the borders of the state, a license is positively required.

Ques.—(5) Can the secondary winding of a ½-inch spark coil be employed as a loading coil in a receiving set?

Ans.—(5) Positively no. The inductance value is too high for the purpose and the presence of the iron core would be detrimental to its efficiency.

* * *

A. B. Fayette, Ala., inquires:

Ques.—(1) I constructed a 3-inch spark coil after the design given in the book "How to Conduct a Radio Club," page 33, with the exception that I used a core ⅞ of an inch in diameter, instead of the dimensions given. I also used two pounds of No. 34 enameled wire, winding it in four sections. These sections were connected together to form a continuous winding and the precaution was further taken to boil the secondary winding in linseed oil. I obtain a much better spark from a 1-inch coil than from the designs given in that book. Can you tell me what changes I can make to secure a discharge of the normal rating of the coil?

Ans.—(1) In the first place the condenser across your vibrator is too small. It should have at least 2,000 square inches of foil and preferably 2,500 inches. Likewise, you should use No. 36 wire as advised in the original specifications. It would seem, however, from your communication that the various sections of the secondary winding are improperly connected, for a single section of the dimensions stated should give a spark a fraction of an inch in length. While you may believe your winding to be continuous, it probably, after examination, will be found not to be so. It may also be that the vibrator which you have fitted to the primary winding does not make a clean cut break. This is a very important consideration and unless a vibrator is properly constructed and fitted with a first-class grade of platinum point, the result will be anything but satisfactory. A number of coils have been constructed from the designs given in the book "How to Conduct a Radio Club," and with 8 volts applied to the primary winding, have easily given a spark discharge three inches in length.

Ques.—(2) It was my intention to use the coil referred to without condenser or vibrator on a 110-volt, 60-cycle circuit. What should be the size of the "choke" coil for cutting down the current flow in the primary winding? Also is a protective condenser or resistance rod necessary for protection of the primary circuit?

Ans.—(2) This coil positively will not function on alternating current, as the secondary winding possesses an abnormal value of inductance, while the primary winding has insufficient value. Unless a rather large choke coil is employed, the primary winding will over-heat and burn out.

Ques.—(3) Approximately what would be the rating in watts of the 3-inch spark coil?

Ans.—(3) Under normal conditions of operation it should not consume more than fifty or sixty watts.

* * *

H. P. H., Alton, Ills., inquires:

Ques.—(1) During last winter I employed a Packard transformer designed for a secondary potential of 13,200 volts and when used in connection with the condenser, consisting of twenty sheets of tin foil, 4½ inches by 6½ inches separated by plates of glass ⅛ of an inch in thickness, I secured a good spark with the rotary gap having 12 points, revolving at a speed of 1,750 R.P.M.

With this apparatus my spark note was not ragged, but was, of course, rather low. I then cut down the condenser capacity to about one-half of its original value, which, of course, cleared up the spark note, but even with the speed of 3,000 r.p.m. at the rotary, the safety gap sparks badly each time the key is closed. The safety gap is set at ⅞ths of an inch, which is ⅛th of an inch in excess of that recommended by the manufacturers. What I desire is to have my spark note remain clear and at the same time prevent the safety gap from sparking. Can you help me out?

Ans.—(1) The average rotary spark gap places an excessive strain on a high potential transformer, due to the fact that the condenser discharges just as soon as the points of the rotary are close enough for the available potential. When you reduce the condenser capacity of your set to one-half, you undoubtedly raise the available potential at the secondary winding of the transformer and perhaps considerable separation exists between the stationary and the moving electrodes of the gap; consequently you secure a continuous discharge at the safety gap. There are two solutions of your problem. You may either construct your rotary gap so that the separation between the moving and stationary electrodes is no more than one-fiftieth of an inch, or allow it to remain as at present and widen out the safety gap until all sparking ceases. It is quite probable that this will not harm the secondary winding.

* * *

L. J. T., New Orleans, La., inquires:

Ques.—(1) Considerable interference is experienced at my receiving station from a local station employing the arc generator. What is the cause of this? Why should this station be heard at all with a crystalline detector? If this is due, as I have heard, to a slight damping of the wave train, what is the probable cause of this damping? With a certain adjustment at my receiving apparatus, only a single continuous sound can be heard, but if a slight change in the coupling is made, the dots and dashes of the telegraph code can easily be distinguished. How do you account for this? Apparently, I only hear the back stroke of the telegraph key.

Ans.—(1) Signals can sometimes be heard from these stations on crystalline detectors up to distances of fifty miles. This is, as you intimate, due to a slight damping of the wave train and is caused by the irregularities in the action of the arc gap. You can readily understand that the ionized discharge path between the electrodes of the arc gap is not one of continuous or constant conductivity. The oscillations, therefore, are not of continuous amplitude, and a small amount of damped energy is accordingly radiated. The phenomenon observed in the last part of your query will be readily understood when you consider the method by which signaling is accomplished at these stations. When the telegraph key is in the "open" position a wave, let us say of 3,000 meters, is radiated, but when the telegraph key is pressed, a few turns of the transmitting helix are cut in the circuit and a longer wave radiated. By extremely careful adjustment of your receiving tuner, you can make the signals of either wave audible, but only one is readable.

* * *

W. E., Waverly, N. Y., inquires:

Ques.—(1) Which do you consider the best arrangement for the lead-ins of an aerial system? Should the rat-tails unite near the flat top portion of the aerial or at the place where they enter the radio station?

Ans.—(1) With the flat top type of aerial it is preferable to bunch the lead-ins the entire distance from the flat top portion to the point where they join the transmitting apparatus.

Ques.—(2) In connection with a small spark coil giving a discharge ½ inch in length, does a helix and condenser increase the range of a set or not? If a helix will increase the range, please give the correct dimensions.

Ans.—(2) It has been the experience of experimenters as a whole that better results are obtained with a small spark coil, by connecting the spark gap directly in series with the antenna system; in other words, use the "plain aerial" connection.

Ques.—(3) Will the tikker detector work successfully with both damped and undamped waves, or is it intended primarily for the reception of undamped oscillations?

Ans.—(3) It responds better to undamped oscillations. Spark stations can be heard on the tikker, but the note of the transmitting station is broken up at irregular intervals, the resulting note being of a very disagreeable pitch and characteristic.

* * *

E. W. M., Keyport, N. J., inquires:

Ques.—(1) Will a straight coupled helix or an oscillation transformer give the greatest efficiency with a ¼ k.w. transmitting set?

Ans.—(1) Practically equal results will be obtained from either type, provided the method is understood for adjusting the plain helix for a loose degree of coupling between the primary and secondary windings. The inductively-coupled transformer is favored because it permits the coupling between the primary and secondary windings to be altered in a very simple manner and without the complications with the straight helix. The matter is fully discussed in the book "How to Conduct a Radio Club."

Ques.—(2) Please give a brief outline of an oscillation transformer which can be constructed to work at the wave-length of 200 meters in connection with a Blitzen ¼ k.w. transmitting set, 4 sections of moulted condenser, a straight gap and an aerial system 85 feet in length, 30 feet in height, consisting of 2 wires.

Ans.—(2) A satisfactory description of an oscillation transformer for a set of this description is given in the book "How to Conduct a Radio Club."

* * *

W. H. S., Boston, Mass., inquires:

Ques.—(1) As a constant reader of The Wireless Age I should like to inquire the meaning of the "R. Q.'s" frequently used by the Sayville station in sending messages to Nauen.

Ans.—(1) This is a repetition signal used as a prefix when a number of messages sent on a previous schedule are to be repeated.

* * *

K. D., Defiance, Ohio, inquires:

Ques.—(1) Please give the dimensions for an oscillation transformer and condenser to be used in connection with a ½ k.w. Packard 13,200-volt transformer rotary spark gap in connection with an aerial system 70 feet in length, 40 feet in height, the entire apparatus to be operated at a wave-length of 200 meters.

Ans.—(1) Your condenser should have a capacity of .008 microfarad and it may consist of 4 plates of glass, 14 inches by 14 inches, covered with tinfoil, 12 inches by 12 inches. These plates should be connected in parallel and immersed in oil. The oscillation transformer may have four turns of 3/16-inch copper tubing for the primary winding, made on a form 10 inches in diameter, the turns being spaced 1 inch apart. The secondary winding may be 8 inches in diameter and comprise 10 or 12 turns of 3/16-inch copper tubing spaced ¾ of an inch apart. A good insulating material, such as a first-class grade of hard rubber, should be used as a support for the tubing.

Ques.—(2) Please give the natural wave-length of the aerial mentioned in the first query.

Ans.—(2) The natural wave-length of this antenna is approximately 200 meters and you will require a short wave condenser when the secondary winding of the oscillation transformer is connected in series.

Ques.—(3) On what wave-length does the Great Lakes naval station transmit the time signals?

Ans.—(3) At the wave-length of 1,000 meters.

Ques.—(4) Which is the more efficient, an antenna of the inverted L type or one of the T type, provided both have the same wave-lengths?

Ans.—(4) Practically equal results will be obtained from either type, but the inverted L is the one mostly used.

* * *

R. W. L. T., Lake Hopatcong, N. J., inquires:

Ques.—(1) I have two aerials, one 75 feet in length and the second a hundred feet in length, with approximate height of about 40 feet. I also possess a receiving tuner, the primary of which is 5⅝ inches in diameter by 9¾ inches in length, fitted with thirty-nine contacts. The secondary winding is 9¾ inches in length and 5 inches in diameter. Approximately what is the maximum range of wave-length adjustments and do I require a loading coil for receiving the time signals of Arlington?

Ans.—(1) You failed to give us the size of the wire used in the primary and secondary windings, and consequently we cannot calculate the possible wave-length adjustment, but if these windings are made with the usual sizes of wire, that is, No. 24 for the primary and No. 32 for the secondary, your apparatus should respond to wave-lengths including 5,000 meters.

Ques.—(2) What is the best aerial for receiving waves up to 5,000 meters and also for transmitting at the wave-length of 200 meters?

Ans.—(2) The largest aerial that you can employ is one of the T type, which may comprise four wires, 110 feet in length and approximately 50 feet in height. The lead-in wires are of course attached to the center.

Ques.—(3) What crystal detector do you consider to be the most sensitive?

Ans.—(3) Cerusite and galena seem to stand at the top of the list.

* * *

W. R. M., Bangor, Me.:

The diagram of connections for the receiving apparatus you have sent is applicable to both short and long waves, but it represents a complicated circuit and one that would be confusing to a beginner. If, however, it is well understood by yourself you should have no difficulty in effecting the purpose desired. Keep in mind that it is desirable to employ simple apparatus.

The aerial shown in your second sketch possesses no particular value and in fact has no advantage over the ordinary 4-wire type, with a spacing of about 2½ feet between wires.

The spark coil which you mention will give a secondary discharge about 6 inches in length and will consume approximately 200 watts of energy.

Your aerial, 45 feet in height and 30 feet in length, has a natural wave-length of approximately 135 meters. With the apparatus which you have shown in your first drawing you should have no difficulty in tuning this equipment to the wave-lengths of Sayville and Tuckerton.

* * *

H. B., Walden, N. Y.:

The natural wave-length of your aerial is approximately 230 meters and the loading coils you describe in connection with the receiving tuner have not sufficient inductance to adjust to the wave-length of 10,000 meters. The loading coil in the antenna circuit should be approximately twice its present length and an additional loading coil, approximately 18 inches in length, 6 inches in diameter, wound fully with No. 32 S. S. C. wire, should be placed in the secondary circuit. With the present design of your apparatus it should be responsive to wave-lengths including 6,000 meters. It would probably improve conditions to substitute antenna wire of 7 strands (No. 22) in place of the No. 18 copper wire used at present, and put insulators in the guy wires rather than have them grounded direct.

Your inductively-coupled receiving tuner, without the loading coils, will respond to wave-lengths including 3,500 meters.

* * *

M. J. F., Philadelphia, Pa.:

The description you give of your receiving apparatus is incomplete, but if the loading coil and the 2-slide tuning coil mentioned have dimensions similar to those usually supplied for amateur equipments, the apparatus should easily be responsive to the wave-length of 1,500 meters. Your aerial, 50 feet in length and 35 feet in height, has approximately a wave-length of 150 meters and it does not require a coil of large proportions to respond to the wave-length of 1,500 meters.

* * *

M. E. K., Duquoin, Ills.:

It is extremely difficult to give advice concerning the probable decrease in range of your transmitting apparatus caused by the near-by trees. The actual amount of interference or absorption of energy can only be determined by an elaborate series of experiments. Undoubtedly trees, when covered with foliage, do absorb a considerable amount of energy, but in your case we cannot state just how serious this may be nor do we know any method by which you can improve the present conditions. We believe that the fact that your amateur apparatus transmits to a distance of seventy-five miles is sufficient proof that it is working well.

Ques.—(2) What is the capacity of a condenser having plates 8 inches by 10 inches, coated on both sides with tinfoil, 5 inches by 7 inches? There are 7 plates in each bank of this condenser connected in parallel and the two banks are connected in series.

Ans.—(2) Each plate has a capacitance of approximately .0005 microfarad and 7 connected in parallel have a value of .0035 microfarad. The two banks connected in series represent a capacity of .00175 microfarad.

Ques.—(3) At what speed should I run a semi-quenched gap, having 16 electrodes on a disc 5 inches in diameter and used in connection with the condenser referred to?

Ans.—(3) The disc should revolve at a speed of approximately 1,800 revolutions per minute.

* * *

J. E. R., Cuenca, Ecuador, inquires:

Ques.—(1) Is there any particular advantage in regard to the distance that may be covered with a transmitting apparatus located on the top of a hill as compared to one that is situated at the sea level?

Ans.—(1) Generally it is difficult to secure a first-class earth connection at high altitudes and for this reason a station will give better results when located near the sea level. Again, atmospheric electricity is especially severe at the higher altitudes and may seriously interfere with the reception of signals from considerable distances. When radio stations are located on the top of a mountain it is customary to use an artificial earth connection—a large grid of copper wires spread radially over the surface of the earth.

* * *

V. C. De C., Issaquah, Wash.:

Ques.—(1) How is the auto transformer, illustrated on page 77 of the book "How to Conduct a Radio Club," wound?

Ans.—(1) The method for winding this transformer is fully described in the book. It merely consists of an iron core of the dimensions given with the wire wound in several layers. The core is, of course, covered with several thicknesses of insulating paper before starting the winding. Coils of this type can be purchased from the Manhattan Electrical Supply Company, New York City.

Ques.—(2) Where can I purchase a ½ microfarad condenser?

Ans.—(2) Condensers of this capacity can be purchased from any telephone company in your vicinity. It is not essential that this condenser should have exactly that value of capacity; in fact, it may vary from ½ to 2 microfarads. You will find it much easier to purchase a condenser of this type than to construct it.

* * *

R. P. P., Newark, N. J.:

Practically any manufacturing house supplying amateur apparatus can furnish you with an oscillation transformer and condenser for your set. The condenser should have a capacitance of about .008 microfarad and may be made up of a number of glass plates connected in parallel. The method for attaching the tin foil to the plates and the general construction is fully described in the book "How to Conduct a Radio Club."

A helix can be employed in place of the oscillation transformer with practically equal results, but the majority of amateurs favor the inductively-coupled oscillation transformer.

Your aerial has a fundamental wave-length of almost 180 meters and is well suited for transmission at a wave-length of 200 meters.

An oscillation transformer for your set may have a primary winding 10 inches in diameter, comprising four turns of 3/16-inch copper tubing, spaced one inch apart. The secondary winding may be eight inches in diameter and have 10 or 12 turns of the same size tubing spaced ¾ of an inch apart.

Parts and material can be purchased from such concerns as the Manhattan Electrical Supply Company, New York City, or advertisers in the columns of this magazine.

* * *

J. M. C., Camp Greenbrier, Alderson, W. Va.:

The signal A. S. T. is the special abbreviation for "all stations attention," while QST is a general call for all stations, as indicated by the London Convention.

* * *

D. W. W., Montpelier, Ky., inquires:

Ques.—(1) Would a large static or X-ray machine, giving a spark 16 to 20 inches in length, be of any value for transmitting wireless telegraph signals? If so, what distsance could be expected?

Ans.—(1) This machine is of no value for the transmission of radio signals as the potentials are excessive for wireless telegraph work.

* * *

J. R. B., Washington, D. C., inquires:

Ques.—(1) What is the approximate wave-length of an aerial consisting of two wires, spaced five feet apart? It is 115 feet in length, 150 feet in height at one end and 80 feet at the other. The lead-in is 70 feet long and also consists of two wires.

Ans.—(1) The wave-length of this antenna is approximately 400 meters.

Ques.—(2) Will an aerial 80 feet in height at one end and 30 feet at the other, consisting of four wires spaced two feet apart, comply with the law?

Ans.—(2) We might answer this if you had stated the length of the flat top portion, but lacking this we cannot reply.

Ques.—(3) On the building on which my aerial is located is another aerial, the distance between the two being approximately 20 feet. Will these aerials have any effect upon each other?

Ans.—(3) If either of these stations makes use of a transmitting apparatus having considerable power and voltage, you had better arrange some method of signaling each other; otherwise your receiving aerial will pick up considerable potential (when the opposite aerial is sending) and possibly injure the receiving apparatus. In fact the aerials are close enough so that tuning on one during the reception of signals will somewhat affect the tuning on the other.

* * *

J. R. F., Washington, D. C., inquires:

Ques.—(1) Please advise why I cannot hear the time signals of Arlington either at noon or in the evening with the following equipment: The aerial is 70 feet in height at one end and 38 feet in height at the other. It is 75 feet in length and comprises four wires, spaced 2½ feet apart. The receiving apparatus comprises an inductively-coupled tuner rated at 800 meters and a 5,000-meter loading coil. The receiving detector is home-made and the telephones are of the Brandes type, 2,000-ohm. I also have a buzzer testing apparatus.

Ans.—(1) It is likely that although you have placed a loading coil in series with the primary winding of your receiving transformer, you have made no arrangement in the secondary winding to obtain resonance with the antenna circuit. With a properly designed receiving equipment, you should at least hear the signals from this station at the 10 P. M. Eastern Standard Time schedule. You might insert a loading coil in series with the secondary winding as well as the primary winding or place a variable condenser of .001 microfarad in shunt to the secondary winding. By either of these methods you could place your apparatus in resonance and consequently hear the signals from this station.

Ques.—(2) How far should I be able to transmit under normal conditions with the aerial described in my first query, a 1/2 k.w. E. I. coil, interrupter, condenser and oscillation transformer, together with a stationary gap?

Ans.—(2) The natural wave-length of your antenna system is approximately 200 meters and if properly adjusted to resonance with your apparatus, you should cover from 15 to 40 miles, depending upon the nature of the receiving apparatus used at the distant receiving station.

* * *

N. H. A., Newburyport, Maine, inquires:

Ques.—(1) Will you kindly advise through the columns of your magazine how I may test the efficiency of my 1-inch spark coil transmitting set with condenser and oscillation transformer, in view of the fact that I do not possess a hot wire ammeter. I generally employ a six-volt lamp connected across the terminals of the secondary winding, but I do not find this method reliable.

Ans.—(1) You might connect the six-volt lamp in series with the antenna system and if there is not sufficient energy flowing to light it up, you had better purchase a smaller lamp—one of two volts. If the current in the antenna circuit proves of too great value for this lamp, you might shunt it by a turn of wire six inches in diameter and about six or eight inches in length. At any rate you could easily adjust this shunt until the glow of the lamp was reduced to a value below the danger point. Maximum glow is of course obtained when the two circuits of the transmitting apparatus are in exact resonance.

Ques.—(2) Can I employ this 1-inch spark coil as an open core transformer and thereby secure increased results, and if so, how many 5 by 7 condenser plates would be required?

Ans.—(2) A 1-inch spark coil of usual construction will not function on alternating current and it would be dangerous for you to attempt it.

Ques.—(3) Will the boring of a number of holes in the zincs of a spark gap give a better pitch to the note?

Ans.—(3) We cannot see how this would affect the pitch of the note. If the spark gap is of the correct length, the surfaces perfectly even and smooth and the vibrator in proper adjustment, you should secure a clear note without the use of any special attachment or changes.

* * *

F. B., Newark Valley, N. Y., inquires:

Ques.—(1) Is a 90-foot vertical aerial preferable to a T aerial 60 feet in height and 6 feet in length, if used for transmitting at the wave-length of 200 meters?

Ans.—(1) The 90-foot vertical aerial would have a fundamental wave-length of about 130 meters, whereas the 60-foot aerial has a natural wave-length of approximately 140 meters. We are inclined to believe that about identical results will be obtained from either type of aerial.

Ques.—(2) What type of aerial do you consider best for operation at the 200-meter wave and what should be its overall dimensions?

Ans.—(2) The inverted L or T type of aerial seems to be preferred by the amateur field as a whole. An inverted L aerial, 60 feet in length and from 40 to 50 feet in height, will do for operation at the wave-length of 200 meters. If of the T type, the flat top cannot exceed 110 feet in length and it may vary in height from 40 to 60 feet.

Ques.—(3) Is a receiving tuner with 288 turns of wire on a primary coil 4 1/4 inches in diameter, too large for the reception of 200-meter signals when connected to an aerial having a natural wave-length of 160 meters?

Ans.—(3) We could answer this question more clearly had you given the dimensions of the secondary winding. You will not require the entire 288 turns to adjust the antenna circuit of the receiving system to the wave-length of 200 meters; in fact, you will require no more than eight or ten turns.

Ques.—(4) Approximately how much does a series condenser decrease the strength of reecived signals?

Ans.—(4) This can only be determined by experiment. In the average case, however, a decrease in strength of signals does take place when capacity is added in series to the antenna circuit. This is due to the increase of resistance caused by the series condenser.

Ques.—(5) What should be the capacity of a series condenser for an amateur's aerial?

Ans.—(5) The maximum value need not exceed .001 microfarad.

* * *

H. F. W., Chicago, Ills., inquires:

Ques.—(1) What should be the approximate dimensions of a tubular condenser to have a capacity of .0005 microfarad?

Ans.—(1) The outer tube may be 4 inches in length and 1 inch in diameter; the inner tube 7/8 of an inch in diameter with the same length. The inner tube should be covered with a thin sheet of hard rubber or other insulating material.

Ques.—(2) When I shunt a fixed condenser across my telephones, the signals completely disappear. Does this indicate a short circuit in the condenser?

Ans.—(2) If the capacity of the condenser does not exceed .05 microfarad, it should not seriously affect the strength of signals and the fact that it completely cuts out the signals would seem to indicate a direct short circuit.

Ques.—(3) Would the speed of a small Rex motor operated by two dry cells be sufficient to operate an ordinary slipping contact detector?

Ans.—(3) Yes.

Ques.—(4) Does the station WGO at Chicago, Ills., use undamped or damped oscillations?

Ans.—(4) Spark apparatus is employed at that station.

THE WIRELESS AGE

DECEMBER, 1916

Hammond's New Radio Boat Completed

AFTER several weeks' delay in hull and machinery construction, the 53-foot radio powerboat H-4, built at City Island for John Hays Hammond, Jr., and the United States Government, reached the Charlestown Navy Yard on October 23, and at last reports was awaiting favorable weather to proceed to her Gloucester destination.

The "ghost ship" was nearly a week coming down Long Island Sound owing to unfavorable weather, and was still further delayed at New London by easterly gales. When the craft started for Gloucester it was estimated that she would be capable of reeling off a 24-knot gait with her 400-horsepower gasoline engines, but an accident caused a hitch in calculations.

As the little craft was passing Race Rock Lighthouse, a lobster buoy or similar piece of flotsam struck the H-4's thin manganese bronze propeller blades. Thereafter the boat was compelled to limp at half speed along the Connecticut and Rhode Island shores, through the Cape Cod Canal and up Cape Cod Bay to Boston, which was finally reached about 7 o'clock Sunday night.

The H-4 is not, as yet, equipped for night piloting, her compass not having been adjusted and electric lights have yet to be installed. The future wireless wonder is practically an unfinished steel hull. Captain Marsters, who was in charge of the boat, deemed it advisable to lie to under the lee of Fort Warren over night, and again started for Gloucester at daybreak. The northeast breeze was kicking up such a high sea outside Boston Lightship that the powerboat cavorted like a bucking broncho and Captain Marsters returned to Boston Harbor, later shifting to the Charlestown Navy Yard, through orders of Mr. Hammond. The boat is moored alongside the old frigate Constitution.

The H-4 has none of Hammond's wireless mechanism installed on board, but it is said several valuable pieces of electrical apparatus have been constructed and are waiting the boat at Gloucester.

According to the description obtainable, the vessel is a radio-dynamic torpedo craft and is a practical development for army or navy use of the experimental vessels which for years Mr. Hammond has had in operation off his home at Glaucester, Mass., the courses of which were controlled by wireless from a shore station. The means for transmitting power to drive this craft as it has been described by Mr. Hammond is: "A wireless station of special design is located at a point where it will be indestructible or out of range of the fire of the enemy. Then that is connected by land lines to a number of observers situated in concrete turrets along the coast. Each of these observers is enabled through his wire connection to operate a wireless transmitter at the station so as to send out energy to control one torpedo (or vessel). A dozen or more torpedoes may be controlled simultaneously from one station, but each observer will control one. Under the system which we have worked out for some years at Gloucester the accuracy of control is such that we are enabled to strike a bamboo rod one inch in diameter, standing upright, ten out of fifteen times at a distance of three and one-half miles."

With regard to possible outside interference in the way of wireless energy coming from the enemy, Mr. Hammond said some time ago: "I have evolved a system which, when there is interference present in the way of wireless energy coming from the enemy, will cause the torpedo (or vessel) to turn around and face that source of energy and move toward it. That has been demonstrated experimentally."

The new vessel, painted in war gray, with H-4, Gloucester, on her transom, is 50 feet long, with a beam of 10 feet and a draught of less than three feet, while her main power plant consists of a 12-cylindered Van Blerck motor that develops 450 horsepower, at 1,400 r.p.m. She is built of 10 and 12 gauge steel, has three water tight bulkheads and a steel conning tower, with a steel trunk aft, over the maneuvering apparatus. She has two rudders, and has clamps on both sides, at the bow, apparently to hold a torpedo. In her trial it was evident that the motor was not tuned up to more than 900 r.p.m., but she attained a speed of more than 25 miles an hour.

Petty officers and members of the crew of the battleship Michigan declare that John Hays Hammond, Jr., inventor of the unmanned wireless boat, narrowly escaped being killed or injured when a 12-inch gun was blown to pieces during experimental gun practice on September 20th. These assertions were made while a board of inquiry, ordered by Secretary Daniels, was making preliminary arrangements for an investigation.

Yeoman Robert W. Cooper, of Baltimore, was struck by a fragment of the shattered gun and suffered a compound fracture of the left arm. Extensive structural damage was done, it is said, to the big battleship.

Men of the crew said a huge fragment of the gun carried away a section of the bridge close to where Mr. Hammond and several officers of the ship were standing. They had gone to the bridge to watch the results of the experimental shot, and the jackies call their escape remarkable.

The crew and petty officers said that the most powerful explosive known—twenty times more powerful than nitroglycerine and said to have been invented by Hudson Maxim—was used in the experiment. They asserted that instead of the shell containing this powerful charge sailing off in the direction of the target, the old monitor Miantonomoh, 2,000 yards away, and exploding after it had penetrated the steel hull of the monitor, it exploded within the gun, shattering the entire 25-foot section that protruded from the turret.

Had the gun burst near the breech, it is asserted the twelve men in the turret would have been blown to pieces.

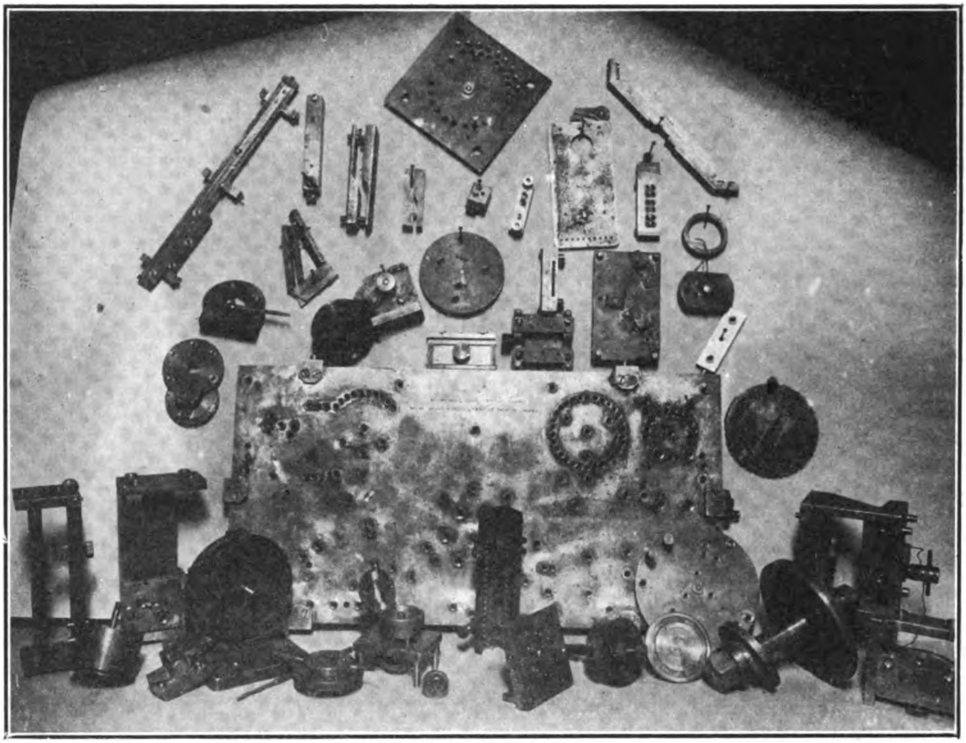
One portion of the big gun was blown through the main deck on the port side. It passed through a bulkhead, whisked through the galley where several men were at work, and finally wedged in a ventilator leading to the fire room. Another piece ripped through the after fire control mast, brought the wireless clattering from aloft and dropped on the deck.

NATIONAL ELECTRIC SIGNALING CO. AGAINST ATLANTIC COMMUNICATION CO.

A suit of the National Electric Signaling Company against the Atlantic Communication Company has been on trial before Judge Julius M. Mayer in the United States District Court, New York City, for several weeks past. This suit alleges patent infringement and involves a sine wave generator of radio frequency directly in the antenna. The proof of infringement involves a transformer between the dynamo and the aerial. Among those called as witnesses are John Stone Stone, John L. Hogan, Jr., Nikola Tesla, Professor Michael I. Pupin, Professor J. Zenneck, E. F. W. Alexanderson and other men well known in radio work.

The suit of the National Electric Signaling Company against the Atlantic Communication Company, for alleged patent infringement involving the heterodyne system of reception, will be heard before Judge Mayer in December.

The control of the installation of wireless on French mercantile ships has been placed in the hands of a commission of nine, who will act in conjunction with delegates of the French Navy.



The assortment of jigs, fixtures, punches and dies necessary to low cost manufacture of one type of receiving tuner. There are similar tools for all other apparatus

Making Wireless Sets

A Visit to the Marconi Factory

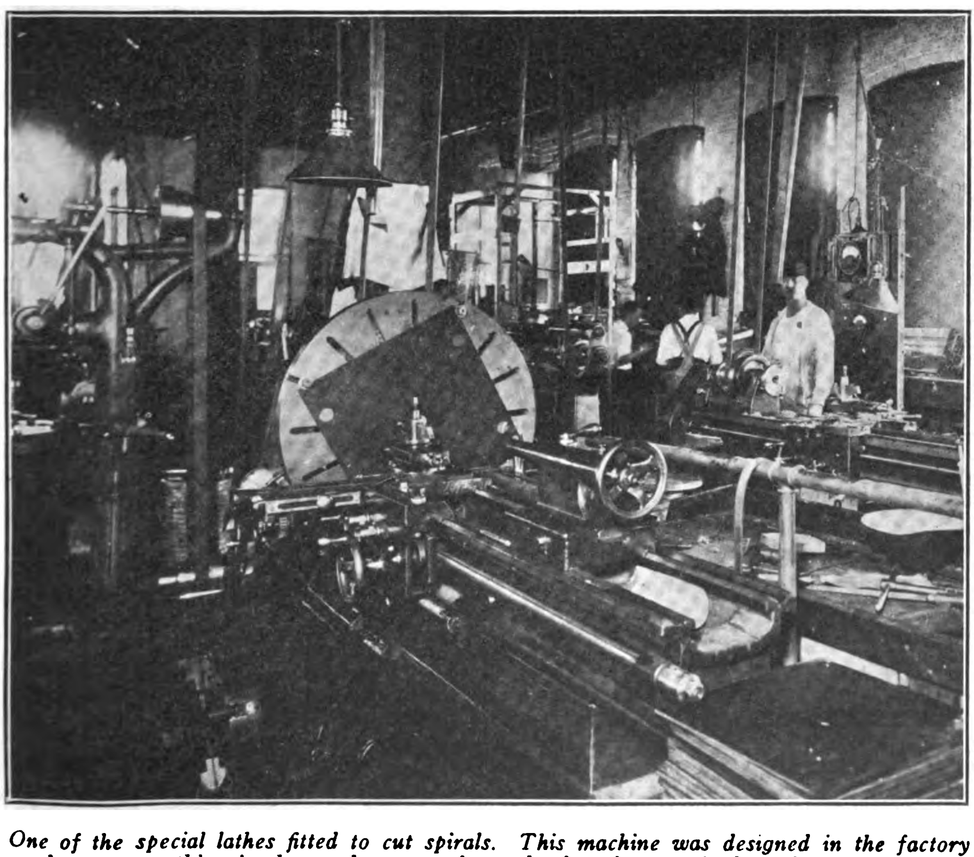
By James W. Valandi

MY first interest in wireless and its attendant mysteries dates back five years, but my first knowledge of how the sets which carry the burden of the world's ether-waved intelligence are made, is but as many days old. I had always wanted to see the wheels go 'round, it seems to me, and from the beginning of my interest in the art it had been my intention to visit the factory where sets for ship and store stations are made and learn a little from observation. I have now seen, step by step, how Marconi sets are machined and assembled, and the processes of manufacture disclosed to me have left the distinct impression of thoroughness that parallels the activities of the entire art, experimental and commercial, and accounts for the rapid progress of radio communication throughout the entire civilized world.

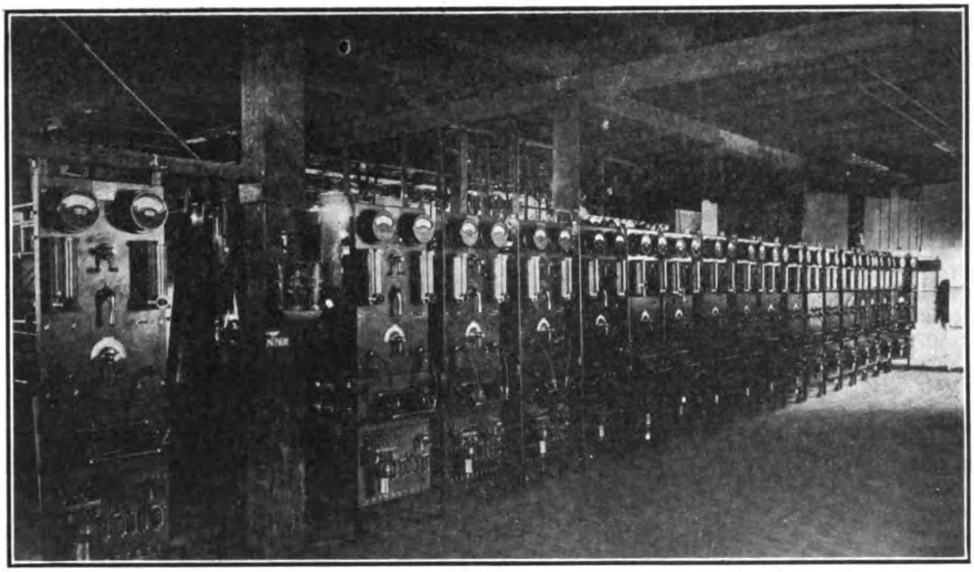
Efficiency — accuracy with speed, and progress without friction—are the dominant notes in the working of the Marconi plant at Aldene, N. J.; men and machines move with the same directness of purpose and to a common end. On all sides may be noted the value of standardization of processes and apparatus, even the raw material which figuratively flows in at one end of the hopper has the appearance of identical sameness that is so striking in an observation of the finished product as it comes rolling through the shipping department's wide open doors and on to the waiting freight car.

Just as there have been many changes in the art itself, so have industrial revolutions been effected in the creation of apparatus for everyday use. Efficiency engineering and systematizing of every step in manufacturing and business administration have left their mark in all departments of the 20,000-square foot area of this birthplace of life-saving and money conserving instruments. Cost-keeping systems and leak-proof requisition forms save many thousands of dollars annually, explained the courteous official who showed me through. "We are down to bed-rock business now," he said. "There is no guesswork in this plant. Every step is planned in advance by the executive heads and we are very proud of the fact that our overhead expense does not have to take into account that insidious time thief best described by the mechanical term, 'lost motion.' This is very gratifying —and surprising, too—in an infant industry."

It was a very healthy and thriving infant from all appearances. The place hummed with activity from foundation to rafters; every man was busy. Those at the machines followed the task in hand with that surety of action which makes the skilled mechanic at work one of the most fascinating sights on earth. Men moved here and there, but nobody ran. There was no hesitation; not once did I see a single individual look about him in perplexity, bewilderment, anxiety or impatience; it was evident that each one knew exactly where an article wanted was to be found and, when occasion demanded something, the worker walked unerringly toward the proper location. My visit lasted several hours and the only inquiries made during that time about any phase of the work, as near as my trained sense of observation could detect, came from me as a curious spectator. My investigations embraced



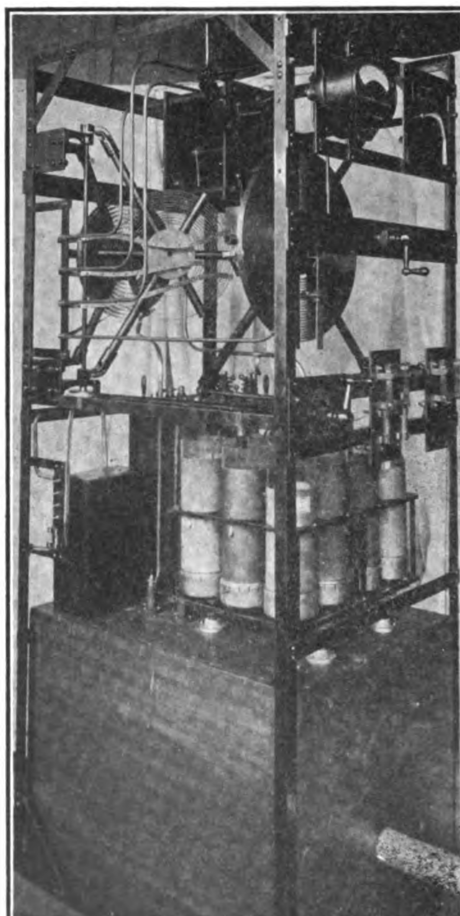
One of the special lathes fitted to cut spirals. This machine was designed in the factory as there was nothing in the market to perform the function required at the speed desired. It operates at a speed five times greater than the ordinary lathe



Long rows of completed panel sets stood ready for inspection and test

workmen well over a hundred in number, and in every case they seemed as much a part of the organization as the cogs in the machinery they directed. I inquired the extent of the operations laid out before me. The "principal" work in hand, the superintendent explained, embraced the construction of 400 or more complete ship sets, numerous shore station equipment and countless accessories such as tuners, wave meters and direction finders. "Rush deliveries—practically all of them," he added with an easy air of assurance that the work would be done on time.

The figures astonished me. The quantities of wireless apparatus which this man had mentioned so casually seemed to me sufficient to supply the needs of the whole wireless universe at one fell swoop. I asked where they were all going. "A few hundred sets will be shipped abroad, England and Italy have sent us some orders lately," my informant explained, "but there are some sizable orders from the United States Government, too, and we are always making better equipment for our own use. The American Marconi Company is strong on standardization of apparatus, now that the art has advanced sufficiently to make this practicable, and every ship under its con-

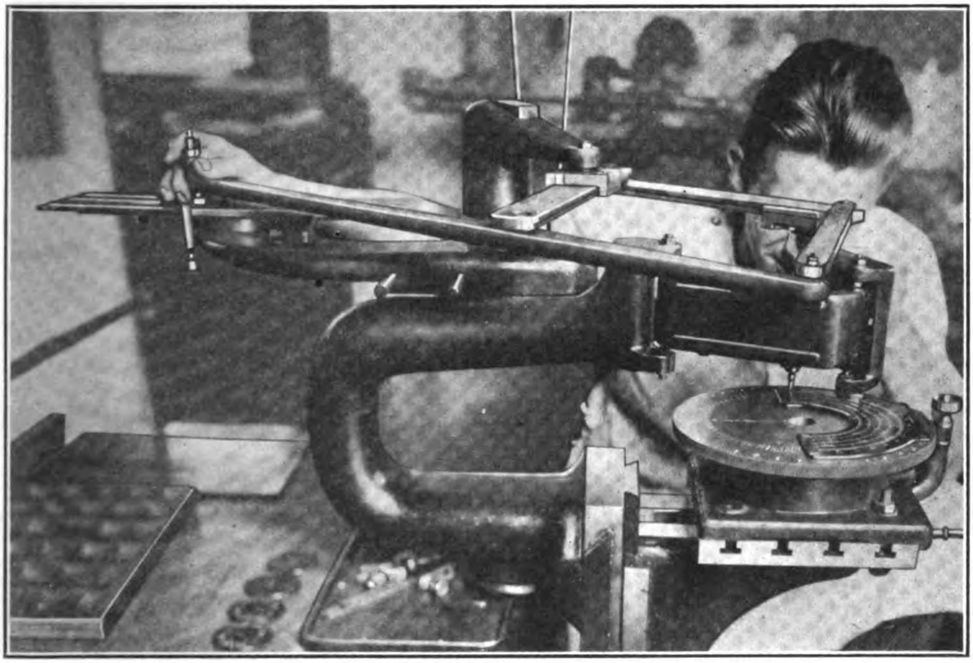


The new 3 k.w. non-synchronous set

trol gets the latest and best type of equipment as fast as we can turn them out here."

An interesting detail caught my eye as we strolled through the works. Men with ladders and planks were distributed about the machine shop on the second floor. They were preparing, so I was told, to whiten the whole place, the application of paint with high refracting qualities and overhead distribution lighting by nitrogen lamps, being the latest aid to the betterment to be added, and a chucking and turning machine, entirely automatic and able to do the work of four ordinary engine lathes, had just been purchased. Time and labor-saving devices that kept down the cost paid for themselves in savings very quickly.

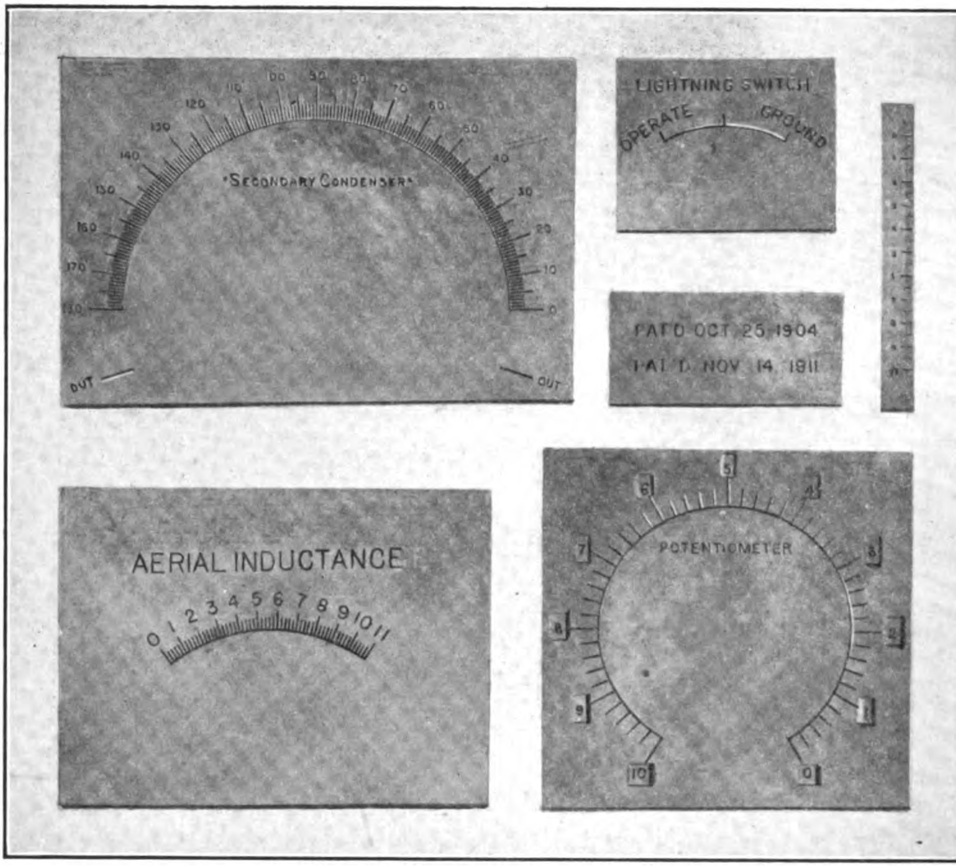
The L-shaped building has been arranged to secure the greatest efficiency and economy of space; all of the departments have light from all sides and are laid out on what might be termed a gravity basis; that is, the work of



Making the fine recording scales and dials of the wireless instruments on a machine which operates on the pantograph principle. Various forms of engraving tools are used, according to the fineness or coarseness of the lines

of working conditions. Nothing was to be stopped, or even retarded, by reason of the improvement; little things like this were constantly executed without interference to routine. Constant changes for the better were going on imperceptibly, year in and year out, said Superintendent George Hayes; new tools had recently been added, better communication between departments was then being effected, dumb-waiter lifts to convey small parts were being installed, in another week a new 50 h.p. high pressure boiler was fashioning the apparatus begins on the second floor, where machine shop, tool rooms and research laboratory are located; finished work then goes down to the floor below to assembly and testing rooms, thence out to the railroad siding at the door of the shipping room.

The machine shop is a fascinating spot. A hundred different types and styles of machines are constantly revolving, grinding, turning and shaping the numberless small parts that are later to be assembled into apparatus for sending and receiving



Models from which graduating scale plates are cut by the pantograph machine; sometimes the models are several times larger than the work and, in simple work, are the same size, or even smaller

wireless messages. A skilled foreman of wide experience heads this department and directs the operation of a comprehensive checking system that apparently leaves nothing to chance. A section is given over to the milling machines, upon which are cut, shaped and formed the intricate parts of irregular form and design. Then there is a long row of precision lathes designed to handle the parts which require almost microscopically accurate machining; mechanics specially picked for their skill are entrusted with this delicate work and accuracy to the thousandth part of an inch is required of them at all times.

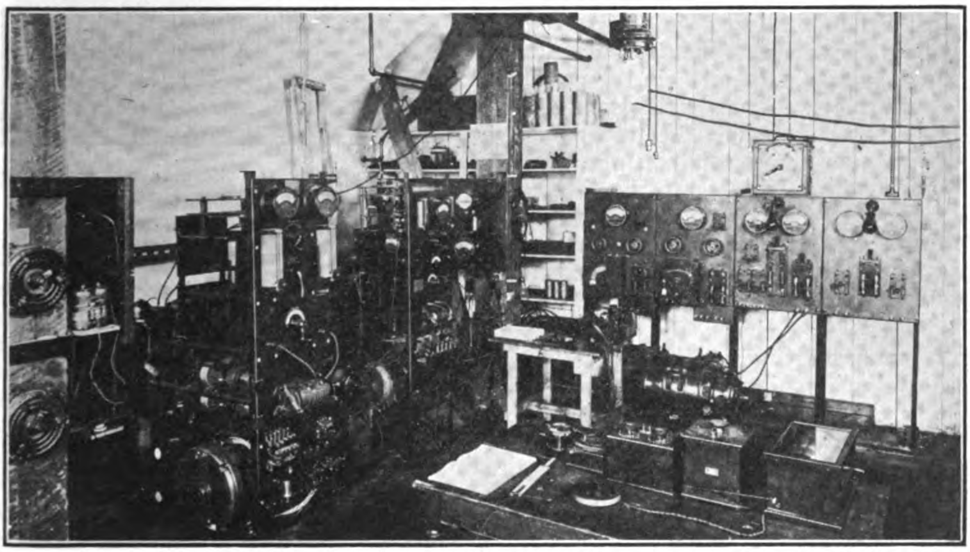
On the floor below can be seen transformers in all stages of construction. A visit here would prove a revelation to any power or illuminating engineer who had never penetrated the mysteries of constructing the dry, high-potential transformers used in wireless transmission of signals. Thousands of feet of very fine wire are wound into the "pancake" coils, then taped with linen and impregnated with a high-insulating compound under vacuum in apparatus specially designed for Marconi use. Baking in a special oven follows, and several hours elapse before the coils emerge from the high temperature electrically and mechanically strong.

In another section of the factory is a room that reminds one of nothing so much as the shop of a manufacturer of finely engraved jewelry; here are made the fine recording scales and dials of the wireless instruments.

For use in engraving various forms of scales used on instruments of its manufacture, the Marconi Company employs machines operating on the pantograph principle. Most of these scales are gradnated on plates or dials composed of a black compound resembling hard rubber, and in order to make the graduations as easily read as possible, zinc oxide mixed with a sufficient quantity of paraffine to give the required consistency is rubbed into the graduation marks after they are cut on the machines. This mixture hardens through exposure to the air, giving a high degree of durability, and as it affords a combination of white graduations on a black background, the scales are very easily read. The illustrations show an example of one of these graduated plates and graduating machines producing work of this kind.

These machines operate on the pantograph principle. A model is made in which graduations are cut to correspond with required graduations on the work, and in use this model is set up on a holder on the machine so that a tracer point can run over it. This tracer is secured to an extension of one arm of the pantograph and the engraving tool is supported at the opposite side of the pantograph linkage. Various forms of engraving tools are used according to the nature of the work; where fine lines are to be cut the tool is generally in the form of a pointed "cannon drill," while for heavier classes of work end mills of various forms are employed.

The size of model used also varies according to the character of the work. In cases where fine graduating is to be cut over a relatively small area, it is desirable to make the model several times larger than the work, owing to greater convenience in making the model, while in the case of simple designs the model may be of the same size or even smaller than that of the work. Adjustment of the pantograph linkage is provided in order to obtain any required ratio between size of the model and that of the work produced from it. The models are made of brass and it will be evident that they can be conveniently cut on a milling machine equipped with a circular attachment.



A portion of the test room where the faultless construction of each panel set is verified. It is in this department that the future radio engineer starts on his three-year course of training

In operation of these graduating machines the work is clamped to the main table and the model is strapped down on a copy table. The tracer point is drawn over successive graduations on the model and this causes the cutter to automatically follow corresponding graduations on the work, the relative size of work and model being controlled by setting the pantograph mechanism as previously mentioned. Operation of the machine is semi-automatic; it is necessary only for the operator to draw the tracer point over successive graduations on the model, and as a result work can be done very rapidly.

There are a great many cases where circles have to be divided into degrees, examples of this kind being shown on scales marked "Primary Condenser" and "Secondary Condenser." In order to avoid the necessity of having to make special models for this purpose, the expedient has been adopted of producing a universal fixture. This fixture is secured to the work table and has a pivoted disk with 360 equally spaced teeth cut in its periphery. On the model table there is a simple plate with graduations cut in it of the required lengths for the scale to be produced on the work. The work is strapped to the top of the pivoted plate of the fixture and indexed space after space by means of teeth in the periphery of this plate. After each setting of the work has been made, the tracer point is drawn over the graduation mark on the model, which which governs the length of graduations cut on the work. This fixture can be used for graduating any scales requiring circles or parts of circles to be divided into degrees.

When I had viewed the various stages of manufacturing a wireless set I was naturally impatient to reach what might be termed the verification point, the testing room, in other words. This department's location I found immediately preceded that of the shipping department, the last stop on the way out. Long rows of complete sets ready for installation on board ship stood ready for inspection and test. Those I was most interested in were the 2 k. w. panel sets, the equipment which marks the first real standardization of apparatus known to the wireless field. My eye took in an aisle of these and I made a quick count—thirty-six powerful equipments, good for ranges up to 500 miles, each one absolutely identical in appearance with those alongside it, were in transit through the inspecting and testing room. I gave a fleeting thought to industrial preparedness; it was a very comfortable feeling to realize that this important industry had grown to such proportions, almost over night.

Operations in the test room further confirmed my confidence; it was evident that no mistakes were made in these equipments. There were two panel sets

An instance of the unusual experiments in a day's work. An automobile used to try out current generation by aero motor for an aeroplane wireless set

undergoing test, one of 2 k. w. power and another ½ k. w. The equipment had been set up complete, just as is done on shipboard. Actual working conditions were cleverly counterfeited in the six-hour, full load test; readings were taken on all circuits, the sets started and stopped at frequent intervals to insure good working of all parts, the temperature was taken regularly of all current-carrying parts, particular attention being given to the bearings and armature field and wherever there might be a tendency to overheat. It was all very thorough, for after the completion of the tests the equipment passes on for a general inspection of its workmanship, under the eyes of a man carefully chosen and assigned chiefly to this job. Not until it has been passed by him, is the equipment ready for delivery.

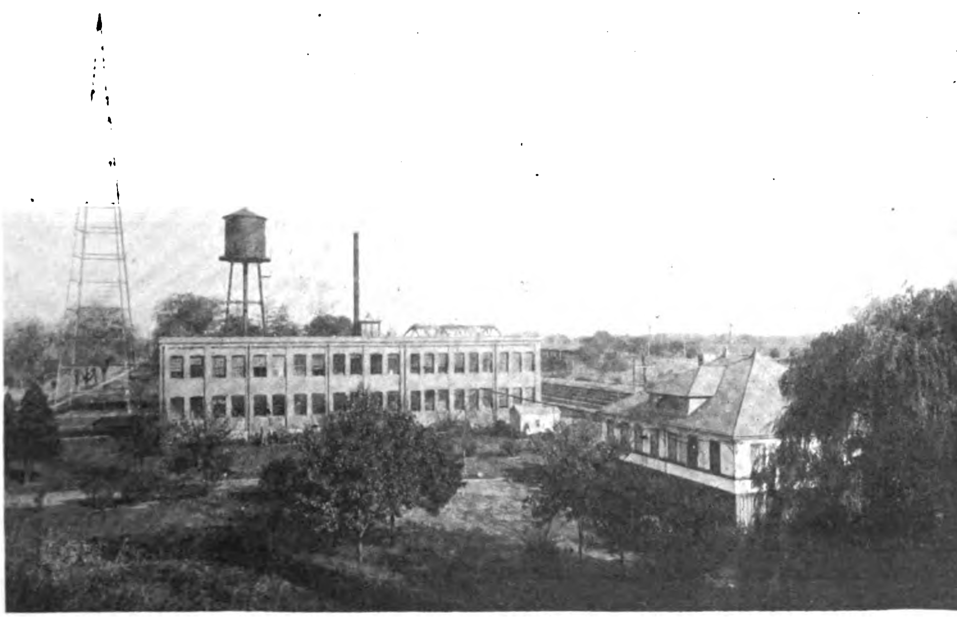
There is a human interest appeal in this department, for it is in the testing room that the future radio engineer begins his three-year course of training. Under the supervision of a chief qualified by wide knowledge of design and operation of wireless instruments, the aspirant for engineering recognition is required to test not only transmitters, but intricate apparatus such as transformers, receiving panels, telephones, wavemeters, motors and motor generators, in fact, all of the apparatus manufactured in a plant that is running to full capacity all the time.

The experience thus gained is of the most practical kind. For example, in the testing of a tuner, a special standard instrument and one of its own type is set beside the new arrival. Through the use of specially designed transmitting apparatus wave-lengths over the entire range of the tuner are emitted and, before it can be passed, the new instrument must respond to every indication on the scale.

On every hand there were evidences of how well worth while it is for a young man to rise up in this new profession. Problems absolutely new are solved every day in the year, and once a position on the laboratory staff has been attained, there is seemingly no end to the opportunities to exercise ingenuity in the creation of apparatus that is making the technical history of the day. As an instance of the unusual experiments that are carried on, I call to mind my surprise at noting, as I was about to leave, a party of factory engineers drive up in an automobile. On a frame suspended from supports that once had held a windshield was a miniature aeroplane propellor attached a generator. At a speed of fifty-five miles an hour this automobile had been dashing over the New Jersey roads for the greater part of the afternoon, the force of the wind driving the propeller on the generator and it in turn delivering energy to apparatus in the rear of the car to a maximum capacity of 1 k. w. It was a test—a successful one, incidentally—of the proposition to generate current by aero motor for an aeroplane wireless set then in course of construction. Incidents of this kind are a daily occurrence; there is always something new to be learned, some new problem to be brought to a speedy and satisfactory solution.

It didn't take me long to understand how the men themselves felt about their

(Continued on page 199)



A view of the Marconi plant at Aldene, N. J., taken from the elevated tracks of the railroad, showing the west side of the factory building, a portion of the laboratory, oil house, tank for sprinkler system, one of the wireless towers and the surrounding grounds

Wireless Ideas by the Thousands

Something About the Applications Filed in the United States Patent Office

By J. B. Brady

A typewriter attachment which translates the wireless code and sets it down on paper, whether or not the receiving operator is familiar with the signals; an apparatus for recording wireless messages when the operator is absent from the set; these and thousands of other devices attesting the inventive activities of wireless men are indexed in the Radiant Energy Division of the United States Patent Office in Washington.

The rapid growth of wireless has greatly increased the work in the Patent Office, three examiners being engaged in analyzing the ideas of those who file applications. On these men devolves the responsibility of granting and denying applications for patents.

The public is permitted to examine the index of all wireless telegraphy and telephony patents. A search through these patents is interesting as well as profitable, for here are found ideas that are unknown in the commercial field and can be experimentally developed by the amateur.

The broad class of Radiant Energy is divided into a number of subclasses to include the various apparatus and systems. Patents granted for instruments which have a similarity of function are placed together in one subclass. Those granted for apparatus disclosing a particular structure are also classified together in one subdivision. In making a preliminary examination of the records, which is the first step taken in determining the question of granting a patent, it is necessary to analyze the several subclasses and select a division which appears to be pertinent to the function or the structure of the new instrument.

The official classification of Radiant Energy is substantially as follows:

CLASS 250—RADIANT ENERGY

Subclasses

41. Condensers.
1. Miscellaneous.
36. Oscillation circuits—
37. Disruptive discharges—
38. Spark gap.
34 Special ray—
35. Tubes.
2. Teledynamic—
16. Apparatus—
33. Antennæ,
20. Receivers—
21. Detectors—
22. Electro-dynamic,
23. Electrolytic,
27. Gaseous element,
28. Liquid element—
29. Capillary,
24. Magnetic,
30. Solid element—
31. Crystal,
32. Granular,
25. Thermal,
26. Thermo-electric,

Teledynamic—
Apparatus—

17. Transmitters—
19. Controllers,
18. Sustained oscillation,
3. Earth transmission—
5. Telegraphy,
4. Telephony,
8. Radio-telegraphy—
13. Complete station,
10. Co-operative wave,
11. Directive,
12. Group frequency,
9. Multiplex,
14. Portable sets,
15. Repeaters,
6. Radio-telephony—
7. By light waves.

40. Tuners.
39. Wave-meters.

The beginner in radio will appreciate the typewriter attachment to translate and set down on paper the wireless signals. The patent covering this appliance is classified in subdivision of "Miscellaneous." There are two main levers attached to the typewriter, one to be depressed for the dots, and the other to be operated upon the receipt of dashes. At the end of the code word the shift key of the typewriter is depressed, actuating all of the type which has been locked into place by means of the dot-and-dash levers.

The records show that early in 1913 an apparatus for recording a wireless message when the operator is away from the apparatus, was patented. Two sensitive relays are connected in series at the point usually occupied by the telephone receivers in the ordinary receiving set. One relay controls a circuit through a battery and the magnetic clutch positioned upon the motor of a phonograph. The receipt of a signal automatically sets the phonograph cylinder in revolution by means of the magnetic clutch. The second sensitive relay acts as an intensifier through a telephone receiver circuit, so that the sound vibration of the signal in the receiver is strong enough to be reproduced by the sound box of the phonograph to which the receiver is coupled. Hence the wireless wave automatically sets the phonograph into operation and permits a record of the message to be made.

A rotary spark gap which is entirely non heating has been designed. The rotor consists of a spirally grooved cylinder which rotates between two flat bars positioned adjacent the length of the cylinder. A new sparking surface is continually presented to the fixed electrodes as the cylinder revolves, the sparks beginning at one end of the cylinder and traveling throughout the length thereof between the spiral groove and the stationary electrodes.

One patent suggests a stationary spark gap in the form of two cones, one cone within the other. The idea is that a large surface is presented for the sparks. The inventor claims that in the ordinary spark gap the discharge occurs at substantially the same points, forming minute globules of metal which shorten the sparking distance between the surfaces. Thus the resistance is lowered, and the condenser which is to discharge its energy across the spark gap is discharged at a lower capacity; hence the resonance of the primary circuit is materially effected. The new cone spark gap does not have this undesirable feature.

Another patent of considerable interest is one recently issued on a wireless safety ship signal. A multiple wave receiving antenna, comprising a series of long induction coils vertically disposed about a circle at eight points of the compass, is provided. Each induction coil is made up of the ordinary antenna wire, the primary of which is wound close together, one end thereof being connected to the earth. Each secondary coil which surrounds the primary is connected through a coherer circuit with an electro-magnet. The magnets connected to each of the eight induction coil circuits are positioned in an indicator box around a sensitive compass. The compass needle is deflected by the magnet coupled in the induction coil circuit which lies in the most direct line with the ship transmitting a signal of distress.

Several inventors have been working to perfect means whereby the arc of the wireless telephone may be made steady. The simplest solution of the problem is apparently to surround the arc with an atmosphere of alcohol. This is accomplished by placing the arc electrodes in a casing upon an alcohol tank. A wick passes from the alcohol tank to a point very near the arc and feeds alcohol by capillary attraction into the arc casing where it is vaporized by the heat of the discharge. The carbon from the denatured alcohol then deposits upon the arc electrode as it wears down, thus preventing any unevenness in note as a result of a variation in size of the arc. In some devices of this nature the alcohol drips between the arc electrodes from a pine connected with a supply tank.

The records show that there has been a constant tendency on the part of inventors to combine two or more instruments into one device. A combined tuning coil and condenser has been developed. The tuning coil is wound upon a semi-circular core which fits within the circular casing of a rotary variable condenser between the movable plates and the wall of the casing. The arm which rotates the condenser plates carries a

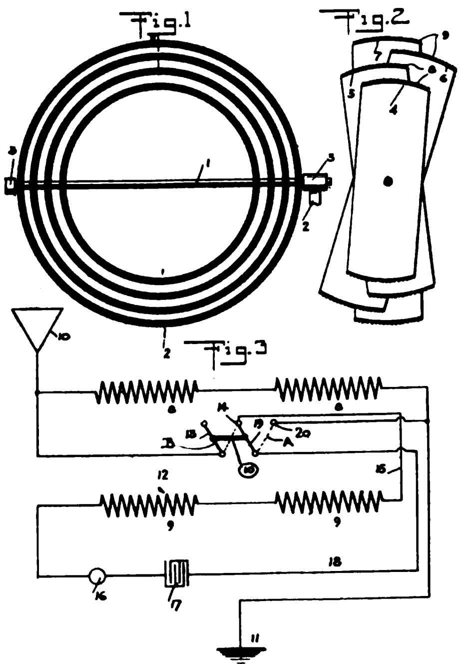


Fig. 1

slider engaging the coil. Another arm pivoted at the condenser shaft provides the second slider for the adjustment of the tuning inductance. Thus a means is presented for adjusting the capacity and the inductance of the receiving circuit in unison, and at the same time the condenser and double slide tuning coil are made into one compact unit. A crystal of silicon is carried in the ordinary spring-pressed tuning coil slider, a sensitive point upon the crystal engaging the turns of wire upon the tuning coil to serve as a rectifier and as an inductance adjuster.

A tuning coil entirely without mechanical or electrical variation in the length of winding has been devised. Four coils wound upon tubes about 1½ inches wide are mounted in concentric relation to each other; three of the coils being revoluble about one inner fixed coil. The two outside windings, 9 and 9, (Figure 1), constitute the secondary of a loose coupler, while the two coils within, 8, 8, make up the primary unit. The coils are connected as indicated in the drawing and permit the reception of a broad wave with switch 10 in position A, or the use of a loose couple circuit with switch 10 in position B. To operate, the primary coils are first adjusted relative to each other to the particular wavelength desired. The angle between the coils controls the number of active inductive turns. The secondary units are next adjusted with relation to each other, and then the pair as a unit rotated to obtain the coupling desired. The new loose coupler has many features not heretofore used in practice.

There have been no patents issued upon any type of tuning coil since the famous Pickard mechanically-fixed winding or contact type of coupler was invented.

The tendency in the vacuum valve field has been to discover means to increase the flow of ions in the partially exhausted bulb. Filaments have been invented by the score to increase the degree of ionization of the gaseous medium of the valve. The number of plate and grid elements have been increased by some inventors with the idea of intensifying the passage of signal pulsations through the sensitive ionized gas. One particular patent shows the arrangement of four sets of these electrodes about the ionizing filament.

The latest Hudson filament was patented in August. Hudson explains that the vacuum valve filament has two functions. First, it must heat the medium within the bulb and thus render the space sensitive to any pulsations; second, it must throw off ions. Some materials are good heating elements, but are not effective in throwing off ions. The filaments which do throw off a large number of ions usually erode quickly and burn out from the continued heat. The new filament invented by Hudson consists of two separate wires, tungsten, especially durable for heating, and tantalum, which possesses to a remarkable degree the property of throwing off the ions. The excellent properties of each of these wires are obtained by winding the tantalum wire around the tungsten heating filament.

In a vacuum valve recently patented a small coil is placed around the bulb of the vacuum valve and energized by means of a local battery circuit through an adjustable resistance. The inventor uses this arrangement in preference to the well known magnet usually placed adjacent to the plate electrode of the valve, and says the coil renders the vacuum valve far more sensitive.

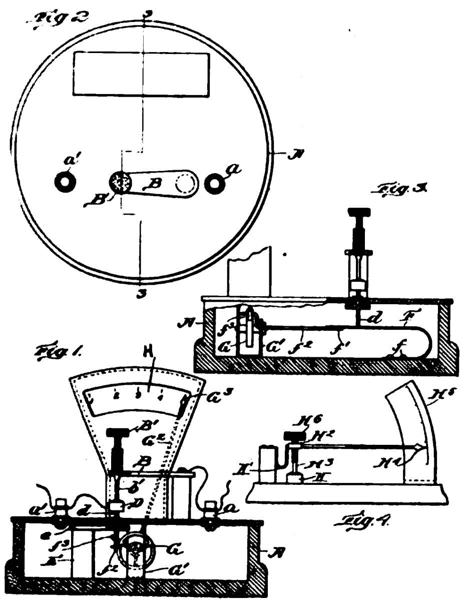


Fig. 2

The art of detectors is quite large. Figure 2 shows an interesting device used in connection with the usual crystal detector to indicate the amount of pressure placed upon the sensitive mineral by the fine wire contact. The usual crystal cup, D, is secured upon rod *d* which is adapted to indirectly actuate the indicating hand, G^3, over the scale H. By this arrangement the operator determines the pressure which places the detector in its most sensitive condition and at any time may bring the instrument again into operation if, through accident, the detector has been thrown out of adjustment. It is only necessary to adjust the contact to the proper degree of tension and search the surface of the mineral for a sensitive portion.

It has been predicted that at some future time the power companies will stretch great antennae over their plants and distribute electric current to subscribers without the aid of wires. Such systems have already been developed in the patent records. The negative pole of a direct current generator is connected with the antenna and a circuit made through a condenser from the positive pole of the generator to the ground. A series of spark gaps are placed between the aerial and the ground. The aerial is continuously charged in one direction only by the generator and is discharged by means of rapid unindirectional impulses through the plurality of spark gaps, causing the transference of energy through space to a considerable distance. The energy transmitted is in the form of a direct current and will actuate an indicating device at the receiving end without the aid of any form of detector. Thus the system is adaptable for signaling as well as for high-power transmission.

One inventor has reduced to practice a system of duplex wireless which has

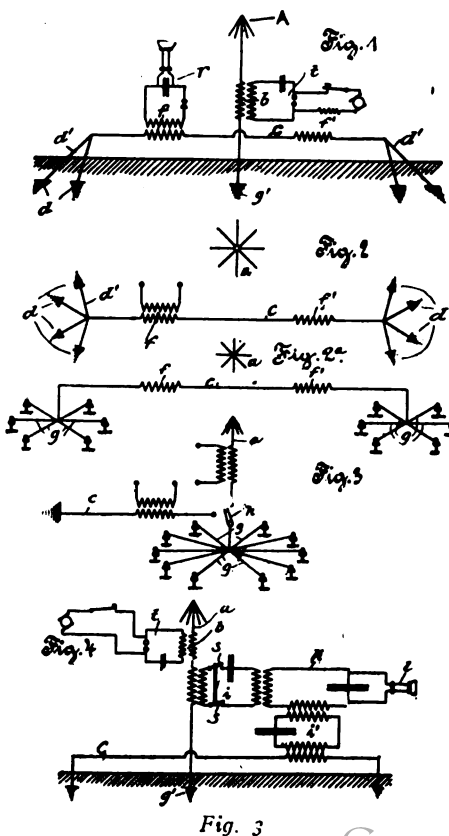


Fig. 3

gained favor in commercial use. He claims that for best efficiency in transmitting the antenna should be of large vertical extent, while for receiving the antenna should be horizontal and close to the ground.

The aerials are arranged as indicated in Figure 3. *A* is an umbrella shaped antenna for transmitting. Arranged symmetrically below this is the low horizontal aerial *C*, connected for receiving. Energy radiated from aerial *A* will not react with antenna C and hence this system permits transmitting and receiving simultaneously at the one station. It is advantageous to employ both aerials for receiving the oscillations when the station is not operating the transmitter.

Such are a few of the inventions of wireless men as found in the Patent Office. I believe that they contain suggestions from which the readers of The Wireless Age can develop new and valuable ideas.

THE BATTLE OF THE WIRELESS

Buzz, buzz, buzz, comes through the head phones. It is the Paris wireless station making a wireless charge against some statement of the central powers. Suddenly there are other sharp reports. "Tick-tick, Tick;" "Tick, Tick, Tick-tick." The Berlin station is replying to the attack. A few minutes later the London Marconi tower breaks in. Rome, too, enters, then Athens and Constantinople.

Within a few minutes the wireless battle is on. The allies and the central powers are fighting in the air. Charge after charge is made. The "tick-ticks" come as quick and sharp as "drumfire" at the front. It is between 3 and 4 o'clock in the afternoon and the battle has reached its height.

This brief description of a wireless battle was written on the battlefield in southern Hungary. These battles between the belligerent wireless stations to one who could understand telegraphy would be the most thrilling and fascinating of any battles in the war.

They are interesting because the weapons are bloodless, because the cannon are the wireless stations and because the shots are waves of sound, sent through the air.

Just as the men on the battlefields in France and Russia are fighting for victory, so the wireless stations are fighting for the same, but their immediate object is to reach the neutrals. Because France and Germany and Germany and England are at war these stations cannot communicate with each other. They must fight the air currents to reach New York. All their attacks are directed to neutrals, but in so directing them the attacks encircle the globe.

Day and night some wireless station is battling. But at three o'clock in the afternoons, European time, the greatest battles are fought, for at that time the official war announcements of the contending armies are announced. These are the ammunition for the battles. Berlin opens the attack with a statement regarding the fighting on the west and east fronts.

The Eiffel tower in Paris replies with a counter attack—the official Paris announcement. Later Vienna comes in, then Rome, Constantinople and London.

A correspondent visited a wireless station in the field where a lieutenant explained how a plunger in one cylinder changed the radius of the wireless sound so that Paris could be heard and a change in the plug made it possible to hear London. Another change brought Constantinople to the auditor's ears, and other changes took him to the battlefields of Athens and Rome.

Messrs. Cutting and Washington, two Harvard men, have evolved the idea of a brass helmet to be worn by wireless operators in flying machines for protection against the noise made by the engines and propellers during the receipt of messages. The helmet is designed so as to cover the head of the operator.

The Mutiny On the Santana

A Christmas Fiction Story

By Magda Leigh

THEY were talking in undertones, their voices filled with deep emotion.

"No tree for the little fellows! No toys! No Santa Claus! The Old Man says they're old enough to know there isn't any Santa Claus—and we've got to cut out the foolishness this year."

McGann, wireless operator, tapped the deck emphatically with the soles of his shoes as he talked.

"No Santy!" echoed the First Mate. "And you remember last year how the little shaver yelled for joy when he saw that hobby horse I made? Remember the way he used to drive Katy-Belle for months with the reins Olsen made him out of the old signal halyards?"

"And the doll I fixed up out of that old tarpaulin for Katy-Belle?" McGann broke in eagerly. "Her mother says she still turns in with it—and it's all rust stains and coal dust!"

"To think of the Skipper acting that way with his wife and kids along!" The First Mate shook his head dismally. "It's seven years since I was home in Brooklyn with the wife and kids for Christmas. I send 'em things from wherever we are—but that's not seeing their faces when they open the parcels!"

"And him with his kids right here wanting to cut it out!" and the wireless man sighed feelingly.

At that moment there came the sound of shrill voices from the starboard side of the deck house, closely followed by the sound of galloping little feet on the iron deck.

Katy-Belle, four years old and round as a butter-ball, was "horse" for her five-year-old brother, commonly known as Mickey-Dooley. She was harnessed in the old signal halyards, unearthed from an over-burdened locker full of discarded toys. Katy-Belle was galloping steadily, in spite of the long, slow roll of the deeply-laden Santana.

Discovering the two men, they sent up a glad shout and precipitated themselves upon McGann and the First Mate.

Katy-Belle's eyes were wide and serious. "Ithin't Thandy Clauth comin' to our ship thith year? My Daddy thayth he ithin't!"

McGann hugged Katy-Belle hungrily.

"Your Daddy's fooling you. Of course he's coming."

"But do you know he is?" insisted Mickey-Dooley, shrilly.

McGann glanced at the First Mate. Their eyes met. And in that glance a message of understanding passed between them.

"Mickey-Dooley," the wireless operator answered, weightily, as if registering an oath, "I *know* he is."

McGann and the First Mate had been with the Santana for a considerable time. In fact, the members of the ship's company were remarkable in their steadiness. The Santana had been a home—up to the present—and now the Old Man was beginning to change.

His intimates could have told of an unfortunate investment and the loaning of what remained of his saving to a friend who did not live up to his promise to repay. The loss of his little fund meant much to the Skipper, for he had fondly hoped to make of Mickey-Dooley something different than his father: in his vision there had been college days and perhaps a profession by means of which the boy might wrest a living from the world. The Skipper was now advanced in years—too old, he believed, to accumulate enough to carry out his plans. And with the loss of his savings came a disregard of some of the little things that help to smooth out life's rough places. His attitude regarding the Christmas celebration was an illustration of this. In fact, things were not as of old, and the first murmurings of discontent were beginning to be heard.

Since Mickey-Dooley's second Christmas on the big freighter—and Katy-Belle's first—the holiday had been distinctly one of much rejoicing. McGann was a bachelor, but the three mates and most of the engine room force were married men, with families scattered to the four quarters of the globe. Many of the crew had children, too, and although presents were purchased throughout the year at the various ports of call and sent "home," wherever that might be, it was not like having the day with their own and seeing the fun when the parcels were opened.

There were only a few of the men, therefore, who did not have their family Christmas celebrations by proxy, as it were. Katy-Belle and Mickey-Dooley were totally unaware of the part they played on each holiday. In fact, perhaps only Mrs. Barbour, the Old Man's wife, realized what the celebration meant to these bronzed wanderers of the seas. Tears had crept slowly down her cheeks more than once, when she had seen the expressions in the hungry eyes of the men—and she knew each was picturing his "own kids" in their distant homes opening *their* Christmas gifts.

The change in Captain Barbour was a blow to his wife. And as for giving up Christmas, Mrs. Barbour was horrified at the idea. Not only for the sake of the little ones, but on account of the big, strong men of the crew, to whom the day was of more import than it possibly could be to the two little recipients of their fondly-lavished gifts.

There had always been some kind of tree bought at the nearest port to Christmas, or else the First Mate had manufactured one—a clothes-horsey affair, to be sure, but something upon which gifts could be hung. And gifts! Many had been purchased in out-of-the-way places, for the Santana was a tramp of the Seven Seas; and many were made by loving hands—crude things of canvas, wood or rope. But Katy-Belle and Mickey-Dooley invariably loved the home-made articles best—why, only a child could answer. They were more "playable-with" through their very toughness. They lasted longer than the Japanese dolls or the Danish harness with bells, or the easily broken toys labelled "made in Germany."

Had Captain Barbour been able to see through his wife's eyes, or had his wife been able to see just a little deeper into her man's mind, there might have been no such order given aboard the Santana as the abandoning of the Christmas celebration. Not for one instant did the Old Man appreciate what the day meant to his men. His whole soul was wrapped up in the successful running of his ship and in the making into a real man of his diminutive son. To this latter idea was due in part the root upon which sprouted his contention that Christmas festivities had no place at sea. He was afraid Mickey-Dooley would not grow into a manly man, like the First Mate, or McGann. He wanted Mickey-Dooley to throw aside his childhood at the age of five, and begin to "grow up." Had anyone put these facts before the Skipper in plain language he would have denied them vehemently. He scarcely realized the enormity of his own ambitions for the boy—and the present absurdity of them.

There were only a few days left before Christmas—and only one more port of call before the bleak passage of the Strait of Magellan. The port was Coronel, where the Santana would fill her bunkers with coal, and from there down to Cape Pillar she would battle her way against high winds and higher seas. A poor place for "Santy Claus" to find a ship and come down the foremast with his sack of toys; but the two youngsters understood that Santy wasn't afraid of storms. And McGann had assured Mickey that he just *knew* Santy would come this year. Wasn't that enough?

At Coronel, Mrs. Barbour, after a

whispered, yet lengthy conversation with McGann, persuaded the Skipper to take her and the children ashore for a day. It would be horribly dirty on the decks, she argued, with the coal coming aboard. There would be no place for the kiddies to play. And besides, there would be so much wet weather for a week after—the children needed a romp ashore. There was small amusement to be found in Coronel, but a lunch at the Rhoemheld Hotel would be a break in the everlasting routine, and it would do them all good.

Had Captain Barbour been able to see the strangely wild dance that took place on the ringing deck of his ship, after his small boat put off, he would undoubtedly have thought his crew either suddenly gone insane, or else suspected the presence aboard of a case of *chicha*. The dance was one of sheer, unadulterated joy, however, watched over by three grinning mates and a triumphant boson. There was mutiny brewing on the Santana.

An unusual amount of shore leave was granted certain members of the Santana's crew, during the absence of the Skipper. The shore-going party, be it known, was careful not to land in the vicinity of the Rhoemheld, and it went stealthily up side streets to its destination, returning to the ship along the byways rather than the highways, and with a large covered cart at its head.

When Captain Barbour returned, with his tired, but happy little family in the evening, everything was quiet and shipshape aboard the Santana.

The Santana had called at Coronel once or twice before, in the past five years, and although Coronel is anything but an Eden, Captain Barbour could well remember his crew's distaste for the putting to sea, when going southward, owing to the heavy weather which invariably set in and the consequent extra watches. But on this occasion there was not any of that usual distaste apparent.

After passing Santa Maria Light other matters took possession of the Skipper's attention. These matters consisted principally of rain and a slowly increasing beam sea.

It would have shocked the Skipper beyond words had he overheard Olsen, one of the sailors, at mess.

"Ay hope she bane blow like sin on Chris'mas Eve!" the big Swede remarked, gently, between mouthfuls of chow. A sentiment to which the entire assembled force of the Santana's deck department gave grinning assent.

And Christmas Eve it did blow—just like that. There was a head sea and a heavy wind, according to the entry in the scrap log. To the landlubber, this sounds prosaic enough. But to the man out on the southern Pacific it means the word Olsen used softly.

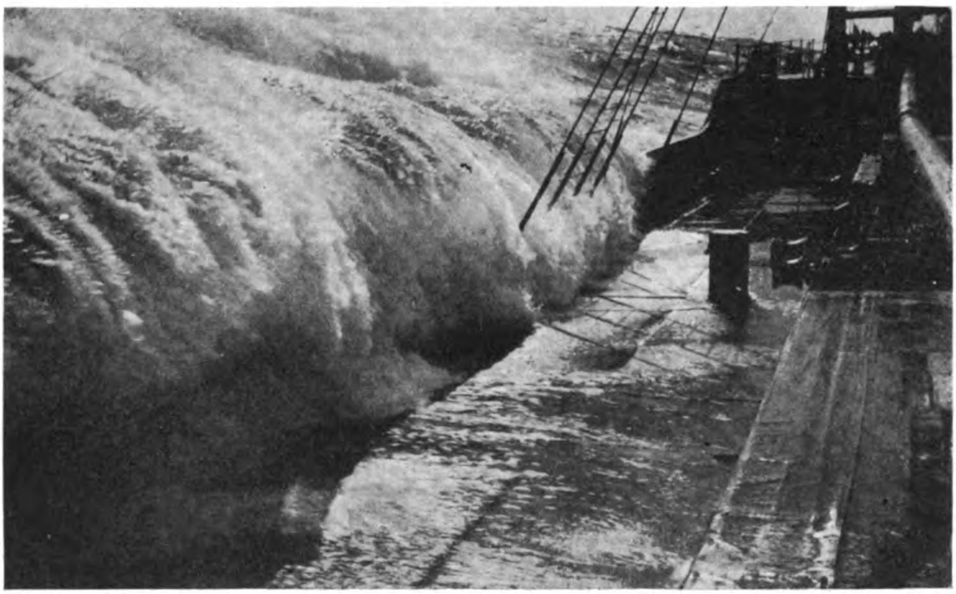
All afternoon the Santana butted sullenly into the huge seas that piled up and crashed down over her fo'c'sle-head. The well-deck was one seething broil of cascading waters. Through the ratlines the gale shrieked and tore like a relentless fury.

The Old Man was on the bridge. There would be no leaving the bridge for perhaps twenty-four hours. His meals would be eaten in the wheel-house—meals snatched to keep up his strength—whatever could be brought to him through the storm.

Katy-Belle and Mickey-Dooley had been put to bed. They had first listened, wide of eye and glowing of cheek, to the old rhyme about " 'Twas the Night Before Christmas." To be sure, the dear old poem had little bearing on the way these two had been taught to picture Santa's approach, but they always demanded it on Christmas Eve. And this particular time Mrs. Barbour told it with a strange look of determination in her hazel eyes, and a firm set to her sweet mouth. After she had kissed her babies and had listened to their rapidly uttered prayers, which wound up with the inevitable "And please, God, let Santy find our ship," she switched off the light and made her way to the dining saloon.

It was a strange picture for such a place and such a night! The dining saloon of the Santana was filled with men—big, chuckling, whispering men—if one may call their gruff attempt at quiet, whispering. It was filled, too, with greens. Greens of all sorts. The biggest of these was a tree—perhaps not the regulation Christmas tree, but a tree, as the Chief grinned, "for a' that!" One entire side of it was shaven and shorn of its foliage, so that it could be made fast to the bulkhead. This was the only way a Christmas tree could "grow," at sea, in such weather. The crew—every man not on watch—was engaged in decorating the room with the boughs and branches brought so surreptitiously at Coronel. That they were a trifle wilted, mattered not a whit. They were Christmas greens, and the spirit in them was fresh and fragrant. That was what mattered, Mrs. Barbour comforted the First steward and handed them by "the Missus" herself. Oilskins and sou'westers were discarded, and willing hands took up the acrobatic task of decorating the staunchly battened tree.

Mira Barbour, sitting on the settee along the table, could have wept. Wept for sheer thankfulness and love! As each man dug into some cavernous pocket and brought forth his little gift to the "kids," the big tears welled into her eyes. They were so happy—these big, crude men! So happy in their little gift-giving! Well did Mira Barbour understand how their hearts reached out toward their own little ones, across miles and thousands of miles of sea and dis-



All afternoon the Santana butted sullenly into the huge seas

Mate, when he bemoaned the fact that they were wilting.

The heavy freighter butted and rolled against the crashing waters without. Again and again the entire roomful of men went tumbling across from one side of the saloon to the other. But this was not work. This was "fixin' up" for Katy-Belle and Mickey-Dooley. And more, this was the Santana's first mutiny!

When the watches were changed men came in from the deck, dripping and shivering with cold. These were served with hot coffee, made by the chuckling

tant land. There were dear, amusing explanations of why this or that wasn't "made as good" as it might have been, under different circumstances. As if that mattered! Mira Barbour could have hugged them all—from the big, faithful, homesick First Mate to the utterly unintelligible but broadly grinning Finnish mess boy. This was for Katy-Belle and Mickey—her kiddies, that they were disobeying orders. Just what Captain Barbour would say was something Mira scarcely liked to consider. The First Mate and McGann had told her they would look out for that. And like

Mickey-Dooley she accepted their word as final.

Evangelistas Light was not sighted until early Christmas morning. Somewhat heavy at heart, because of his having forbidden any celebration, and weary with his long watch, Captain Barbour made up his mind he would leave the bridge long enough to have breakfast with the wife and children.

And so it happened that as the breakfast gong sounded, Captain Barbour descended from the upper deck and struggled against the wind until he managed to get the door to the deck house open.

A strange whiff of woodsy smell greeted him. He sniffed—and then strode through the short alley to the saloon. As he paused at the door three figures came bursting through the door opposite him from his own quarters.

"Mewwy Cwithmuth! Mewwy Cwithmuth!" shrieked the unmistakable lisp of Katy-Belle, and he felt her two little arms tightly clutching his legs. He stooped and caught her to him, just as Mickey-Dooley came catapulting upon him, with repeated good wishes. Then he heard the words repeated in the low sweet tones of his wife's voice, while her lips met his and her two hands made a gentle pressure against his shoulders.

And then the peculiar mist which had gathered in his eyes, cleared, and he looked about him.

For a minute there was a horrible silence. Then the storm broke. Putting Katy-Belle down on the deck the Old Man faced his wife.

"What does this mean?" he asked, with sinister quiet.

Mira met his eyes steadily. "You'll have to ask some one else," she replied. "In fact, McGann has requested the particular privilege of explaining this to you."

As the Second Mate entered the saloon the Skipper turned on him. "I want all hands—at once!" he thundered.

The Second Mate turned and left the room without a word. In the silence that followed, Katy-Belle and Mickey-Dooley crept to the shelter of their mother's skirts. From this safe point they stole excited, yet anxious, glances at the tree. Mickey-Dooley almost choked in his effort to maintain the quiet which he felt was demanded of him, for his eyes had caught sight of the most marvelous swing hanging on the tree—a swing that might almost have been called a bosun's chair, had it not been meant as a Christmas gift to a little boy from a loving ship's carpenter.

Into the room filed the men of the crew who were not on watch. And with them was McGann.

"Mrs. Barbour says you will explain —*this!*" the Old Man sputtered, furiously, sweeping a hand comprehensively toward the tree and the greens.

"Yes, sir! This——" the wireless man stumbled for a moment over his words, "this is Christmas."

"I thought I forbade any such shenanigans this year."

"You did, sir!"

"You mean you deliberately disobeyed my orders?"

"Yes, sir."

The answer came so swiftly that the Old Man was left, for a moment, breathless. Then he glared at the men shifting from foot to foot before him.

"Don't you know that to disobey orders is mutiny?"

"Yes, sir!"

The Old Man choked, suddenly.

"You mean—you mean this *is* mutiny? Now, come, what does this mean?"

"Oh—the little *fellows!*"

The plea was spoken softly, but the words carried a world of meaning. For an instant the Old Man hesitated. Then he capitulated.

"Mira, take them back to the room for a minute," he ordered, sternly. And after the woman had led away the two softly weeping children, who did not understand, but who knew something was all gone wrong, the Captain folded his arms and waited for McGann to begin.

But it was not he who spoke. A voice from behind the group in the doorway broke in upon the silence.

"As I am the one to blame for this whole matter, maybe you'll let me explain, sir!" And into the now wholly outraged Captain's sight came the First Mate, a pleasant smile in his eyes, but a strangely determined look about his lips.

"This was done with my knowledge and consent, sir," he began, quietly. "If it is mutiny, then there is not a soul on the ship, including Mrs. Barbour," with a sudden smile, "who is not guilty. We just couldn't keep Santy Claus away from the Santana!"

He paused and waited for his superior to make some comment. There was only a silence. So he continued, pleasantly: "One reason we have been able to keep the same men for so many voyages aboard the Santana has been this very sort of thing—this homelikeness. The men have been like members of one big family. They haven't had their own homes and their children to enjoy on Christmas, but they've had yours. They've been able to keep the Christmas spirit through this yearly celebration. The Mate leaned suddenly forward, his face closer to the Skipper's. "There's hardly a man among us who hasn't held Katy-Belle in his arms some time during Christmas day and crooned his own particular country's Christmas hymn to her. There's hardly a man who hasn't through some gift he's made Mickey-Dooley, helped that little chap a step along toward big generous manhood. That little chest over there for Katy-Belle's dolls' clothes has taken McGann the better part of a year to make. He cut all those little fancy figures on it himself. You see if Katy-Belle doesn't just go crazy over it! Did you think you could take things like that away from the men, sir? And away from the Kids? They need it—both sides! And as to the Missus—she's been working on this year's Christmas presents ever since the twenty-fourth of last December! Could you take that occupation away from her? There's been one day, every year that's helped make us put up with lots of things. That's been Christmas Day! If you really mean to take that away from us, you'll have to ship a new crew. We—we—need it!"

The Mate paused suddenly. There was a lump in his throat. His heart was in Brooklyn, with the three small stockings hanging over the familiar mantelpiece. And just as the Skipper was beginning to understand this, another voice broke into the conversation.

The Skipper looked thoughtful. "I had never thought of it the way you all think of it," he finally remarked, with most extraordinary meekness. "I was simply afraid Mickey-Dooley would be too much a baby if we kept up this Christmas business. I want him to be a real man."

"Real man? Real man?" The Mate shouted a derisive laugh. "Do you call *these* real men?" pointing to the crew, as he glared at his superior. "Then don't worry about Mickey-Dooley. These men, sir, are patiently waiting to get down on the deck and play—*play*—did you get that, sir?—with your two children! They've got to go on watch, some of 'em, in a few minutes. Don't you think you can countermand this order about no Christmas celebration, sir, and call off this—mutiny?"

The Old Man looked about at the grizzled, bronzed faces of his men. In every eye was a mute supplication. And somewhere in back of him, behind a closed door, there was a sound of sobbing. The Old Man swallowed hard and drew himself up.

"I'm a fool," he acknowledged before his crew. "The order about Christmas is countermanded!" Then, before anyone could speak, he strode over to the closed door and shouted, boyishly: "All hands come here and report to Santy Claus' Christmas tree! I've got to get back on the bridge—and I want to see what that old scamp, Santy, has brought me!"

As Mickey-Dooley and Katy-Belle, despite still-wet eyes, swept like a hurricane into the room, a great cheer went up from the throats of the men. Then, "Look, Kitty!" "Look Mickey!" "See what the old chap left for ye." "Oh! Kitty-Belle, the gran' box fer yer dollies' gear, now!"——and more.

Mira Barbour crept into the arms stretched out blindly toward her. "Mira! Forgive! I've been a fool!" the Old Man whispered, brokenly. "I'll be different."

And thus ended the mutiny on the Santana—save when Katy-Belle defied mother, father and heaven to take away from her bed that night the little carved doll's trunk McGann had fashioned with his loving hands.

A Half-Kilowatt 200-Meter Amateur Transmitting Set

By Elmer E. Bucher

ALTHOUGH the panel type of transmitting set appeals to the experimenter lacking space for the installation of a wireless equipment, a number of amateurs prefer apparatus of the open kind which, in the event of necessity for repairs, can be easily reached. Those favoring the latter type of equipment declare also that the station with exposed apparatus presents a more businesslike appearance than one in which the component parts are screwed to the board.

To assist beginners in the design of a small transmitting set that will not exceed the wave-length of 200 meters, the apparatus shown in Figure 1 will be described. It is of course understood that the design presented will not be strictly adhered to, but the general plan will in many cases be adopted.

The set shown in Figure 1 includes a ½-k.w. open core transformer, four standard copper plated Leyden jars of the type furnished by the Marconi Company (capacity .002 microfarad each), an oscillation transformer mounted directly above the condenser, a non-synchronous rotary spark gap, an aerial changeover switch and a hot wire aerial ammeter. The majority of the readers of THE WIRELESS AGE are aware that the connections in the closed oscillation circuit of an amateur

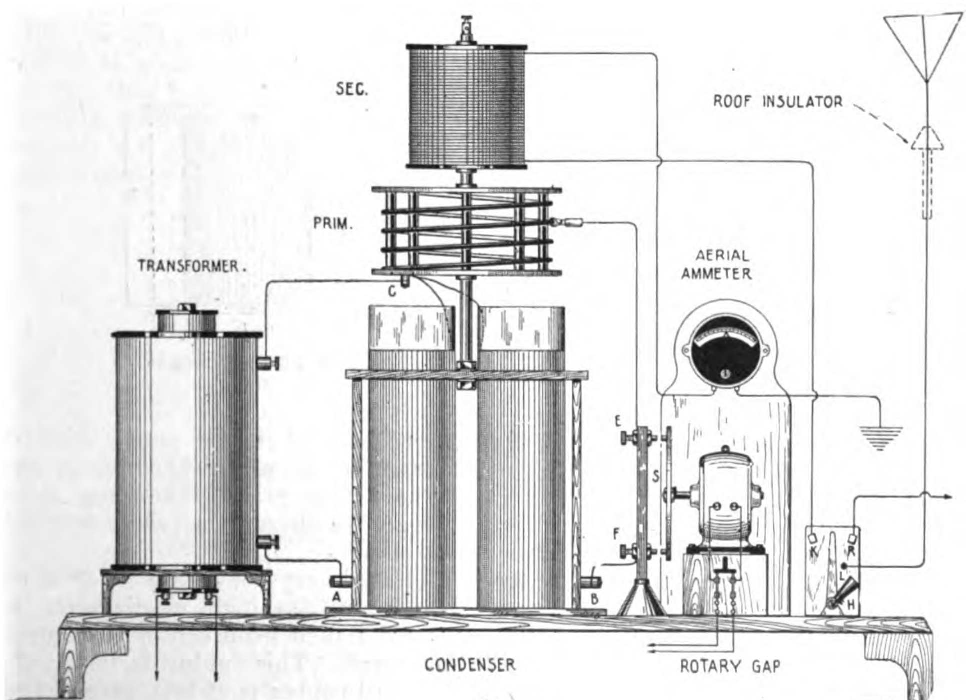
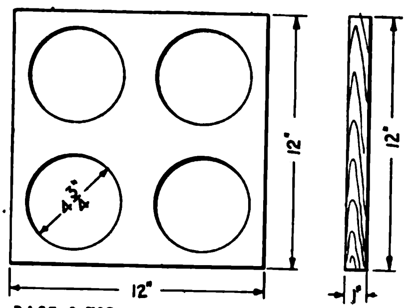


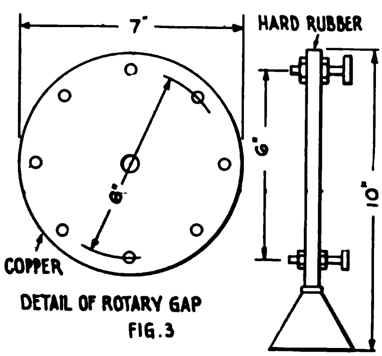
Fig. 1

wireless telegraph transmitter must be exceedingly short to permit the use of a condenser of large capacity for a given wave-length and since the experimenter is restricted to a condenser of .008 microfarad capacity, this value is used in the set described.

It is to be noted that the condenser jars are mounted in a wooden rack, the base of which is covered with a sheet of copper. Small upright posts having 4 holes 4¾ inches in diameter (cut out by a jig saw) to take the jars



BASE & TOP JAR RACK
FIG. 2
WOODEN UPRIGHT

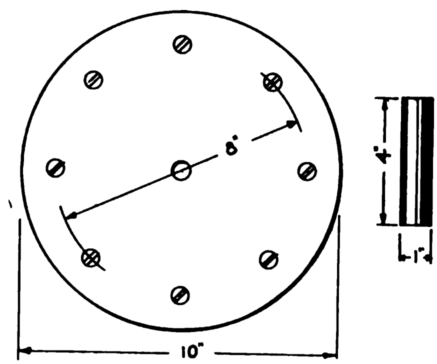


DETAIL OF ROTARY GAP
FIG. 3

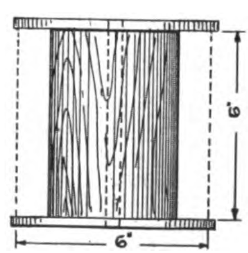
support the top piece shown in Figure 2.

Fastened to the top of the rack is an upright rod of metal, hard rubber or wood, that supports the primary and secondary windings of the oscillation transformer. It will be seen that with this arrangement of apparatus the connections in the closed circuit are exceedingly short and the complete closed oscillation circuit can be traced out in the following manner:

The four connections from the inside coating of the four Leyden jars are connected to the binding post, C, which is mounted on the base of the primary winding of the oscillation transformer. The circuit continues through the turns of the primary winding through the flexible contact, D, to the binding post, E, of the rotary spark gap. The circuit then continues through the disc of the gap, out the binding post, F, and finally makes connections to the binding post, B, which in turn is connected to the copper strip



BASE & TOP OSCIL TRANSFORMER
FIG. 4



DRUM FOR SECONDARY
FIG. 5

at the base of the jar rack. With this connection no more than two or three turns of the primary winding are required to obtain the wave-length of 200 meters.

The primary winding is made of copper tubing ⅜ inch in diameter and spaced 1 inch from center to center of the turns. This tubing is fastened to the hard rubber post by means of brass machine screws, the copper tubing and the hard rubber post being drilled accordingly.

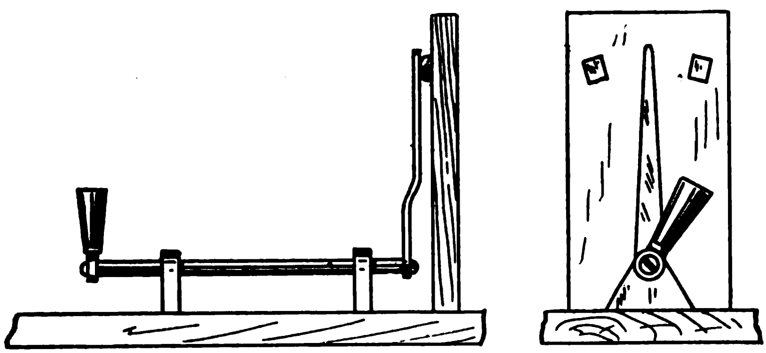
The secondary winding of the oscillation transformer comprises from six to twelve turns of No. 6 D. B. R. C. wire which are closely wound and the top terminal connected to one binding post of the aerial meter while the opposite terminal of the latter is connected to earth. The other terminal of the secondary winding leads to point K of the aerial change-over switch, then extends to the contact blade, L, and thus on to the aerial. When the switch is thrown to the contact point, R, the aerial is connected to the receiving equipment.

Drilling and over-all dimensions for the top of the jar rack appear in Figure 2, similarly for the rotary gap disc in Figure 3, while the top and base for the primary winding of the oscillation transformer are constructed as shown in Figure 4. Figure 5 gives the dimensions of the drum support for the secondary winding which may be of wood.

Specific dimensions for the wooden block upon which the rotary gap motor is mounted cannot be given, owing to the difference in the dimensions of motors, but whatever the make it should be designed to revolve at a speed of 1,800 revolutions per minute when connected to a sixty-cycle source of alternating current. The disc, S, mounted on the shaft of the motor, should be about 7 inches in diameter and should have eight sparking points equally spaced about 1 inch in circumference. These may be made of machine screws. The sparking points should be placed on a radius of 3 inches from the center and the stationary electrodes, B and F, should accordingly be separated by 6 inches. With this design 240 breaks or interruptions of the condenser circuit per second are obtained being about the equivalent of 120-cycle alternating synchronous sparks.

As will be observed, the transformer is of the open core type and is mounted in a vertical position, being supported by three wooden legs equidistantly spaced on the wooden base. The dimensions for the transformer are as follows: The primary core should be 14 inches in length, 2½ inches in diameter, consisting of a bundle of very fine soft iron wires which are taped in circular form. The core is then covered with two or three layers of empire cloth and afterwards wound with two layers of No. 14 double cotton covered wire. The entire primary winding is then inserted in a hard rubber tube of about 3/16 inch in thickness.

The secondary winding is composed of ten separate sections, each about 7 inches outside diameter 1¼ inches in thickness. The inside diameter is approximately 3½ inches. Each of the pancakes comprising a section should be wound with No. 32 S. S. C. wire which has previously been soaked in hot paraffin after the method



DETAIL OF AERIAL SWITCH
FIG. 6

described in a previous issue of The Wireless Age. The secondary sections may be separated from one another by micanite or paraffin paper washers.

The aerial ammeter is mounted on a board immediately behind the rotary spark and at such a height that the reading of the scale is directly visible. A suitable ammeter was described by the author in the preceding issue of The Wireless Age, or if desired one can be purchased on the open market.

The aerial change-over switch appears in Figure 6. A metal rod is mounted on the bearings and has a hard rubber handle. On the opposite end is mounted the switch blade which is 8 inches in length. The antenna connects to this rod by means of a stranded flexible conductor, but the opposite end makes contact with the stationary points, K and R, as in Figure 1. The upright supports for the contacts should be of hard rubber and they should be separated by at least 6 inches.

A simple roof insulator was described in the November, 1916 issue of The Wireless Age.

The receiving apparatus for this set is of extreme simplicity and is shown as assembled in Figure 8. It must be remembered that it is designed for the reception of signals at the wave-length of 200 meters and the construction is simplified accordingly.

Diagrammatically the circuit appears in Figure 7 wherein a variometer, V, is connected in series with the antenna system and in series with it is placed a crystal detector, D, and the fixed condenser, C. The latter is shunted by the head telephone, P. A suitable variometer was described in the book entitled "How to Conduct a Radio Club" and the dimensions for it are given in that publication. The placing of the apparatus is as follows: Alongside the variometer (See Figure 8) is placed a fixed condenser of .005 microfarad, and immediately to the right a suitable crystal detector. Two binding posts are furnished, one for the aerial and earth connection, the other for the head telephones.

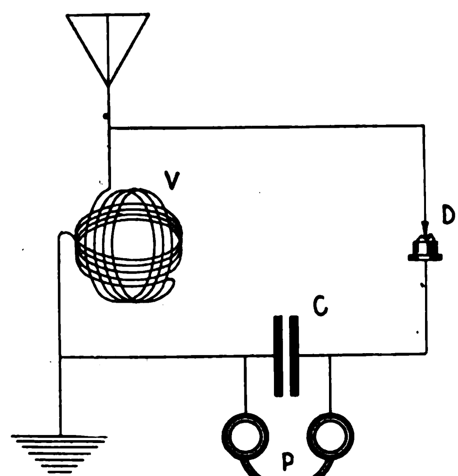


FIG. 7

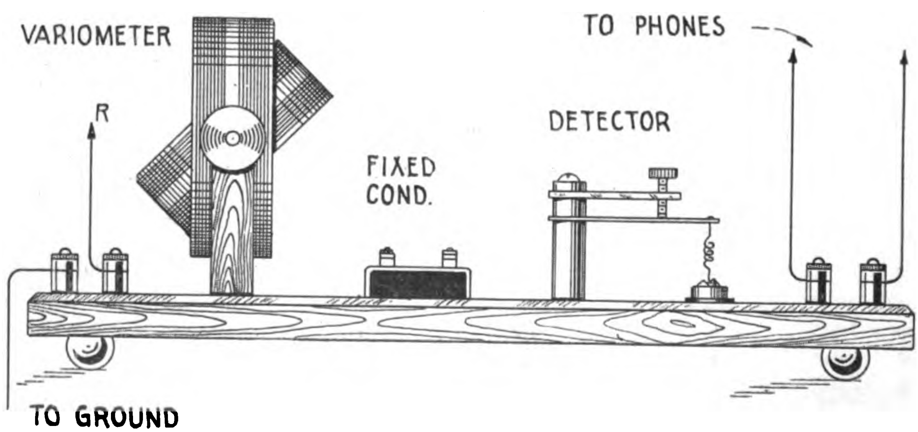


Fig. 8

Dimensions for the variometer are as follows:

Two cardboard tubes one, 6 inches in diameter the other 5 inches in diameter each being 2 inches in width, are wound with a single layer of No. 24 C. S. C. wire. A space should be left in the winding in the middle of the tube for about 1/4 inches. Care should be taken to get the same amount of wire on each tube. The tubes are then connected in series. A hole is drilled in both sides of each tube and through these holes is placed a piece of 1/4-inch round brass rod 8 inches in length. When mounting the variometer a small tube should be fastened 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.

In tuning to an amateur station it is then only necessary to vary the relative positions of the outer and inner coils of the variometer until maximum response is obtained.

To adjust the transmitting apparatus, the builder of this set should purchase a wave-meter (or if he desires, construct one) and then accurately adjust the closed circuit to 200 meters. The turns may be added or taken off at the secondary winding until the hot wire ammeter gives the maximum deflection.

An ammeter having a maximum range of three amperes is satisfactory.

A small fused switch may be mounted on the wooden block supporting the motor for turning the current on and off. By more elaborate design extra contacts can be added on the shaft of the aerial switch to start and stop the motor.

SPECULATION REGARDING INTERSTELLAR COMMUNICATION

A newspaper says that interstellar wireless communication may be a possibility of the future according to a belief now held by some scientists, and it has remained for M. Pierre Guzman, of Paris, France, to stimulate by the offer of a monetary prize the efforts of what may be called our astronomical telegraphers to get into touch with our planetary neighbors. M. Guzman has promised to pay $20,000 to the astronomer who first establishes communication with any planet or star other than Mars.

M. Guzman's elimination of Mars as a wireless station in the competition he is promoting is based upon his belief that experiments made by American astronomers in Arizona prove that a wireless expert who talked with the Martians would be overpaid if he received 100,000 francs. This performance, to his mind, is too easy, too lacking in romantic and sensational features to be worthy of the modest fortune he has dedicated to science. It may be that M. Guzman considers the Martians merely an insignificant lot of chronic canal builders, whose conversation over an interstellar wireless apparatus would be of no interest to us.

To the average person, nevertheless, it would appear that direct and authentic news from Mars might be of some value to us. The Martians appear to have solved various engineering problems that prove the ingenuity and technical skill in lines of endeavor in which we Americans are at present intensely interested. If the Martians have learned how to build canals without inviting landslides, have made of irrigation processes an exact science, and have, as various authorities contend, learned how to fly by their own motive power, there are numberless specialists in this country who would be pleased to call them up by long distance at once.

INSTITUTE HEARS A PAPER ON ENERGY LOSSES

At a meeting of the Institute of Radio Engineers held on the evening of November 1st at the Engineering Societies Building, New York City, a paper on "A Determination of the Energy Losses in a Radio Telegraph Transmitter," by Bowden, Washington and T. H. Boyster was presented. An interesting new method of determining heat losses in transmitters was described.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS
How a Type D Tuner Was Reconstructed

I should like to tell the readers of The Wireless Age how I reconstructed the former Type D United Wireless tuner into one of the inductively-coupled type without a great mechanical change.

While talking with experimenters I was surprised to hear many criticisms regarding the operation and results obtained from the carborundum detector. Many said that the efficiency of this detector is not to be compared with that of a piece of galena or silicon, but little did they realize that experience is necessary in order to obtain satisfactory signals with a carborundum detector.

Nine-tenths of the complaints were made by the users of the old reliable Type D tuner, using a common form of carborundum detector and potentiometer. Some of these experimenters undertook the task of reconstructing their sets; others, believing that the working qualities of the tuner would thus be spoiled, are still using the set in the manner originally designed. If the reconstruction is undertaken carefully these tuners are ideal in every respect; in fact, the type which is the subject of this article has given very satisfactory results, stations having been heard in Canada and Honolulu on a single wire aerial, 25 feet in length and 50 feet in height.

By studying the drawing it will be seen that use has been made of every switch and slider that the tuner originally possessed. But to rearrange the design, as per my suggestion, the potentiometer is dismantled, the circuits rewired, a galena detector employed and a loose coupler inserted in place of the original double slide tuner. (Figure 1).

All switches, contacts and metal parts should be removed from the box and the woodwork sand-papered, thus removing the original finish. A new coat of some high-grade varnish should be applied, allowed to dry, sand-papered and again varnished. This will give the cabinet a beautiful appearance, making the set look like new.

The potentiometer material should be discarded, as only the switch-arm and the points are to be used again. In place of the potentiometer we will use this switch for variation of the inductance value of the secondary winding. The latter is tapped at eleven points and flexible leads are soldered to the original potentiometer contacts as shown in Figure 2.

The detector holder should be slightly altered to allow the use of a galena crystal; this will be clear from Figure 3.

The fixed condenser that was originally used with the carborundum circuit should be shunted across the head telephones. The left hand coil is permitted to remain in its original position, as wave-lengths as high as 3,000 meters can be tuned to using the average amateur's aerial with the loose coupler that will be described further on. The switch marked "Shunt" will be used to shunt the galena detector, one point being left dead as three points only are required. By tracing out the diagram of connections we notice that with this arrangement the detector may be either short circuited or open circuited. The switch marked "Battery" is to be used for a test buzzer; in fact, a buzzer of any type may be inserted in the box, as indicated in Figure 1, and in detail in Figure 4.

In place of the double slide tuning coil we insert an inductively-coupled receiving tuner, using one of the original sliders for variation of the inductance of the primary and the other to vary the coupling of the secondary. The slider on the top of the box should be used for the primary circuit and the one on the side of the box for the coupling adjustment.

The inductively-coupled receiving tuner should have the following dimensions: The primary winding is 3 inches in diameter, 5 inches in length, wound with a single length of No. 22 wire. The secondary winding is 2¾ inches in diameter, wound with a single layer of D. C. C. No. 26 magnet wire, tapped at eleven equidistant points.

A round piece of wood, ¼ of an inch in thickness, should be inserted in each end of the secondary tube, and a piece of ¼-inch inside diameter brass tubing fitted between the two end centers to allow the secondary to slide along the ¼-inch square brass rod, supported as shown in the diagram. The secondary taps should be fastened to machine screws arranged along the circumference of the secondary end piece, a flexible wire or tinsel cord being used to make contact with the secondary taps on the top of the box.

To shunt the detector the shunt switch must have the arm resting on two contacts, as will be seen from the diagram. To open the detector circuit, only one point is required.

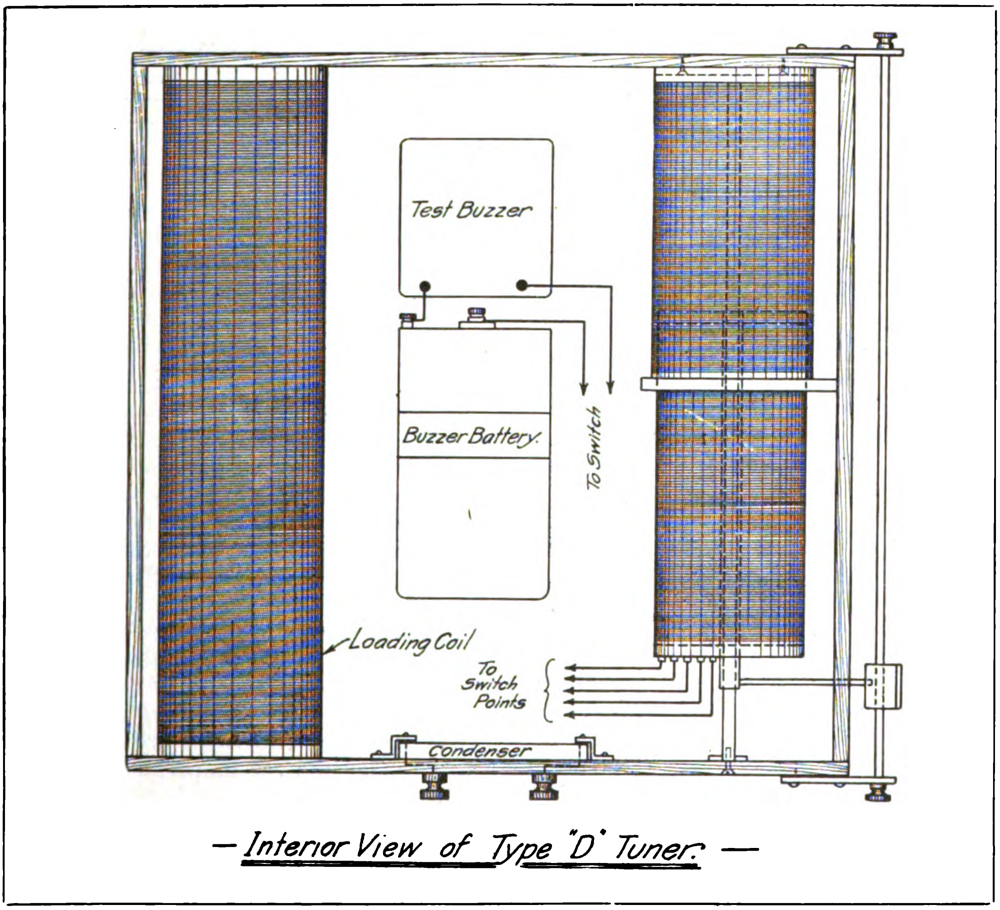


Fig. 1, First Prize Article

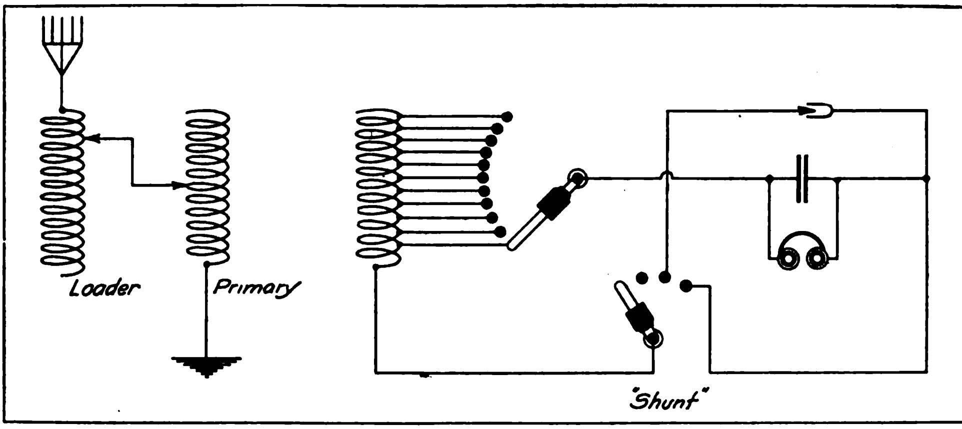


Fig. 2, First Prize Article

A variable condenser cannot be placed in the box as space will not permit it. However, two additional binding posts may be installed in some convenient place, the connections being extended to a variable condenser.

By carefully following out the foregoing instructions a receiving set of good appearance and notable efficiency can be constructed.

H. W. DICKOW, *California.*

SECOND PRIZE, FIVE DOLLARS

Directions for Making a Navy Type Receiving Set

Considerable interest has been aroused among amateurs by the announcement of a special type of receiving apparatus developed by Dr. Louis Cohen of the United States Bureau of Standards. Although the circuits of this receiver are somewhat radical, the results obtained by its use warrant the construction of the apparatus.

It will be noted particularly from Figure 4 that the apparatus comprises mainly two coils, one connected in the antenna circuit and the other connected to the terminals of the detector, which are coupled together by means of the two variable condensers (mounted in a single unit) No. 2. These two coils are mounted on a square base, leaving a space of about eighteen inches between them. The actual dimensions for the coil will vary with the desired range of wave-lengths, but with coils twelve inches in length and five inches in diameter wave-lengths up to 4,000 meters can easily be attuned to. Additional inductance may be added, if desired, in the antenna circuit, thus increasing the wave-length 12,000 or even 15,000 meters, without detracting from the efficiency.

The construction is as follows: Two cardboard tubes are obtained that will just fit inside the tuning box (Figure 1) and they are wound loosely with No. 30 wire, the entire coil being tapped at ten equi-distant points. These coils are then mounted on the inside of the box and a switch to control the inductance values placed on the end nearest to the operator. Care should be taken that the current in the tuning coil circulates in the same direction as that in the loading coil; otherwise the magnetic fields will neutralize and render the set inoperative.

The coils having been constructed, the construction of the coupling condensers is next in order. Two are required, which are operated simultaneously by the single handle. A general idea of the construction of these condensers will be clear from Figure 2. A wooden roller, 8 inches in length, 3 inches in diameter, has glued on it two sheets of heavy tinfoil as shown, with a space of one inch between. These sheets are 3 inches in length by 4½ inches in width and a connection is made from each to the nearest end of the core. The pivots for the roller can be driven into each end and thus be insulated from each other. A brass bushing in the wood end serves to make connection from the pivots to the remainder of the circuit.

The next step is to fasten tightly and smoothly a layer of empire cloth over

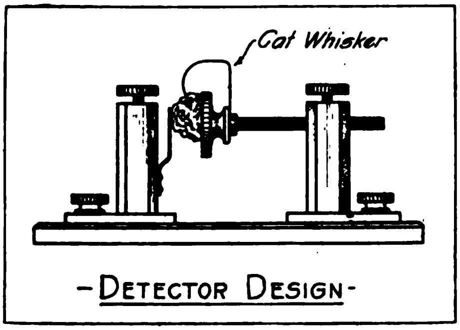


Fig. 3, First Prize Article

the tinfoil by means of shellac. This serves as the dielectric. Two sheets of aluminum are bent to fit around one-half the roller and a strip is extended from it to fasten to the inside of the box.

It is now apparent that when the roller is turned so that the tinfoil will be partly under the aluminum, the capacity is increased and when turned through 180 degrees it will be at the minimum value. The general idea of these condensers is not new, but the improvement lies in the fact that they are adjusted simultaneously.

The condenser can be enclosed in a box about 4 inches square and 9 inches in length. A handle and a scale may be arranged on the front to readily determine the relative amount of capacity in use.

Two additional condensers are required. These should be of the fan switch type. Six strips of paraffin paper, 3 inches in width and 24 inches in length, are required for each condenser and also four strips of tinfoil, 2 inches in width and 20 inches in length, are used as the active material. The entire units are mounted in a small box, 2 inches by 3 inches by 10 inches, for each condenser.

The construction of this condenser is as follows: Place a strip of paper on a flat surface, then a strip of tinfoil, followed by another strip of paper. Cut a length of tinfoil into three pieces, each 6 inches in length. These are fastened to the paraffin paper with a few drops of shellac under each piece. A space of one inch should be left between each piece. Connection is then made to each piece by laying a finely stranded piece of wire, 6 inches in length across the surface, with 4 inches of its length protruding.

A strip of paraffin paper is laid on these, then another long strip of tinfoil, followed by another layer of paper. The next strip of tinfoil is also cut into three 6-inch pieces and connection made to each. The two long strips of tinfoil are connected together and a wire extended therefrom.

The next step is to cover the top with a sheet of paper and roll it into a compact bundle. The condenser should be carefully tested for short circuits and afterwards pressed together by means of a moderately hot iron, which will thoroughly bind the sheets due to the melting of the paraffin.

The fan switches are mounted on the top of the boxes and are made out of thin copper with six contact points placed directly under each (S-1 and S-2, Figure 1). The leads from the small

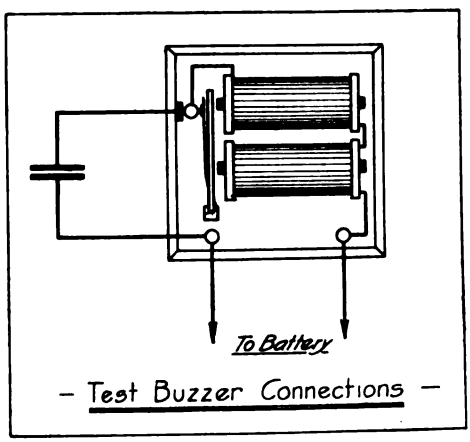


Fig. 4, First Prize Article

condenser sheets are connected to these contacts, after which the condenser unit is placed in the box. After the complete connections are made the condenser box may be filled with melted paraffin and the bottom nailed on.

To complete the cabinet one or more detectors are required; a double pole, double throw lever switch, 2 single pole,

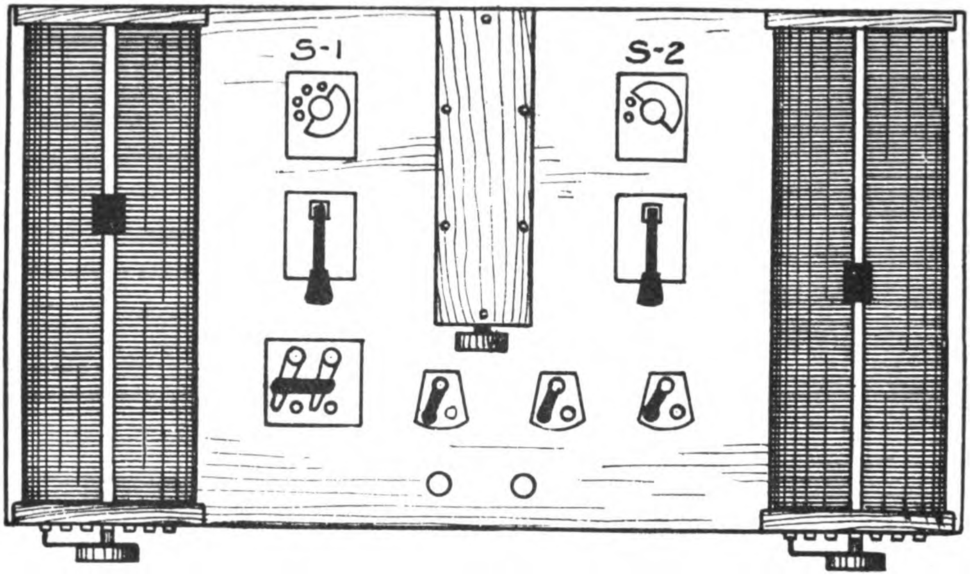


Fig. 1, Second Prize Article

single throw switches and one single pole triple throw lever switch. The detectors, two in number, on the set shown, may be of any crystal type, but the writer prefers the easily adjusted and rugged type shown in Figure 3.

The foregoing having been completed, the instruments are then mounted on the board and wired as shown in Figure 4, and the operation of this set is similar to that of the standard Cohen set.

Switch B is open, switch C is placed in the center or dead contact. The detector to be used is selected by the switch, D, and for short wave-lengths the variable condenser, I, is placed in series by throwing switch A in the downward position. The apparatus then functions like a single slide receiving set and all adjustments are made on the left hand tuner and loading coil with condenser. With this adjustment the duplex roller condenser is set at the minimum value of capacity.

When the station is picked up, the second tuner is thrown into the circuit by means of the switch, C, with a corresponding readjustment of the left hand slider, if necessary. The capacity of condenser 2 is then reduced until all interfering signals are eliminated. For long wave-lengths the condenser 1 is shunted across the tuner and condenser 3 is connected into the circuit. When switch C is on the right hand point the detectors are short circuited. The condenser connected across the head telephones is easy to construct and is similar to all small condensers used for the same purpose in other sets.

At first sight it may appear that this apparatus is complicated and difficult to handle, but as a matter of fact its operation becomes second nature after a little practice. Should the constructor desire to purchase variable condensers for the linking circuit, the following information will be of value to him: Condensers 1 and 3 should have a capacity of .004 microfarad and condenser 2 a value of .0004 microfarad. This value, of course, is rather small, but it will be found that the lower the value at this point, the more selective will be the test.

Robert Kennedy, *New Jersey.*

THIRD PRIZE, THREE DOLLARS

A Transmitting Key that Can Be Made at Home

My drawings (Figures 1, 2, 3 and 4) show the details of a transmitting key that will easily take care of a 1-kw. transmitting set. A general view is shown in Figure 1 and, as will be seen, the key is of very simple construction. Perhaps the most difficult part for the amateur to construct is the base, which is made of marble.

Many amateurs are under the impression that it is difficult to work marble, but after a trial they will soon become familiar with the method. The base of this particular key is made of white marble and practically every amateur will have access to some of the same grade, as it is of the kind used on the tops of the old style bureau, table, etc. The base is preferably ¾ to 1 inch in thickness.

The base may be cut out of a slab with a hack saw, and with a little patience the job can be completed in about half an hour. Care must be taken during the sawing process when nearing the end of a given cut, as it may break off and also might break out the base on the side and spoil it.

After the base is sawed the four corners and top edges should be rounded off as shown in the drawings (Figures 1 and 4), because if they are left sharp a piece might break off if it were given a sharp blow. The bottom edges should also be rounded off slightly. To smooth marble, place a piece of sandpaper on a flat board and sandpaper the surface in the same manner as a piece of wood. The holes may be drilled by means of a common twist drill, flooded with turpentine. A hard rubber or fibre base would also be satisfactory, but I am aware that many amateurs prefer marble.

It may interest them to know how I had the marble base for this key polished. After drilling was complete, I took it to a shop where marble was polished and the entire base was finished smoothly at a cost of 25c.

The lever indicated in drawing No. 3 is made of cast bronze. A pattern should first be made and then taken to the foundry. The standards are also of cast bronze and are to be made in the same manner as the lever. The bearing shaft shown at H (Figure 2), is of brass and should be a drive fit or soldered in the lever. The contact points are made of ⅜-inch brass rod, with a piece of coin silver soldered on the ends.

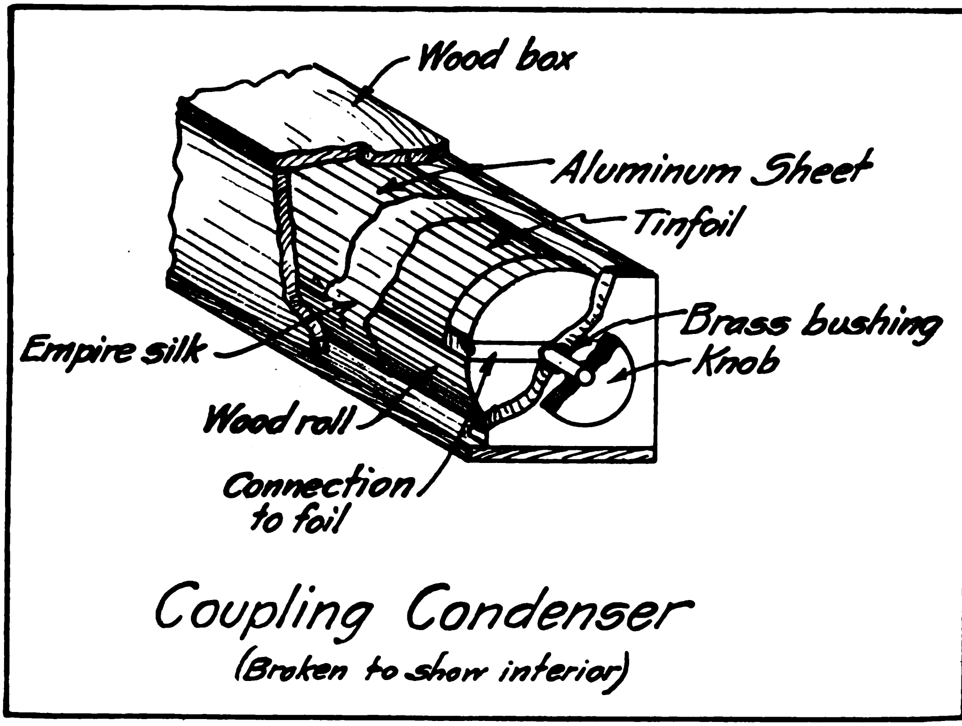


Fig. 2, Second Prize Article

The spring is wound on a 3/8-inch arbor and made of No. 18 piano wire. The thumb screws and nuts shown at E and G (Figure 1) can be bought from an electrical supply house or taken from an old telegraph sounder.

The binding posts and knobs are left to the taste of the maker. It will of course improve the appearance to have all metal parts nickle-plated.

O. E. Cote, *Rhode Island.*

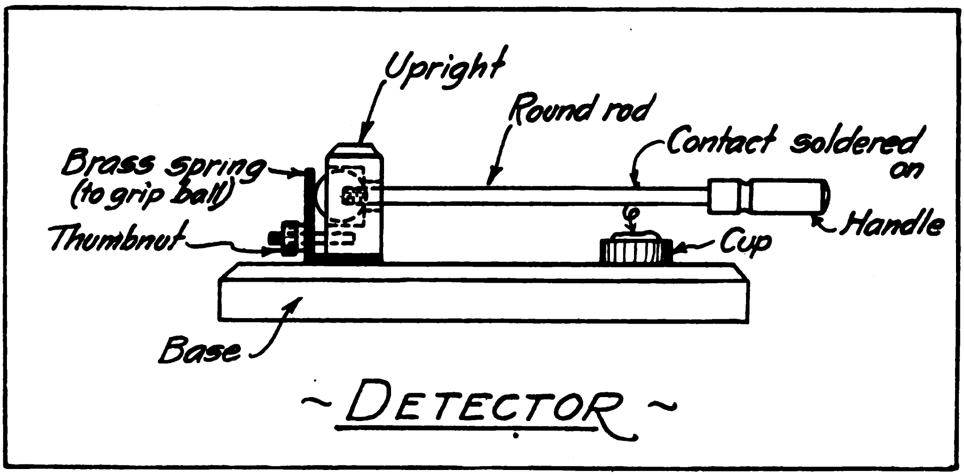


Fig. 3, Second Prize Article

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

High Speed Vibrating Key Which Is Easy to Construct

An instrument of great value to the wireless operator, amateur or professional, is the high speed vibrating key, since it permits extremely high speed in transmission with but comparatively little effort. There are several well-known makes of this type of key on the market, but the price prevents many amateurs, who would otherwise be glad to experiment with it, from owning one. The key here described and illustrated, although it may seem complicated, is really very simple and can be readily constructed from parts generally found about the experimenter's work-shop.

The first part to be constructed is the base shown in Figure 2. It can be made of almost any non-conducting material, but marble will no doubt give the best appearance. After the base has been bevelled and drilled, attention should be given to the bearings, shown in Figure 2. These consist of two uprights, R and U, of square brass rod, separating the cross bar, T, and the base plate, B, which hold the bearings proper. The adjustable bearing screw, Z, (fitted with a thumb-check-nut) is screwed upon the cross bar, T. The end of this screw has a conical hole drilled in it, to receive the pointed end of the pivot, to obviate the drilling of this hole, which is a somewhat difficult job, the bearing screw from an old sounder was used. The lower bearing consists of a conical hole drilled in the base plate, B.

At the back, in order to check the return stroke of the swinging rod and also to protect the latter, is mounted the upright, H, given in detail in Figure 3. It consists of two pieces as shown, one forced into the other. A screw, I, carrying a thumb-check-nut is mounted, as shown, to check the return motion of the vibrating bar. In order to stop the sharp sound which occurs when the bar strikes the end of the screw, a small piece of rubber is glued to the end of the screw.

The next part to be constructed is the vibrating mechanism for producing the dots, shown in detail in Figure 2. This consists of an arm, A, which is 5/16 of

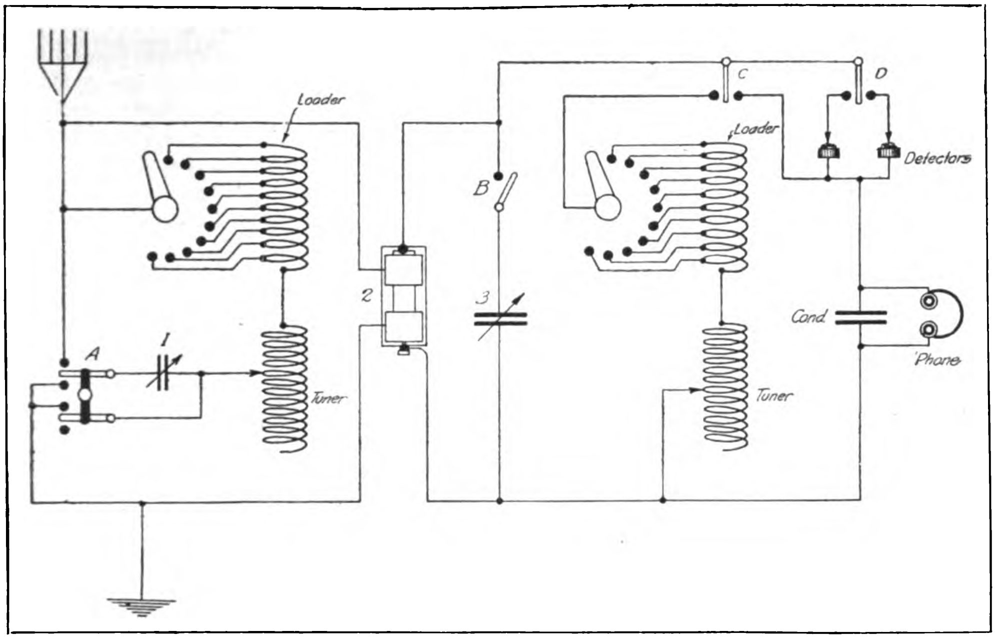


Fig. 4, Second Prize Article

an inch square. To this is attached by means of a small bolt and nut the hard-rubber manipulating handle, L. An ordinary key knob, K, is attached to the handle, L. A pivot is next fitted to the arm, A, and should be made of steel. At the other end of the arm a slot is cut with a hack-saw to admit a small piece of clock-spring or corset steel, C, which is soldered in place. Over the other end of the spring is forced and soldered a small length of 5/32-inch round brass rod, V.

In soldering these parts great care should be taken not to heat the spring too highly, as it will lose its elasticity and cause trouble if an excessive amount of heat is applied. In the same slot a small bent piece of spring brass, N, carrying the contact point is also soldered. The contact point consists of a small silver disk about 1/8 inch in diameter and 1/16 inch or less in thickness, soldered to the spring, N. A small brass block, S, acting as a weight, is pushed over the rod, V, and should have a small set-screw so that it may be fastened any place on the rod. This block is used to regulate the speed at which the dots are to be made.

In order to limit the motion of the arm two stops, F and G, are provided which are made of two short lengths of 3/8-inch square brass rod, and two short lengths of 1/8-inch round brass rod with a hard-rubber or composition handle at the end of each. A spring is compressed over the rod of stopper, F, to keep the arm, A, to the right when no pressure is exerted on the operating handle.

Another post similar to G, is provided at E, and it carries a contact point of silver on the end of O. A contact point is also soldered on the end of the rod, P, and one on the arm, A, as shown in the sketch.

The vibrating mechanism can now be mounted in position by unscrewing the bearing screw, Z, a short distance, placing the lower pivot in its corresponding conical bearing, and then screwing Z down over the upper point of the pivot.

All parts should now be finished, the metal parts being either lacquered or nickel-plated. The finished instrument is connected in the same way as any other ordinary key and is operated in the following way: For making dots the lever is pressed to the right and held there until the required number of dots are made. For dashes the lever is pressed to the left and held there as long as the dashed is desired.

E. C. Eriksen, *California.*

HONORARY MENTION

A Transmitting Set that Will Give Satisfaction

The construction of an efficient amateur transmitting set that will permit communication for several hundred miles during the more favorable months of the year depends on several factors, which taken singly perhaps are of small importance but collectively make the difference between a possible range of forty or fifty miles and one of 600 or 700 miles. The following suggestions refer to what is commonly called a 1-kw. set as it is the most popular among the better class of amateurs. While equal results are often secured with ½-kw., they depend on a finer attention to detail and it is also more difficult to secure the close adjustment that is necessary to secure maximum results.

The best results seem to be secured with a T type antenna as high as possible, the combined length of ground, lead in, and one half the length of the flat top not exceeding 100 or 110 feet. The aerial is preferably of six or eight wires and from point of expense and utility second-hand hard drawn copper wire can usually be obtained at a slight advance over junk prices. If all connections are made with copper ½ sleeves (any lineman will show you how to make these connections), and no soldered connections are used, this wire will be found strong enough to resist the worst sleet storms likely to be encountered. The strength of hard drawn copper wire lies in the surface film and if care is taken to avoid scratching the surface and making short bends or kinks in it, no difficulty will be experienced.

For successful long distance working it is essential that the aerial be as high as possible above all surrounding objects. An antenna a few feet above the roof of a tall building is seldom satisfactory. The lead should be of the same kind and number of wires as the flat top, twisting or lacing them together.

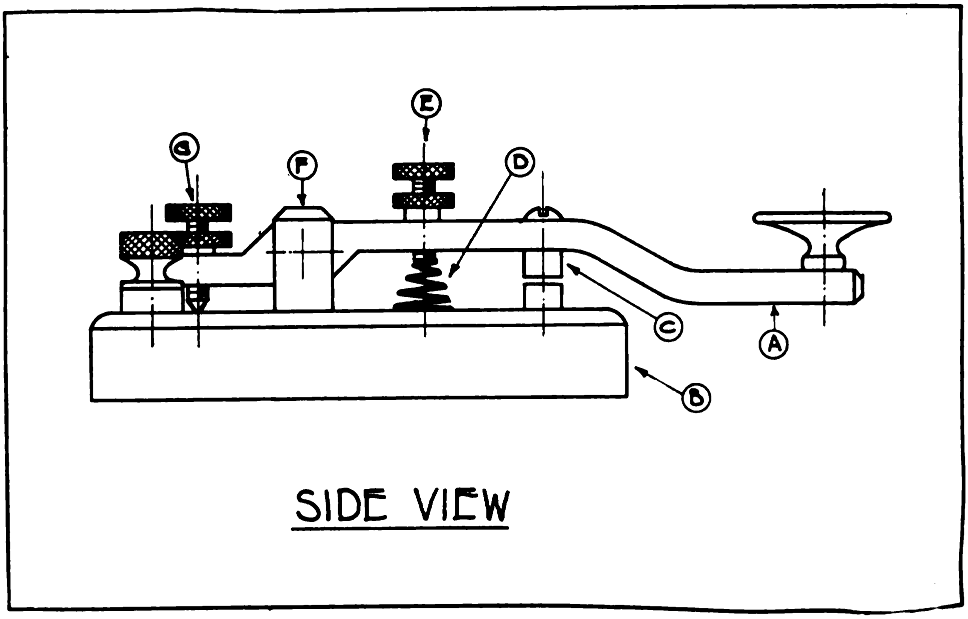


Fig. 1, Third Prize Article

The earth connection is very important. Connecting to a water pipe that wanders for 50 or 60 feet around the basement before entering the earth is not a good ground connection. Make the ground connection as short and heavy as possible; it should not exceed 5 feet in length to the nearest actual connection to the earth. Then run additional wires to everything within reach; the tin pipes of

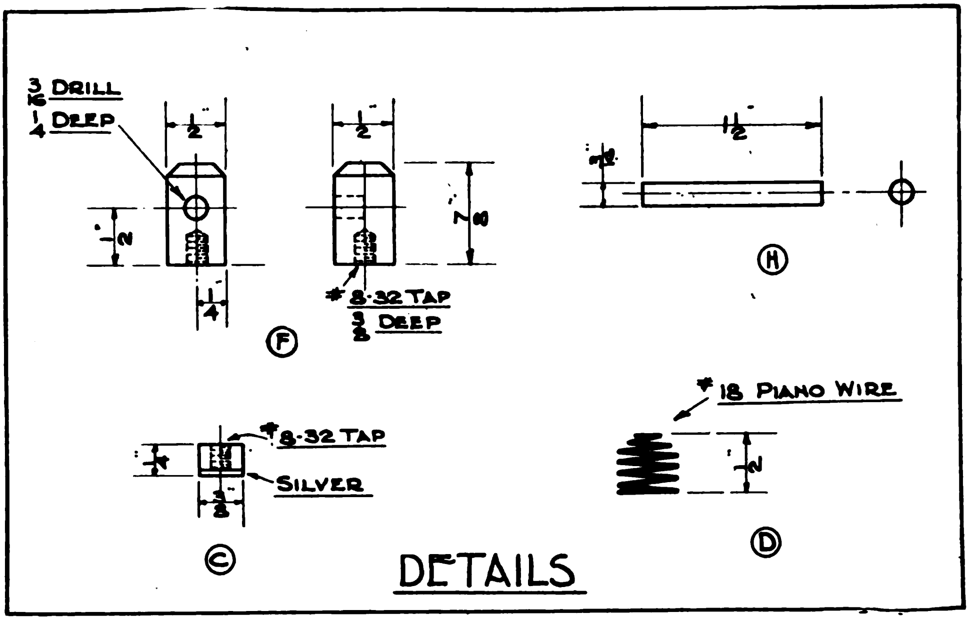


Fig. 2, Third Prize Article

The brass bearing shaft is indicated at H in Figure 2. It can be a drive fit or soldered in the lever. Brass rods, 3/8 of an inch in diameter, with a piece of coin soldered on the ends make the contact points. The spring shown at D is made of No. 18 piano wire wound on a 3/8 inch arbor.

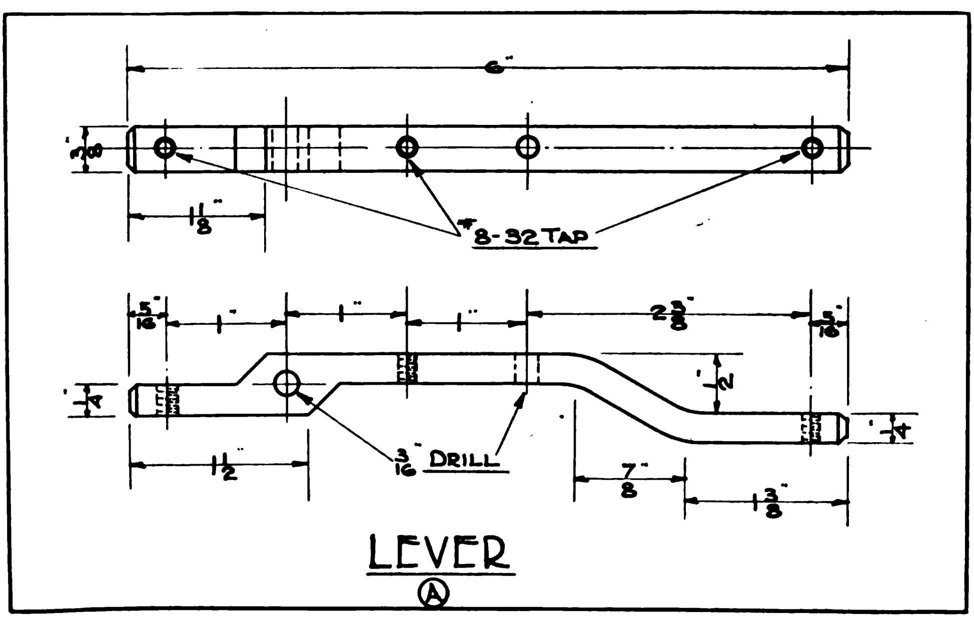


Fig. 3, Third Prize Article

the hot air furnace, metal plates submerged in nearby cisterns, gas pipes, metal waste pipes and anything that will give you a large metallic surface whether in actual contact with the earth or not. There is no place that low resistance counts for as much as in the ground connection. If you expect 6 or 6½ amperes radiation from a 200-meter set the resistance factor must be kept very low.

The oscillation transformer is the next consideration. As in a 200-meter set there is little room for complicated tuning devices a secondary of from 8 to 12 turns will give good results. The pancake type possesses some advantages and the ribbon, tubing or wire used should be at least equal in conductivity to the lead in. Simply connect one end of the secondary to the ground and the other to the lead in. Personally I prefer to connect the receiving set across an anchor gap in the ground wire and if some device is "rigged up" to short circuit the anchor gap while sending no loss will be experienced and a complicated antenna switch can be dispensed with.

The primary winding should consist of not more than six turns. Best results are secured with not more than 1½ or 1¾ turns of primary in use and by using a pancake type of oscillation transformer larger or smaller turns can be used, giving small variations of inductance which, together with adding to or subtracting from the number of plates in the condenser, gives very accurate wave-length adjustment.

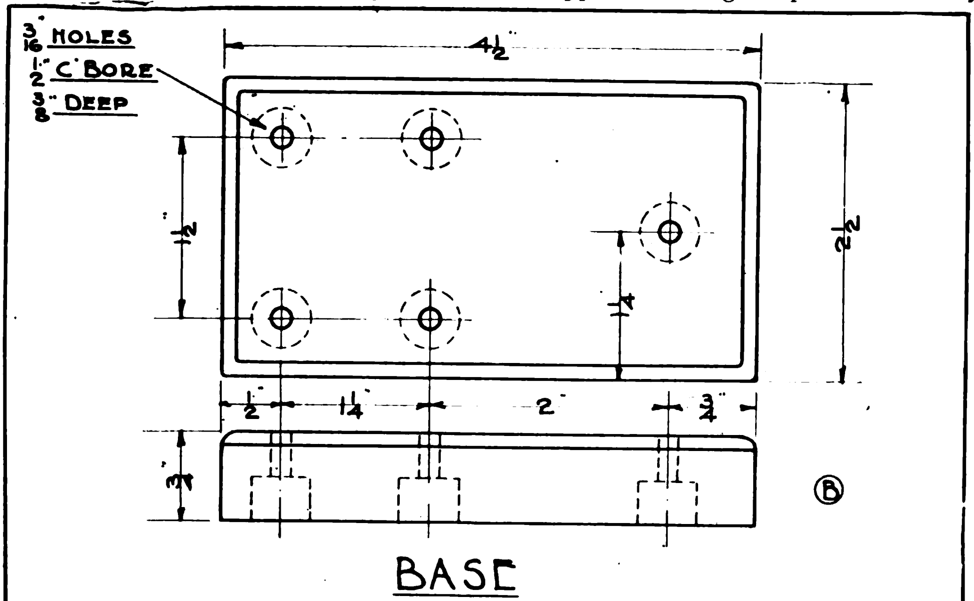


Fig. 4, Third Prize Article

If you wish to avoid condenser trouble as far as possible do not experiment with photo plates or window glass. Get plate glass (pieces from broken wind shields will do very well and can usually be secured for nothing) and coat each side of each plate with foil, soldering a thin brass ribbon to each foil long enough to reach to the coil of the primary in one case and the terminal of the rotary gap in the other. Round off the corners of the foil opposite the lugs as plates invariably puncture near where lugs are soldered. Then set the plates on end in a tank of oil. Automobile engine oil is as good as any, in fact, oil that has been used will give good results if allowed to stand until all sediment has settled.

Concerning the spark gap: Often you will see a rotary gap so arranged that the current has to turn six right angles and traverse a distance of eighteen inches from one terminal to the other. This would probably prove efficient on a 600-meter set but is out of place in a 200-meter set.

Personally, I prefer an eight-inch disk

with three or four lugs revolved at a speed that gives a spark frequency of from 250 to 300 per second. If the revolving lugs are not connected together but simply extend through the disk and the stationary electrodes are placed on opposite sides of the disk a very short path through the gap is secured, minus right angles. Very short connections

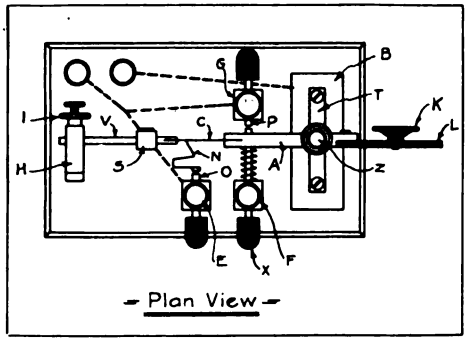


Fig. 1, Fourth Prize Article

can be secured by arranging the condenser, gap and primary in a triangle, if the three pieces of apparatus are set on different levels so as to bring the center of the primary on a level with the top of the condenser and the stationary lugs of the gap. Do not solder connections in the closed circuit with the exception of the leads from the foil in the condenser.

The high voltage transformer is preferably placed at some distance from the rest of the apparatus and the connections from it to the transformer are made of comparatively fine wire, say No. 20 or 22. If a considerable quantity of this wire is coiled around a form of, say, 2 inches in diameter and one of these coils is placed in each lead from the transformer to the condenser, the high frequency current is prevented from passing into the secondary of the transformer and in a very large measure prevents the "kick back." This also seems to raise the voltage to which the condenser is charged and will add to the clearness of the tone and also to the strength of the signals if other things are properly proportioned.

If a set is constructed along the lines suggested and sharply tuned, success is bound to result. However, maximum signal strength is secured when the voltage of the condenser is increased to the highest safe limit. A condenser of the type described should work with the safety gap set at 1½ inches without danger of puncture.

With the set in operation gradually reduce the speed of the gap until the spark jumps the safety gap across the condenser. If the lowest speed at which the gap will run and not permit discharge across the safety gap is too low for good results, remove one or more plates from the condenser and retune the closed circuit. In other words use a tone which is a low musical note with the smallest possible condenser. Assuming of course, that you are using at least a 20,000-volt transformer. With a rotary disk with few points far apart the magnetic leakage feature is of little advantage and if a transformer of the Thordarson type is used the yoke can be removed as it will be impossible to use the full 1 kw. with a condenser of this size. The slightly lower efficiency will be more than offset by the higher voltage and increased strength of signals.

The voltage to which the condenser

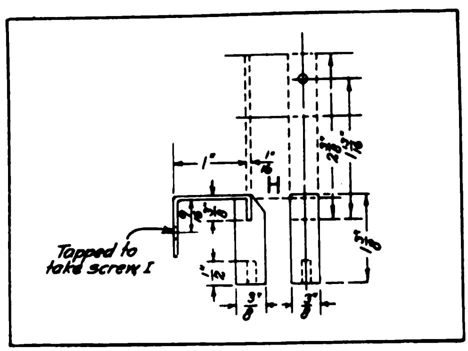


Fig. 3, Fourth Prize Article

can be charged is not limited by the secondary voltage of the transformer, but can be increased by making the condenser smaller, decreasing the speed of the gap and thereby giving it a longer time to charge. The increase can be effected to a lesser extent by placing choke coils in the leads from the transformer to the condenser. It is the short, quickly cut-off discharge of a highly charged condenser that adds more to the strength of the signals than any other one feature.

M. B. West, *Ohio.*

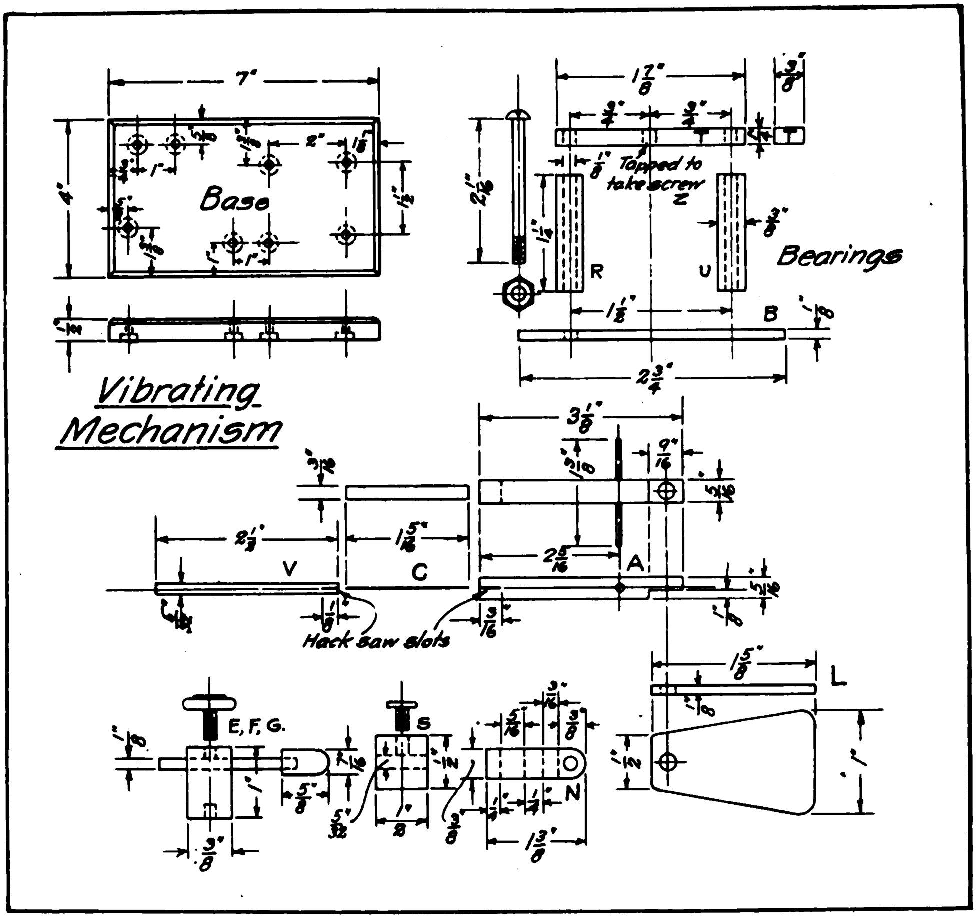


Fig. 2, Fourth Prize Article

LONG DISTANCE WORK

Noting the letters of other experimenters in the columns of your magazine, we thought we would express our opinion on the efficiency of certain amateur stations. At this season of the year amateurs over the entire country are fixing up their sets for the coming relay work and as a result many long distance records are bound to be made. In the matter of strength of signals and continuous communication we consider the sending sets of the following stations very efficient: 2-ZP, 2-IZ, 4-AA, 4-CL, 8-ER, 8-NA, 8-AEZ, 9-FY and 9-UZ. Perhaps the most efficient one of the list is 2-ZP, which is 400 miles distant. Although this station only uses a ½-kw. set, nevertheless the signals come in as loud as other amateurs located but eighteen miles away.

For receiving we use a navy type of tuner, a vacuum valve detector and Brandes superior head telephones. We have heard a station in Alaska which is approximately 3,500 miles away.

In addition to these stations we have also heard KIX, 9-ABD, 9-GHS, 9-BD, 9-DB, 5-ZT, 8-LQ, 1-LE, 2-FH and many others.

Our ½-kw. transmitting station has covered considerable distances during the past winter. Our maximum record is about 850 miles. We have worked 9-GJ, 9-PC, 8-XC, 8-WW, 3-WN, 2-ID, 2-IC, 2-DA, 2-ZE, 2-ZP, 1-ZL, 1-ON, 1-IZ and others. All the stations just mentioned are over 300 miles distant, with the exception of two. We expect to install a 1½-kw. sending set and will be glad to hear from anyone who has heard our signals.

Lot and Hodge Alexander.
Pennsylvania.

In the Wake of the U-53

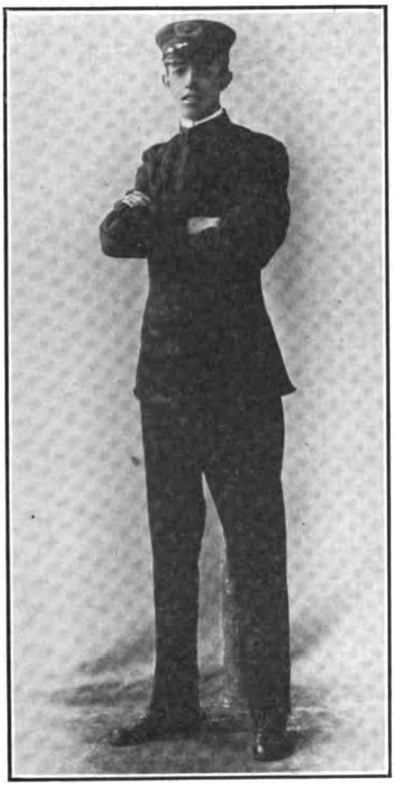
By Oscar B. Hanson, Marconi Operator on the Steamship Stephano

As details of the sinking of six steamships by the U-53 off the New England coast on October 8th become known, it is discovered that the story is interwoven with wireless. It was wireless that brought the United States destroyers to the aid of the doomed ship's people and warned other vessels of the undersea boat's presence; it was wireless that gave the facts of the raid to newspapers, making a new chapter in the history of journalism as well as of radio.

"HAVE been fired upon by submarine. We are getting men into boats. Position, 40.25 north—69.00 west."

This was the message that I picked up at fifteen minutes after twelve o'clock in the afternoon on October 8th, while the Stephano was plying her regular run between New York, Halifax, N. S., and St. Johns, N. F. Flashed from the steamship West Point and repeated by the Kansan, it bore a harbinger of the fate which was to overtake us some six hours afterward.

The Stephano left Halifax at one o'clock in the afternoon on October 7th, carrying ninety-seven passengers, of whom forty-seven were Americans. I was the only operator aboard, the junior having left the ship at St. Johns. I copied the appeal as transmitted by the Kansan's operator and gave it to Captain Smith, the commander of the Stephano. The Stephano was at this time heading in the direction of the Nantucket Shoals lightship, thirty miles northwest of the position of the West Point. Believing that the submarine would submerge after she had sunk the West Point and not immediately attack any more craft, we saw no great risk in keeping on our course. We had hopes, too, of picking up the West Point's people.



Oscar B. Hanson, who tells a thrilling story of the attack on the Stephano

At the request of the captain I sent a message to the New York agents of the Stephano, telling them of the time that we expected to arrive in port. I called WSC (Siasconsett), which received the message. This station had previously sent calls broadcast, informing all ships of the position of the West Point.

This was about four o'clock in the afternoon. Soon afterward the Kansan was sighted on the horizon off our starboard quarter, heading south. She asked if we could see her and if we knew of the West Point's condition. I replied in the affirmative. From an American destroyer then came the QST, followed by another message from the Kansan to the effect that as she was not needed she had changed back to her original course and was proceeding to Boston. While these messages were flying back and forth, men stationed in the crow's nest of the Stephano were scanning the waters in a search for the West Point's boats. They looked in vain, however, and it seemed for a time as if the submarine were a myth when two United States destroyers were seen lying a short distance to the east. Beyond them was a grotesque, rakish looking craft which we who sail the seas now have much in mind—a submarine.

I made my way to the bridge where Captain Smith handed me the glasses and pointed out the hazy outlines of the underwater craft which was about one mile ahead of us. Darkness was approaching, however, and in the fading light her numbers could not be read.

Despite the nearness of the submarine there was no alarm on the Stephano. This was due to the fact that up to this time the passengers did not know of the raider's activities and the ship's officers, their minds put at ease by the sight of the destroyers, decided that the craft were going through manoeuvres. And so I went down to dinner, satisfied like the others that we were in no immediate danger.

But we had barely seated ourselves before we heard a shot and the ship shivered. Three more shots fired in quick succession followed, but the ship stood stanch and I concluded that they had crossed our bows.

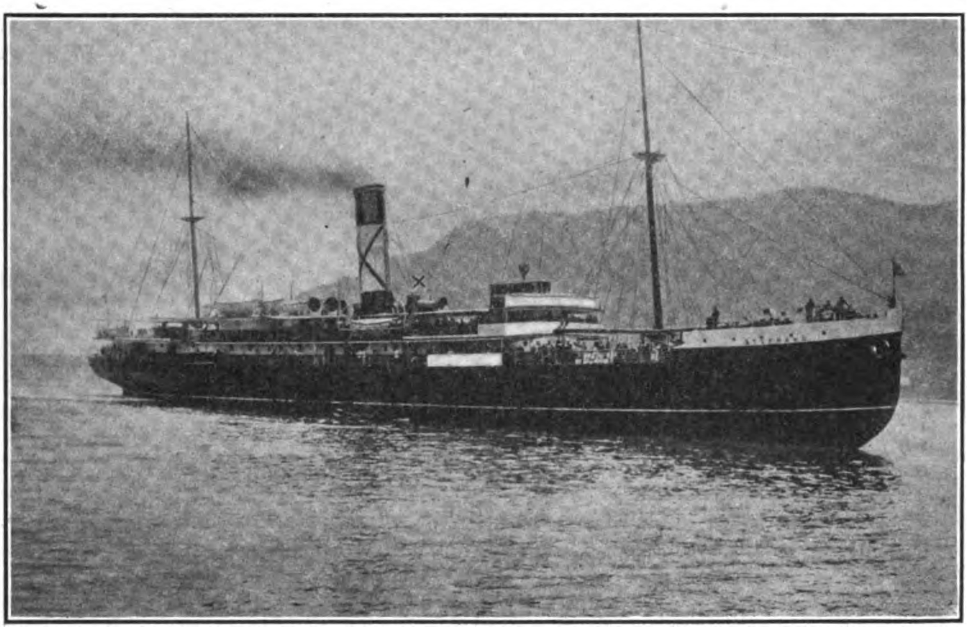
Hurrying from the saloon, I started for the bridge, where I found Captain Smith. He ordered me to tell the U-boat commander that there were forty-seven Americans aboard the Stephano. I did so, but received no reply. Then I called the destroyers. The Balch, which was at that time visible on the horizon, responded, asking "Who and where."

"Stephano being torpedoed off NLA" (Nantucket Shoals), I flashed.

Almost immediately he answered

"Am coming to your aid full speed."

Fifteen minutes afterward she was alongside.



The Stephano as she appeared when photographed off the Newfoundland coast

Meanwhile the Stephano's eight lifeboats had been successfully launched and the passengers found places in them. The boats were picked up by the Balch and the Ericson. A motor boat from the Balch took off the greater part of the ship's company of the Stephano.

With the completion of the rescue work came darkness, and the fleet of destroyers began to operate their searchlights. In the spectacular display which resulted could be distinguished the lights of the submarine. The latter inquired if all were off the Stephano and then steamed toward the vessel. Whether the Germans boarded her or not, I do not know. At any rate they did not sink her until about ten o'clock.

At this time the submarine opened fire, sending thirty high explosive shells into the doomed ship. But they did not take effect and her lights remained burning as brightly as when we abandoned her. One shell started the electric fog horn blower and another hit the Morse lamp on the bridge. It was a torpedo which accomplished the final destruction of the Stephano and she went to the bottom flying the British ensign which Mr. James, the second officer, had hoisted before leaving the ship.

When the last light of the Stephano had disappeared beneath the waters the Balch turned her prow toward Newport and steamed away. And as she passed close to the U-boat the latter threw the rays of her Morse lamp toward the destroyer while she seemingly waited like some voracious creature of the deep for other victims.

Following the attacks of the U-53, various vessels on the Atlantic were warned by wireless of the presence of the submarine. As a result all of these craft took measures to elude the raider, some racing toward their ports of destination at full speed, with lights out, and others hugging the safety zone.

When the French liner Lafayette steamed away from Bordeaux no one on board knew that the U-53 had been raiding off New England. After the liner had been several hours out of port, however, her commander received a wireless saying that the submarine had crossed the Atlantic. In mid-ocean he received another wireless, this message warning him to be on the lookout for submarines off Nantucket. Then he received a marconigram containing news of a ship being chased by a submarine, and the course of the Lafayette was changed. The ship arrived in New York harbor without mishap, however.

The Cunarder Orduna left Liverpool on the afternoon the U-53 was in Newport Harbor. After she had passed out of the Mersey word came of the submarine raids. Following the message, a lookout was posted in each crow's nest and the commander of the vessel remained on the bridge every night throughout the voyage.

From Captain J. L. Jones, of the freighter Bovic, came a story to the effect that when the vessel, bound for New York from Liverpool, was twenty-eight miles southeast of Nantucket lightship, the lookout man in the upper crow's nest had reported that he could see the periscope of a submarine. The submarine had suddenly changed her course and followed in the wake of a vessel which those on the Bovic believed to be the Scandinavian liner Hellig Olav. Messages were sent to the Hellig Olav from New York, asking for details of the chase and the following reply was received from the liner's captain "Have not seen any submarine."

A submarine, believed to have been the U-53, was sighted on October 10th about 100 miles off Nantucket lightship, by a neutral vessel. The submarine wirelessed the latter, asking her name and nationality. The information was transmitted and then, "Who are you?" was the message flashed to the undersea craft.

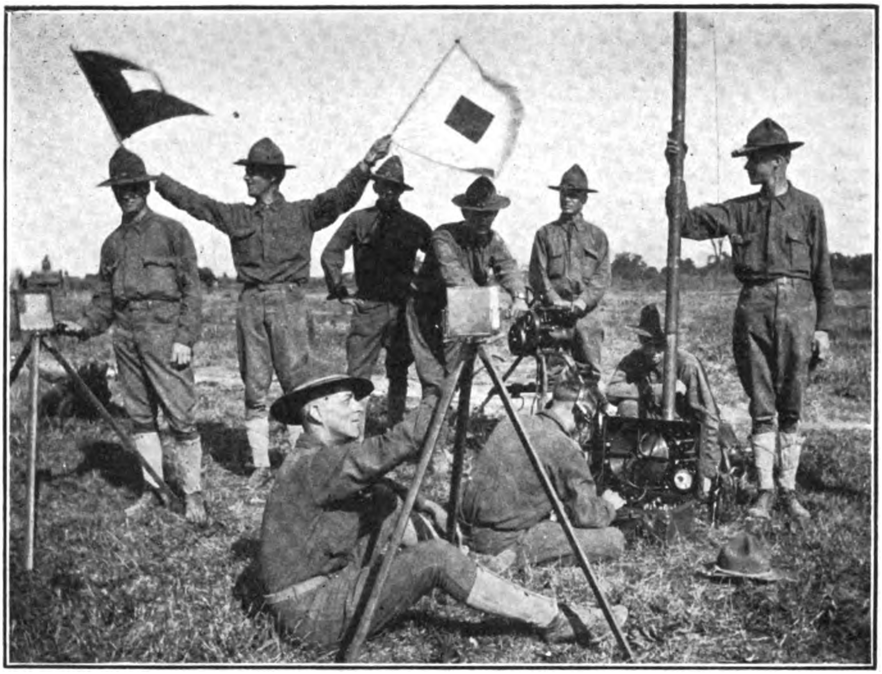
"German submarine from Newport. Goodby," was the answer.

That the news of the raid had come by means of wireless gave added importance to the art in newspaper offices. This is the way the news reached the office of a New York afternoon newspaper on Sunday, October 8:

When the steamship Kansan was stopped off Nantucket by a submarine, the liner's commander sent a wireless message to the Nantucket Shoals Lightship telling of the incident, and the facts were telegraphed to New York.

Then came wireless messages relating that other steamships had been stopped by the submarine, and when the last edition went to press all the details of the occurrence available were in type.

Thus did wireless share in a journalistic triumph.



Illustrating two visual and one electrical means of signaling; heliograph and wigwag at left, wireless on right

Paul Reveres of Our Own Time

How The Message is Sent From Command to Command In Modern Day Warfare

Felix J. Koche

HAD the great Napoleon only been possessed of the first stage of it, Grouchy could not have possibly failed him!

Had Marconi been born, say, a hundred and fifty years ago—in season to give New England colonists a chance at the wireless—Paul Revere would never have made his famous ride!

If Caesar, in Gaul, had only had the telephone, or if the great Hannibal could have sent marconigrams—fancy, if you can, how all world history might have changed!

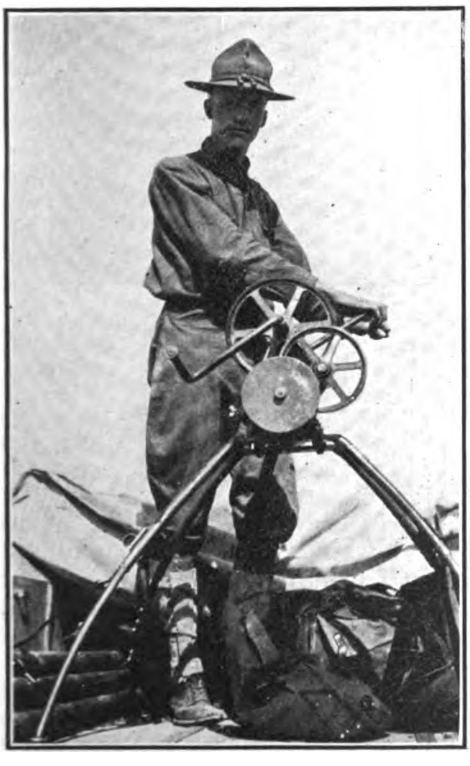
Someone has said, and with undoubted truth, that *if* is, after all, the most important word in the language; and if any modern army should venture forth into battle not prepared, as its enemy, to get word from command to command, said army would fail in the end, no matter how well equipped otherwise.

To the laymen this wonderful system for "getting across" the message is almost wholly unknown.

In a ramble through the great muster camp, where such things concentrate, what appears as the Signal Corps, means but little to untrained lay eyes.

Thus, not so long since, at Camp Willis, on the outskirts of Columbus, where the Ohio National Guard was encamped, those who paid the Signal Corps a visit were greeted by three great wagons, drawn up alongside the tents, with trappings and harness nearby; horses were to be supplied when they came to the scene of action. But beyond volunteering this much information, the soldiers left you to make your own estimate of the equipment. At one place a squad of men was devoted, evidently, to wireless service; at the other the wiremen held their own. Given proper guide, and at either one of these places the visitor can remain long and profitably.

A two-horse cart is shown the favored caller. The cart is equipped with an outfit of wire, on a spool beneath the box proper of the wagon; each of these spools is wound with five miles of wire. Arrangements are such that this wire can be strung, even though the horses dash along at gallop; so that communication may be established, though the corps travel at top speed. Such wire will be attached to the ground, to fences and so on, where need be. Two linemen mounted on horses ride behind the fast-flying cart, and, by expert use of the pike and other tools, are able to properly lay the unreeling line, without quitting their steeds. Daring riders, too, keep up with the other cart, in a mad and seemingly impossible gallop. Both telephone and telegraph wires are laid in this way.



The hand generator which supplies current to the pack wireless set of the Signal Corps

In the enemy's country, however, and among mountains and difficult terrain, it's not always feasible to resort to such means as this, and so the wireless comes in handy.

Wireless for such work is carried on mule back and the entire outfit is modelled to insure transportation flexibility.

There is a generator, mounted on a metal frame, fitting the pack saddle exactly. This generator is worked by hand; two men do the grinding, one relieving the other, but working continuously. This media generates all the current they may need, for the average sending radius is hardly over 35 miles.

The mast, a forty-foot affair, is also transported on mule back. En route, it is taken apart in compact sections which occupy a position beneath the special carrying device on the mule; or, circumstances permitting, it is carried on the wagon given over to the wireless transmitting instruments. This latter, as now carried by the Signal Corps of the Ohio militia, represents the perfection of practical compactness. A single case has been designed to contain both the sending and receiving apparatus.

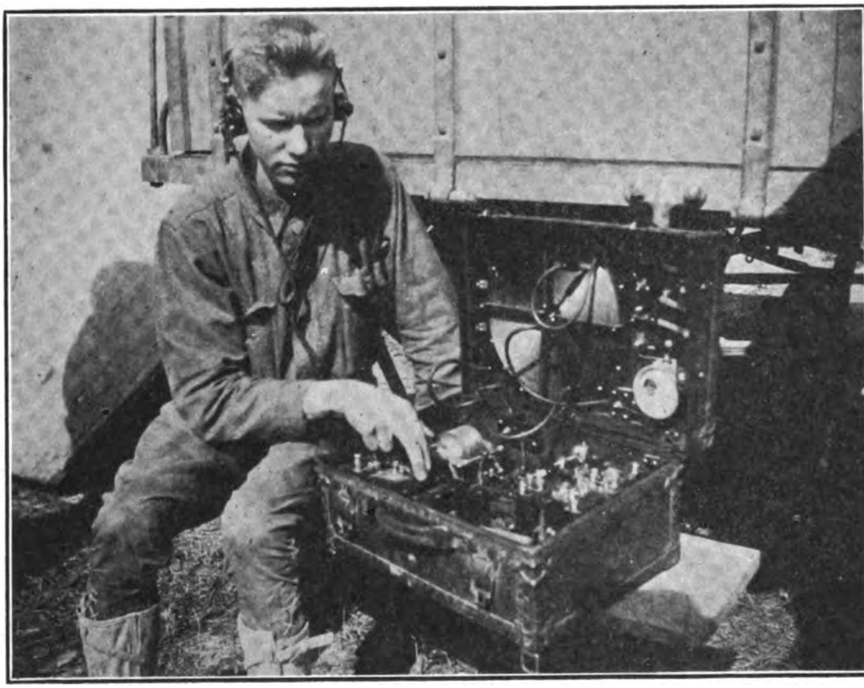
When the lid to this is open it is found that one-half of the space is occupied by the oscillation transformer; next this, in a corner, is the aerial-switch, and below it a clock-like device is indicated as the hot wire ammeter. In the body of the case are the primary and secondary coils, the loose coupler, and the complete detector, all so compact that a single operator can easily take charge of the station at all times.

These Paul Reveres of to-day, to whom is entrusted the sending of most vital messages, accomplish their task seated on the ground, wherever they happen to be. The generator is removed from the mule's back and put on the earth also; current sufficient to put the set in running order is manufactured inside three minutes. Meanwhile other men bring the mast from the mule—seven sections there are in all—and set it to rights. Wonderful system prevails here; superb discipline. Each man has his especial duties, and no time is lost.

You appreciate this more as you watch the new corps arrive. Two men unpack the generator, one man unships the pack set. Two more have taken charge of the bag containing the antennae and the counterpoise. Every one of these men is numbered. Nos. 1, 2, 3 and 4 run their lengths in as many different directions, each with his prescribed material. No. 9, assigned to such an end, raises the mast hand over hand. Man No. 7, ready on the instant, quickly assembles the sections. Meanwhile 5 and 6 connect up the generator and run out the counterpoise, while No. 8 acts as horse holder. It's all done in less time than it takes here for the telling!

Just so soon as the mast is up, they connect the instrument case with the generator and the aerial and are ready to commence work. The seemingly intricate process may be completed within three minutes from moment they strike camp—should such haste be desired.

The signal corps men concern themselves only with the matter of communication. Special cavalry is provided for their protection, keeping the communication intact under all adverse conditions. Use is also made of a secret key-word, against the enemy making use of such orders as it might intercept; and this is changed each day.



The Ohio militia's suitcase set, a light equipment designed for communication at 35 miles or less

The communication as it stands extends not only over land and water, but to things above. A master signal electrician devised apparatus for communicating to and from war balloons, wireless being, of course, involved. A service buzzer is employed here; the ground being woven into the anchor cable and other devices being so applied that they can communicate with a balloon at a height of 2,000 feet!

Buzzers employed to such ends resemble, to lay eyes, nothing quite so much as a camera case, but of a yellow leather. Open this and you find, inside, the battery and condenser, the phone, receiver, and the sending key. The entire outfit weighs less than five pounds and the man operating it rests himself, conveniently, upon the ground. In times of emergency, should no wire be near, he can attach the buzzer to any barbed wire fencing nearby. More commonly, however, the instrument is used with a wire. This line is unreeled by hand, generally running, from the tent of the commander to tne various unit headquarters and to the firing-line.

But, should wireless and telephone and telegraph fail, the Signal Corps relies on the semaphore and wigwag and the time-honored heliograph. Its operation of the latter is near perfection. Using it properly, tripods are set up, and the shutter employed to close off the light flashed from the mirror. Simple it all is; the mirror flashes as before it the shutter revolves and is lowered to produce the dots and dashes, effective at surprisingly long ranges. And, what's more, the men get from their instruments the very best that's in them.

At the camp it's a round of drill, with all present. Now they set up the heliograph and send a message. Now they raise an aerial, striving to break their own record time. Now there's a drill at the unreeling, now at packing or at breaking camp. Whatever else may be said of military unpreparedness, Uncle Sam's signal-men stand well equipped for duty.

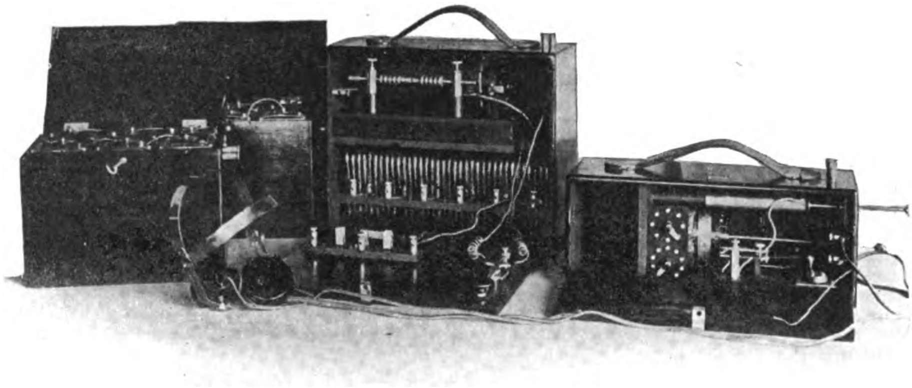
MAKING WIRELESS SETS

(Continued from page 163)

work and the opportunities. Boys, mechanics, testers and engineers were all of one mind in considering their employment as a special privilege. "They know how to treat a fellow in this plant," observed a veteran lathe-hand, in response to my inquiry. "Not only do we get the best working conditions, but special provisions are made for us all the time. Why, only recently, the company notified every man who'd been in its employ a year or more that his life had been insured. It doesn't cost us a cent; the company pays all the premiums and we get the money—that is, our wives or mothers do, if anything happens to us. After five years' service the amount doubles up. Now that's pretty fine treatment. Every man of any account feels it his duty to provide for loved ones in case they should suddenly be deprived of his wage-earning powers. But lots of us would find it mighty hard to keep up paying premiums on a life insurance policy. It's a fine thing to know that this is taken care of without a cent of expense to us. Maybe the boys don't appreciate it, too! You should see the pull-together spirit in this plant; every fellow's the other's friend, and we're there for the company forty ways all the time."

I saw an illustration of this pull together spirit during my visit, and incidentally caught a sidelight on the attention given to safety first details for these men. It so happens that I arrived on the day designated for the regular fire-drill. The factory has two organized fire brigades working under the supervision of a chief fireman. In exactly one minute and six seconds after the alarm sounded the Marconi boys had two streams of water playing on the building. Less than a minute later, the engine-driven apparatus of the Borough of Roselle Park had arrived and two more streams of water were in action. I was told that this was a feature of the drills, the local firemen respond regularly to the alarms for the Marconi factory drill and work in conjunction with them, the Borough Chief taking command as soon as he arrives on the scene and giving practical instruction in fire fighting.

Before I left, I spent a wonderful hour in the laboratory. Some day soon I shall set down my impressions of this branch of the work; for here, too, were countless first-hand evidence that the manufacture of wireless apparatus is one of the smoothest working highly specialized and thoroughly enjoyable vocations in the commercial industry of today.



The Ideal Signal Corps Set

Description of the Portable Transmitting and Receiving Equipment Made by the Marconi Company from Designs Approved by the Military Committee of the N. A. W. A.

PORTABLE wireless equipment of special interest to all amateurs and invaluable to military signal corps, has recently been manufactured by the Marconi Wireless Telegraph Company of America. This set is the first Marconi apparatus to be made specially for amateur wireless workers and follows closely the design details given in the instruction book. "How to Conduct a Radio Club."

In making this set it was considered that portable apparatus having a sending range of five miles is ordinarily sufficient for all cadet military maneuvers. The Military Committee of the National Amateur Wireless Association has officially approved this equipment as one that is entirely practical for short distance work and well within the funds usually available in signal corps organizations.

This proceeding followed a series of field tests which proved notably successful. Excellent results were obtained and it was definitely determined that during field communication a receiving aerial is not required as a part of the equipment to receive signals from the headquarters or control station.

If the maneuvers are conducted in a locality where access can be had to a barbed wire or other wire fence (attached to wooden posts), direct connection can be made from the upper wire to the aerial post of the receiving cabinet and signals received with surprising clearness. In recent tests conducted on Long Island, N. Y., the upper wire of a fence was employed as the aerial and the lower wire as a "capacity" earth and, although the natural period of this system was excessive, remarkable results were obtained in receiving from transmitting stations operating at the wave-length of 600 meters. Experimenters duplicating this feat should, if possible, connect a condenser in series with the antenna lead to reduce the natural wave-length to a value suitable for the shorter range of wave-lengths.

These tests proved conclusively that the signal corps of a military organization can receive direct orders from its headquarters by using any available elevated insulated capacity as the aerial system.

The complete transmitting and receiving instruments are well illustrated in the accompanying photographs. The transmitting apparatus comprises mainly a 3-

inch spark coil energized by 12 dry cells. The receiving apparatus, although primarily designed for the wave-length of 200 meters, will respond to wave-lengths between 600 and 1,000 meters, but it is more efficient on the amateur wave-length.

The entire equipment is assembled in four containing cabinets as follows:

CABINET NO. 1—

- 1—3-inch spark coil with special high speed interrupter.
- 1—Aerial tuning inductance with several binding posts for connection.
- 1—Special zinc spark gap with cooling flanges.
- 1—Aerial changeover switch.
- 1—Transmitting key.

CABINET NO. 2—

- 1—200-meter receiving tuner of the inductively coupled type with 2 multipoint switches on the primary winding and a single multipoint switch on the secondary winding.
- 1—Sliding tube variable condenser.
- 1—Crystal holder with a cat whisker adjustment.
- 1—Fixed condenser.
- 1—Pair of special head telephones.

CABINET NO. 3—

6—Red Seal dry cells.

CABINET NO. 4—

6—Red Seal dry cells.

Convenient connecting leads are supplied for connecting together the various cabinets.

The induction coil of the transmitting set is fitted with a special high speed interrupter giving a current output of unusual volume, in fact the set connected to an amateur aerial of .0003 microfarads indicated a current flow of 1¼ amperes—all that can be expected of a small transmitting set.

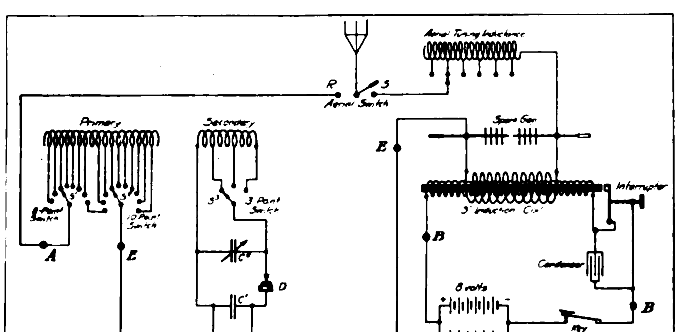
The amateur experimenter accustomed to receiving tuners ordinarily supplied to the amateur field for 200 meter use may be surprised at the diminutive proportions of the coupler furnished with this equipment, but it should be borne in mind that a winding for 200 meters requires but a few turns of wire.

The receiving cabinet has a compartment for the head telephones, thus making the entire receiving set one of desirable compactness. Provision has also been made in this apparatus whereby the coupling between the primary and secondary windings can be altered from the outside of the box by means of a sliding rod. The same method is applied to the variable condenser in shunt to the secondary windings, for, owing to the small size of the receiving cabinet, it is not convenient to do this by placing the hand inside the box.

To enable the experimenter to mount his own "pet' crystals, the crystal cup has been left empty. Crystals such as silicon, galena, molybdenite, cerusite, etc., are the ones that probably will be used.

Apparatus of this type is highly recommended for organizations desiring a small transmitting and receiving outfit, for it is the only type of apparatus that can be employed where there is no source of alternating current.

The range of this equipment varies widely, depending upon local conditions, such as the height and length of transmitting aerial, the nature of the ground connections and the topography of the surrounding country, but under favorable conditions, with an aerial having a fundamental period of 190 to 200 meters, 16 miles have been covered, which range



Wiring diagram for the portable equipment may be increased considerably by the addition of a sensitive vacuum valve detector. It should be kept in mind, however, that the set was designed for transmitting and receiving over a distance of five miles, and with the proper aerial and earth connections should easily make good.

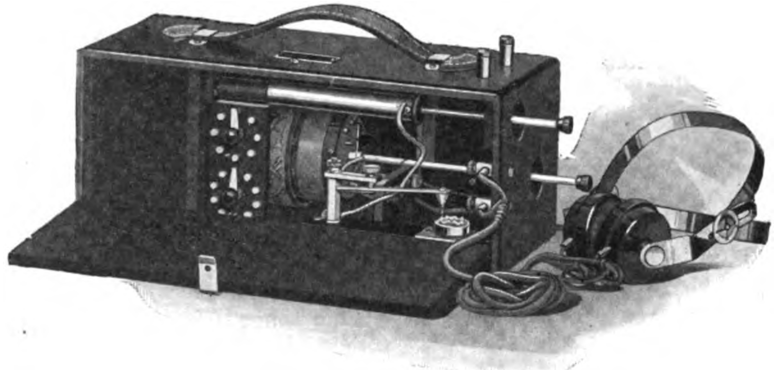
At the military camp a spot may ordinarily be located where an aerial can be swung in the trees, but whatever the type of aerial support, it is recommended that an antenna of the flat top type be employed having 2 or 4 wires spaced about 2 feet apart. A T type of aerial, 100 feet in length, is excellent for the purpose.

If possible, the station should be erected where contact can be made with damp earth, and the actual lead contacts from the portable sets to the earth should be short and of heavy copper wire. Two 5-foot sections of iron or brass pipe, driven to a considerable depth in the earth, should give sufficient contact surface. Experiment has proven, however, that a surface ground, consisting of galvanized iron wire netting, is the most effective, particularly if spread directly underneath the antenna wires.

Of unquestioned utility is a buzzer tester in determining the requisite degree of sensibility of the receiving detector. For these sets two alternatives are offered. There is sufficient space in the receiving cabinet to mount a small buzzer, a terminal of which can be connected to one of the leads of the local detector circuit (a connection, of course, must be made from an external battery), or, at a slight additional cost, the buyer may purchase a small buzzer testing outfit complete, mounted in a box, with binding posts for immediate use.

In adjusting the transmitting apparatus of these sets, the amateur should adjust to secure a high pitched note rather than a long spark discharge of irregular pitch. With the average aerial it is of no value to lengthen the gap beyond one-quarter inch. It is of course understood that the barbed wire fence has insufficient insulation to be employed as a transmitting aerial, but that it functions extremely well as a receiving aerial.

When the batteries furnished with these sets are fresh, a good spark can be obtained with a single set of dry cells connected to the primary terminals of the induction coil, but when they indicate signs of exhaustion another set can be connected in parallel. After both sets of batteries have become fairly well exhausted, they can be connected in series and the entire apparatus will function at its normal rate over a considerable period.

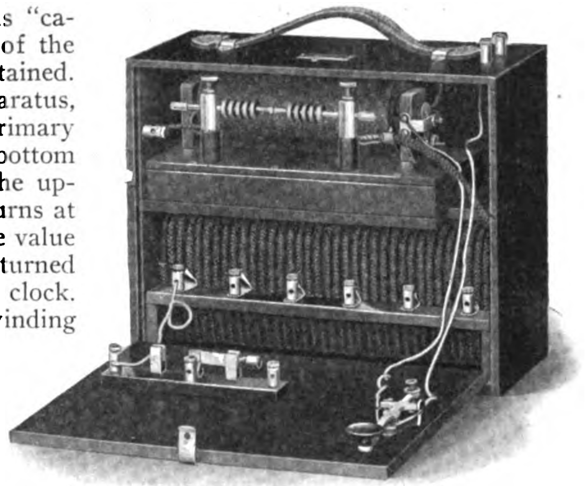


The receiving cabinet weighs only five pounds, yet has an effective range of 500 miles

In making use of the transmitting equipment considerable attention is given to the earth connection. A single piece of gas pipe, five or six feet in length, driven in moist earth, cannot be considered having sufficient conductivity to allow the transmission of signals to any distance. Several pipes should be driven in the earth to a considerable depth and connected in parallel. As a substitute four or five copper wires can be spread over the surface of the earth directly under the flat top portion of the transmitting aerial. If this "capacity" earth has the dimensions of the flat top portion good results are obtained.

Considering the receiving apparatus, the single turn switch for the primary winding is the one located at the bottom of the small switchboard, while the upper switch cuts in groups of ten turns at a time. To increase the inductance value of this circuit both switches are turned in the direction of the hands of a clock. The inductance of the secondary winding is also increased by turning this switch clockwise.

The experimenter should keep clearly in mind that these sets have a maximum adjustment of 600 meters and were primarily designed for operation at wave-lengths between 150 and 450 meters.



The transmitter is less than a foot square in size, but sends a message 16 miles

A portable mast for the pack set can easily be constructed of six or seven 6-foot sections of spruce, the bottom one being about 2½ inches in diameter, and the top one tapering to 1½ inches in diameter. The joints should be lapped by about 18 inches, being fitted with iron sockets permanently bolted to the top of one section, into which the base of the next section above fits snugly. This mast may be supported by two sets of guy wires, of four wires each, one set being attached to the center of the mast and the second set about 1 foot from the top. Iron or wooden anchors may be driven about 30 feet from the base of the mast and equi-distantly spaced. No. 12 iron wire will do for the guys.

It is recommended that each field station be fitted with two of these masts separated by about 100 feet and that there be suspended between them a two, three or four wire aerial of aluminum wire with the lead-ins attached to the center. The spreaders should be made of a bamboo pole which can be purchased from any supply house dealing in fishing rods.

During field maneuvers it is customary to have a powerful station at headquarters by means of which instructions can be transmitted to the various divisions in the open field. However, if care is not taken in the design of this station it will not be able to receive from the field equipment. The receiving aerial of the permanent station must be small enough so that it can be placed in resonance with the shorter wave-length used by the field station. Hence care should be taken to have an aerial of about the same dimensions as that employed for the portable set.

A powerful portable field set for headquarters may be made up by the following pieces: 10-inch induction coil (now on sale by the Marconi Company) the type D storage cell unit of 30 volts and a type A transmitting key. The spark gap should be connected directly in series with the antenna system, no condensers or tuning coils being required. If, however, the phenomenon of resonance is to be taken into account and it is desired to emit a sharp wave, then an oscillation transformer should be purchased or constructed. It will be found by experiment that with a flat top aerial erected in the trees and having a length of at least 150 feet, this apparatus will transmit to a distance of 15 to 30 miles, depending upon the receiving apparatus at the receiving station and the dimensions of the receiving aerial. Care should be taken not to have the emitted wave of the permanent station in excess of the possible adjustment at the receiving tuner of the field station.

A considerably more powerful field set could be requisitioned if one of the members of the military organization possesses a motorcycle with a side car. The basket of the side car should be removed from the chassis and a floor of 1¼ inch planking substituted. A complete transmitting set of ½ k.w. capacity should then be mounted on this base adn set into position for immediate operation. Possibly the alternating current generator could be mounted on the base and by means of a short chain drive, driven by the motor-cycle engine. Owing to the vibration of the engine it is not desirable to mount the receiving apparatus on the same base, but it can be carried there during transportation and then mounted on a small portable table or camp stool. The side car should be fitted with clamps for strapping on the portable mast. With an equipment of this type the entire apparatus can be moved from point to point with considerable dispatch and, owing to the power available, it should prove more efficient than with dry cell sets.

The receiving station at the headquarters should be fitted with some form of the vacuum valve amplifier to insure against loss of signals from the field station. The field receiving set, however, should be simple, free from all complicated adjustments and yet sufficiently sensitive to receive signals from headquarters. In this manner two-way communication is easily possible because, even though the receiving equipment at the field station is not sensitive, the increased power available at the permanent station makes up for the lack of sensitiveness.

For ordinary maneuvering, tuned transmitting circuits should be avoided. With the spark gap of the transmitting system connected directly in series with the aerial wires, it is not necessary to tune two circuits to resonance, to radiate energy. The value of this arrangement will be immediately understood by those who have had previous experience with radio telegraph equipment.

The Military Committee of the National Amateur Wireless Association has arranged to supply to the amateur field with military portable sets entirely practical for short distance work. A number of experiments will be made to determine the range of these sets and information accordingly supplied.

RELAY LINES IN THE MIDDLE WEST

It may be of interest to your readers to know that a 5-kw. spark set was installed at NAJ (Naval Station, Lake Bluff, Ill.), and it has been in operation since June 16. Under the supervision of the Navy Department six relay lines or routes, as they are designated, are radiating in as many directions from NAJ, having been made up through the medium of amateur stations throughout the Middle West.

A system of drills has been inaugurated as follows:

At 6:30 P. M. of each Tuesday and Friday, test messages are sent out by NAJ, which are copied and relayed by the stations of the several routes and the results obtained at each station reported back to headquarters. Every Sunday morning the stations of each route transmit their own call letters for a period of five minutes, the schedule being so arranged that no two stations on a single route send at one time. Since it has been ordered that all other stations on a single route are to listen in during these tests, calls are made followed by a complete report of the strength of signals, which gives a fairly accurate estimate of the efficiency of each station. During these tests stations failing to respond, either through negligence of their owners or inefficiency, are to be eliminated from the service. All reports are made to the A station of each route. Reports are submitted the first day of each week.

At eleven o'clock each night NAJ sends out the weather report for the benefit of amateur stations on the several routes in Illinois, Michigan, Wisconsin, Minnesota, the Dakotas, Nebraska, Kansas and Missouri. The work has progressed to such an extent that the United States Weather Bureau is furnishing the operators of those stations getting the weather reports with the necessary blanks, cards, etc., including card holders, for the purpose of posting each day the weather reports as they are received from NAJ. Lee Henry, *Kansas.*

Detroit is now the headquarters of the United States radio inspection service for the eighth federal district.

With the Amateurs

The Amateur Marconi Radio Association, of Troy, N. Y., is planning to provide its members with pennants bearing the Association's initials. The pennants will be flown from the aerials of all members.

The members of the Association are also planning to erect a temporary aerial on the Y. M. C. A. roof. A course in instruction has been inaugurated and every member is to be supplied with a textbook, written by E. E. Bucher, instructing engineer of the Marconi Wireless Telegraph Company of America.

Charles Everingham, of Troy, has been appointed to send out weekly bulletins. Stations in Albany and Schenectady have been designated for the same purpose.

The Wireless Association of Atlantic City held a meeting recently at its office, 314 Guarantee Trust Building. Activities for the coming winter radio session were outlined, among which will be press service sent from the club station, "3if," St. Charles place, in the evening from seven o'clock to fifteen minutes after seven. "QST" will be sent at a speed of about ten words a minute. The regular business meeting will be held the first Wednesday of each month at the Association's office, while the "general" meetings will be held at the club station.

Kansas farmers will soon receive the weather forecast by wireless at the station nearest their postoffices in time to go out on the early morning rural route.

J. O. Hamilton, professor of physics, at the Kansas State Agricultural College, has installed a service which will be extended to all towns asking for it. He receives a special Government service, in connection with the college work. There are several hundred amateur wireless outfits in the state.

The Government forecast is telegraphed from Chicago to stations in all parts of the Middle West every morning at nine o'clock. From the central stations it is mailed or telephoned to some three or four hundred smaller distributing points. By using wireless no delay will result, as the operator of the radio station can transmit the forecast instantly to all parts of the state.

Two towns have already placed their names on Professor Hamilton's calling list. They are Logan, Phillips county, and Bennington, in Ottawa county. There are amateur stations in nearly every town with a high school. The operators transmit the forecast to the central office of the telephone company, and the farmers receive it almost as soon as the station in Topeka, the section center for Kansas.

Meetings for the winter season of the Washington Radio Club, Trenton, N. J., an affiliated organization of the National Amateur Association, were resumed recently in the headquarters in the Washington Market Building.

It was decided, upon motion of Martin K. Pillsbury, the president, that the club should participate in the electrical exhibit which will be held in Trenton during the week of December 9. Arrangements are now being made to have a display by the club during that time.

Weekly meetings will be held each Thursday evening. A complete Marconi receiving set and a high-power transmitter are now in use at the club, besides a smaller receiving set which is used for work among amateurs and boats.

At the last meeting several of the members spoke on the various phases of wireless telegraphy, which proved most interesting. A social hour followed the business and practice period.

The physical science department of the Wayne (Neb.) Normal College has undertaken the sending of wireless messages twice each day. The purpose is to give students practice in handling wireless stations and to give schools and those interested in science an opportunity for practice in receiving.

A wireless station over the ocean was opened successfully Friday evening, October 27th, by the Crescent Bay Radio Association of Santa Monica, Cal., by an exchange of messages with the U. S. S. South Dakota, which was anchored in Santa Monica Bay. The new home of the Association is at the end of the Loof amusement pier and was donated by the owner of the pier, C. I. D. Looff.

T. J. P. Shannon, president of the Crescent Bay Radio Association of Santa Monica, Cal., sending the first message from the Association's station

The wires are suspended from a flag pole at the highest point on a scenic railway to the roof of the station. This feature gives it a considerable advantage in exchanging messages with coastwise ships and for other long distance work.

The first message sent after the instruments had been installed was a greeting to the battleship's crew from the people of Santa Monica, through the secretary of the Chamber of Commerce. The first one received was a reply of thanks from Arthur McArthur, commander of the ship, and an invitation to the wireless men to visit it next day.

There are now twenty-four members in the Association, which has only recently been organized. The apparatus used is owned by members, but it is planned soon to purchase instruments for the Association. The president is T. J. P. Shannon, motorcycle sergeant of the Santa Monica police department, who sent and received the first messages.

The Hoosier Radio Club of Philadelphia, a new organization, is a consolidation of the Hoosier Radio Club and the

Boy Scout Radio Club. F. E. Hamilton will be in charge and F. O. Belzer, scout executive, will represent the Boy Scouts. An efficient receiving station has been installed in the Chamber of Commerce Building.

At a meeting of the San Francisco Radio Club, held at its home, 50 Frederick street, on the evening of October 13th, E. W. Stone, United States Radio Inspector, made an address on "Decrement." He explained the tuning of sets to resonance to comply with the radio law and declared that amateurs should use only a short aerial without the aid of a series condenser on 200-meter work.

H. D. Dickow, president of the club, has arranged for a series of lectures to be delivered to its members. The membership of the organization now numbers fifty-six, twenty having been admitted to the club recently. A fifty-page magazine, containing the proceedings of the organization will be issued quarterly.

The Nassau Radio League was organized at a meeting of the amateurs of Freeport and Merrick, L. I., held recently at the headquarters of the League, 8 North Main street, Freeport. The following officers were elected to serve until September 1, 1917.

President, Thomas F. O'Brien; vice-president, Stephen Carpenter; secretary, Holmes Swezey; treasurer, John McCord. An executive committee, consisting of the officers and Clifton Weindeck, Stanley Terry and Wilbur Verity was named.

Business meeting of the club will be held the first Friday in each month and code practice and lectures the second, third and fourth Fridays in each month. Correspondence is requested. Communications should be addressed to the secretary, 8 North Main street, Freeport.

The amateurs of Essex, Mass., met recently at the station of Carl G. Ricks and formed the North Shore Radio Association. The following officers were elected:

President, Carl G. Ricks; secretary and treasurer, John F. Hardy; chief operator, David L. Haskell, Jr.; radio policeman, Walter W. Hammond. A committee to take charge of the general promotion of the affairs of the Association has been formed. Meetings will be held on Friday evenings when topics relating to wireless will be discussed, and lectures by the members delivered. The Association is installing a ½ k. w. transmitter. Amateurs in Essex and the vicinity are invited to join the Association. Correspondence should be addressed to the secretary.

The Wireless Club, of Chatham, N. J., is carrying on a campaign for new members. It offered a receiving condenser to persons joining the club before November 10th.

The Nyack (N. Y.) Y. M. C. A. Radio Club, which was organized about a year ago, held its regular Tuesday evening meeting in the Y. M. C. A. on October 17th. The following officers were elected for the coming year:

President, M. V. Bryant; vice-president, W. A. Robertson, Jr.; secretary, M. E. Robertson; treasurer, E. Hoffstatter.

A receiving set has been installed and the purchase of a ¼ k. w. sending set is now being considered. M. V. Bryant and M. E. Robertson are the chief operators. Correspondence with other clubs is invited. It should be sent to the secretary, at 98 Piermont avenue, Nyack.

The Wireless Club, of Worcester, Mass., met on October 18th and elected Warren B. Burgess, of Hyde Park, chief operator in charge of the maintenance of the Tech station. Twelve new members were voted in and plans were discussed for a series of talks to be given by Instructor Carleton D. Haigis, of the physics department on the theory of electric waves and other subjects interesting to wireless students. The president was empowered to appoint a committee to draw up plans of a new antenna to be erected this year.

The Wireless Association of Atlantic City has called its members together for the winter session with the following as officers: President, Charles Seymour; secretary, Clarence Cramer; treasurer, N. J. Jeffries; business manager, Earle Godfrey.

Business meetings are held the first Wednesday of each month at the Association's office, 314 Guarantee Trust Building. General meetings for experimenting and theoretical discussion are held on the remaining Wednesdays of the month at the Association's station (3if), St. Charles place. The Association will be pleased to hear from any of the radio clubs on wireless topics for exchange of ideas and general discussion. Correspondence should be addressed to the secretary of the Association's office.

The Radio Club of the Young Men's Christian Association of Nyack, held its annual meeting on October 10th, and plans for the winter work were discussed The following officers were elected:

President, Marquis Bryant; vice-president, William Robertson; secretary, Merle Robertson; treasurer, Earle Hofstatter.

Members of the Topeka (Kan.) Radio Club showed their willingness to offer their services and the use of their radio instruments to the Government in case of need, following the distribution of applications to join the volunteer radio operators' reserve. F. G. Howell, head of the Topeka naval recruiting station, addressed the club members at a recent meeting.

The Wireless Club has been formed at the Scotia High School, Schenectady, N. Y.. The officers are:

President, Erick Green; vice-president, Leonard Reid; secretary-treasurer, Morrison Mulhall; first operator, Roy Peugh; second operator, C. Dougall.

A club has been organized at the University Settlement, New York City, to study the non-technical aspects of various scientific subjects. The problems of wireless telegraphy, engineering, surveying and allied subjects will be taken up. The club will afford to those interested in these subjects an opportunity for informal discussion. It will further serve the purpose of giving an insight into the possibilities of engineering and similar professions. The club will be equipped with a wireless outfit for experimental purposes. It will meet at the University Settlement, 184 Eldridge street, on Sunday afternoons at five o'clock. The organization will be under the direction of Jacob C. Holzman, Esq., C. E. Detailed information can be obtained at the Settlement.

The Western High School Radio Club of Bay City, Mich., was organized in October, 1915, a wireless set being installed under the supervision of the physics instructor in the physics laboratory. Only High School pupils are eligible for membership. Last year the club gave a "Wireless Carnival," at which experiments in static electricity, a Tesla transformer made by members of the club, and miniature wireless and telegraph sets were among the features. The club is planning to repeat the carnival on a larger scale this year.

In a letter to the editor of The Wireless Age, Wendell F. Holst, a member of the National Amateur Wireless Association, who went to the Mexican border with Co. A, Illinois Signal Corps, says:

"During our stay down here we have done some very good radio work considering the equipment we have to work with. The sets we use are the 1912 ⅛ k. w., 500-cycle type. They produce a very pleasing tone which is also a good carrying one in interference and static. Our aerial is of the 60-foot high four-wire umbrella type. We have transmitted thirty-five miles under the poorest conditions I have known."

The members of the Hudson City Radio Association have secured rooms at 541 Central Avenue, Jersey City, N. J., where they have erected a large aerial and a sensitive receiving outfit.

Code practice is given every night to those who desire it. Lectures on how to secure an operator's license and the use of the vacuum valve will be given shortly.

Election of permanent officers was held recently. The following were elected

President, Joseph F. Grece; vice-president, William Biedenkapp; financial secretary, Frank V. Bremer; recording secretary, Clarence Maves; treasurer, William S. Davidson.

All amateurs in Hudson Country are invited to join the Association. Address Clarence Maves, 90 Ferry street, Jersey City, for an application blank.

A San Antonio (Tex.) amateur writes: "There is mighty little going on in wireless in San Antonio among the amateurs, as there has been too much interference with the federal station. The Secret Service, the police and even the mail carriers are looking for antennae. Those who persist on operating their sets are arrested."

The first number of The Suburban Radio Journal, published monthly under the auspices of the Suburban Radio Club of Washington, D. C., has made its appearance. It announces that amateurs both in and out of Washington can obtain copies of the Journal by addressing Charles W. Longfellow, 5515 Potomac avenue, N. W., Washington.

The Suburban Radio Club, which is affiliated with the National Amateur Wireless Association, was formed in the autumn of 1912, the first meeting being held at the home of Howard Fellows. Five persons were present and a constitution, which contained many of the main features of the present one, was drafted. In 1914 it had a membership of fifteen. At this time it was believed advisable to buy a wavemeter capable of measuring wavelengths up to 700 meters. This instrument was so popular among the members that it was decided to obtain a hot wire ammeter. About this time it was found that if one member had an important message for another, he must trust to luck to find in his station the person for whom the message was intended. As a result the delivery of messages was sometimes delayed several days. So a scheme was devised whereby each member was allotted ten minutes in the evening, when he was sure to be "on." These ten-minute periods were printed on a "schedule card" after the names of the respective members, one card being posted in each club station. In this way by referring to the card one could readily find the time at which any member would be "listening in."

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of THE WIRELESS AGE, published monthly at New York, N. Y., for Oct. 1, 1916.

State of New York, }
County of New York, } ss.:

Before me, a Commissioner of Deeds in and for the State and county aforesaid, personally appeared John Curtiss, who, having been duly sworn according to law, deposes and says that he is the business manager of the WIRELESS AGE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit.:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, John Curtiss, 450 Fourth Avenue, New York; Editor, J. Andrew White, 233 Broadway, New York; Managing Editor, J. Andrew White, 233 Broadway, New York; Business Manager, John Curtiss, 450 Fourth Avenue, New York.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) John Bottomley, 233 Broadway, New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner: and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

JOHN CURTISS.

Sworn to and subscribed before me this 3d day of October, 1916.

[SEAL.] B. M. SWIFT.

Commissioner of Deeds, City of New York. Residing in New York County. Certificate filed New York County No. 1202. New York Register No. 17071.

(My commission expires April 20, 1917.)

Random Thoughts of an Old Timer

By Lloyd Manuel

WE have in our town a man with brains and ability. We call him, when not featuring his decisions in superlative terms, the Superintendent of Wiring. More than twelve years ago, when I asked him if I might run a telegraph line across a trolley's right of way, he turned me down. That proved his wisdom. If he hadn't turned me down, I probably would be on the shelf now as far as wireless is concerned. And the art thereby might have suffered. Perhaps it has suffered anyhow; but that isn't the story.

You see, it's this way. With the aid, counsel and support of a chum, I had decided to get a telegraph line across that trolley, but when we were refused permission to cross, we swore by all that is good and holy that we would establish communication in some way. We started to do it by wireless.

I began by getting together a lot of hay wire. This was easy; my brother at the time ran a livery stable. It was finally all patched together, after many trials and tribulations. Then I nailed a broom handle on one end of my woodshed. This was the mast. Two clothes pins served for spreaders and the completed cage was about a foot long, each wire separated by about an inch. Such is the ignorance of youth.

For a station, I commandeered my brother's hen-house, after evicting the hens. This of course made my brother peeved, but to his credit be it said that he did not block the progress of science. As a matter of fact, he remarked that my experimenting might lead to great things, and proceeded to sell the hens. As may well be imagined, this good word and action nearly overwhelmed me; since then, however, there has come the disturbing conclusion that his magnanimity had some relation to his needing money about that time.

I bored an inch hole in the roof of the house for an antenna lead-in, and inserted the neck of a soda-water bottle, after punching a hole through the bottom of the bottle. One of my mother's saucers ornamented the top of this dignified and formidable arrangement, and my insulator was complete. It looked quite like a commercial product. Even though it wasn't the most efficient insulator ever constructed, it was the joy of my heart for some little time.

After getting the lead-in through, I commenced to realize that a real outfit should have instruments. I had no more idea what the instruments were like than I had knowledge of Chinese script.

So, I hied myself to the public library and procured a book which gave a layman's account of the Marconi apparatus. I didn't understand the whole write up, but dimly realized that I must have a coherer and a relay.

I swapped my air rifle for a relay. The coherer—embryo inventors please note—I made as follows:

First I took a bottle and filed the neck off; this was the glass tube. For plugs I took two small corks and covered them with tinfoil. Then I went junking!

After raising rags, bones and bottles worth fifteen cents, I sold out. I filed enough silver off the dime to partly fill the space between the plugs and mixed 'em with a few nickel shavings from the five cent piece. This was my mixture, and the end of my finances. After mounting this "Busy Bertha" on a base, my coherer was complete.

To decohere, I quietly removed the electric bell from the house, leaving as a substitute my little dollar motor with a fan attached. Over this fan I placed a bell so that when the fan revolved it would hit the tongue of the bell and cause it to ring.

I connected the "instruments" and tried for about a week to get signals. Sometimes I thought that there was something doing, but more often. . . .

Then a friend, a real electrician, who had seen the aerial harzarded a guess that I was using a microphonic detector. Not having the least idea in the world what that was, I denied the allegation. He then told me of the Massey microphone. I scouted around under the electric light pole on the corner, found several carbons and fixed up a microphone. Then I was stuck. I had to have a telephone receiver. Nothing could be done without a 'phone.

I went junking again. With the money procured by three days' work, I bought a long receiver, second-hand.

I possessed, at this time, a little box of tools, presented to me by that genial and mythical old gentleman, Saint Nicholas. I dumped all the tools out of the box and mounted the carbons on the top. I had an eye for the esthetical, so in order that things might look quite orthodox and beautiful, I bummed some twisted pair and wired this wonderful instrument up as per instructions received from the before-mentioned electrician friend.

I hadn't listened for more than five minutes, when—wonder of wonders!—the contraption began to buzz! My chest swelled with pride. I ran out of the place with more agility than ever an occupant (hens included), had left it before.

Into the house I dashed and breathlessly informed my parents that I was some boy; that I was designed for a more useful place than the reformatory. To better impress the achievement upon my five brothers and two sisters, I announced that I was headed for the scientific class. Verily, I believe in all truth that I felt that day greater than Sir Oliver Lodge.

With what I considered becoming modesty, I permitted them all to listen-in, gravely informing them that the signals which they heard emanated from a station about five hundred miles away. I afterwards got to know that spark very well, and had I told them five hundred feet, my chances of getting to heaven would now be brighter.

But allowing the family to listen helped some, for they all clubbed in and bought me a dinky little quarter-inch Rhumkorf coil, which I hooked up.

I now started to learn the code. In those days Morse was used more extensively than the Continental. I took the bell which I had used on the coherer set, hitched it up in series with a battery and a strap key made from a piece of barrel hoop and a round headed screw. I then started in to practice.

At night I took this outfit in upon the kitchen table and sat up sending to myself until some unspeakable hour, when my father would appear with fire in his eye and a slipper in his hand, and make me sashay. My code practice would then be finished on my brother's shins—he slept with me, poor soul—until I fell asleep. After a while I was able to handle about five words a minute.

I will never forget the day when the government station answered my signals. They reduced their speed to such an extent that I could read them. My sign was GR. "GR GR GR," they said, "if you don't stop operating that coil, you will find yourself in the jug shortly." I answered by sitting on the key. I was such a nice boy!

My first receiving tuning coil was made from a portiere pole wound with No. 18 annunciator wire. This was inserted in the aerial circuit, in series. Meanwhile, the house bell had been shorn of its wire and discontinued. Such trifles as annunciators for callers could not be allowed to stand in the way of scientific research; the coil added materially to my range.

The next thing that comes to mind is the fact that a friend of mine had seen a silicon detector. He informed me that he had seen a detector that worked without battery. I promptly told him that the operator had been stringing him. But I set out to find out about it, and soon got hep to a piece of a fused silicon. What an improvement! Immediately I threw the microphone into the junk-heap; it was a thing of the past.

Then I left school and got a job driving a grocery wagon, at the fabulous sum of five dollars per week. As a promulgator of the quardruped, I was not what is called a success, my mind being constantly on the wireless. If a customer ordered a pound of coffee, I was sure to bring a barrel of flour. Anyway, at the end of nine weeks, the inevitable happened; I got fired. Not, however, until I had saved enough money to buy myself a good head set and a decent aerial.

Immediately, I erected a fifteen-foot mast on my house and a thirty-footer on my woodhouse, a large edifice of its kind with a chimney. Since the erection of that mast, the chimney has never been seen. I may say in confidence that the chimney was used as a fulcrum to raise the mast. How myself and my brother ever managed to raise that pole is beyond me. But raise it we did, amidst the slangy protestations heaped upon my, so to speak, innocent head by a battered and torn brother.

One neighbor asked me if I had erected a pigeon trap; and I now see the justification of the question. Marconi himself never used more wire in a single aerial.

There is nothing like a decent aerial to make a boy proud, I reflected.

Dilapidated though the station be,
Antenna you're a joy to me.

With the advent of these improvements, my range was immediately increased to about a hundred miles. So satisfied was I then, that for want of something better to do, I went to work as a carpenter's helper. On this job, I received nine bones a week, and between the fact that I was a real scientific explorer and a youth of means, I acquired a swelled cranium. So I started to stick signs up in my station, making patent the fact that I was not running an information bureau and that I was controlling 3,500 volts in my transmitter. Soon I had little kids, in short trousers, and big kids who should have been dressed in pinafores, on my trail.

They all wanted a set, and I was invited in all manner of ways to aid them. Feeling, in my egotism, that I could uphold the reputation of a consulting engineer, I elected to assist anyone who would pass over the formidable sum of ten cents. I had one customer on this basis. I was an information bureau, after all.

Finding that the cash proposition didn't go, I opened my heart and became a king to the kids. But, O my, when I think of some of the answers that I handed out, I feel that shooting is too good for me.

The electrolytic detector, the carborundum, the magnetic, the perikon, the galena and many others were tried in their turn. I had good success with all the different types.

Now, so far as the personal reminiscence thing is concerned, it is time for me to cease firing.

My experience has been that the youthful enthusiast is not willing to start simply, and let his instruments grow with his knowledge. Yet this is unquestionably the best way to get a good fundamental knowledge of the subject, and will make for success every time.

At the present time I use the vacuum valve. Combined with this I have a good loose coupler, doughnut type, a 2,000-ohm pair of phones, two variables and a loading coil. I reside in Rhode Island and get Guantanamo, Cuba in good shape. Figure that out on your sliding scale. I have received Pensacola when using a crystal, and a single straightaway wire, 200 feet long and forty feet high.

My radio set has kept me in many nights, when I probably would have otherwise been out wasting my time on the street corner. So seriously, it is a real thing to be interested in. How better can a fellow spend his loose change than by becoming acquainted with this, a most interesting field of study that has been opened by Marconi and the great men who have contributed to the art.

So boys, men, aye and girls, go to it.

It has been announced that a new wireless station will be erected at Ooresäter, Norway. The station, which is designed for communication with connecting links in other parts of Europe, will have masts 300 feet in height.

A wireless call for help from R. R. Buck, navy radio operator at Diamond Shoals Lightship, who had been taken suddenly ill, caused the dispatch of the destroyer Cushing from the Norfolk navy yard to the ship on the night of November 8 with a physician and a substitute operator.

The wireless truck of the New York Police Department's Military Signal Corps passing down Fifth avenue in the recent parade

Police Preparedness in New York

What the Police Department Has Accomplished in Military Preparation for Home Defense and the Participation of the Signal Corps in the Recent Parade

NEW YORK had a chance on October 17 to see its police soldiers. They marched down Fifth avenue, khaki clad, 2,500 strong, with all their accoutrements of war. From the reviewing stand in front of the library at Forty-second street the Mayor, Police Commissioner Woods, and many others watched them swing past. Every man in the line had attended the military training camps of the Police Department at Fort Wadsworth last summer, and the purpose of the parade was to demonstrate to the public the result of that training.

The olive drab khaki-clad columns marched out of the Seventh Regiment Armory in command of Chief Inspector Max Schmittberger, shortly after 1 o'clock. The men were formed into two regiments of three battalions each. The Police Department band headed the first regiment.

Next came the Signal Corps, commanded by Acting Captain McKenzie, of the Telegraph Bureau. The operators were transported in a police motor patrol wagon. A wireless mast reached toward the sky, while signal flags fluttered at the front and rear of the patrol. The wireless transmitter was working continually, keeping up a buzzing that could be plainly heard fifty feet away.

Back of the Signal Corps came two glittering rapid fire guns from the police boat Patrol. The rapid fire battery was commanded by Lieutenant Edward B. Mulronney, with half a dozen stalwart men dragging a gun along each curbstone. Following came the machine gun company under Lieutenant H. A. Taylor. It looked about as businesslike a unit as was in the parade. There were eight machine guns in as many small automobiles. Each gun was mounted on a tripod and stood in the tonneau, with two men in the rear seat and two men in the front seat.

The men presented a soldierly appearance as they passed the reviewing stand with "eyes right," the officers with their right hands at the brims of their hats. They marched with a springly step and nearly every rookie looked in fit condition.

There were old men leading companies who a few years ago would have been doubtful whether military training could have been carried out in the Police Department. There were others in the line who had received their first military training in the Spanish-American War. Indeed, the parade seemed to emphasize the passing of the old style policeman, who grew stout on the job, and as a class furnished a subject for the cartoonist and joke writer.

The military camp has become a permanent part of police training. The men carried guns, and the only evidence that they were members of the department were the badges pinned to each drab shirt.

Among those in the reviewing stand were Mayor and Mrs. Mitchel, Commissioner and Mrs. Woods, Magistrate Barlow, Major General Daniel Appleton, Ambassador James D. Gerard, Senator M. M. Coronado of Cuba, Secretary to the Mayor Theodore Rousseau, Secretary to the Police Commissioner Henry J. Case and the following officers from the Artillery Corps at Fort Wadsworth: Colonel Bartlett, Major Kilbourne, Major Martindale, Captains Eddy, Gilmore and Campbell and Lieutenants Easterday and Waddell.

The automobile wireless equipment of the Signal Corps excited comment all along the line of march. It carried a 20-foot mast set in the frame of the machine and grounded on the chassis; an 8-wire aerial with 5-foot spreaders extended to a short mast 12 inches above the roof, giving an antenna 14 feet long. The transmitter consisted of a Marconi 10-inch coil operated by three 24-volt storage batteries and included the standard equipment of the Marconi auxiliary sets, oscillation transformer, stationary gap and accessories. The receiving tuner was of crystal detector type equipped with three sets for phones for the operators carried. The wave-length tuning was 300 meters.

A representative of The Wireless Age was invited to "listen in" as the truck stood in front of the armory before the parade. The Marconi station at Wanamaker's could be heard very plainly and signals from Sea Gate, just outside New York harbor, were easily read. This reception clearly indicated the practicability of using the motor truck apparatus at any place within the 60-square-mile area of Manhattan and the Bronx. With a counterpoise under the truck frame, as is now proposed, the transmission range could be brought up to 25 miles, enabling communication to be established with any point in the five boroughs of the city.

Sergeant Charles E. Pearce, instructor in wireless to the police, explained the proposed uses of the automobile station. "It is equally valuable as a civic asset as it is obviously an indispensible military equipment," he said. "While the truck as it stands today represents a mobile means of quick communication should New York be invaded and its police instantly become soldiers, the Department expects to demonstrate that automobiles equipped with wireless are of great value in emergencies, such as riots or serious fires when the telephone might be put temporarily out of commission. The motor truck can always be kept in readiness and be sent direct to any locality that felt its need. Of course, the wireless equipped automobile is merely an auxiliary station, but so, for that matter, is the entire system of police wireless which the Department is planning. Radio telegraphy to us means insurance of communication with any point in the city, should the hour come when all the wires are down. As there is no telegraph, we are now considering establishing a wireless station at Fire Headquarters to serve as an auxiliary to the telephone.

"The New York Police Department will thus soon be ready to cope with any emergency that may arise to threaten the safety of New York."

How ably the problem of safeguarding the interests of its citizens is being studied was demonstrated by a visit to Police Headquarters. By a comprehensive system of laying out the city in zones and establishing innumerable points of contact with all quarters, sections and sub-sections, it is believed that 10,000 policemen could be mobilized in any threatened district within three or four hours. The headquarters staff has prepared data for dealing with every contingency and wireless plays a prominent part in the various schemes for protection.

The practical usage of the headquarters set was illustrated during the writer's visit to that station. Chief Inspector Schmittberger came in person to the operating room to inquire the weather conditions prevailing off the coast just outside New York harbor, which would influence the movements for the day of the harbor police boat Patrol. Communication with the Marconi station at Sea Gate returned the weather observations before the Chief had left for his desk.

The class in instruction which was inaugurated with eight members has now grown to thirty-five and the school will continue all winter without interruption. Those who have passed the examination and secured government licenses are: Lieutenants George H. Quackenbos, John A. Altenbach and William H. Van Keuren, Sergeant Charles E. Pearce and Patrolmen Michael C. Moroney, George T. Valentine, George Wolf, Emil Kepko and John F. Murphy. Others in the class are: Sergeants Charles P. Vosburg and Harry Kahl and the following patrolmen: John E. Hanley, Charles Gaul, Harry Upham, William R. Black, John Seymour, William Hughes, James J. Ward, John W. Ray, Frederick Schwartz, John F. Ward, Russell McKee, William J. Gaffney, William E. Northrop, William J. Ferrick, Robert C. Jewett, Francis X. Madden, John J. Mahoney, Patrick J. Driscoll and John A. Lovett.

RADIUM AND WIRELESS IN AN EXPERIMENT

The European war interrupted the experiments that a young man was conducting near Berlin, but in order that other scientists might take up his work and carry it to a conclusion, his experiments have been described in the Elektrotechnische Zeitschrift. He was endeavoring to carry out a theory that the presence of radium causes a definite and remarkable action upon a wireless station.

The first experiments were carried on indoors, with an antenna consisting of a small wooden rod, upon which wire was loosely wound. With the receiving instruments adjusted, he placed a tube containing 50,000 units of radium salts near the wooden rod. Immediately he could hear the buzzing of distant signals which the apparatus was unable to detect otherwise.

Encouraged by this success, he carried on his experiments, using a full-sized outdoor antenna, or aerial. With a delicate measuring instrument known as the galvanometer, he discovered that the presence of the radium tube near the aerial wires would cause an appreciable current of electricity to flow. But when the radium tube was attached to the wires at their mid-point, reception of signals was found impossible, even with the most sensitive of ear receivers. Technically speaking, it was found that the presence of radium under certain conditions shortened the wave length.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Lysefjord	Huddleston Marsh Mahogany Co.	LHL (provisional)
S/Y May	J. R. De Lamar.	KZI
Tug Wellington	Cook-Cummer Steamship Co.	KMR
Brynhilda	Brynhilda Shipping Corporation.	KIO
Epson	Furness, Withy & Co.	ERH
Tug Britannia	Bay Steamship Co., of America.	KXS
Tug J. W. Thompson	Bay Steamship Co., of America.	KXT
Niels Nielsen	B. Stolt Nielsen.	(Unassigned)
Hanna Nielsen	B. Stolt Nielsen.	(Unassigned)
Luise Nielsen	B. Stolt Nielsen.	(Unassigned)
Stolt Nielsen	B. Stolt Nielsen.	(Unassigned)
Washington	H. Waalmann.	(Unassigned)
Golaa	Fridtjof Siegwarth.	(Unassigned)

CHANGE IN NAVAL CENSORS

A meeting of bankers of New York City was held on October 30th, to protest against an order issued by Lieutenant Charles R. Clark, U. S. N., as naval censor of wireless messages stationed at the Sayville, L. I., station, directing them to send him their secret code key. Afterwards other bankers received from Commander David W. Todd, U. S. N., Director of Naval Communication, a ruling in answer to previous protests from them concerning the Clark order. He countermanded the order.

Almost simultaneously with the news of Commander Todd's action came despatches from Washington announcing that Lieutenant Charles R. Clark and Lieutenant Keep, the naval censor at Siasconsett, had been relieved from duty by order of Admiral Benson and that Lieutenant J. C. Clark had been ordered to Sayville. The reason for these changes was not stated.

Lieutenant Charles R. Clark some time ago asked bankers to send him their private cipher key before their messages could be transmitted. The bankers already had filed with the censor their private codes. But the "secret cipher" which this order required is used to "authentic" money messages. It is employed as a safeguard against fraud by anyone who might obtain a copy of the code and use it to transmit unauthorized messages by which transfers of money might be effected. It was explained to Commander Todd by bankers that these keys were held by them as sacred as signatures.

Commander Todd replied that he understood their position thoroughly. He proposed that the bankers give guarantees by signing affidavits to that effect when using secret key words and numbers in the future. To this the bankers agreed.

NEW DISTANCE RECORD

Marconi Operator A. J. Costigan, of the Floridian, reports a new long distance record.

The Floridian left San Francisco for Sydney, Australia, on July 13th; from that date, up to and including July 31st, the vessel's position was transmitted to San Francisco. With a single exception, these position reports were received directly at the Marconi Hillcrest Station, near San Francisco, up to a distance of 5,227 miles.

The Floridian is equipped with the standard Marconi 2 k. w., 500 cycle panel set. The current consumption at the transformer did not exceed 1,600 watts up to 2,600 miles and at 5,200 miles the power consumed was 2,600 watts. Costigan says the San Francisco signals were audible up to some 3,000 miles.

THE SHARE MARKET

New York, November 8.

Bid and asked quotations to-day:

American, 3⅛—3⅜; Canadian, 2—2¼; English, common, 15—19; English, preferred, 14—18.

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.

V. J. S., Allston, Mass., inquires:

Ques.—(1) Please tell me the greatest possible length of the flat top portion of a two-wire aerial that can be used for the wave-length of 200 meters where the vertical lead-ins are 50 feet and the height of the aerial from the ground is 60 feet?

Ans.—(1) The flat top cannot exceed 80 feet in length. With these dimensions the natural wave length will be about 175 meters, and with the secondary winding of the oscillation transformer in series the wave-length of 200 meters can be obtained.

Ques.—(2) Please give the number of plates, with dimensions 8 inches by 10 inches, for a condenser to be immersed in oil and to have a capacity of .008 microfarad. These plates are to be connected in parallel. With this connection will the glass be able to withstand the voltage of 13,200 volts?

Ans.—(2) If you cover the 8 by 10 plates with foil, 6 inches by 8 inches, each plate will have an approximate capacitance of .00066 microfarad. Twelve plates connected in parallel will give the required value of capacity. Unless a very good grade of glass is obtained, they will not withstand this potential; consequently you will require 48 plates, 24 connected in parallel in each bank and the two banks connected in series.

Ques.—(3) What is the best arrangement to use as a container for these plates and what is the best grade of oil that can be purchased for insulating purposes? Where can I obtain it?

Ans.—(3) A metal tank will do, providing the precaution is taken to thoroughly insulate the plates from the bank. If a local oil dealer can supply you with Swan & Finch's Special Atlas AA Oil, it is to be preferred.

* * *

E. W. B., Alta, Iowa, inquires:

Ques.—(1) What is the approximate wave-length of an aerial 400 feet in length, 65 feet in height, composed of a single wire having a 50-foot lead-in?

Ans.—(1) The wave-length of this system is approximately 700 meters.

Ques.—(2) How may this wave-length be reduced to receive signals from amateur stations?

Ans.—(2) The aerial is too long for the reception of amateur signals at the wave-length of 200 meters. The largest aerial that you can employ for this work is one of the T type, comprising one or two wires 110 feet in length, approximately 50 or 60 feet in height with the lead-in wires attached to the center.

Ques.—(3) What is the comparative sensitiveness of the crystaloi and the vacuum valve detector?

Ans.—(3) We have no exact quantitative data, but the vacuum valve detector is considered more sensitive than the crystaloi.

Ans.—(4) We cannot tell the possible wave-length adjustment of your loading coil without more complete data concerning the manner in which it is wound.

Your query concerning the running of a ground wire from the top of the 65-foot wooden pole to the earth, is not thoroughly understood and consequently no reply can be given.

* * *

G. S., Los Alto, Cal., inquires:

Ques.—(1) Is there 39.39 feet in one meter?

Ans.—(1) No. 39.37 inches are the equivalent of one meter.

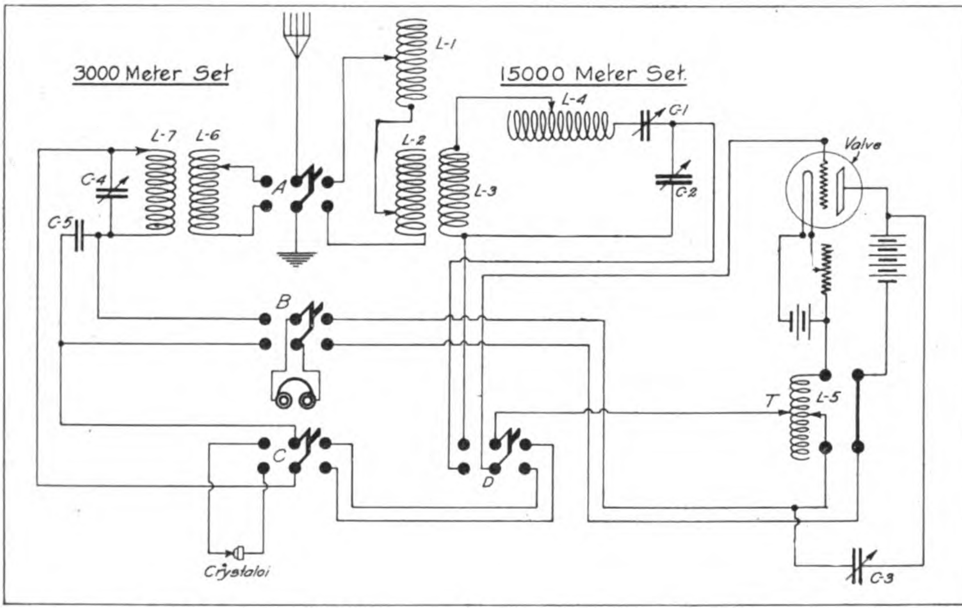
Ques.—(2) Should you obtain a shock if you place your finger on the secondary winding of an oscillation transformer during sending? I do not get a shock from mine.

Ans.—(2) It would seem from the statement further on in your queries, that you have employed your body as a radiation indicator and while it has not proved fatal in your particular case, we would not advise a repetition of the test with all types of apparatus. You may find that the capacity of your body is not sufficient to carry the current. Of course if you stand on an insulating material you will not receive a severe shock from the secondary winding of any oscillation transformer, but should you by chance be standing upon earth or upon a conductor connected to the earth you would probably soon be aware of the fact.

Ques.—(3) How can I determine where to place the primary and secondary clips on my oscillation transformer in order to obtain the best results?

Ans.—(3) Lacking a hot-wire ammeter connected in the antenna circuit, you had better place these clips on different positions and have a nearby receiving station listen in until the signals come the loudest. For example: Set the clip for the antenna circuit at a definite point on the helix and then shift the clip from the closed circuit until the distant station obtains the loudest signals. With the hot-wire ammeter connected in series with the antenna circuit or a small glow lamp, you can adjust the position of these clips until you get the greatest value of antenna current as indicated by a brilliant glow of the lamp.

Ques.—(4) How can I measure the secondary amperage of a spark coil and the voltage?



Ans.—(4) The amperage can be measured by connecting a small milli-ammeter in series with the winding. The voltage is best measured by the jump spark method, a table for which is given in the "Naval Manual of Wireless Telegraphy" for 1915. Two sharp needle points can be mounted on a base and separated by a certain distance. They are then connected in shunt to the secondary winding and the gap widened out until all sparking ceases. By observing the length of the gap, reference can be made to the table and the secondary voltage approximately determined.

* * *

S. W. H., Williamsport, Pa., inquires:

Ques.—(1) Please publish a diagram of connections for a damped and undamped wave receiver, employing a 15,000-meter and a 3,000-meter inductively-coupled receiving tuner, the former for undamped waves, the latter for damped waves. Please include in this circuit a vacuum valve and arrange it so that it can be switched to either tuner. The circuit is also to contain a crystaloi detector as an auxiliary for damped waves. The telephones are to be arranged by means of switches so that they can be connected to either circuit.

Ans.—(1) Your question is comprehensive, but by following closely the accompanying diagram you will obtain the desired result. The necessary connections from one tuner to the other can be effected by means of four double-pole double-throw knife blade switches. On the right hand side of the drawing we have indicated the complete circuit, comprising the necessary loading inductances for an oscillating vacuum valve, and call your attention particularly to the coil, L-5, through which the wing and grid circuits are coupled. This coil should be rather long, approximately 20 inches in length, 6 inches in diameter, and wound closely with No. 30 S. S. C. wire. The slider, T, should be arranged to include just a few turns of the circuit.

To make use of an oscillating vacuum valve for the longer wave-lengths, throw the switches, A and B, to the right and switch C to the left.

If it is desired to use a 3,000-meter tuner in connection with the crystaloi detector, throw switches A, B and C to the left. To use the vacuum valve in connection with a 3,000-meter tuner, the switches, A and B, remain in the left position, but the switches C and D are thrown to the right. With this connection the sliding contact on the coil, L-5, should be placed at the zero position. Complete dimensions for the various coils of this tuner have been published in previous issues of The Wireless Age and also in the book "How to Conduct a Radio Club."

* * *

F. C. S., Washington, D. C.:

An amateur residing in Washington, D. C., should have no difficulty in receiving signals from the Arlington Station. After reading your communication we believe that you do not fully understand the difference between an undamped wave receiving set and a damped set. The diagram of connections which you have attached to your query is quite correct and will give good results, but you had first better decide for yourself on the type of circuit best suited to your work. For example: a receiving set particularly suitable for the reception of signals from Nauen, Sayville, Hanover, Tuckerton, etc., will not be efficient on the shorter range of wave-lengths unless it is fitted with a special set of dead-end switches, thereby completely disconnecting the unused portions of the inductance. You had, therefore, better construct a receiving tuner for the reception of spark signals with a maximum adjustment of 3,000 meters and the second equipment for adjustment to waves inclusive of 10,000 meters. Complete circuits for both types are given in the book "How to Conduct a Radio Club" and if you will follow instructions carefully you should have a set that will respond uniformly. Note the September, 1916, issue of THE WIRELESS AGE, in the series "How to Conduct a Radio Club," which contains a number of diagrams applicable to long and short distance receiving apparatus.

The Arlington tuner described in the January, 1916, issue of the National Amateur Wireless Association Bulletin should give good results on wave-lengths between 600 and 3,000 meters and the fact that you do not even obtain fair signals seems to indicate there is an error in the circuit at some point.

* * *

E. B. J., Newark, N. J., inquires:

Ques.—(1) With a two-slide tuning coil primarily constructed for the reception of wave-lengths of 1,600 meters, I am able to hear the signals of the Arlington station. Do you think it is possible that this tuner is in reality adjustable to the wave-length of 2,500 meters?

Ans.—(1) It is quite likely that the upper range of this receiving tuner is much greater than you suppose and consequently it can be placed in resonance with Arlington; or again it may be that you employ a very close degree of coupling between the primary and secondary circuits and the apparatus responds by reason of forced oscillations.

Ques.—(2) Please give the fundamental wave-length of an antenna consisting of four No. 16 copper wires, 50 feet in length and 40 feet in height, with a lead-in of 70 feet.

Ans.—(2) The fundamental wave-length is approximately 165 meters.

Ques.—(3) Would you recommend a 1-inch or 2-inch induction coil with above described aerial?

Ans.—(3) Either size may be employed. A slightly greater range will be obtained with a 2-inch coil.

Ques.—(4) Please give the dimensions of a condenser suitable to a 1-inch coil or a 2-inch coil.

Ans.—(4) The dimensions of the condenser for induction coils vary widely, depending to a large extent upon the action of the vibrator, such as the speed of interruption, etc. Ordinarily one or two plates of glass, 5 inches by 7 inches, covered with tinfoil 4 inches by 6 inches, connected in parallel, will give the right capacity. The maximum allowable value is in the neighborhood of .0005 microfarad.

The correct value of capacity for a given coil is best determined by experiment, but you can rest assured that it will be less than .0005 microfarad.

* * *

J. C. L., Jr., Baltimore, Md., inquires:

Ques.—(1) Would an inductively-coupled receiving tuner of the following dimensions be efficient? The primary winding is 8 inches in diameter, 24 inches in length, wound with No. 24 D. C. C. wire. The secondary winding is 7 inches in diameter, 24 inches in length, wound with No. 26 D. C. C. wire. What is the possible wave-length adjustment?

Ans.—(1) This receiving tuner is easily responsive to the wave-length of 10,000 meters.

Ques.—(2) Are the coils of this tuner of the right dimensions for use with an oscillating vacuum valve?

Ans.—(2) Yes, but additional coils are required in the local telephone circuit for resonance. The correct dimensions for these coils are given in the book "How to Conduct a Radio Club."

Ques.—(3) How long should the coils of this receiving tuner be for a wave-length of 15,000 meters?

Ans.—(3) With a variable condenser connected in shunt to the secondary winding and a few turns of inductance added in the antenna circuit, the present tuner will respond to wave-lengths of 15,000 meters. The actual dimensions for the loading coil depend upon the dimensions of the antenna with which it is to be used.

Ques.—(4) How can I calculate the total area of the 2 plates in a condenser to have a capacity of .005 microfarad and another of .001 microfarad? I also require a third condenser to have a capacity of 1 microfarad.

Ans.—(4) To calculate the capacity for these condensers use the following formula, namely:

$$C = \frac{K\ A\ 2248}{T\ X\ 10^{\circ}}$$

Where C = the capacity of microfarads.
A = the area of the dielectric in use in square inches.
T = the thickness of the dielectric in inches.
K = the dielectric constant of the insulating medium.

For glass K varies from 6 to 9; for paraffine paper 2; for air 1 or unity.

This formula is only approximate owing to the wide variation in the dielectric constant of the different grades of insulating material.

You have not stated in your query whether you desire the dimensions for a variable condenser or for one of fixed capacity.

The condenser of 1 microfarad capacity usually consists of two long sheets of tinfoil, separated by a thin piece of paraffine paper, and you will find it as cheap to purchase one of these as to construct it.

Ques.—(5) What should be the wave-length of the small variometer described in the N. A. W. A. bulletin for January, 1916, if it is used as a receiving tuner? How can I change the dimensions to attain the wave-length of 600 meters?

Ans.—(5) We do not understand the query. How do you intend to employ this variometer as a receiving tuner? Do you expect to connect it in series with the antenna circuit and shunt across it a fixed stopping condenser and a crystalline detector? If so, the variometer will alter the wave-length of the antenna circuit about 300 meters, the actual variation of course depending upon the constants of the aerial. A larger range of inductance values would be obtained with a variometer wound with No. 32 S. S. C. wire.

* * *

C. L., North Adams, Mass., inquires:

Ques.—(1) I have an aerial composed of three strands of antenium wire, 57 feet in length and 50 feet in height, the wires being spaced 1½ feet apart. The lead-in is 20 feet in length. What is the approximate capacity of this aerial?

Ans.—(1) The natural wave-length is approximately 195 meters and the capacity about .00025 microfarad.

Ques.—(2) I have an E. I. Company, Jr., tuning coil which has metal bars for supporting the windings. Do these bars deduct from the efficiency of the set?

Ans.—(2) No.

* * *

W. J., Jr., Louisville, Ky., inquires:

Ques.—(1) What is the natural wave-length of a 2-wire aerial, 125 feet in length, 50 feet in height, with a lead-in of 35 feet?

Ans.—(1) The fundamental wave-length is approximately 330 meters.

Ques.—(2) Which is the more efficient, a 4-stranded antenium wire or a 1-strand copper wire, for receiving purposes?

Ans.—(2) We do not understand whether you refer to an antenna comprising 4 wires as compared with one containing a single wire or whether the antenna wire is made up of four twisted strands. Good results can be obtained on a single wire aerial in receiving, but most amateurs prefer a 2 or 4-wire equipment.

Ques.—(3) How can the aerial mentioned in my first query be reduced to the wave-length of 200 meters without decreasing the dimensions?

Ans.—(3)) A short wave condenser will not reduce the natural wave-length of this system to 200 meters and consequently you had better cut down the flat top portion to a length of 110 feet and afterward attach the lead-in wires to the center.

Ques.—(4) Please give the dimensions for a ¼ k.w. open core transformer.

Ans.—(4) The core should be 16 inches in length, 2 inches in diameter composed of a bundle of soft iron wires. The primary winding contains two layers of No. 14 double cotton covered B & S gauge magnet wire. The winding is 14 inches in length and is insulated from the secondary winding by Empire cloth of several thicknesses.

The secondary winding comprises ten sections, each of which is 5½ inches in diameter and 1¼ inches in thickness, and is wound with No. 30 or No. 32 single silk covered wire. The various sections should be separated by fibre or micanite washers to prevent sparking between them. This transformer is preferably immersed in oil.

Ques.—(5) Please give a description and the dimensions of a condenser for a ¼ k.w. transformer.

Ans.—(5) For the wave-length of 200 meters, the capacity cannot exceed .008 microfarad. Eight plates of glass 14 inches by 14 inches, covered with tinfoil, 12 inches by 12 inches, the glass being ⅛ of an inch in thickness, will give about the required value of capacity. Four plates should be connected in parallel in each bank and two banks finally connected in series.

* * *

J. F. D., New York City, inquires:

Ques.—(1) What is the approximate wave-length of an aerial composed of a single strand, of No. 14 phosphor bronze wire, 1,000 feet in length, 150 feet in height at one end and sloping down to 80 feet at the lower end, with a lead-in of 25 feet?

Ans.—(1) The wave-length is approximately 1,500 meters.

Ques.—(2) If this aerial were increased to two wires instead of one, what would be the change in wave-length?

Ans.—(2) It would have but a slight effect on the wave, probably increasing it by about 75 meters.

Ques.—(3) Approximately what is the possible wave-length adjustment with an inductively-coupled receiving tuner the primary winding of which is 6 inches in length and 5¼ inches in diameter, wound with No. 28 single silk covered wire. The secondary is 6 inches in length and 4½ inches in diameter, wound with No. 32 single silk covered wire.

Ans.—(3) Shunted by the proper values of capacity at the secondary winding, this tuner will easily respond to 5,000 meters.

Regarding the latter part of this query (not published): We cannot give any data on the possible wave-length adjustment without a more complete description of the loading coil referred to.

Ans.—(4) We cannot calculate the possible receiving range of a complicated set of the type you mention, but with it you should hear stations employing wave-lengths in excess of 1,000 meters on the Atlantic coast.

Ques.—(5) Would it be possible to receive Nauen, Germany, Sayville, and Tuckerton with a tikker detector in connection with a crystaloi type AA detector with the aerials and apparatus referred to?

Ans.—(5) It would be rather difficult to receive signals from foreign stations on a tikker; in fact, we know of no station which has performed this feat over a continuous period.

Ques.—(6) Is there such a device on the market as a ½ k.w. transformer coil operated by dry cells or storage batteries, and if so, where can one be purchased?

Ans.—(6) A ½ k.w. coil is manufactured by the E. I. Company, New York City, but it is made to function on 110 volts direct current. Induction coils consuming approximately 300 watts and giving a 10-inch spark discharge are on sale by the Marconi Wireless Telegraph Company of America, 233 Broadway, New York City.

The only stations we know of that employ long wave-lengths are the Marconi stations at Glace Bay, N. S., and Bolinas, Cal. You of course are aware that the Arlington station has a 100 k.w. spark set that operates at the wave-length of 2,500 meters.

The fundamental wave-length of your 85-foot flat top aerial approximates 260. When connected to the receiving apparatus you describe it should permit the reception of signals from stations located throughout the Atlantic Coast.

* * *

T. P., Brooklyn, N. Y.:

The Brown amplifying relay is fully described in the "Text Book of Wireless Telegraphy" by Rupert Stanley, a copy of which can be obtained from the Marconi Publishing Corporation, No. 450 Fourth Avenue, New York City.

Regarding your last query: Certain types of used apparatus can be purchased from the Marconi Wireless Telegraph Company of America and all inquiries concerning it should be directed to the Traffic Department of the company No. 233 Broadway, New York City.

* * *

G. G. G., Whiting, Ia.:

The only method by which you can get rid of the inductive noises from the telephone line lying parallel to your aerial is to change the position of the antenna and, if possible, place it at a right angle to the telephone line.

The apparatus you have described should permit the reception of signals from local amateur stations and from certain commercial stations located in the Great Lakes district during the night hours.

* * *

F. B. W., Elgin, Ills., writes:

Ques.—On page 608 of the June, 1916, issue of The Wireless Age it is stated: "A multi-layered loading coil, regardless of the radio frequency of the circuit in which it is to be used, is not practical. A high frequency current will not traverse turns of a multi-layered winding." We question the correctness of this statement in view of the fact that at present we are using multi-layered loading coils in both the primary and secondary circuits. Our primary and secondary transformer coils are also multi-layered and by the use of these coils in a vacuum valve circuit for the reception of undamped waves, we have obtaned very satisfactory results, having no difficulty in picking up OUI, KSS, NPL, NBA and other distant stations using undamped waves."

Ans.—The statement published in The Wireless Age holds good, for a multi-layered winding in which the adjacent layers are separated by the thickness of a piece of paper. Multi-layered windings are entirely practical when the adjacent layers are separated by about a half inch and will give practically the same results as a very long coil with a single layer.

* * *

E. W. E., Red Bluff, Cal., inquires:

Ques.—(1) I desire to erect the most efficient possible aerial to have a fundamental wave-length of 160 meters and would like to have you give the correct dimensions, including the height of the mast, the length of the flat top portion, the number of wires, spacing, etc.

Ans.—(1) The flat top portion should consist of 4 wires spaced 3 feet apart, and should be 40 feet in length and 50 feet in height. The lead-in wires should be attached to one end of the flat top portion. The fundamental wave-length of this aerial will be about 163 meters.

Ques.—(2) Is not a slanting aerial more efficient than one of a flat top type?

Ans.—(2) Not necessarily. We are inclined to believe that a flat top aerial of the usual construction will give the best results.

Ques.—(3) In which direction should this aerial point in order that the major portion of the energy may be sent in one direction?

Ans.—(3) Have the free end of the flat top portion point in the direction opposite to that of the distant receiving station.

Ques.—(4) Which is the better conductor for wireless work, a seven-strand bronze cable consisting of No. 22 wire, a No. 14 copper clad wire or a No. 14 solid copper wire?

Ans.—(4) We would have to know the specific resistance of each wire to answer the question intelligently, but if the aerial system comprises at least four wires, practically equal results will be obtained with either of the three types mentioned. Seven-strand bronze cable is used in commercial work with success.

Ques.—(5) How much aerial insulation is required to hold the potential of a 1 k.w. Thordarsen transformer?

Ans.—(5) The free end of the antenna system must have the better insulation. In commercial apparatus hard rubber insulators 2 feet in length are employed at this end of the antenna.

* * *

R. W. P., Caro, Mich.:

Ques.—(1) Please state the natural wave-length of a four-wire aerial 120 feet in length and 45 feet in height.

Ans.—(1) Approximately 300 meters.

Ques.—(2) What should be the sending range of a ½ k.w. open core transformer when used in connection with this antenna?

Ans.—(2) From 40 to 100 miles in daylight and perhaps several hundred miles after dark.

Ques.—(3) I noted this spring that whenever I have been able to see the Northern lights from my station signals from the government station at Arlington seemed to come louder, but owing to the low grumbling noise I hear at this period I find that the signals from Arlington are very hard to read. I would like to know if other readers of your excellent magazine have observed this phenomenon.

Ans.—(3) We have received no reports from other sources concerning this phenomenon, but actual data would be of great interest to the radio field at large.

Ques.—(4) Now and then I hear a certain station making the test letter "V." This letter is usually made for two or three minutes with sometimes a pause for intervals of ten or fifteen minutes. Will you please advise if this is the call of the station or what the signal means?

Ans.—(4) It is simply a test letter for placing two stations in resonance and is probably used by radio inspectors in your district or possibly Canadian stations of the Great Lakes District.

Ques.—(5) Would two different aerials fastened to the same mast, but placed at right angles to each other, work as well as if they were placed further apart?

Ans.—(5) Yes, practically so.

* * *

A. L. B., Danvers, Mass., inquires:

Ques.—(1) What is the wave-length of a two-wire aerial 105 feet in length, spaced 10 feet apart, placed 35 feet above the earth?

Ans.—(1) Approximately 240 meters.

Ques.—(2) What is the wave-length of an aerial composed of a single wire of No. 16 composition, 225 feet in length, 40 feet in height at one end and 35 feet at the other?

Ans.—(2) The natural wave-length is close to 375 meters.

Ques.—(3) If these aerials are constructed of No. 14 copper wire instead of No. 16 composition wire, would there be much difference in the receiving range, and if so, how would it be affected?

Ans.—(3) The copper wire is undoubtedly a better conductor of high frequency current than the composition wire and should give better results, but just how much is difficult to state.

Ques.—(4) Will a receiving transformer having a primary winding 4 inches in diameter, 6 inches in length, wound with No. 22 S. C. C. and a secondary winding 5½ inches in length by 3½ inches in diameter, wound with No. 30 S. C. C. wire, be efficient for the reception of Arlington time signals? Is a loading coil required? If so, what should be the dimensions? The receiving detector is of silicon. The head telephones have a resistance of 2,000 ohms and are shunted by a small fixed condenser.

Ans.—(4) This tuner should respond to the time signals from Arlington if a small variable condenser is connected in shunt to the secondary winding. If the primary winding were made of No. 24 wire it would respond to the time signals of Arlington with the aerial having the longer natural period without the use of a loading coil. At the most, the loading coil need not be more than 4 inches in diameter by about 4 inches in length wound with a couple of hundred turns of No. 22 wire.

Ans.—(5) Since we do not know the composition of this wire or its relative tensile strength, we cannot compare it with hard or soft drawn copper. This is a matter that you should take up with the manufacturers of the wire.

Ans.—(6) You should hear stations throughout the Atlantic coast during the night hours.

* * *

W. S. M., Farmington, Ill.:

Your four-wire aerial, 50 feet in length, 45 feet in height at one end and 25 feet in height at the other, has a fundamental wave-length of approximately 170 meters, which is quite the correct value for communicating at the amateur wave-length of 200 meters, for the reception of signals from Lake Bluff, Ill., and Arlington; however, you should erect an aerial of increased dimensions, say 200 or 300 feet in length. The receiving tuner you describe has a probable wave-length adjustment of about 2,500 meters and hence is not satisfactory for the reception of signals from the Lake Bluff station which operates at the wave-length of 6,000 meters. The diagram of connections for the receiving apparatus which you enclosed is not correct. There is no fixed condenser in the secondary circuit of the receiving tuner. The variable condenser should be connected in shunt to the secondary winding. In your circuits the loading coil should be connected in series with the secondary winding in order to keep that circuit in resonance with the antenna system which already possesses a loading coil according to your diagram.

As we understand from the description, you support your aerial by means of an iron pipe mast which is fastened in a socket on the window-sill. And in order to protect it from lightning you have placed a copper wire through the pipe with about 1 foot extending above the upper end. The ground wire then continues to the earth without being insulated from the building or the pipe at the window-sill.

It is customary to insulate an earth connection, even a lightning rod, from the building which supports it; consequently you would do well to fasten this earth wire on large glass insulators such as are used for the better class of telephone work or for high tension transmission lines. We do not see any necessity for connecting the iron pipe mast to the copper wire, provided the copper wire is at least No. 4. The underwriters require that the earth wire be capable of carrying a current of about 100 amperes.

It will aid you in your problems to purchase a copy of the book "How to Conduct a Radio Club," which gives a complete set of diagrams for receiving apparatus; also note the article on Receiving Tuners for A Definite Range of Wave-Lengths in the May, 1916, of the series "How to Conduct a Radio Club."

* * *

O. N., Washington, D C., inquires:

Ques.—(1) What is the range of wave-lengths of a receiving tuner having the following dimensions: The primary winding is 9¾ inches in length, 4¼ inches in diameter, wound full with No. 24 D. S. C. wire. The secondary winding is 9¾ inches in length, 3⅝ inches in diameter, wound full with No. 34 S. S. C. wire. A condenser of .0001 microfarad capacity is to be connected across the secondary winding, and the receiving tuner is to be employed in connection with a vacuum valve detector. Dead-end switches are also provided.

Ans.—(1) With a condenser of the value stated, in shunt to the secondary winding, the circuit is responsive to a wave-length of 3,600 meters. With a condenser of .001 microfarad this winding will respond to a wave-length close to 10,000 meters.

Ques.—(2) What is the wave-length of an aerial 175 feet in length, with an average height of 55 feet? It is composed of two wires of the inverted L type. The lead-in wire is 16 feet in length.

Ans.—(2) The capacitance of this aerial is about .006 microfarad, and the inductance approximately 80 000 centimeters. The natural wave-length is therefore about 415 meters, and if the primary winding described in your first query is connected in series therewith the antenna circuit will have a possible adjustment of about 3,800 meters.

Ques.—(3) With the receiving transformer described in your first query, fitted with a proper primary and secondary loading coil and a condenser of .001 microfarad connected across the secondary winding and a variable condenser of .0005 microfarad in series with the grid of the vacuum valve, how far should I be able to receive undamped wave stations, provided I use the Armstrong hook-up?

Ans.—(3) You should hear undamped wave stations at a distance of ?,000 miles.

Ques.—(4) How far could I receive spark stations cutting out the loading coil?

Ans.—(4) You should hear ship stations at a distance of 600 or 700 miles and the shore stations at perhaps a greater distance during the daylight hours.

Ques.—(5) I wish to receive arc stations using wave-lengths up to 10 000 meters. With the set described in the foregoing, what should be the dimensions for the primary and secondary loading coils and the size of wire?

Ans.—(5) We advise you to construct a primary and secondary loading coil, also the complete tuner, after the diagram given in the book "How to Conduct a Radio Club." The secondary loading coil may, if desired, be wound with No. 36 wire, but the primary loading coil should have No. 22 S. S. C. wire.

Ques.—(6) Could I receive Nauen, Germany, at night time with the set referred to by the use of a single wire aerial 252 feet in length with an average height of 40 feet in place of the aerial described in my second query? Or would it be advisable to use both aerials?

Ans.—(6) Provided your apparatus is in correct adjustment throughout and is thoroughly understood by the manipulator you should hear the signals from Nauen during the night hours by means of a single vacuum valve. The signals however, will be weak and can only be read at periods when the atmospheric electricity is at a minimum.

* * *

A. C. Y., Buffalo, N. Y., asks:

Ques.—(1) Which style rotary gap do you think the most efficient for long distance transmission on the 200-meter wave with a ¼ k.w. set?

Ans.—(1) A gap of ordinary construction, giving about 240 spark discharges per second, will give the best results. A disc 8 or 10 inches in diameter fitted with from ten to twelve electrodes and revolved at a speed varying from 1,800 to 2,400 revolutions per minute, will give a clear spark note and a fair value of current in the antenna circuit.

Ques.—(2) Does the Delaware, Lackawanna & Western Railroad still make use of the wireless system aboard trains?

Ans.—(2) All radio equipment of this company is still in use for auxiliary purposes.

Ques.—(3) Does increasing the height of an antenna raise the wave-length or increase the strength of signals and allow a further distance to be covered or does it affect both factors?

Ans.—(3) An increase of height will increase the wave-length and also the distance that can be covered, provided the wave-length desired is not exceeded in increasing the height.

Ques.—(4) In receiving over long distances from the spark station would better results be obtained by employing an "audiotson bulb" connected to a galena detector as an amplifier than by using the bulb singly?

Ans.—(4) Probably not, but the entire apparatus in connection with the crystalline detector, particularly if carborundum were used, might prove more stable during heavy static. Results of the experimental tests from these circuits seem to vary, some experimenters preferring the crystal-bulb combination, others desiring to record the signals directly on the single vacuum valve. You might do well, however, to construct a high voltage battery like that described in the October, 1916, issue of this magazine.

* * *

D. L. C., Binghamton, N. Y., inquires:

Ques.—(1) Please give the correct dimensions for an 8-inch spark coil.

Ans.—(1) The core of this spark coil should be 14 inches in length by 1½ inches in diameter, composed of a bundle of rather fine iron wire wrapped with three layers of empire cloth and then wound with about 325 turns of No. 14 B. & S. D. C. C. wire. The complete primary winding is covered with a micanite tube ⅛ to 3/16 of an inch in thickness. The secondary winding requires eight pounds of No. 36 wire which is split up into eight sections. The complete winding is approximately 8 inches in diameter and the length, about 8 or 8½ inches. The primary condenser should have about 9,000 square inches of foil. Paraffine can be used as the dielectric medium for the sheets of foil.

Ques.—(2) Can you give me the names of any books on the construction of the vacuum valve detector and amplifier?

Ans.—(2) There are no books devoted exclusively to the subject, but the circuits are described in the "Proceedings of the Institute of Radio Engineers," issued in September, 1915.

The book entitled "How to Conduct a Radio Club," on sale by the Marconi Publishing Corporation, describes amplifiers and long distance receiving sets.

* * *

S. B., Marine City, Mich.:

"Ferron" is the trade name for crystals of iron pyrites.

Your aerial, 100 feet in length, with an average height of 45 feet, has a natural wavelength of about 270 meters. It is rather long for operation at a wave-length of 200 meters, but, of course, it may be reduced by a series condenser. It is somewhat difficult to estimate the range of your receiving apparatus, but it may be possible during the nighttime and during the favorable months of the year for you to receive signals from stations on the Atlantic coast. You should hear the Great Lakes stations, of course, in your immediate vicinity, with considerable strength.

Under the average conditions you cannot expect to communicate more than ten or fifteen miles with a 1½-inch spark coil.

* * *

W. E. P. N., Pittsburg, Pa., writes as follows:

Ques.—While working my receiving set recently I heated my bulb on a vacuum valve detector by simply holding a lighted match under the bulb and slowly revolving the match so as not to crack the bulb. I was greatly surprised to hear the stations come in at nearly double the strength. Can you give me a reason for this? The same result apparently is obtained every time I apply a lighted match to the bulb. Anyone who has not experimented in the manner described will be astonished at the results.

Ans.—This is an old-time method of increasing the sensitiveness of the vacuum valve and has been employed for many years. In fact, it has been discussed several times in the columns of The Wireless Age. When the vacuum valve bulb was heated the glass became porous and air was admitted lowering the vacuum. You thus secured an increase in the strength of signals because there was insufficient voltage at the high voltage battery to overcome the degree of vacuum. If there had been sufficient voltage in the high voltage battery you would have obtained the same results without heating the bulb.

* * *

G. C. C., New Rochelle, N. Y.:

For the measurement of the overall efficiency of a radio telegraph set, particularly the efficiency of the oscillation generator, you are referred to pages 217, 218, 219, 220, 221, 222 and 223 of the book, "Wireless Telegraphists' Pocketbook of Notes, Formulae and Calculations," by J. A. Fleming, on sale by the Marconi Publishing Corporation. The subject is discussed fully and you can calculate the comparative efficiency of the closed oscillatory circuit so compared with the energy supplied to the primary winding of the power transformer by means of the instructions given.

Ques.—(3) In a 1 kw. transmitter, taking 1,000 watts at the primary winding of the transformer, approximately how many watts could be expected to flow in the closed oscillatory circuit provided the capacity, the frequency and the voltage were so proportioned as to get an average practical efficiency?

Ans.—(3) From fifty to seventy per cent. of the energy supplied to the transformer flows in the closed oscillatory circuit of a well-designed quenched spark transmitter. Ordinary spark transmitters of other designs represent a lesser value of efficiency.

Ques.—(4) I desire to replace an aerial with one of another type. The new aerial, consisting of four wires, spaced 3 feet apart on 9-foot spreaders, will be 100 feet in height at one end and 45 feet at the other. The lead-in wires are taken off 60 feet from the highest end and come directly to the instruments which are 14 feet above the ground level. What should be the flat top length of this aerial to have the natural period of 350 meters?

Ans.—(4) The length of the flat top portion should be approximately 180 feet.

Ques.—(5) If three wires were used on the aerial referred to, spaced 4 feet apart, what would the length of the flat top portion need to be to have the wave-length of 350 meters?

Ans.—(5) This change in the spacing of the wires would have little effect upon the natural period. The dimensions would be approximately the same.

Price 15 Cents

January, 1917

THE WIRELESS AGE

MARCONI STATION IN HAWAII CONNECTING JAPAN WITH THE U. S.

THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

JANUARY, 1917

The New Radio Legislation

Full Details of the Bill Drafted for Presentation to Congress and a Report of the Discussion at the First Informal Conference Recently Held in Washington

IMPENDING changes in the present laws governing radio communication, which have been the subject of rumor and conjecture, were given tangible form about the middle of November, when the Inter-Departmental Committee on Radio Legislation presented for discussion the draft of a bill which it is proposed to have introduced in the present session of Congress.

An informal discussion was arranged for at the Department of Commerce building in Washington, on November 21. Among those present in person were E. J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company. John Bottomley, vice-president, secretary and treasurer, and Roy A. Weagant, chief engineer of the Marconi Company, David Sarnoff, representing the Institute of Radio Engineers, and other representatives of commercial companies and the Radio Club of America. Professor Arthur E. Kennelly, of Harvard, president of the Institute, and Professor Alfred N. Goldsmith, of the College of the City of New York, stated in communications their views of the proposed legislation, their observations being of particular interest to amateurs, as both of these men are vice-presidents of the National Amateur Wireless Association.

The general trend of the discussion disclosed the feeling that in this bill was evident a distinct spirit of hostility toward existing wireless organizations. Criticism was leveled at the proposal to confer power upon Government departments to compete with commercial stations operated by American citizens, and at the same time dictate the terms of regulation. It was asserted that the quickest way to stifle inventive effort would be to permit Government competition or confiscation to destroy the market for private enterprise; furthermore, that this was an unpatriotic action, since it is perfectly obvious that encouragement and aid should be given to promote invention and improvement in the art, so that the United States should have the best obtainable system in time of need.

Proposals to restrict the operation of commercial stations in time of peace and to impose handicaps which would prohibit profitable operation of these stations were unanimously opposed by all representatives at the meeting. The draft of the bill follows:

An Act to Regulate Radio Communication

Sec. 1. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That wherever used in this Act the term "radio communication" shall be construed to mean communication by any system or method of electrical communication without the aid of wire or other conducting connection; the word "apparatus" to mean machines, devices, and all other equipment used in radio communication; the words "transmitter" and "receiver" to mean the sending and receiving apparatus, respectively, used in radio communication; the word "radiogram" to mean any message, communication, or signal, transmitted or received in radio communication; the term "radio station" to mean a place where apparatus is used for transmitting, or for transmitting and receiving, the signals used in radio communication; the term "Government land station" to mean any radio station on land, or on a permanently moored vessel, controlled and operated by any department of the Government; the term "Government ship station" to mean a radio station on any ship of the Government controlled and operated by any department of the Government and not permanently moored; and the term "Territory of the United States" or the word "Territory" to mean any Territory, District, Zone, insular possession, water, or other place subject to the jurisdiction of the United States, and not within any State.

The word "person" as used in this Act shall be construed to import both the plural and the singular and to include a corporation, co-partnership, company, or association; and when construing and enforcing the provisions of this Act, the act, omission, or failure of any director, officer, agent, or employee of such corporation, co-partnership, company, or association acting within the scope of his employment or office shall in every case be deemed to be the act, omission, or failure of such corporation, co-partnership, company, or association, as well as that of the person acting for or on behalf thereof.

Sec. 2. Radio stations are divided for the purposes of this Act into the following classes:

1.—Coastal station, a station on land or on a permanently moored vessel used for the exchange of correspondence with ships at set. Coastal stations include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Coastal stations of class (b) transmit and receive public messages to and from certain stations only, which are designated in the license.

2.—Station on shipboard, a station on board any vessel not permanently moored. Stations on shipboard include (a) those open to general public correspondence, and (b) those open to limited public correspondence. Ship stations of class (b) transmit and receive public messages to and from certain stations only, which are designated in the license.

3.—Commercial station, a land station used in the transaction of commercial business and not used for the exchange of correspondence with ships at sea. Commercial stations include (a) those open to limited public correspondence, (b) limited commercial stations, (c) special stations for transoceanic or transcontinental communication. Commercial stations of class (a) transmit and receive public messages to and from certain stations only, which are designated in the license. Limited commercial stations (class b) are stations of private interest, and carry on a specific commercial service or services defined in the license; they do not transmit public messages to, or receive them from, other stations. Special stations of class (c) are open to limited public correspondence or not, as stated in the license.

4.—Experimental station, a land station of private interest actually engaged in conducting experiments for the development of the science of radio communication or the apparatus pertaining thereto.

5.—Technical and training-school station, a land or ship station of private interest used for purposes of instruction in radio communication and training operators.

6.—Amateur station, a land station of private interest not covered by (3), (4) or (5) of this section, and not operated for financial profit. Amateur stations include (a) general amateur stations, (b) restricted amateur stations, which are within five nautical miles of a Government station, (c) special amateur stations, the operation of which seems likely to result in some substantial benefit to radio communication.

7.—Government station, a station controlled and operated by any department of the Government.

Sec. 3. Nothing in this Act shall be construed to apply to the transmission or exchange of radiograms or signals between points in the same State, if said transmission or exchange shall not interfere with the reception of radiograms or signals from beyond the jurisdiction of the said State, or the effect thereof shall not extend beyond said jurisdiction.

Sec. 4. No radio station other than those belonging to or operated by the United States shall be used by any person within the jurisdiction of the United States to transmit any radiogram by the apparatus and methods of radio communication, except under and in accordance with a station license issued by the Secretary of Commerce. Any person who shall operate any radio station in violation of this Section shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; and any radio apparatus operated in violation of this Section shall be subject to forfeiture.

Authority to Fix Commercial Message Rates.

Sec. 5. The Secretary of Commerce shall fix the rates charged by all licensed stations open to public correspondence.

The heads of Government departments having jurisdiction over Government land stations and Government ship stations shall, in their discretion, so far as it may be consistent with the transaction of Government business, open service, to such general public business, and shall fix the rates for such service, subject to the control of such rates by Congress. Such executive heads shall arrange, each in his own department, and for stations under his own jurisdiction, for the transmission and receipt of commercial radiograms between land stations and vessels at sea, between land stations and licensed radio stations within the United States or any territory thereof, and between land stations and radio stations under foreign jurisdiction, under the provisions of the London Convention of nineteen hundred and twelve and future international conventions or treaties to which the United States may be a party. The receipts from such radiograms, less an amount not to exceed twenty-five per cent. per annum for the necessary expenses of each department for the handling of such commercial business, shall be turned into the Treasury as miscellaneous receipts.

No radio station other than that belonging to or operated by the United States, or by the Government of the Philippine Islands, shall be operated on land or on a permanently moored vessel in the Canal Zone, or in the Philippine Islands, or in any territory of the United States in the West India Islands other than Porto Rico, or in the Pacific Ocean west of the one hundred and sixty-first meridian of longitude west of Greenwich and South of the fortieth parallel of north latitude.

Every Government land station and Government ship station shall have special call letters which shall be designated and published by the Department of Commerce in a list of radio stations of the United States.

Sec. 6. After three months from the passage of this Act and at any time within five years after the expiration of said three months, but not longer, the Government through the Navy Department shall have authority to acquire by purchase at a reasonable valuation any coastal radio station now in operation in the United States which the owner may desire to sell.

Sec. 7. The station license required by Section 4 hereof shall not be granted to any alien, nor to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country; and a license shall become void if ownership or management of the station or apparatus shall be transferred to any alien, or to any company, corporation, or association of which any officer or more than one-third of the directors are aliens or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof or by any company, corporation, or association organized under the laws of a foreign country.

A license shall not be granted if, in the opinion of the Secretary of Commerce, the operation of the proposed station will seriously interfere with the operation of existing Government or licensed stations in the vicinity.

Government to Determine Type of Apparatus Which May Be Installed.

Sec. 8. The station license prescribed by Section 4 hereof shall be issued only in response to a written application therefor, addressed to the Secretary of Commerce, which shall set forth the following facts:

1. The name and address of the applicant, the date and place of birth, and, if naturalized, the date and place of naturalization.

2. If the applicant is a corporation, the date of incorporation and under what laws incorporated, the principal place of business of the corporation, the names and addresses of the officers and directors, a statement as to each officer specifying his place of birth and the country of which he is a citizen, and, if a naturalized citizen of the United States, the date and place of naturalization, and a statement showing what proportion of the capital stock is owned or controlled by aliens, by foreign governments or representatives thereof, and by companies, corporations, or associations organized under the laws of any foreign country.

3. The ownership of the station and apparatus.

4. The exact location of the station.

5. The stations with which it is proposed to communicate.

6. The purpose or purposes for which the station is to be used.

7. The wave-length or wave-lengths which it is proposed to use at the station and the period or periods of the day during which it is proposed to operate the station.

8. The proposed rate to be charged per word.

9. Such further information as the Secretary of Commerce may, by regulation, prescribe.

Every application shall be signed by the applicant upon oath or affirmation. If the applicant is a corporation, the application shall be signed upon oath or affirmation by at least two officers thereof.

The Secretary of Commerce may upon request determine in advance of the erection of a radio station, on the basis of an application substantially conforming to the requirements of this Section, whether the apparatus to be installed in such station will be licensed upon completion of such station, and upon what condition such license will be granted.

Whoever shall knowingly make any untrue statement in the application for a license prescribed by this Section, shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars, or by imprisonment for not more than five years or both.

Giving the President Power of Seizure in Time of Peace.

Sec. 9. Station licenses shall be in such form as the Secretary of Commerce shall prescribe and shall contain a statement of the following conditions to which such licenses shall be subject:

1. The station shall at all times be subject to inspection by officials of the Department of Commerce; and the President of the United States, in his discretion, may cause the closing of such station and the removal of all radio apparatus, or may authorize the use of the station or apparatus by any department of the Government upon just compensation to the owners, as provided in Section 14 (b) of this Act.

2. The ownership or management of the station or apparatus therein shall not change without the consent of the Secretary of Commerce, nor be transferred to an alien or aliens, nor to any foreign government or representative thereof, nor to any company, corporation, or association organized under the laws of a foreign country, or of which any officer, or more than one-third of the directors, are aliens, or of which more than one-third of the capital stock is owned or controlled by aliens or by a foreign government or representative thereof, or by a company, corporation, or association organized under the laws of a foreign country. The ownership or control of more than one-third of the capital stock of any company, corporation, or association to which a station license has been issued shall not be transferred during the term of the license to an alien or aliens, or to a foreign government or representative thereof, or to any company, corporation, or association organized under the laws of a foreign country. No company, corporation or association to which a station license has been issued shall thereafter during the term of the license have any officer who is an alien.

3. The rates to be charged shall be

as fixed by the Secretary of Commerce, and shall be specified in the license.

4. Apparatus other than that specified in the license shall not be used for radio communication.

5. Every licensed radio station open to general public correspondence shall be bound to exchange radiograms with any other such station without distinction of the radio systems adopted.

Such license shall also show specifically the ownership and location of the station in which the apparatus is to be used and such other particulars as the Secretary of Commerce may deem necessary for the identification of the apparatus and to enable its range to be estimated, shall show the purpose of the station, the rates authorized by the license, the wave-length or wave-lengths and the decrement or decrements authorized for use by the station, and the hours for which the station is licensed to work.

Sec. 10. Any station license shall be revocable by the Secretary of Commerce, in his discretion, for violation of or failure to observe any of the restrictions and conditions mentioned in the preceding section, or other provision of this Act or regulation of the Secretary of Commerce, and the books and records of the licensee shall be open at all times to inspection by officials of the Department of Commerce to enable them to determine whether such violation or failure to observe has occurred.

Sec. 11. Every radio station for which a station license is required by this Act shall be in charge of or under the supervision of a person to whom an operator's license shall have been issued hereunder. No person shall operate any such station except under and in accordance with an operator's license issued to him by the Secretary of Commerce. The Secretary of Commerce, in his discretion, may grant special temporary licenses to operators of radio apparatus when any emergency arises requiring the prompt employment of such an operator. Whoever shall employ any unlicensed person in the operation or supervision of any licensed radio station, or whoever without an operator's license shall operate or supervise such a station, shall be punished by a fine not exceeding one hundred dollars for the first offense, and by a fine not exceeding two hundred dollars or imprisonment for not more than two years, or both, for each offense thereafter.

Sec. 12. An operator's license shall be issued only in response to a written application therefor addressed to the Secretary of Commerce, which shall set forth the name, age, and address of the applicant, date and place of birth, the country of which he is a citizen, and if a naturalized citizen of the United States the date and place of naturalization. The application shall also state the previous experience of applicant in operating radio apparatus and such further facts or information as may be required by the Secretary of Commerce. Every application shall be signed by the applicant upon oath or affirmation. An operator's license shall be issued only to a person who, in the judgment of the Secretary of Commerce, is shown to be proficient in the use and operation of radio apparatus and in the transmission and receipt of radiograms. An operator's license shall not be granted to any alien or representative of a foreign government. Whoever shall knowingly make any untrue statement in an application for an operator's license shall be guilty of perjury and shall be punished by a fine not exceeding two thousand dollars or by imprisonment for not more than five years, or both.

Suspension of Licenses

Sec. 13. An operator's license shall be in such form as the Secretary of Commerce shall prescribe, and may be suspended by the Secretary of Commerce for a period not exceeding one year, upon proof sufficient to satisfy him that the licensee has violated any provision of this Act or regulation of the Secretary of Commerce, or that he has failed to compel compliance therewith by an unlicensed person in his employ or under his supervision, or the license may be revoked by the Secretary of Commerce upon proof sufficient to satisfy him that the licensee was or is ineligible for a license.

Censorship, Interference and Disclosure of Messages

Sec. 14. (a) Radio stations licensed under the provisions of this Act shall at all times be subject to inspection by officials of the Department of Commerce. During any war in which the United States shall be a neutral nation, and in time of threatened or actual war in which the United States may be a party, and in time of public peril or disaster, the President may, by proclamation or Executive Order, issue regulations for the conduct and censorship of all radio stations and radio apparatus of every form and nature within the jurisdiction of the United States. Any person who shall knowingly violate or fail to observe any of said regulations shall be punished by a fine not exceeding ten thousand dollars or by a term of imprisonment of not more than three years or both; and in case of any such violation or failure to observe any of said regulations, the radio station, or apparatus, or both, shall be liable to forfeiture to the United States.

(b) The President, further, in his discretion, may cause the temporary closing of any radio station within the jurisdiction of the United States and the temporary removal therefrom of any radio apparatus for a period or periods of not more than five months each, or may authorize the temporary use of the station or the apparatus thereof by any department of the Government for a like period or periods upon just compensation to the owners.

Sec. 15. (a) Whoever shall maliciously or wilfully interfere with or cause any interference with radio communication carried on or sought to be carried on by any radio station or apparatus shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, for each offense thereafter.

(b) Whoever shall wilfully divulge or publish the contents, substance, purport, effect or meaning of any radiogram, or any part thereof, to any person other than the sender or addressee thereof, or his agent or attorney, except to a telegraph or radio station employed to forward such radiogram to its destination, or in response to a subpoena issued by a court of competent jurisdiction, or on demand of other competent authority, shall be punished by a fine not exceeding five hundred dollars for the first offense, and by a fine not exceeding one thousand dollars, or imprisonment for not more than one year, or both, for each offense thereafter; provided, that this section shall not apply to the divulging or publication of the contents of any radiogram by the sender or addressee thereof.

Sec. 16. All stations shall give priority over all other radiograms to radiograms relating to ships in distress, shall discontinue all sending on hearing a distress signal, and, except when answering or aiding a ship in distress, shall refrain from sending until all radiograms relating to the ship or ships in distress shall have been completed.

Every coastal station and every station whose operation can interfere with the exchange of messages between ship and ship, or ship and coast is required, during the hours it is in operation, to listen in at intervals of not less than 15 minutes, and for a period of not less than 3 minutes, with the receiver tuned to receive messages on a wave length of 600 meters, or such other normal wave-length as may be required by future international conventions.

Logarithmic Decrement Limitation

Sec. 17. When sending distress signals, the transmitter of a station on shipboard may be tuned to create a maximum of interference with a maximum of radiation. In all other circumstances, all stations shall use the minimum amount of energy necessary to complete any communication.

Every radio station shall use such transmitting apparatus that the energy is radiated in as pure and sharp a wave as practicable, and have a logarithmic decrement not greater than the limits which may be specified by the Department of Commerce, but the owner or operator of a station mentioned in Section 18 following shall not be liable to the penalties provided in Section 28 for a violation of the requirements of this paragraph unless such owner or operator shall have been notified in writing that the transmitter owned or used by him has been found, upon tests conducted by the Government, to be so adjusted as to violate said requirements, and opportunity given such owner or operator to adjust such transmitter so as to conform to said requirements.

Receiving apparatus shall be of such construction and so adjusted and used as to give the greatest practicable protection against interference.

Sec. 18. General amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one kilowatt.

Restricted amateur stations shall not use a transmitting wave-length exceeding 200 meters or a transformer input exceeding one-half kilowatt.

Special amateur stations are permitted to use any wave-length less than 600 meters and an amount of power not exceeding the limit which shall be specified in the license, provided the Secretary of Commerce is satisfied that such operation would not interfere with Government, commercial, coastal, or ship stations.

Sec. 19. The Secretary of Commerce may, in his discretion, grant licenses to experiment stations to permit the carrying on of tests with any amount of power or any wave-lengths, at such hours and under such conditions as will insure the least interference with the work of other stations.

Wave Length Restrictions.

Sec. 20. Commercial stations and technical and training-school stations shall not use a transmitting wave-length of 1800 meters nor any wave-length exceeding 600 meters unless it exceeds 1600 meters, except in special cases to be determined by the Secretary of Commerce. Such a station shall operate in such a manner as not to cause interference with Government stations or other commercial stations. Such a station shall not use any wave-length between 200 and 600 meters if operation at such a wave-length would, in the opinion of the Secretary of Commerce, cause interference with coastal or ship stations.

After the passage of this Act no license shall be granted to a commercial station permitting the use of a wave-length between 200 and 4000 meters, except when so far removed from Government or coastal stations that in the opinion of the Secretary of Commerce no interference can occur with Government or coastal communications.

In considering complaints of interference and in deciding whether the license of a station causing serious interference shall be revoked by the Secretary of Commerce, preference shall be given to stations communicating with ships or between points where other means of communication are not available.

Sec. 21. Every coastal station and ship station shall at all times be ready to send and receive messages and signals on such wave-lengths and of such wave character as are required by the existing or future international conventions, one of these wave-lengths to be considered as the normal sending and receiving wave-length of the station. Such stations may also use 1800 meters and such additional wave-lengths less than 600 meters as may be granted by the Secretary of Commerce. Every such station shall have its receiving apparatus so marked that the operator can quickly and conveniently adjust it to a receiving wave-length of 600 meters or other distress wave-length that may be designated by future international conventions.

Sec. 22. No licensed ship radio station when within fifteen nautical miles of a Government land station or a coastal station shall use a transformer input exceeding one kilowatt, nor when within five nautical miles of a Government land station or a coastal station, a transformer input exceeding one-half kilowatt, except for sending distress signals or signals or radiograms relating thereto.

The Secretary of Commerce may regulate or prohibit the use of the transmitters of stations on shipboard in harbors within the jurisdiction of the United States, as he may deem necesasry.

Location and Transmitting Restrictions.

Sec. 23. No licensed land station in operation on the date of the passage of this Act within fifteen nautical miles from the Government receiving stations at the following points: Boston, Mass.; Newport, R. I.; Washington, D. C.; Charleston, S. C.; Key West, Fla.; San Juan, P. R.; Point Isabel, San Antonio, Laredo, and El Paso, Texas; Fort Huachuca, Arizona; San Diego, and San Francisco, Calif.; North Head, Tatoosh Island, and Bremerton, Washington, or from any Government station in Alaska, shall be licensed to change its equipment in any manner that will increase its interference with other stations, and no land station located within fifteen nautical miles of the Government receiving stations herein named, and not in operation on the date of the passage of this Act, shall be licensed for the transmission of public or commercial business by radio communication.

Sec. 24. At all important seaports and at all other places where coastal stations operate in such close proximity to Government stations that interference with the work of the Government stations cannot be otherwise avoided by the enforcement of this Act, such coastal stations as interfere with the receipt of radiograms by the Government stations concerned shall not use their transmitters during the first fifteen minutes of each hour, local standard time. The Secretary of Commerce may, on the recommendation of the Department concerned, designate the station or stations which may be required to observe this division of time. The Government stations for which the abovementioned division of time may be established shall transmit radiograms only during the first fifteen minutes of each hour, local standard time, except in case of radiograms relating to vessels in distress.

Sec. 25. Whoever, including any person in the service of the Government, shall knowingly transmit or publish, or knowingly cause to be transmitted or published, any false or fraudulent distress radiogram, or who, when engaged in radio communication, shall transmit or publish, or cause to be transmitted or published, any other radiogram for the purpose of defrauding or deceiving the Government, shall be punished by a fine not exceeding two thousand dollars or imprisonment for not more than five years, or both.

Sec. 26. No person shall use or operate any radio apparatus on a foreign ship when within the jurisdiction of the United States otherwise than in accordance with the provisions of Sections 14 (a), 15, 16, 17, and 22 of this Act, and all the provisions of said sections and penalties thereto attaching are hereby made applicable to such apparatus: Provided, however, that in no other respect shall anything contained in this Act apply to apparatus on foreign ships, nor shall the restrictions of this Section or of any other Sections of this Act apply to public vessels of foreign governments otherwise than by a general proclamation of the President.

Naval System of Accounting.

Sec. 27. The office of Director Naval Communications, established under the jurisdiction of the Navy Department, shall be charged with the accounting and payment of charges in connection with the settlement of international radio accounts as provided by the London Radiotelegraphic Convention of 1912, or as may be provided by future international conventions. The expenses involved in the settling of international radio accounts, not exceeding five thousand dollars per annum, shall be borne by the United States.

Sec. 28. In all cases of violation of any provision of this Act for which no penalty is otherwise prescribed, or of any regulation of the Secretary of Commerce, the Secretary of Commerce may impose a fine of one hundred dollars upon the owner of the apparatus by means of which such violation was effected, or a fine of twenty-five dollars upon the offending operator, or both, but such fines may be reduced or remitted by the Secretary of Commerce in his discretion; and in addition the Secretary of Commerce may in his discretion, revoke the station license of such owner and revoke or suspend the license of such operator as provided in Sections 10 and 13 of this Act.

Sec. 29. The Secretary of Commerce shall have power to enforce the provisions of this Act by appropriate regulations through collectors of customs and such other officers as he may designate; and said Secretary shall also enforce the provisions of such international radio conventions as have been or may hereafter be ratified or adhered to by the United States, except that provisions thereof relating to Government radio installations shall be enforced by the Departments respectively controlling such installations.

The Secretary of Commerce may, upon application therefor, remit or mitigate any fine, penalty, or forfeiture provided for in this Act with the exception of penalties including imprisonment: Provided, that the penalties not involving imprisonment incurred in the Philippine Islands, may be remitted or mitigated by the Governor General and President of the Philippine Commission, and such penalties incurred in the Panama Canal Zone may be remitted or mitigated by the Governor of the Panama Canal on application therefor being made, in such manner and under such regulations as they may deem proper.

Sec. 30. *Except as otherwise specifically provided in this Act,* the provisions of this Act shall extend to all places subject to the jurisdiction of the United States. The several Courts of First Instance in the Philippine Islands and the District Court of the Canal Zone shall have jurisdiction of offenses under this Act committed within their respective districts, and of conspiracies to commit such offenses as defined by Section Thirty-seven of the Act to codify, revise, and amend the penal laws of the United States, approved March 4, 1909, and the provisions of said section, for the purposes of this Act, are hereby extended to the Philippine Islands and to the Canal Zone.

Provision for Repeal of Present Act.

Sec. 31. The Act approved August 13, 1912, entitled "An Act to Regulate Radio Communication," is hereby repealed.

Such repeal, however, shall not affect any act done or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause prior to sail repeal, but all liabilities under said laws shall continue and may be enforced in the same manner as if said repeal or modifications had not been made; and all offenses committed, and all penalties. forfeitures or liabilities incurred prior to the taking effect hereof, under any law embraced in, changed, modified, or repealed by this Act, may be prosecuted and punished in the same manner and with the same effect as if this Act had not been passed.

Marconi's Pointed Criticisms.

The Marconi view of the proposed legislation was expressed in the following communication, read by the company's Vice-President and General Manager, Mr. Nally, and filed with Commander Todd, chairman of the meeting:

GENTLEMEN:

After reviewing the provisions of the proposed bill to regulate radio communication compiled by your Committee, and entitled "An Act to Regulate Radio Communication," the Marconi Company respectfully submits the following for your consideration:

There has not been sufficient time between the receipt of your copy of the proposed bill, and the date of this hearing to enable us to prepare a complete statement as to each of the sections provided for in the proposed bill, but we wish to go on record at this time as objecting to the sections specically referred to hereafter, because of the hardships and restrictions, the sections, if enacted into law, would place upon the commercial operation and development of the art of radio communication.

Section 5 provides that "The Secretary of Commerce shall fix the rates charged by all licensed stations open to public correspondence." This provision is objectionable, in the first place, because the same provision does not apply to Government radio stations, which it is now proposed to open for public correspondence, in competition with commercial stations. Obviously, a condition of rate competition may be thereby created, to the serious detriment of the commercial companies. Secondly, this power should not be vested in the Secretary of the Department of Commerce. If regulation of rates is necessary, it would seem that it should come under the jurisdiction of the Interstate Commerce Commission.

Section 5 also provides for the opening by the Government of its radio stations to general public business, and if this provision is enacted into law, it will create a condition of competition between Government and private interests, resulting in a heavy financial loss to commercial companies, which have spent considerable sums of money and years of labor in the development of efficient radio stations, so as to provide a satisfactory commercial wireless telegraph service to the public.

Section 6 seems to anticipate the condition referred to in the preceding paragraph, in that it provides that "The Government, through the Navy Department, shall have authority to acquire by purchase at a reasonable valuation, any coastal radio station now in operation in the United States which the owner may desire to sell." It is not stated who shall determine the reasonableness of the valuation which the Navy Department may wish to place on property belonging to commercial interests.

Section 7. The last paragraph of this section provides that "A license shall not be granted if, in the opinion of the Secretary of Commerce, the operation of the proposed station will seriously interfere with the operation of existing Government or licensed stations in the vicinity." We respectfully submit that in the present stage of development of the radio art it is highly undesirable to enact the above regulation into law. Its effect would be to stifle the growth of the radio art and such authority should not be left to the opinion of any one person.

A Check on the Development of the Art.

Section 8. The penultimate paragraph of this section seeks to vest further rights in the Secretary of Commerce concerning the granting of licenses, and actually provides that the Secretary of Commerce may determine in advance of the erection of a radio station whether the apparatus to be installed in such a station shall be licensed.

With the many different types of apparatus now employed in radio communication, and with the different lines along which certain types of apparatus are being further developed, it is in our opinion highly undesirable to have any Government Department determine what type of apparatus may be installed at a proposed radio station. The check that such a regulation, if enacted into law, would have on the further development of the art is obvious.

Making Confiscation Easy

Section 9, in paragraph 1 thereof, provides, "The President of the United States, in his discretion, may cause the closing of such station and the removal of all radio apparatus, or may authorize the use of the station or apparatus by any Department of the Government upon just compensation to the owners," etc.

The President of the United States is already empowered, under the Act of August 13th, 1912, approved by Congress, to "Cause the closing of any station for radio communication and the removal therefrom of all radio apparatus, or may authorize the use or control of such station or apparatus by any Department of the Government, upon just compensation to the owner," "in time of war or public peril or disaster."

The Marconi Company has on previous occasions voluntarily offered its stations, as well as its organization, to the United States Government, if desired for use in time of war or other national emergency, and renews this offer at present, but respectfully submits that the section above referred to would give the same power to the President of the United States in time of peace, a condition which, in our opinion, is unnecessary.

Section 10 provides that "The books and records of the licensee shall be open at all times for inspection by the officials of the Department of Commerce," etc. We submit that if such a provision is to be enacted at all, it should be confined to such books and records only as apply to the transmission of messages, and the apparatus installed at any station licensed by the Department of Commerce.

Section 11 provides, in part, that "whoever shall employ any unlicensed person in the operation or supervision of any licensed radio station . . . shall be punished by a fine," etc.

We desire to call the attention of this Committee to the fact that the supervisors or engineers in charge of important radio stations need not, necessarily, be operators, and if the provision referred to in this paragraph is enacted into law it would prevent, for example, the chief engineer of a high power radio station from being employed, unless he obtained an operator's license, a provision in our opinion unnecessary.

False Elimination of Interference.

Section 17, in paragraph 2 thereof, provides, among other things, that, "Every radio station shall . . . have a logarithmic decrement not greater than the limits which may be specified by the Department of Commerce," etc.

We respectfully submit that this provision is extremely undesirable. The existing laws already provide for a logarithmic decrement not exceeding .2 per complete oscillation, and as it is not always possible to determine in advance of installation the logarithmic decrement of a transmitter, this depending on the antenna and other conditions, a regulation leaving this matter entirely in the hands of the Department of Commerce, would give grounds for controversy.

Section 20, paragraph 2 thereof, which prohibits the use by commercial stations of wave lengths between 200 and 4,000 meters, would, in our opinion, if enacted into law, seriously retard the development of radio telegraphy and telephony for overland communication.

It is evident from this proposed regulation that the framers of this bill have attempted to solve the interference problem by limiting the number of stations that may be erected, and also the wave lengths that may be used by stations already in operation. In our opinion, this is not a solution of the interference problem. What is needed is the removal of the cause of interference, a problem that can only be solved by individual initiative and such research as commercial organizations can engage in. The provisions of this section are evidence of the limitations this bill would place on the future development of the art of radio communication.

Section 21 provides for the further restriction of the already limited number of wave lengths allowed for commercial ship and shore use, while the bill makes no provision whatsoever regarding the wavelengths to be employed by the Government stations, a condition which is manifestly unfair to commercial stations, and especially so in time of peace.

Section 23 not only further limits the number of stations that may be erected on land, but also prevents certain existing commercial stations from changing their equipment. The purpose of this regulation is apparently to limit interference, but the views expressed in the preceding paragraph concerning the solution of the interference problem, similarly apply in this case.

In general the proposed bill is evidence of a desire to limit private enterprise, and tends to discourage and suppress individual efforts to promote or advance the radio signaling art. For the reasons stated, as well as for other technical considerations, the Marconi Company desires to record its protest against the provisions of the bill under discussion.

Respectfully,
Marconi Wireless Telegraph Co. of America,
By E. J. Nally,
Vice President & General Manager.

Commander Todd observed, after the reading of the statement, "Mr. Nally's paper has some things in it which point to possible changes in the Bill. I see several places where the Committee will undoubtedly take a very strong notice of his objections. It is a very fair and open statement of his company's attiture."

Prof. Kennelly's Protest.

Three communications were then read by David Sarnoff, representing the Institute of Radio Engineers. The first was from Professor A. E. Kennelly, president of the Institute, professor of electrical engineering at Harvard and Boston "Tech," and vice-president of the National Amateur Wireless Association. Professor Kennelly said:

Gentlemen:

I am informed that new legislation is proposed, looking towards the invasion of the existing commercial field of radio communication in the United States by certain department or departments of the Government, and that a hearing is proposed in the near future, at very short notice after the preparation and promulgation of the said proposed legislation.

The views of the Board of Directors of the Institute of Radio Engineers have recently been expressed officially upon this question, and I beg to state my endorsement of those views, which will doubtless be presented to your notice.

I am not commercially interested either directly or indirectly, in any radio communication system plant, company or organization, so that I am not actuated by any financial consideration in urging my point of view before your committee. I am deeply interested, however, in the active development of the science and art of radio communication in America as a scientist, a teacher, an operator a telegraphist and a United States citizen.

Although, in the past, the commercial field of radio communication has unfortunately been exploited by certain unscrupulous promoters, to the detriment of all interests involved, nevertheless, a large aggregate amount of capital, and the savings of United States citizens, has been honestly invested in it. I submit that it is the duty and interest of the Government to protect that investment and the American enterprise that goes with it.

If the Navy Department, or any other department of the Government, is allowed to compete in times of peace with existing industrial shore stations in the hands of American citizens, such competition is likely to degenerate into the confiscation of private property, because the Government now claims the right to regulate radio communication, under the terms of the London Convention, and it needs no argument to show that, with the Government in competition and at the same time construing the terms of regulation of their competitors, the competitors might quite easily, and very probably would be regulated out of existence, and their properties confiscated at scrap valuation prices by the Government. I do not, of course, say that such injustice is the intention of any department of the Government, but I do say that any legislation which permits any branch of the Government to compete commercially with existing stations for messages in times of peace is likely to lead to the injustice above mentioned.

Blocking Preparedness.

In times of war, or national peril, it is of course the duty of every citizen to sustain and cooperate with the Government in the general commandeering of all electric communication, radio or otherwise, but in times of peace such commandeering of private enterprises by the Government is not only fatal to the private interests, but also fatal to the Government interests. This is shown by the fact that in those countries of Europe where the telephone system is owned and operated entirely by the Government, the telephone communication of the country is in a relatively backward state, by comparison either with the United States or with countries in which the telephone is not owned and operated by the Government. Statistics on this point are so ample and accessible that I need not refer to them here. In order, therefore, that the highest development of radio communication shall constantly be obtainable for the support of the Government in time of need, it is very desirable that inventions and improvements should be open to the public and to public competition. If the radio system is a Government institution, nearly all incentive for improvement, and most of the inventive and scientific effort for development will cease. There will be no market for private enterprise. I therefore urgently contend that, for the present, there should be no legislation increasing the already great powers of the Government in the radio communication field.

Yours respectfully,

A. E. KENNELLY,
Professor of Electrical Engineering at Harvard University and Mass. Institute of Technology.

Prof. Goldsmith's Protest.

Professor Alfred N. Goldsmith, of the College of the City of New York, editor of the Institute Proceedings, and a vice-president of the National Amateur Wireless Association, was next heard from. His communication read as follows:

GENTLEMEN:

The undersigned has had the opportunity to read through the provisions of a proposed bill to regulate radio communication compiled by your Committee, and respectfully submits the following comment thereon:

In considering radio legislation, he assumes as a necessary and fundamental basis that the welfare of the country is dependent on the encouragement of commercial enterprise in legitimate directions, the fostering of determined inventive effort, and sympathetic co-operation of Government officials in the directions mentioned.

In the radio art, the need of such a friendly attitude on the part of the Government is peculiarly necessary, since it is well known to those engaged in this useful art that the commercial concerns have not yet passed out of the initial stages of development, and that they have sunk great sums of capital in the establishment of a valuable field which has not given them, up to the present, an adequate return. Whatever may have been their shortcomings in the past, it is very evident that the leading companies in the radio field in America are now very earnest in their desire to develop the field in the right directions and to bring the United States to a position of pre-eminence in character of equipment and grade of service. In this worthy task, they are entitled to every encouragement.

The radio art itself bristles today with unsolved problems which obviously demand concentrated research and commercial trial on the largest scale to facilitate their solution. The undersigned need only mention in this connection the great difficulties of elimination of atmospheric disturbances of reception ("strays"), the unsolved problem of long distance reliable radio telephony, the problem of securing adequate selectivity of choice of station in reception, the elimination of station interference in reception, the securing of a reliable and simple calling system whereby the continual attendance of a skilled operator in the receiving station may be avoided, and a multitude of others. These problems can be solved only by individual initiative expressing itself through large commercial organizations which, out of a portion of their profits, maintain the necessarily elaborate research laboratories, and offer suitable remuneration to those carrying out the research work itself.

There is, indeed, a marked parallelism between the development of the radio field and that of wire telephony. The evidence is irrefutable that the telephonic field would not be today at its high state of development if the attitude of the Government after 1880 had been one of unfriendly interference and threatened confiscation.

Legislating Commercial Companies Out of the Field.

The undersigned is reluctantly forced to believe that the spirit of the legislation proposed by the Inter-Departmental Committee is one of hostility to the existing organizations. Throughout the proposed bill there is evidence of a desire to eliminate commercial enterprise and healthy competition. The suggested clauses giving the Secretary of Commerce the arbitrary power to suppress a station in which the smallest detail of the apparatus is changed without a license application (Section 9, paragraph 4, "Apparatus other than that specified in the license shall not be used for radio communication"), the even more arbitrary power vested in the Secretary whereby all wave-lengths between 200 and 4,000 meters are, in effect, closed to commercial stations except in the hearts of unpopulated wildernesses where the sensitive receivers in Government stations can not detect their existence and potential interference with Government traffic (Section 20: " . . . no license shall be granted to a commercial station permitting the use of wave lengths between 200 and 4,000 meters, except when so far removed from Government or *coastal* stations that in the *opinion* of the Secretary of Commerce, no interference can occur with the Government or coastal communication"); these clauses can only be interpreted as expression of a desire to drive the commercial companies out of the field. To clinch the matter, the undersigned need only cite the clause of the proposed bill whereby the Government is authorized to purchase commercial stations within five years from their (presumably bankrupt) owners.

If the commercial companies are driven out of the field in this early stage of its development, the undersigned is firmly convinced that a great wrong will have been done to the United States and that the future of radio communication and its legitimate development will be irretrievably destroyed. Against so unfortunate a policy, he begs to protest. He urges respectfully that the proposed legislation be abandoned as being contrary to the interests of the United States and prejudicial to the commercial and engineering development of the radio art.

Very truly yours,
ALFRED N. GOLDSMITH, Ph. D.,
Director, Radio Telegraphic and Telephonic Laboratory.

As secretary, Mr. Sarnoff then noted:

At the last meeting of the Board of Direction of the Institute of Radio Engineers, the following resolution was recorded in the minutes of the Institute records, and I am instructed to present the resolution to your Committee:

I. R. E. Resolution of Opposition to Bill.

Whereas: Certain unwise provisions in the London Radio Telegraphic Convention of 1912 through serious Governmental interference have retarded the engineering development of the radio art; and

Whereas: The development of new arts of electric communication has always been checked by Government interference and has always been fostered by the existence of free individual initiative as, for example, telephony, in the United States; and

Whereas: Many important problems in radio telegraphy and telephony are still unsolved, as, for example, the problems of long-range radio telephony, adequate selective reliability, call systems and the elimination of atmospheric strays; and

Whereas: The solution of these important problems calls for the highest engineering and inventive talent and research; and

Whereas: Such inventive effort and research can only exist under free institutions and under the stimulus of healthy competition; and

Whereas: Certain foreign Government have assisted and not opposed individual initiative and private enterprise in developing the radio communication systems of their countries with great success; and

Whereas: Government competition, or confiscation by the Government, would effectively stifle inventive effort; and

Whereas: The military control of radio —or any public-service communication— in times of peace, virtually constitutes a continuous military inquisition into private correspondence, an undemocratic and dangerous institution; and

Whereas: The reliability and superiority of our radio communication in times of sudden national peril is dependent upon the inventive and engineering resources of the nation, which should therefore be kept at the highest pitch and of the broadest scope; therefore, be it

Resolved: That the Board of Direction of the Institute of Radio Engineers is opposed to the competition by any Department of the Government, and particularly by any Military or Navy Department, with existing organizations founded for radio communication; and

Resolved, further: That this resolution be brought to the notice of such Congressional Committees as may have charge of any proposed legislation on the subject.

Respectfully,
Board of Direction,
THE INSTITUTE OF RADIO ENGINEERS,
By David Sarnoff,
Secretary.

In his address to the meeting Commander Todd stated that the principal reason for the Government's desire to handle commercial business was that operators in Government service at shore stations are not obtaining enough practice to make them efficient as operators.

Navy Views Government Monopoly in Thin Disguise.

"I ask," said Mr. Nally, vice-president and general manager of the Marconi Company, "if the Government has any other reason for entering into the commercial business than to give its operators practice?"

Commander Todd's reply was to the

effect that it would be necesary to take the traffic away from the commercial stations in order to give Government operators the practice needed to become efficient. He added: "The framing of sections that suggest Government monopoly is just the handwriting on the wall; it must come, unless all these beautiful dreams come true."

Two Views of Proper Preparedness

"Naturally, Mr. Chairman," said Mr. Nally, "it isn't clear to us as a question of business, why this should come true. Why a service which in itself has not been criticized, which is considered as developing from day to day, which is improving every hour and is doing really good service to the public, why it should be legislated out of business mainly for the reason that Government operators are not given sufficient practice. We might say that it is necessary for the Army and Navy to be constantly at war in order to be prepared!"

After some hesitation, Commander Todd replied: "It might be a good thing."

"It would be disastrous!" observed Mr. Nally.

The meeting adjourned shortly after Prof. E. B. Rosa, a member of the Inter-Departmental Committee, chief psysicist of the Bureau of Standards, had given his interpretation of some of the provisions and asked the members of the Institute to discuss matters with the Committee.

HOW FORT VAUX RECEIVED ELECTION NEWS

A newspaper says that news of the Presidential election in the United States was communicated by wireless telegraphy to Fort Vaux on the Verdun front and created intense interest even amid the activities of defense preparations and under a very severe German bombardment.

DR. DEGROOT'S PAPER

At a meeting of the Intsitute of Radio Engineers, held on December 6th, in Room 1201, Engineering Societies Building, New York, a paper on "The Classification and Elimination of Strays," by Dr. C. J. deGroot, was presented. Dr. deGroot, who is head of the radio service of Holland in the Dutch East Indies, has developed some remarkable methods of classifying and eliminating strays.

ALASKAN STATIONS CLOSED

The following land stations in Alaska have been closed and will not be reopened until March, 1917: Akutan (KNW), Chignik (KHC), Egegak (KMF), Hales Creek (KMT), Koggiung (KVV), Koggiung (KHB), Naknek (KHT), Naknek (KMK), Nushagak (KMG), and Snag Point (KHF).

The importance of all legislative matters concerning Government control of the radio field has led The Wireless Age to publish this full report for the benefit of its readers.

The annual report of the Secretary of the Navy, received as we go to press, makes clear the determination to make radio a Government monopoply, if possible. Secretary Daniels says: "No censorship of radio stations can be absolutely effective outside of complete Government operation and control." He adds: "The Government must . . . obtain control of all coast radio stations and operate them, in conjunction with naval stations, for commercial work in times of peace."

Before this can be done, however, laws must be passed. And in the end the law must express the will of the people of the United States.

Study the Bill and send in your comments to the Editor.

British Law to Compel Ship Installations

The following regulation has been published in the London Gazette:

"37B (1) Every British ship of three thousand gross tonnage or upwards, in respect of which a license to install wireless telegraph apparatus has been granted by the Postmaster-General, and which puts to sea from a port in the United Kingdom after a date to be specified in such a license, shall be provided with a wireless telegraph installation, and shall maintain a wireless telegraph service, and shall be provided with a certified operator, together with suitable accommodation for the apparatus and operator:

"Provided that where a license has been granted in respect of a ship before the making of this regulation, this obligation shall apply as if the twenty-first day of August, nineteen hundred and sixteen, were the date specified in the license.

"(2) Application to the Postmaster-General in a form prescribed by him for such a license shall, unless a license has before the making of this regulation been granted in respect of the ship, be made:

"(A) In the case of a ship of such tonnage as aforesaid, registered in the United Kingdom, by the owner thereof on or before the twenty-first day of August, nineteen hundred and sixteen: and

"(B) In the case of a British ship of such tonnage as aforesaid, registered elsewhere than in the United Kingdom, by the master of the ship within two days from the arrival of the ship in the United Kingdom next after the making of this regulation.

"(3) The Postmaster-General shall, as and when wireless telegraph apparatus and the service of operators becomes available for the purpose, cause licenses to be issued in respect of such ship as in the opinion of the Admiralty should in the national interests be fitted with such apparatus, and the licenses shall specify the date as from which the carrying of such apparatus under this regulation is to be compulsory, the character of the apparatus and the qualifications of the operator.

"(4) The Postmaster-General may

"(A) Extend the time mentioned in the license as the time within which any apparatus is to be provided; and

"(B) Exempt any ship from the obligations imposed by this regulation.

"(5) If the provisions of this regulation or the terms of any license granted thereunder are not complied with in the case of any ship, the master or owner of the ship shall be guilty of a summary offence against these regulations, and if any master or owner fails to make an application in accordance with this regulation he shall be guilty of a summary offence against these regulations, and in either case if the ship is at any time subsequently found at a port of or within the territorial waters adjoining the United Kingdom the ship may be seized and detained.

"(6) In this regulation expressions have the same meaning as in the Merchant Shipping Acts, 1894 to 1914."

The Operator and the Tramp

The Viewpoint of a Wireless Man Assigned to a Tramp Steamer—Facts About the Rolling Stone Which Acquires None of the Moss That Gathers on Ruins But Gains Brightness by Contact With Diversified Interests—A Journey That Afforded a Chance to Rub Elbows With Incas from the Tropic Mountains, Zulus from the Veldt, Enigmatic Japanese and Stalwart Siberians

By J. Edward Jones

Marconi Operator on the San Francisco

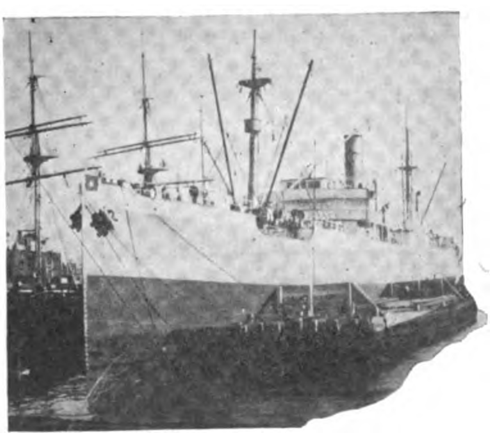
PICTURE yourself strolling about the plazas of tropical cities to the accompaniment of tuneful music with the southern cross bright and clear overhead, and soft-eyed, dusky-skinned senoritas moving here and there with languorous grace; imagine seeing the Inca in the fastness of his mountain home, Zulus fresh from the broad veldt, high-browed Ceylonese on their own picturesque island, enigmatical Japan, the frozen wastes of dread Siberia and Egypt, with its pyramids and mighty river, its veiled maidens and perplexing atmosphere of mystery.

Sounds fascinating, doesn't it? Well, the reality is even more delightful than the description. Moreover, the opportunity to experience the thrills and tingles born of actually journeying to the interesting places referred to, to visit on an average a different country each month, is open to him who sits in the wireless cabin of a freight steamship.

In a previous issue of THE WIRELESS AGE was published an article entitled "Is the Game Worth While?" which caused considerable comment. However, it did not mention the wireless operator on the tramp and the ambition to tell the story of the radio man from the former's viewpoint was one of the reasons that prompted me to write this article. This I feel measureably qualified to do since I myself am a freight operator.

I have heard operators express much gratification upon learning that they had been assigned to passenger steamships, their satisfaction doubtless being due to visions of scenes of gayety and animation. These men could not grasp the advantages of being a freight operator. From my viewpoint the most desirable feature of a post on a passenger liner is the opportunity to handle a larger amount of traffic than falls to the lot of the man in the freighter's wireless cabin.

But the recital of my experiences rather than any argument I could present will, it seems to me, better impress the reader with the advantages which we of the tramps enjoy. Therefore I will hurry on with my story.



Operator Jones and his vessel, the San Francisco, on which he made the interesting voyage described

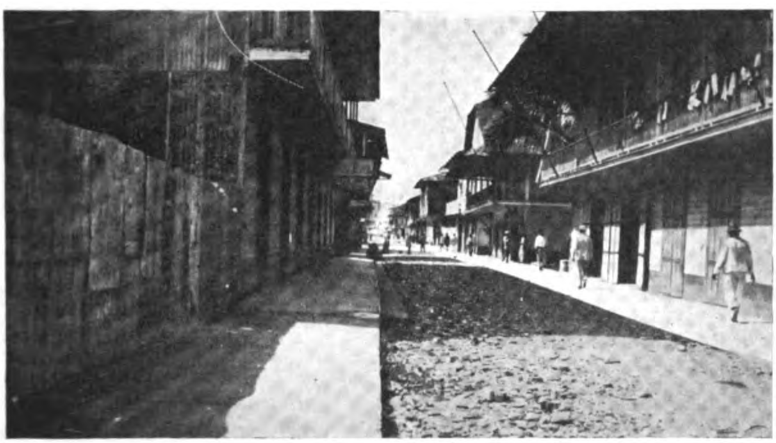
I was assigned in the latter part of August, 1915, to the San Francisco of the Isthmian Line, bound on a voyage to the River Plate. There were days and days of gliding over the waters, then a short stay in Montevideo and Buenos Aires and a delightful trip up the Rio Parana to Rosario. The latter has many attractions and I remember it chiefly because of the fact that we enjoyed some excellent duck shooting while the San Francisco was docked there. We steamed for New York with several thousand tons of linseed and the voyage proceeded without incident until we were four days out. Then fire was discovered on the ship and all hands were called upon to fight it. We succeeded in keeping the flames under control and ran into the harbor of Rio Janeiro, where it was extinguished. Eight days later the San Francisco resumed her voyage northward, stopping at Barbados for coal.

When the vessel arrived in New York we were informed that she had been chartered to go to Siberia with rolling stock for the Trans-Siberian Railway. The Panama Canal was closed, so we were compelled to steam towards the rising sun, instead of taking the shorter route to the west.

We cleared from New York early in December, and twelve days later San Antão, the most northwesterly island of the Cape Verde group, loomed up ahead. Soon other rocky headlands came in sight, and shortly afterwards we rounded Bird Rock and dropped anchor in St. Vincent Bay.

Upon leaving Durban we steamed through the Mozambique Channel, between Madagascar and Portuguese East

Cruz Grande is typical of the smaller ports along the Chilean coast, on the final leg of the return voyage



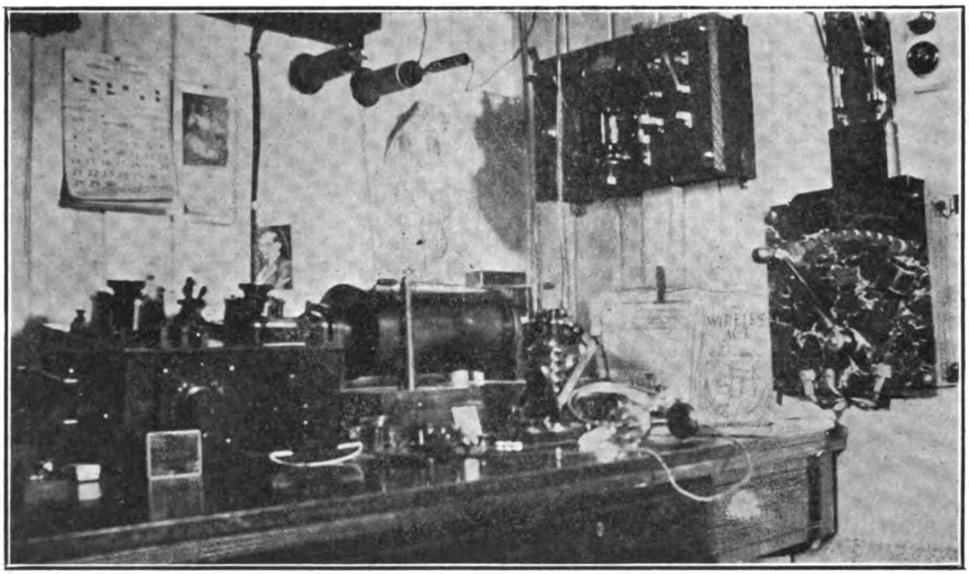
Two days' journey from the Panama Canal is Buenaventura, Colombia, of which this is the main street

Africa. We obtained a splendid view of the beautiful, fertile Comoro Isles and I communicated with the French wireless station at Dzaondzi, on Mayotta Island. Then followed two weeks of steady steaming, almost on and parallel with the equator, but we encountered fair weather and near the end of January the ship tied up in Sabang harbor.

Sabang is situated on Pulo Weh, to the extreme north of Sumatra, the island being mountainous, and covered with luxuriant vegetation. There are numerous pepper and cocoa-nut plantations, the scenery is gorgeous, and the customs of the people very odd. Sabang has about 600 inhabitants, most of whom are coolies employed by the coal company. The bay is very picturesque, being surrounded by high hills covered by a dense tropical growth. The water is clear, and hundreds of fishes can be seen plainly.

Leaving Sabang, we headed down the Malacca Strait, passing among the Malacca Islands, once the center of great piratical activities, and thus into the China Sea. Here the gorgeous sunsets and the large amounts of phosphorous in the water are worthy of note.

We sighted the rugged, mountainous coast of Japan, on February 14th, and through blinding snow-storms entered the Inland Sea and came to anchor between Moji and Shimonoseki. In spite of the weather, we had hardly anchored when a larger number of vendors came on board and set up their shops on the hatches, giving the ship the appearance of a bazaar. Both men and women coaled the ship, and it was difficult to distinguish one from the other, although most of the latter had children strapped to their backs. In the towns most of the buildings are low, have the same color, and are constructed on architectural lines peculiar to the country. The customs of the people are deeply interesting, mystery and strangeness pervading them. The belles, with their swaddling clothes and stilt-like sandals, seemed very odd to us of the Western world. Most engaging were the manners of the Japanese whom we met and my visit to their country was given added interest by the knowledge that in it was one of the links of the Marconi world-girdling wireless chain.

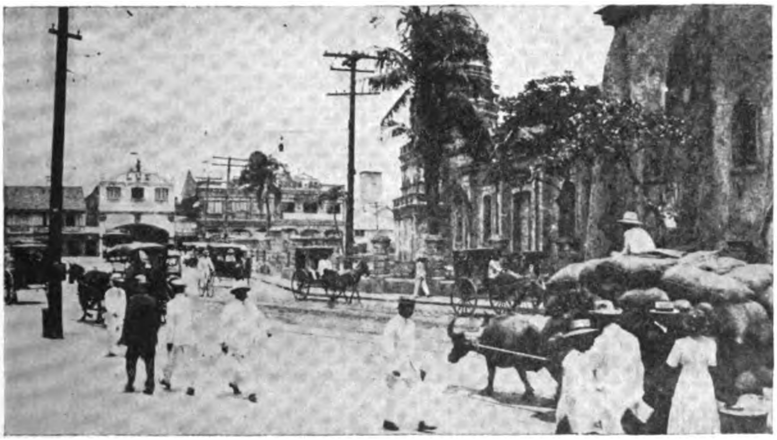


A corner of the wireless room on the San Francisco

After leaving Japan we put in close to the coast of Chosen, and two days later were pushing our way through ice fields, until, preceded by a couple of ice-breakers, we entered Vladivostok harbor.

Vladivostok is built around the inner harbor, with high hills rising at the back. Some straggling streets run almost to the summits of these hills. It is of marked importance as the eastern terminus of the Trans-Siberian Railway, and as an open port during the entire year. During most of our spare time we were skating, skeeing, or sleighing, and we attended many masquerade balls, most of which were given for charity. Swetlanskaia Ulica (Light Street), was the favorite promenade in the evenings and on Sundays, but when inclement weather prevailed, Kokkana's cafe was a popular gathering place. In the midst of this pleasure-seeking throng it was difficult to realize that the dread mines of Kara were but a comparatively short distance to the west and to the north were those of Ust Yansk and others of even more terrible repute.

Thus passed four days in Vladivostok and when on March 15th we steamed slowly out of the harbor we left behind scenes that were associated with many pleasant memories. After coaling at Moji again we departed for Ilo Ilo, the second largest port in the Philippine Islands. The town itself is rather small and the streets are narrow. Most of the stores are conducted by Chinese, and many articles typical of their country can be purchased remarkably cheap. While the town is fast becoming Americanized there still remain many of the customs established by the old Spanish influence, and a considerable number of the natives speak neither Spanish nor English. Their habits proved an interesting study, for in some ways they go back to the days of slavery. The Chinese villages, along the shores of the streams which we explored by motor-boat, were very odd indeed, being built upon piles driven down into the water. No doubt this form of habitation has its advantages in a country swarming with snakes and lizards.



Manila, which arouses the expectations of sightseers, proved to be not very different from other tropical cities

Chinese and natives inhabit these houses on stilts above the water and appear to be happy in the Philippines

From Ilo Ilo to Manila the course of the stream runs in and out among numerous islands. Wireless traffic is handled easily, for stations on several of the islands maintain a good service.

It was with anticipations of an interesting sight-seeing tour that I went ashore at Manila. However, I found it not greatly different from the average Latin-American city. An automobile trip up into the hills provided a welcome diversion, for the country is attractive, being dotted here and there with villages that are extremely primitive.

At Singapore, our next port of call, I found a city with a population of 193, 000, which, because of its geographical position, on a small island at the extreme southern end of the Malay peninsula, possesses a trade and importance out of all proportion to its size. About the outskirts of the place wild animals prowl. Their number includes tigers, elephants, panthers, tapirs, wild hogs and deer, the first-named species frequently finding their way into the city. Singapore has a Coney Island, it should be chronicled, but it differs in every way from New York's famous resort.

Easter Sunday found the San Francisco churning her way into Colombo Harbor where two hospital ships and two transports filled with Australian troops reminded us of the great European war. Just outside the city are the extensive tea plantations of Sir Thomas Lipton, a visit to them providing one of the most attractive features of our stay.

An adventure with sharks in the Indian Ocean marked the next chapter of our voyage. When we were midway between Colombo and the island of Socotra, the ship sprung a leak and it was necessary to lower the carpenter over the side to make repairs. He accomplished his task successfully, but at some risk for the waters about the vessel swarmed with man-eaters and in order to protect the carpenter from attack the officers of the San Francisco directed a continuous rifle fire upon them.

Steaming close to Aden, reputed as the place in which prevail the warmest weather conditions in the world, we ran past Perim late in the evening of the same day into the Red Sea. On the morning of May 7th we sighted the peak of Mount Sinai, where those ten very brittle commandments were made. Then came our trip through the Suez Canal, on the banks of which were encamped Australian troops, and at length we arrived at Port Said.

After steaming the length of the Mediterranean we stopped at Oran, the second largest city in Algeria. It is divided into two parts, the old and the new, which are separated by a ravine and a rivulet, and joined near the beach by a tunnel. The modern part is growing rapidly, and already contains some fine buildings. Oran originally belonged to the Spaniards, but was abandoned by them after a severe earthquake, and was afterwards occupied by the French. There are some celebrated thermal baths near the place.

The ten kilowatt wireless station on top of Mount San Cristobal, a lofty eminence overlooking Lima, at the foot of the Andes

We arrived at Liverpool without mishap on May 22nd. Some of our cargo was discharged there and then we proceeded to Greenock with the remainder.

The San Francisco sailed for the west coast of South America on July 29th, passing through the Panama Canal exactly three months after we made the passage of the Suez. Two days later we entered the Buenaventura River and anchored off the town bearing that name.

Callao, our next stop, is important as the seaport of Lima, the capital of Peru. Lima is about eight miles inland from Callao, an electric train service being maintained between the two places. Lima is built on a level tract of country at the foot of the Andes. The old Cathedral, built in 1625, contains great wealth; there are pillars and other decorations of pure gold and silver. I also saw in the Cathedral the bones of General Don Francisco Pizarro, who founded Lima.

Pizarro, it should be stated for the benefit of those who are not familiar with Lima's history, was that ruthless Spanish adventurer who was sent to conquer Peru, his countrymen having heard of its great wealth. By treachery he captured Atahualpa, the Inca, who offered as his ransom to fill the room in which he was confined, as high as he could reach with vessels of gold. Pizarro accepted the offer, the value of which is estimated at $15,000,000 in gold, but as soon as the treasure was in his possession he put the Inca to death. The powerful dynasty passed away with the death of Atahualpa, but many of the latter's descendants still live in the mountains of Peru.

During my stay in Lima I climbed Mount San Cristobal and visited the Lima 10 k. w. wireless station on top of the lofty eminence. From the station I obtained an excellent panoramic view of the city.

Arica, Caleta Junin, Iquique Antofogasta, Taltal, Cruz Grande and Valparaiso on the Chilean coast were among other places the San Francisco touched at before starting on the final leg of the voyage to New York. The latter port we reached without mishap and there my story ends.

The readers of this article will notice that my recital embraces visits to many countries, showing that the freight operator's assignments may take him to points in every part of the world. And while the old saying about the rolling stone and its failure to gather moss may be recalled, it should also be borne in mind that moss is often found on ruins and the rolling stone becomes bright from contact with various kinds of substances.

Lima, the capital of Peru, as seen from the wireless station atop Mount San Cristobal. The city is eight miles inland from Callao and was the scene of Pizarro's treachery to the Inca chief, Atahualpa

Radio Telephony

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ARTICLE 1.

WORLD ASPECTS. Before presenting to our readers something of the technical details of radio telephony, we may be pardoned for a digression based on the broader viewpoint of world growth.

Most difficult it is for a citizen of a modern state, beside whose breakfast table lies the printed sheet bearing the most recent news of widely distant happenings, to realize the elaborate and delicately adjusted mechanism which makes the entire earth his mental neighborhood. The labor of gathering accurate news, the transfer of these to the telegraph or telephone lines, the transmission of these across ocean or continent by the highly evolved radio telegraph or cable, and the huge task of editing, printing, and distributing them: all this shows but dimly in the final result. And yet, possibly the most fundamental difference between savagery and civilization and the most potent source of the latter is *communication*. The isolation of any modern state, the communication lines of which were irretrievably broken, would be truly tragic. The ties that would be broken would be not merely financial but in every field of human endeavor. Imagine a state which heard nothing of the politics, art, science, and literature of all the others. Picture the provincialism, the backward and undeveloped craving for the beautiful in art, the lack of co-ordinated scientific research and industrial development dependent thereon, and the childish literature which would result. A second "Dark Ages" of the mind and spirit would follow; and the citizens of the segregated state would be willing to pay almost any price for the restoration of communication. The evil effects of lack of communication on commerce need not be dwelt on; their magnitude and inevitability partake of the obvious. It is exceptional that money in the form of the actual gold or silver is physically transferred from one country to another to settle debts. Payment is made by the transfer of credits between the countries or their merchants, and this transfer requires nothing more than the use of the radio or cable station for a few minutes. Only the small outstanding monthly or annual balance in favor of one or the other is physically conveyed between the merchants, and even this but rarely.

2. **PERSONAL ASPECTS.** Aside from these larger aspects of communication, there are other advantages of communication which are priceless to the individual. The most obvious of these is the call for help in time of peril. We cannot gauge the value of a radio station on ship-board to the passenger or crew after collision or the breaking out of fire. The stringent laws of all nations relative to ship sets speak clearly for the opinion of the world. And marine law (and even naval law) have been altered by requiring the captain of the ship to remain directly and immediately responsible to his superiors on shore.

Modern business would, of course, be helpless except for the telegraph and telephone. Imagine our great companies in a world where all communication was by word of mouth, or by letter! The wheels of industry would turn but slowly when weighted down and clogged by slow and unreliable communication.

In the more personal matters of life, the literal extension of the personality by the telephone constitutes an inestimable privilege. The more pleasant social amenities become possible to all. And the wish of the poet, to "Annihilate but time and space, and make two lovers happy," is no longer a dream. Communication has indeed conquered tardy time and weary space.

To summarize: in its larger aspects, COMMUNICATION IS THE LIFE-BLOOD OF CIVILIZATION, OF INTERNATIONAL GOOD WILL, AND OF PROGRESS.

To the individual, IT IS AT ONCE THE CLIMAX OF CONVENIENCE AND THE ULTIMATE EXTENSION OF PERSONALITY IN TIME AND SPACE.

3. **USES OF RADIO TELEPHONY.** (a) The most natural use of radio telephony is from ship to ship and from ship to shore. Since it is the only means of telephonic communication possible under the circumstances, it would not need to compete against wire telephones or cables. By the use of amplifying relays at the receiving end (on shore), it will be possible to enable any person on the ship to communicate directly with persons on land, in part over the regular wire lines and in part by radio. The details of such communication will be explained in a subsequent article of this series. The great advantage of radio telephony over radio telegraphy on board ships is the direct personal contact between the persons corresponding and the resulting possibility of speedily settling the matters at issue, and (e.g., on freighters or tramp steamers) the freedom from the necessity of understanding the code. Of course, this last advantage is bound up with the simplification of ship radio telephone sets to the point where a skilled operator becomes unnecessary, the manipulation being simple and certain.

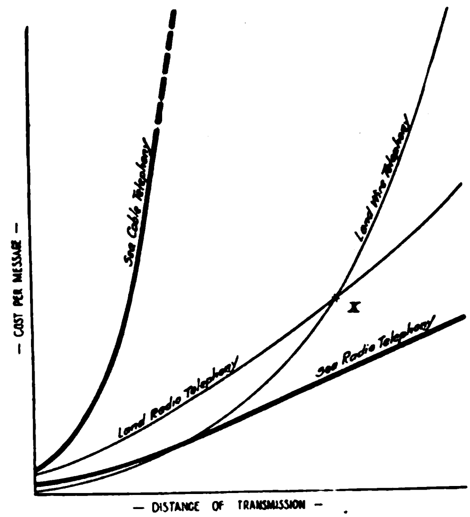


Figure 1

(b) A second important field for radio telephony is in trans-oceanic and trans-continental work. In the first of these, radio telephony is unique in meeting the requirements and is free from competition with submarine telephone cables. In the latter case, it would have to meet the competition of the long distance telephone lines. In each case, communciation between Subscriber A and Subscriber B would be through their wire lines to the nearest radio telephone high power station and thence automatically retransmitted through an amplifying relay. This will be further explained in a later paper of this series.

(c) There are certain types of regions where radio communication is the only one possible of maintenance, e.g., in the arctic regions (because of snow and ice interference with wire lines), in densely wooded tropical regions (because of the enormous difficulty of maintaining a clear right of way through rapidly growing and luxuriant vegetation), in regions or across regions occupied in part by hostile savage tribes (who are addicted to the use of copper telegraph wire for ornament), and between islands and the mainland (where precipitous rocky coasts or swift currents injure or sweep away cables). In all of these cases, radio telephony offers its usual advantages and will no doubt come into increasing use.

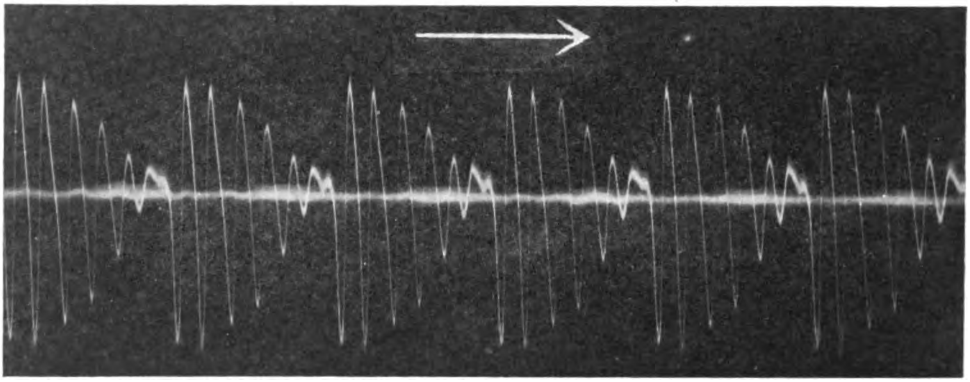


Figure 2

(d) Between two moving trains or between moving trains and fixed land stations. Here, too, we are practically restricted to radio communication. The obvious advantages of such installations in times of storm, when wire lines are almost always incapacitated, has been shown by the experiences of the officials of the Delaware, Lackawanna & Western Railroad in times of blizzards. They have kept in touch with their otherwise marooned trains, and have greatly simplified the problem of resuming normal traffic schedules. And even in fair weather, the advantage of keeping all trains in touch with each other and the control of train dispatching is obvious. Occasional failures of the block system become far less dangerous, because it is possible to warn a train regardless of its position relative to the signals. In foggy weather, this accurate moment-to-moment information as to train positions is far from being a drawback to the normally anxious passenger on certain railroads.

(e) There are a number of special applications of radio telephony which have not as yet been developed to the point at which it is possible to make any very definite statement as to their ultimate value. Among these are telephonic communication between various levels of a mine and the surface (which communication would greatly increase the chance of an early rescue in cases of cave-in, where wire lines are almost always broken), communication between government foresters, communication between aeroplanes or dirigibles and the ground, and communication between submarines and ship or shore.

4. **RADIO VERSUS WIRE TELEPHONY.** It is very difficult, if not impossible, to institute a fair comparison between these fields at the present time. Radio telephony is so far from having reached an advanced stage of development, and is so seriously threatened on the research side by government control and naval or postal administration, that our conclusions are little better than guesses. However, certain broad considerations are fairly obvious and probable.

Let us consider Figure 1. Horizontally we have laid off on an arbitrary scale the distance over which telephone transmission is being carried on, the extreme distance covered by the chart being probably of the order of magnitude of 2,000 miles. Vertically, the cost for a three-minute toll message has been laid off, the extreme cost indicated being of the rough order of magnitude of $15 for three minutes. It is understood that these values may easily be as much as fifty per cent. or more in error.

(a) **Land Telephony.** For short distances, there seems to be no question as to the superiority of wire transmission. The difficulty of preventing interference between a multiplicity of radio telephone stations, the first cost of even a low power radiophone station, the first cost of the transmitting and receiving antennas and ground, and the occasional skilled attendance required, at least, by present-day radiophones render the idea of replacing the complex network of a city's wire telephone system by radiophones highly improbable. This feature is clearly shown by the lower portions of the fine line curves of Figure 1, wherein the influence of first cost on transmission over wire telephones and radiophones is qualitatively shown. There may be occasional exceptions to the curves shown, for example, in the case of very special types of service. Thus, it might be desirable for a military or police force to maintain radiophonic rather than wire line communication, for obvious reasons. But except when such special circumstances render radio communication imperative, the radiophone would seem to be at a disadvantage for short-range communication. As we gradually increase the

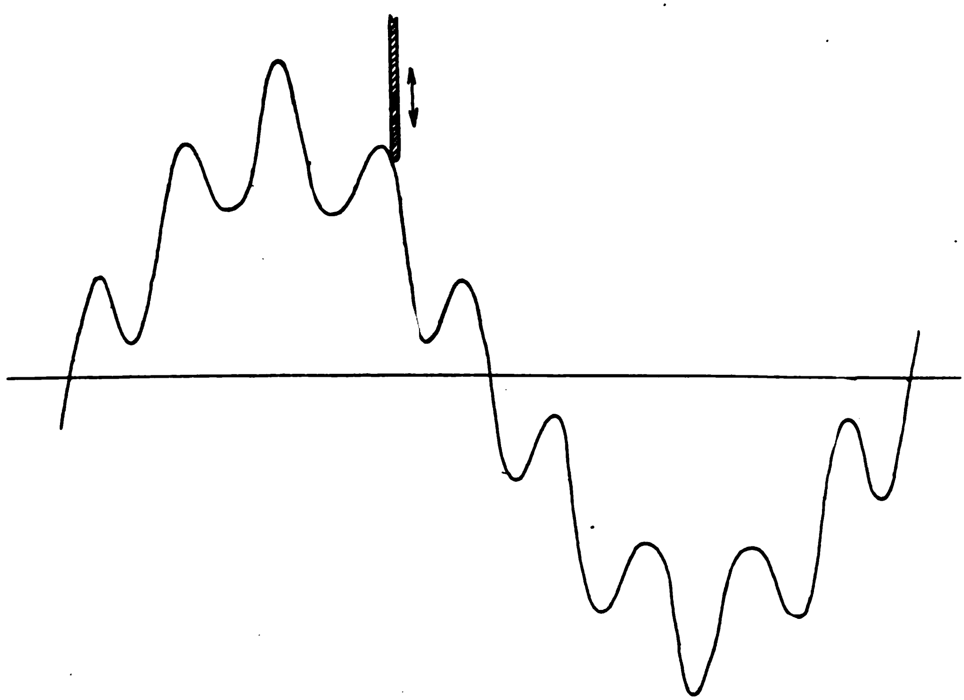


Figure 3.—Typical wave-form

range of communication, the circumstances may, however, alter. The vast expense of maintaining a two or three thousand mile long wire line, against sleet and snow, high wind, defective insulation, casual depradation, (and sometimes over-luxuriant vegetation) then come into consideration. If the wire line crosses one or more mountain chains, there are bound to be troublesome and weak points. Underground cables for wire telephony, except in the case of very high-grade and comparatively short-distance traffic, have not come into use because of their great cost. In addition, long telephone lines must be "loaded" electrically to prevent excessive speech distortion, and require the use of fairly elaborate two-way amplifiers at a number of points along the line. When it is considered that the cost of the line alone in the New York-San Francisco wire telephone transmission is in the neighborhood of two million dollars, and that this line must be constantly patrolled by hundreds of men, it will be seen that radio telephony may well come into

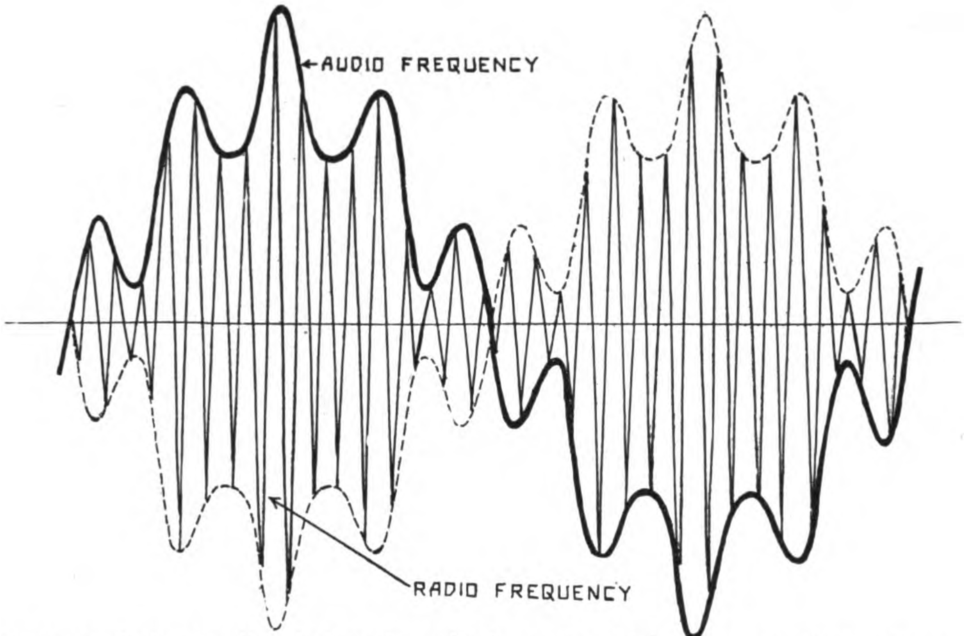


Figure 4.—Basis of radio telephony by audio frequency modulation of radio frequency energy

consideration. That is to say, at some point (e.g., *X* in Figure 1), the radiophone may become more desirable than the wire telephone. There is no question that the distance of transmission corresponding to this point *X* depends directly on the extent to which strays can be eliminated in reception. It can safely be said that so long as radio telephony over long distances is dependent on absence of serious atmospheric disturbances, it will be handicapped thereby. With the advent of apparatus which markedly reduces stray intensity, wire line telephony over very considerable distances will be at a marked disadvantage. This will result in shifting the point X far to the left of the position indicated in Figure 1.

(b) **Oversea Telephony.** As soon as we consider telephony over water, we find a different state of affairs existing. It is questionable whether radio is not always less expensive than cable telephony in this case. Certain it is that over great stretches of water radio telephony is at an enormous advantage because of the great cost of laying and maintaining the type of cable required for submarine telephony and also because radio communication over water is always accomplished with less power than for the equal distance over land. Consequently, we have tentatively indicated in Figure 1 the sea radio telephony curve as lying below the sea cable telephony curve throughout the length of each, and with the advantage of the former becoming specially marked for great distances. Of course, so far as long range overseas communication with ships is concerned, the radiophone has no rival.

Passing now to the technical aspects of radio telephony, we desire to make clear the scope of these papers. They are not in the least intended to give every practical detail of construction of a "50 mile radiophone set," or indeed to go into many practical details of construction at all. The reason for this is two-fold. First of all, the limitations of space would prevent adequately treating all existing methods of radio telephony, even were all data available, and secondly, the cost to-day of building a reliably operative radiophone over any considerable distance is beyond the reach of most experimenters. In other words, the average amateur might just as well not attempt to construct such sets in the present state of the art. Furthermore, it is not possible for us here to give due credit to all those responsible for the historical development of each device described; nor to assign with any certainty patent rights in the apparatus mentioned. Present-day litigation and confusion as to patent rights would render such a course inappropriate on our part. We cannot even cover the entire field of radio telephony exhaustively. At best, we can only describe certain interesting and *operative* methods of radio telephony, assigning them to the manufacturer or designing engineer at present concerned with them, and giving proposed changes or improvements.

5. **BROAD PROBLEMS INVOLVED IN RADIO TELEPHONY.** These problems are the following: (a) that of radiating energy at all for this purpose; (b) distortion of speech due to several causes; (c) the allied problem of amplification of speech at transmitter and receiver without distortion; (d) the obtaining of secrecy, and (e) the reduction of stray disturbances.

(a) **Radiation of Modulated Energy.** It first becomes incumbent on us to consider the nature of speech. In the back of the throat of the speaker, a sort of membrane known as the "vocal cords" is set into more or less continuous vibration by the breath. The quality of the resulting sound is modified in at least two ways: by altering the shape of the mouth with the tongue or otherwise and thus causing a degree of selective resonance, and by actually starting or stopping the stream of sound as is done with the harsher consonants, e.g., the letter "d." The extreme complexity of the resultant sound vibration of the air is illustrated in the oscillogram of Figure 2.* This is a record of the current in a telephone line (and therefore approximately of the sound in the receiver) corresponding to the sustained vowel sound "ah" (as in "bah," a clear-speaking man's voice being used for the test. The total time of the record is slightly over one-twentieth of a second. The basic vibration was of approximate frequency 800 cycles per second and the chief modification thereof occurs with a frequency of 120 cycles per second. The great complexity of speech, even for the comparatively regular vowel sounds, is well illustrated. When the comparative crudity of radio telegraphy is considered, the difficulty of radio telephony becomes obvious. On the one hand, in telegraphy as nearly as possible complete and abrupt starting and stopping of the energy flow is required and this at no very rapid rate. In radio telephony, on the other hand, the outgoing flow of energy must be moulded and modulated with close approximation to the excessively complicated wave form of the speech vibrations. The difference in degree is not far from that between ruling a dot-and-dash line and making a dry-point etching of an autumn landscape.

Given, then, the complex vibrations which constitute speech, the problem of radiating the moulded energy arises. Of course, on a small and feeble scale the problem is solved in every-day conversation between two persons. This may be termed a species of "audio telephony," the frequency of the radiated air waves being those of the speech itself, *i. e.*, of the order of 2,000 cycles per second. The same sort of solution might be attempted, using the electromagnetic "ether" waves of audio *i. e.*, audible), frequency to carry the telephone message. This solution is entirely unsatisfactory for a number of reasons. Firstly, the frequencies in speech vary considerably, and the radiating system (antenna) could not remain resonant to all these frequencies and their corresponding electromagnetic wave lengths. Secondly, the wave length would be excessively long, being 150,000 meters, or 90 miles, for the frequency of 2,000 cycles per second. This would require, for fairly effective radiation, an antenna of the length of say 10 or 20 miles, which is beyond the dreams of even the designers of the highest powered stations.

* This unusually clear record the author owes to the kindness of Mr. John B. Taylor.

Were an ordinary antenna about 300 feet (100 meters) high to be used, its radiation resistance at 2,000 cycles would be 0.0007 ohm, necessitating an antenna current of no less than 12,000 amperes to radiate even 1 kilowatt effectively. It is unpleasant to imagine the voltage at the antenna top under these conditions; its value being not far from a million and a half volts. Obviously, as a practical consideration, radio telephony by means of electromagnetic waves of the same frequency as that of speech vibrations is out of the question.

At this point, the problem of radio telephony looks sufficiently hopeless; but fortunately an ingenious alternative (and a successful one) is available. Let the rippling curve of Figure 3 represent the sound vibrations corresponding to some spoken word. If this word was recorded on a vertical-cut phonograph record, a cross section of the groove of the record would show this curve as indicated. If a needle, indicated in the figure, were to move from left to right along the groove, and were pressed against the record it would also move up and down. If a diaphragm were fastened to the upper end of the needle, this diaphragm would set into motion the air near it, and the resulting sound vibrations would be an accurate reproduction of the original speech used in making the record. So far, we are on familiar enough ground.

But suppose that we were suddenly to encounter a difficulty of the following kind. Imagine that it were not feasible to secure a large enough diaphragm at the top of the needle to set much air into motion. We might choose to use a small diaphragm vibrating *very rapidly* instead. In fact, we might arrange that this diaphragm vibrated so rapidly that its vibrations could not be heard at all, *but only the variation in their amplitude or width of swing.* Our phonograph record would now have to assume the curious appearance of the thin-line to-and-fro curve of Figure 4. This curve has been appropriately marked "radio frequency" in the figure, as distinguished from the heavy or envelope curve marked "audio frequency." The audio frequency curve is exactly the same as before, but it is replaced for radiating purposes by the *moulded or modulated radio frequency curve. The radio frequency curve* should strictly not have sharp peaks at the extreme of each alternations but should be a rounded "sine" curve. For clearness in the figure, it has been indicated as sharply peaked. Its frequency must be over 10,000 cycles per second, corresponding to inaudible "sound."

It may seem peculiar to speak of "hearing the variations in amplitude of a super-audible vibration," yet this is entirely possible. All we should need under the simplest conditions would be a "sound rectifier"; *i. e.,* a device which only permitted one-half of the radio frequency sound to reach the ear. This would correspond, in Figure 4, to admitting to the ear only those portions of the radio frequency vibration which lie above the middle line. Although the ear could not follow each of the myriad radio frequency impulses which it would thus receive, nevertheless the ear drum would receive inward pushes of an amplitude variation corresponding to the heavy line audio frequency curve. Consequently the variations in the super-audible vibration would certainly be heard. The necessity for the "sound rectifier" is clear enough when we consider that without it extremely rapid impulses on the ear drum in opposite directions (corresponding to the entire radio frequency curve) would merely neutralise each other, causing no actual motion of the heavy ear drum. It is assumed that, though the ear drum can follow readily enough audio frequency vibrations, its inertia is so great that it could not follow the radio frequency vibrations to any appreciable extent. Hence the necessity for the "sound rectifier" producing mono-directional impulses of varying amplitude instead of bi-directional mutually neutralising pushes-and-pulls of variable amplitude.

If we substitute for the explanation in the above imaginary acoustic case. the corresponding electrical case, we find that the explanation given holds equally. Since our antennas are too small electrically to radiate effectively audio frequency electromagnetic waves (as shown in an earlier paragraph), we are compelled to telephone by means of the variation of super-audible (that is, radio frequency) electromagnetic waves. In other words, the energy actually radiated from the station must resemble the "radio frequency" curve of Figure 4, and follow in its envelope curve (the audio frequency curve) of he original sound vibrations.

The necessity for the crystal or valve *rectifier* (corresponding to the imaginary "sound rectifier" mentioned) is also evident if we substitute in the analogy already given the combination of telephone diaphragm and ear drum for the ear drum itself. Its function will be seen to be the furnishing of mono-directional mutually assisting electrical impulses which can push aside a heavy telephone diaphragm, which same diaphragm would hardly respond at all to the bi-directional mutually neutralising unrectified impulses.

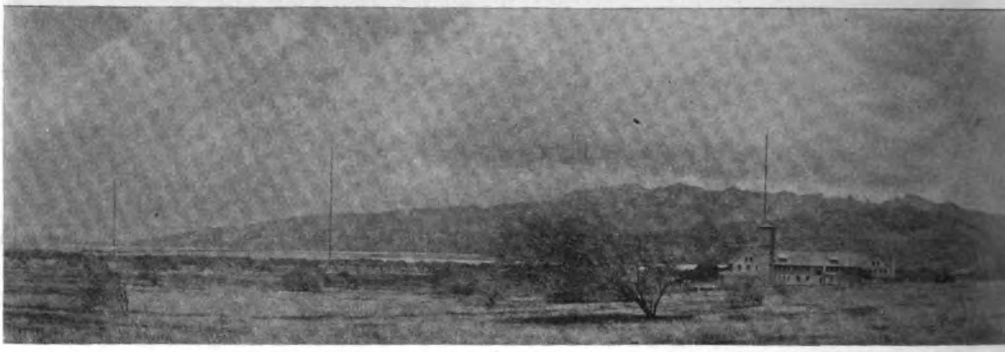
From the foregoing, we can draw one very important conclusion. The radio frequency used in radio telephony must be quite inaudible and completely steady, and many times higher than the audio frequency voice vibrations. Otherwise we should hear in the receivers a continuous, high, and piercing tone corresponding to the ever-present radio frequency, which shrill tone would naturally be an objectionable interference with the conversation. Furthermore, the accurate reproduction of the delicate overtones in the voice, which are of fairly high frequency themselves, is dependent on having many radio frequency cycles available for the moulding process, so that the envelope curve will be very faithfully followed.

It is to be noted that a second method of radio telephony exists, which might be termed "modulation by change of frequency (or wave length)." Instead of altering the amplitude of the radiated waves in accordance with the envelope speech curve, we might systematically increase and diminish the radiated frequency in proportion to the envelope curve. For example, while normally radiating at 50,000 cycles per second (6,000 meters wave length), we might alter the frequency to say 48,000 cycles at points corresponding to the peaks in the audio frequency curve, to 49,000 meters for points corresponding to half-way between peak and zero in the audio frequency curve, and so on. At the receiving station, the response in the detector circuit would then be proportional (or nearly so) to the speech curve in view of the tuning and detuning effects which would occur in the receiver as the rapidly varying frequency was received. This method permits keeping appreciably full load on the radio frequency generator at all times.

It is the view of the writer that any such method is objectionable in that it distributes the radiated energy over a considerable range of wave lengths, thereby increasing the liability to interfence with other stations. Furthermore, stray reduction will probably require the reception of a single sharply defined frequency.

A third alternative method exists for radio telephony, this being a combination of the first two. That is, both the amplitude and the frequency of the radiated waves are varied in accordance with the audio frequency curve. This method, rather than the second, has been occasionally used; but it suffers from the same defects as the second method and has no great advantages over the first.

This is the first of a series of twelve articles on "Radio Telephony" by Dr. Goldsmith, an eminent authority on the subject. Causes of speech distortion, secrecy of communication and the elimination of strays are subjects which will be discussed in the second article, to appear in the February issue.



A view of the Koko Head, Hawaii, mast line, showing the hotel for engineers and oper
the Japanese mast. On top of Koko Head, an extinct volcano, is a t
The Koko Head station was planned originally as the receiving

Intangible Bond Between the Occider
Wireless Linking th

BEHIND the announcement that the wireless service established between the United States and Japan by the Marconi Wireless Telegraph Company of America was inaugurated on November 15 lies a story of overcoming seemingly insurmountable difficulties; of the accomplishment of engineering feats that apparently defied the most skilled efforts; of the battling with nature in remote climes and finally the resultant triumph—the forging of another link in the world-wide radio chain and the unlocking of other gates to the commercial world of the Orient.

The history of the United States-Japan service began about four years ago, when the idea of encircling the world with radio stations was evolved. Not even a rumble of the great European war was being heard at that time, but the advantages of a wireless chain in time of war were pointed out, attention being called to the value of the system in the event of the severing of the cables. Followed an exhaustive investigation by the English Post Office authorities who at length reported that the Marconi system was the one to utilize in the project. The reason for this choice, it was explained, was that this system alone could provide the required service with proven reliability of operation.

The execution of the plan having been decided upon, the far-reaching machinery of the Marconi system was immediately set into motion. The American Marconi Company was called upon to build the following units: Trans-Atlantic stations at New Brunswick and Belmar on the New Jersey coast to send and receive messages to and from corresponding stations in Great Britain; sending and receiving stations respectively at Bolinas and Marshall, California, linking the Pacific coast with the Hawaiian stations, Kahuku and Koko Head, two similar stations in Manila, the Philippine Islands, and receiving and transmitting stations at Marion and Chatham, Massachusetts, to connect in Norway with Stavanger and Naerbo.

Extensive industrial activity marked this herculean task. From the Atlantic to the Pacific, from the Golden Gate to Hawaii, it reached. Station buildings, homes for engineers, operators, towering masts, intricate apparatus—these were built and transported until the dream of a globe-girdling wireless system began to assume tangible form.

One of the first difficulties that came up in connection with the construction of the stations was that of transportation of materials. Practically all of the structural steel and machinery for the

in the center. At the left of the hotel can be seen the San Francisco mast and at the right and an anchorage of the aerial wires is sunk far down in the center. in Hawaii and will be used as the demands of the service require it

and the Orient Strengthened by United States to Japan

Kahuku and Koko Head stations was conveyed by steamship from New York to the Port of Mexico, across the Isthmus of Tehuantepec, and thence by boat to Honolulu, the trip occupying about five or six weeks. The cement and lumber were shipped from California.

Koko Head, which was planned originally as the receiving station in Hawaii, and will be used as the demands of the service require it, is about ten miles east of Honolulu. There were two ways to transport the material to this point: Either by carting it by road, a plan which had many drawbacks because of the condition of the thoroughfare, or by transporting it by boat and unloading it on the beach. A trial of the latter plan was decided upon and a consignment of steel was loaded on a small steamer commanded by a Hawaiian who had earned a reputation for skill in manoeuvering his craft in and out of the numerous difficult landings. A barge and a launch accompanied the steamer, for the latter could not be navigated over a bar on the route to Koko Head and it was planned to unload the material on the barge and have the latter towed ashore by the small steam-propelled boat. All went well until the launch with the barge in tow tried to shoot through the breakers. The first line of rollers was passed in safety, but a short distance farther on two large combers submerged the barge and it sank. Thus ended the attempt to effect transportation by the sea.

Meanwhile the experiment of conveying the material by road was being tried. The caravan, laden until the wheels of the wagons creaked and groaned, started from Honolulu soon after midnight and ran into a tropical rainfall after it had proceeded, only a few miles. The road, which was built of red clay mud, softened and became so slippery that the wagons could not be driven in a straight line, the rear wheels slipping off to one side wherever the surface of the thoroughfare sloped. As a result material fell from the vehicles, parts of harness broke, wheels were put out of commission and it was finally necessary to shift most of the loads, double up on the teams and bring the material piecemeal to the site of the station. Notwithstanding this discouraging experiment, the trucking was continued by means of the road route, although the horse-drawn vehicles were discarded and automobiles substituted.

Koko Head, located on the Island of Oahu, the third in size of the Hawaiian group, is known as the dryest point on the island. The land is undeveloped and is used only for cattle grazing, even the latter getting little nourishment from the scanty surface growths. In fact, they frequently perish because of the lack of fresh water. The inadequate water supply threatened to cause considerable hardship among the engineers and station builders. 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, and after scouring the hills in search of a supply, it was decided to distil all water.

From the operating house as a center, the San Francisco aerial extends southwestward, carried on five 330-foot masts to an anchorage. The Japan aerial extends from the operating house almost due east. The first two masts are of the standard sectional type, 430 feet in height, the first being on level ground and the second on a hillside. From the latter point the aerial makes a span of more than 2,000 feet to the top edge of Koko Head, an extinct volcano, at an elevation of 1,194 feet above the sea level; here there was not room enough to erect a sectional mast, only about forty square feet being available for a self-supporting structural tower, 150 feet in height. 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 100 feet in height. The difficulty in erecting these masts was largely due to the fact that two of them and the anchorage were located in a pond and it was necessary to sink caissons in order to lay the foundations.

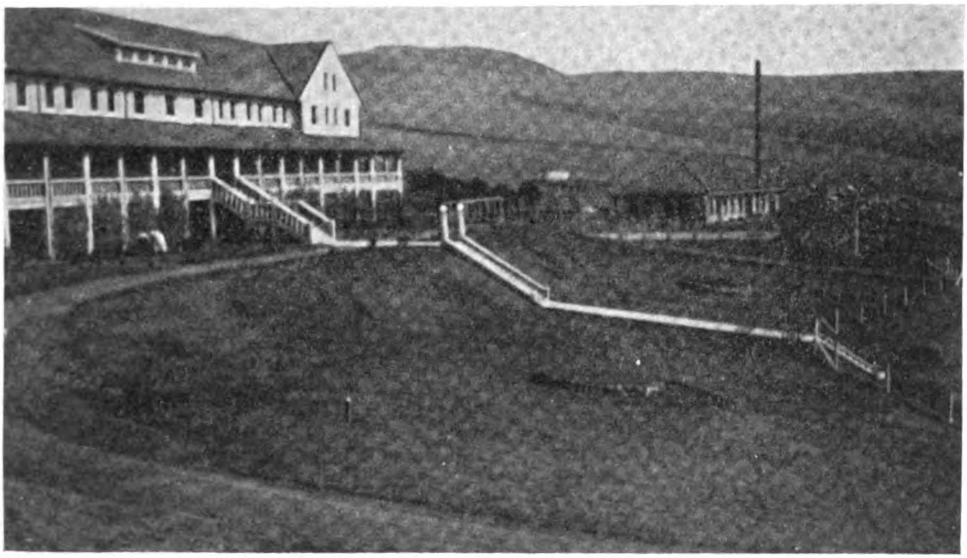
The problems of construction at Kahuku, which is now being employed both as a sending and receiving station, were not as great as those at Koko Head, although the former is the largest wireless station in the world. From the power house the San Francisco transmitting aerial extends southwestward, supported by twelve masts, each of which is 325 feet in height; the Japanese aerial extends to the southeast supported by twelve masts, each being 475 feet in height. The subsoil at the station is made up of porous coral rock and consequently considerable difficulty was experienced in putting down foundations for the power house and masts. 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 required different treatment, but generally the trouble was due to the presence of water in the subsoil, a factor, however, which added to the facility of operating the station.

The task of constructing the Bolinas station involved taking into consideration the fact that most of the material for erection purposes—the mast sections and wire rope for the eight masts, each 325 feet in height, and the steel work and machinery—was manufactured in the Eastern part of the United States and in order to transport it to Bolinas, which is about fifteen miles from San Francisco, it was sent from New York by boat to the Isthmus of Panama, across the Isthmus by rail and thence by water again to San Francisco.. As there was no railroad transportation available from the latter city to Bolinas, it was necessary to ship a considerable part of the material by water route from San Francisco, unload it at the wharf at Bolinas Bay and haul it by motor trucks to the site of the station. A sand bar with a shallow opening through which the tide races, obstructs Bolinas Bay, making it impossible for craft of considerable size to reach the wharf except during high tide. In addition to these handicaps there was the necesity for rushing the work in order to make all the progress possible during the season of comparatively few storms.

As was the case at Koko Head, much difficulty was met with in obtaining a water supply. This was due to the fact that the ground is full of cracks caused by earthquakes and that the salt water from the Pacific seeped in. The solution of this vexed question was found, however, by damming a creek and installing a small pumping plant and a tank.

At Marshall, the receiving station, twelve miles north of Bolinas on Tomales Bay, there were perhaps fewer obstacles to be overcome than at the other stations. The distribution of the construction materials was carried out from two points, a railroad running from Sausalito, near San Francisco, providing transportation. Extension tracks were built on the southern boundary of the site where all material for the buildings and the first two masts nearest these structures were unloaded and hauled away by motor trucks. The material work required while the sections were being bolted together.

The wooden topmast was the key note of this novel system of construction, operating like a man who pulls himself up by his bootstraps. The lower half of this topmast is of square section and is guided by a square hole in the diaphragm



At the left, the Marconi hotel for men of the trans-Pacific station at Marshall, California. The Marshall station is employed for receiving messages from Japan and Hawaii

for the remainder of the masts (there are seven in all, each 330 feet in height) was unloaded at the railroad siding at Marshall and hauled through the town and up a steep incline.

One of the most interesting features of the construction work was the erection of the steel masts. The mast is made up of steel cylinders, constructed in quarter sections flanged vertically and horizontally and secured together by bolts. Stayed with steel cables, these stand in a concrete foundation. Surmounting the main steel column was a wooden topmast, the lower part of which is squared and set in square openings in the plates between the steel cylinders. The hoisting arms attached to the upper end were fitted with blocks and hoisting cables. Attached to these arms were chain hoists supporting a square wooden cage for the workmen, which was lowered or raised as the demands of the plates between each section. The topmast was fitted with a set of hoisting arms which carried blocks through which reaved the material hoisting ropes. A square wooden cage was suspended from the hoisting arms by four chain hoists so that the workmen in it could move themselves up and down to bolt the sections together.

Assume that two cylinders have been bolted to the bed plate, the mast rising through the center. The sections of the third cylinder were raised by a steam winch and bolted in place by the workmen. Then a heavy flexible steel rope was temporarily anchored at the top of this last cylinder. Attached to the top of the steel section, this cable led down inside the cylinders and around a wheel in the foot of the wooden topmast; then it was carried up again on the other side and around a sheave to the top of the steel, thence to the winch. By pulling on this rope the topmast was raised the length of one cylinder and pinned through holes in both steel and wooden masts. With the addition of a new cylinder, the topmast was raised again, the pin supporting it until this was brought about. The stays were attached at the required points as the erection of the mast progressed.

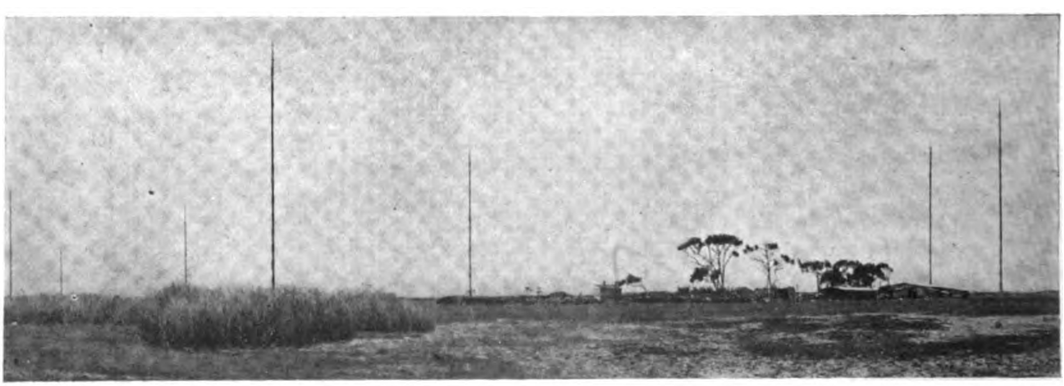
The stays, by means of which each mast is supported, are made of heavy plough steel cable, possessing great tensile strength. For each mast thousands of feet of this cable were used, great care being taken to see that the elastic extension of these stays was not so great as to result in the vibration of the mast during heavy winds. It was essential to break each stay into short lengths connected with great porcelain insulators in order that the electrical energy might not be absorbed, led to the earth by the stays and lost for purpose of wireless operation. For all connections at the masts, insulators and anchorages, special bridge sockets were designed. This did away with the necessity for splicing and permitted a perfect and straight pull, thereby developing the strength of the cable. Heavy concrete blocks were used as anchorages for the stays.

In addition to the antennae stretched between the masts, great quantities of wire were placed in the ground about the stations in order to provide an efficient earthing system or ground connection. Told in brief, a circle of zinc plates is buried in a trench, bolted together and joined to the wireless circuits of the power house by copper wires. Wires radiate from the zinc plates in the ground to a set of outer plates, from which extend another set of earth wires placed in trenches running the full length of the aerial.

The capacity of each of the generators employed in the stations of the United States-Japan circuit with the exception of that at Funabashi is 300 kilowats. These generators are driven by 500 horsepower motors, except at Kahuku, where 500 horsepower turbines are used.

A feature of these stations that stands out distinctively is the type of aerials installed. Thousands of tons of steel are required for these aerials. The distinctive feature of the aerials at the Marconi trans-Pacfiic stations is that they are directional, that is the radiation of wireless signals in the desired direction is very much stronger than in any other. This control of the signals is a long step ahead in wireless communication. All of the stations are of the duplex type and can receive and transmit signals at the same time.

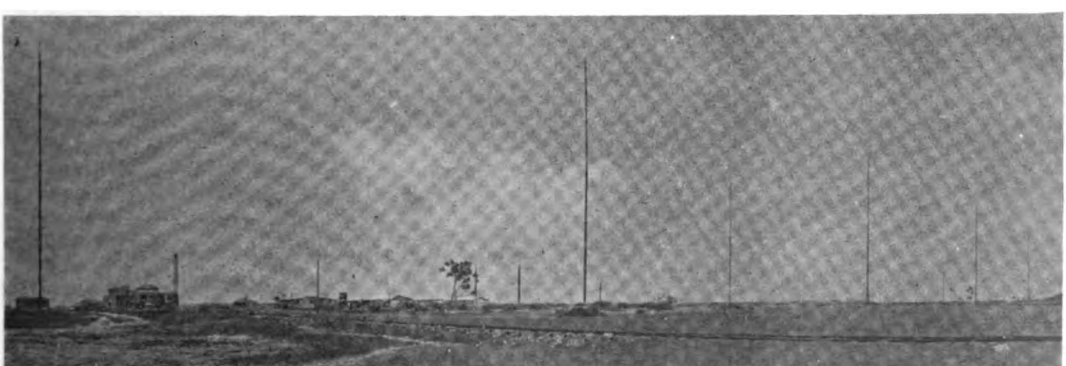
The automatic sending and receiving apparatus plays an important part in the service between the Occident and the Orient. The sending machine somewhat resembles a typewriter and will make possible the transmission of more than 100 words a minute. Under the automatic system, ten or 100 messages can be filed at the same time at the office of the Marconi Company in Honolulu. They will be distributed among the necessary number of operators and the dots and dashes punched in a paper tape by a ma-



The Kahuku, Hawaii, Marconi trans-Pacific wireless station, a general view of which is both for sending and receiving messages. In this photograph are shown the Japanese chine. This tape is fed into an automatic sender and the signals conveyed by land line to Kahuku where the dots and dashes actuate a high power sending key, automatically energizing the aerial instantaneously with the feeding of the tape in the station, thirty miles or more away. At the transmitting station the dots and dashes operate magnets of the high-power sending key in the main energy circuits and the signals are flashed to the points which the destination of the message calls for—either Marshall or Funabashi. If the message is destined for Marshall it will be received on a specially constructed dictaphone machine, each cylinder, as soon as it is filled with the dots and dashes, being handed to an operator who will transcribe it into a typewritten message by means of a dictaphone machine running at normal speed.

Such were the difficulties, the achievements and a few of the problems met with. After the stations had been completed there was a long period of tests and trials. The first results of these were marked by the opening of the service between Hawaii and the United States on September 24, 1914. On February 2, 1915, the station in Ochiishi, Japan, it was announced by newspapers of that country, had received messages from the Kahuku station. Prior to picking up the signals of the Kahuku station Ochiishi was receiving messages from a steamship 1,100 miles off the Japanese coast. The Ochiishi operators declared that the messages from Hawaii were clearer than those from the steamship, notwithstanding the fact that the distance was more than three times as great. This was only one indication of the great range of the Kahuka station, for while tests were being carried on with the station in Funabashi, near Tokio, Japan, which was selected as the Japanese unit to communicate with the Hawaiian stations, inquiries regarding the spark and wave-length of Kahuku were received from Porto Rico, the Falkland Islands, New Orleans and New Zealand, where the signals transmitted by Kahuka were easily read.

At ten o'clock in the morning, New York time, and midnight, Tokio time, of the day appointed for the opening of the service, the cumulative result of the three years of study and effort which Edward J. Nally, vice-president and general manager of the American Marconi Company, and the members of his staff had devoted to the task of establishing communication with Japan was signalized by an exchange of messages between notables in the United States and the former nation. As an illustration of the operation of the service it can be stated that a message from President Wilson to the Emperor of Japan, at Tokio began its radio flight at the Bolinas station, from which, with the speed of a lightning flash, it took an unerring course across the Pacific and was received at the Kahuku station, spanning a distance of 2,372 miles. Quickly it was copied at Kahuku, given a new impetus, and sent speeding across the space of 4,140 miles that it had to traverse before reaching Tokio. In a similar man-



pictured in this photograph, is now employed in the United States-Japan wireless service mast, at the right of the power house (center), and the San Francisco mast at the left ner the reply of the emperor was dispatched to President Wilson. The message was transmitted from Funabashi and relayed at Kahuku to Marshall, which station has direct communication with the Western Union Telegraph Company, over whose wires traffic is forwarded. In Japan, connection is made with the Japanese Imperial Telegraph system to all points in the Orient.

All of the communications between the United States and the Hawaiian and Japanese stations are transmitted in English or French. The Funabashi station is controlled by the Japanese Government and has two staffs of operators, military and civil, being employed by the Department of Posts and Telegraphs for commercial business, as well as by the Government.

A rear view of the mast line of Bolinas, the transmitting station of the Marconi trans-Pacific wireless link in California, from the ranch buildings, in the foreground, adjacent to the station property. The line of masts is a mile in length, extending to the ocean. In the background are shown the power house and the Marconi hotel for engineers and operators. Messages destined for Hawaii and Japan are flashed from this station

For the present the Marconi United States-Japanese service will be confined to San Francisco, Hawaii and Japan. There will be two classes of service between San Francisco and Japan, a full rate or expedited service at eighty cents per word, a reduction of forty-one cents per word from the existing cable rates, and a deferred half-rate service at forty cents per word, the lowest cable rate at present being $1.21 per word.

This linking of two nations by wireless is simple in the telling and in time will doubtless be accepted as a part of the scheme of general conditions in communication. But the men who brought it about, who spent days and nights in determining the solutions of vexed questions, who conducted tests regardless of time and weather, who journeyed to distant parts of the world to blaze the initial path of the project—they will long remember the romance and the difficulties of the undertaking, even though it was all a part of the day's work.

Marconigrams Interchanged by Eminent Men

Men prominent in various walks of life interchanged marconigrams on the day of the inauguration of the service. Besides President Wilson and Emperor Yoshihito of Japan, messages were sent and received by Guglielmo Marconi and Godfrey Isaacs, managing director of the English Marconi Company; Jiro Tanaka, director general of Posts and Telegraphs, the Ministry of Communications, Japan; John W. Griggs, president of the Marconi Wireless Telegraph Company of America; Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, and Frank A. Vanderlip, president of the National City Bank. Among the messages flashed to and from Japan were the following:

The White House,
WASHINGTON, November 15, 1916.

His Imperial Majesty the Emperor of Japan at Tokio:

The Government and people of the United States of America send greetings to your Imperial Majesty and to the people of Japan and rejoice in this triumph of science which enables the voice of America from the far West to cross the silent spaces of the world and speak to Japan in the far East, hailing the dawn of a new day. May this wonderful event confirm the unbroken friendship of our two nations and give assurance of a never-ending interchange of messages of good will. May the day soon come when the voice of peace, carried by these silent messengers, shall go into all the world and its words to the end of the world.

WOODROW WILSON.

TOKIO, November 15, 1916.

President of the United States,
Washington, D. C.:

It affords me much pleasure that the first use of the installation of wireless telegraphy between Japan and the United States has been to transmit your cordial message. In return I send this expression of my thanks for the good will exhibited toward me and my people, and of the hearty desire entertained throughout Japan for the continued prosperity and welfare of the United States.

JOSHIHITO.

WASHINGTON, November 15, 1916.

The American Ambassador, Tokio:

I tender your Excellency my sincere greetings on the occasion of this new conquest of space, which is not only a great triumph of science, but is another powerful addition to the bonds of friendship and good neighborhood between Japan and America.

JAPANESE AMBASSADOR,
Washington.

TOKIO, November 15, 1916.

The Japanese Ambassador,
Washington, D. C.:

Sincere thanks for your Excellency's greetings and congratulations. All true men join you in the hope that this last triumph of science will draw our two nations into still closer bonds of friendship and good neighborhood.

AMERICAN AMBASSADOR.

NEW YORK, November 15, 1916.

Hon. Jiro Tanaka,
Director General, Posts and Telegraphs, Ministry Communications, Tokio:

Accept my heartiest congratulations for your large share in the completion of the Japan link which welds two nations together by an invisible bond. I know of no more encouraging feature in the development of the world's commerce.

JOHN W. GRIGGS,
President Marconi Wireless Telegraph Company of America.

FUNABASHI, November 16, 1916.

John W. Griggs,
President Marconi Wireless Telegraph Company of America,
New York.

My best felicitations upon the successful opening of the trans-Pacific wireless service. I sincerely hope that this invisible circuit will tend to augment the amicable relations of the two countries, and that the service will be developed with rapid strides.

JIRO TANAKA,
Director General, Posts and Telegraphs.

NEW YORK, November 15, 1916.

Hon. Jiro Tanaka,
Director General, Posts and Telegraphs, Ministry Communications, Tokio:

For three years we have worked together to commercialize this miracle of wireless. Our relations have been so harmonious and so pleasant that we have added reasons to celebrate this day and to exchange felicitations upon the happy completion of what seemed a well-nigh impossible task. Accepting this as an augury of the future character of communications which may pass between us and between those who may use our service, it brings us assurance of continued friendly relations. My congratulations and best wishes to you and to all the members of your staff.

EDWARD J. NALLY,
Vice-President and General Manager, Marconi Wireless Telegraph Company of America.

FUNABASHI, November 16, 1916.

Edward J. Nally,
Vice-President and General Manager, Marconi Wireless Telegraph Company of America, New York:

On the occasion of this happy event allow me to offer our best and cordial greetings to you and your company, coupled with the earnest wish that this new bond of communication across the Pacific, and this achievement of the modern scientific invention, will serve to enhance the political, commercial and friendly relations existing between the two countries. I avail myself of this opportunity to tender you and all your staff interested in bringing about this successful result my heartfelt thanks and warmest congratulations.

JIRO TANAKA,
Director General, Posts and Telegraphs.

LONDON, November 15, 1916.

Director General, Posts and Telegraphs of Japan, Tokio:

Our warmest congratulations upon the inauguration of a public wireless telegraph service between your country and the United States of America. The cheaper and the easier communication is made betwen two peoples the better do they learn to know and understand each other and the greater is the development of their mutual interests. May this new service contribute substantially in this direction.

GUGLIELMO MARCONI,
GODFREY ISAACS.

FUNABASHI, November 16, 1916.

Guglielmo Marconi,
Godfrey Isaacs,
London:

Accept my thanks for your telegram conveying greetings for the opening of the public service which is heartily reciprocated.

JIRO TANAKA,
Director General, Posts and Telegraphs.

NEW YORK, November 15, 1916.

Doctor Jiro Tanaka,
Japanese Minister Communications:

Heartiest congratulations on successful opening Japanese-American circuit, marking a new era in scientific achievement and closer knitting of two great nations.

JOHN BOTTOMLEY,
Vice-President, Secretary and Treasurer, Marconi Wireless Telegraph Company of America.

FUNABASHI, November 16, 1916.

John Bottomley,
Vice-President, Secretary and Treasurer, Marconi Wireless Telegraph Company of America, New York:

Your telegram conveying greetings gratefully acknowledged. May our new route uniting the far East and far West bring lasting welfare to the people of both countries.

JIRO TANAKA,
Director General, Posts and Telegraphs.

FUNABASHI, November 16, 1916.

The New York Times, New York:

Greetings heartily returned on fortunate occasion of establishment of wireless communications between America and Japan.

TERAUCHI,
Prime Minister, Tokio.

NEW YORK, November 15, 1916.

Count Seiki Terauchi,
Prime Minister, Tokio:

Greetings over the marvel of a wireless telegraph link between Japan and America.

THE NEW YORK TIMES.

SOME WIRELESS SPEED RECORDS

Although the service of the Marconi Wireless Telegraph Company of America between the United States and Japan was inaugurated only a short time ago, several speed records in sending and receiving messages, which prove wireless faster than existing cable practice, have already been made by operators in the trans-Pacific stations.

Operator "Paddy" Walsh of Honolulu recently sent to the Marconi receiving station in California, a distance of 2,372 miles, sixty-seven messages in one hour and twenty minutes. None of the messages was shorter than fifteen words and some of them contained forty words. W. H. Barsby, operator at the receiving station, copied the messages without a "break" or an error.

Operators in the Marconi office in the heart of the business section of Honolulu are today, with the aid of repeaters, transmitting direct to both the United States and Japan. Automatic transmission and reception of messages at a speed of from eighty to one hundred words a minute, will be brought into use in the near future. Duplex transmission through the ether between stations thousands of miles apart at a speed of a hundred words a minute, may appear as improbable to some persons as did wireless transmission across the Atlantic a few years ago. However, the equipment has been provided, the tests made and when conditions warrant the step, transmission at that speed in two directions simultaneously will be employed.

MORE USEFUL COMMUNICATION—MARCONI

Guglielmo Marconi, according to a dispatch from Rome, Italy, in an address on November 12 before a gathering which included the Duke of Genoa and the elite of scientific, literary, and aristocratic circles, said that wireless telegraphy had rendered magnificent services to Italy and her allies in the war.

He regretted that it was impossible, for obvious reasons, to explain as fully as he would have liked to do the progress made during the last two years in radio-telegraphy, but he described problems that are still unsolved, such as the origin, nature and means of dominating those natural disturbing waves known as "intruders," which he had been studying and experimenting with. He expressed the conviction that he would soon be able to announce means of communication more practical and economical.

WIRELESS CONVEYS RE-ELECTION NEWS TO WILSON

President Wilson was steaming up New York Bay in the yacht Mayflower when he received confirmation of his re-election. It reached him in the form of a congratulatory wireless message from his secretary, Joseph P. Tumulty, who was in Long Branch, N. J.

Mr. Tumulty had told the President he would not congratulate him until it was definitely known that he was elected. When the result was no longer in doubt, he sent the news by wireless.

THE SHARE MARKET

New York, December 6.

Bid and asked quotations in Marconi shares today:

American, 3⅛-3⅜; Canadian, 2-2⅜; English, common, 14-17½; English, preferred, 12½-15.

Famous Wireless Sets

By Blaine McLean

The Stars and Stripes and house-flag, too,
For sixty years on the ocean blue;
We'll haul them down with uncovered head
And furl away as loved ones dead.

THE transfer to the Atlantic of the former Pacific Mail trans-Pacific liners Mongolia, Manchuria, Korea and Siberia, and the disposal to foreign companies of the steamers Nile, Persia and China, recalls to mind the excellent wireless work accomplished by the sets on these vessels—work that has made them famous among radio operators the world over.

Wireless was first established on these ships in 1910, soon after the Florida-Republic disaster. During the seventeen-day voyage across the Pacific, the sets installed were practically always in communication with land, being able to send position messages to San Francisco nightly. On the last homeward-bound trip of the Mongolia communication was established in the same night with Japan, Siberia, Alaska, Hawaii and America.

An official record compiled a few years ago of the longest distances to which ships on the Pacific have communicated, shows that on February 21, 1912, the Persia established direct communication with San Francisco at a distance of 4,708 miles. This record, as far as I know, has never been exceeded by any ship station. During that year the Persia operated to distances of more than 4,000 miles at four different times.

While the Persia holds the record for long distance work the best average results have been obtained with the set on the Korea. The results accomplished have earned for this ship the reputation of having a "freak set." It is recorded that on March 3, 1912, she sent her position to San Francisco, when she was 2,193 miles west of Honolulu, or approximately 4,300 miles from San Francisco.

Most of the long distance records accomplished by the San Francisco station have been made by Operator in Charge F. W. Shaw, who has been at the station for nearly five years.

Long range work has not been so frequent recently, this condition being due perhaps to the large increase in radio traffic, which has prohibited coast stations operators from devoting as much time as formerly to this work. While messages are still being sent considerable distances, they are, in most cases, relayed.

Some wireless men are of the opinion that it is possible, with sets of equal power, to work further on the Pacific than on the Atlantic. Whether or not this is true, I do not know, but it is evident that the results obtained on the Pacific have, indeed, been most remarkable.

GERMAN ATTACK ON SEPNAVOLAK STATION

A Russian torpedo boat sank two German submarines and crippled another after the submersibles had attacked the Russian wireless station at Sepnavolak, on the Murman coast, according to information received recently in Christiana from Petrograd.

Several persons were killed by the gunfire of the submarines.

The Murman coast is the northern seaboard of Kola Peninsula, in the Arctic Ocean. It lies to the west of the entrance to the White Sea, in which is the important Russian seaport of Archangel.

RADIO ELECTION RETURNS FIRST IN

In a recent election in Maine the first town to report was the little hamlet of Criehaven, which constitutes a cluster of islands far off the mouth of the Penobscot, and commonly known as Matinicus. A few of the voters in this town are the keepers of the two granite lights on Matinicus rock, 20 miles off the mainland. The vote of Criehaven was sent to the county seat of Knox County, Rockland, by wireless, and so far as known this was the first instance of the use of wireless communication for the collection of election returns.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

The Construction and Use of a Calibrated Receiver Shunt Box

If I were to judge solely from the conversations I have had with fellow amateur workers, I should venture to assert that a pronounced haziness regarding the subject of quantitative measurements prevails. As an example, take the case of two receiving detectors and ask the owner how much better one is than the other—generally you receive a rather vague or perhaps indefinite reply.

It is well understood that the foundation of scientific knowledge is based upon accurate measurement and unless a given device is subject to careful quantitative analysis, it has but little scientific value. To say the least we should be able to compare it with some known standard in mechanics or electrics in order that we may judge its probable cost or commercial worth.

I am certain that the average amateur gives this phase of the subject too little attention and on this account gropes more or less in the dark. In my own experience this was distinctly the case and therefore I began at an early date to study the art of scientific measurement.

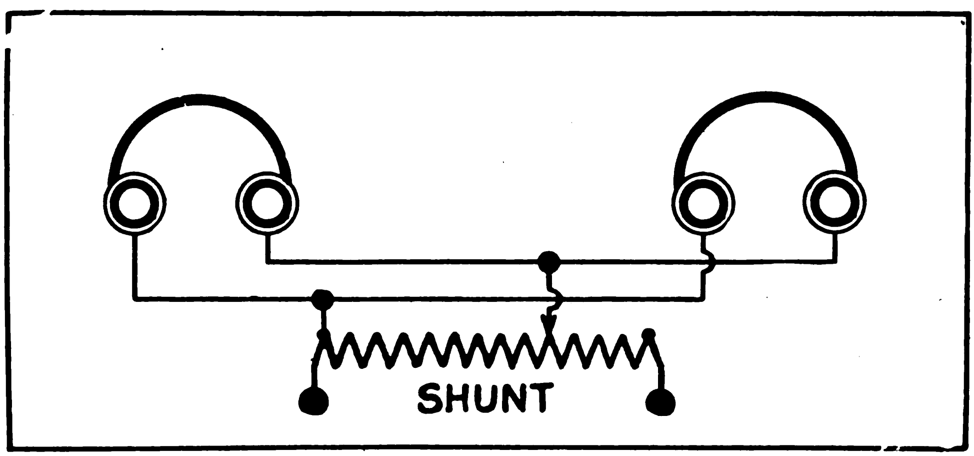


Figure 1, First Prize Article

Now it is comparatively easy to construct or purchase a wave-meter at a reasonable price which, when checked against a standard, gives a fair degree of accuracy; and although we may use such devices as the glow lamp, the hot wire milliameter, the wattmeter and the neon gas tube for determining the point of resonance, all these indicators are not as flexible and as rugged as the calibrated shunt box I am about to describe.

The telephone resistance shunt is generally termed an audibility meter because it can be used for comparing the strength of two signals in a receiving telephone. I have found a calibrated shunt box, sometimes called an "audibility meter," a valuable aid in making comparative measurements. A description of its construction will, I believe, interest readers of The Wireless Age.

The loudness of a signal in a receiving telephone is proportional to the square of the receiver current according to Dr. Austin (Manual of Wireless Telegraphy, Robison Edition of 1915, page 173) and conversely the intensity of the current is proportional to the square root of the loudness.

Thus if one sound is 100 times as loud as another the current which produced it is ten times as great.

Suppose that a signal produced by the current, I_1 comes in just at the limit of audibility, that another N times as loud produced by the current, I_2, follows, and we are required to determine the numerical value of N. If, by shunting the receivers, we reduce the receiver current down from I_2 to $\frac{1}{\sqrt{N}} I_2$ the second sound will be just at the limit of audibility and the multiplying power of the shunt will give us the measurement of the strength of it. Now this can be readily accomplished as follows: Let R be the resistance of the receiver, S the resistance of the shunt, I the incoming current in the telephone circuit and I_r the current in the receiver,

$$\text{Then } I_r = I \frac{S}{R+S} \text{ or } I = I_r \frac{R+S}{S}$$

The ratio, I/I_r, is called the multiplying power of the shunt and is represented by the letter M,

$$\text{Hence } M = \frac{R+S}{S} \quad MS = R + S$$

$$MS - S = R \text{ or } S = \frac{R}{M-1}$$

That is, in the case assumed, if we wish to reduce the receiver current to the $\sqrt{N}$ the part, we must shunt the receiver with a resistance S = Receiver resistance Sq. Root of N, — 1. Numerically, if the receiver is a 1500-ohm instrument and a current, I_1, coming in produces in the receiver when shunted with 750 ohms, a signal equal in audibility to that produced by a current, I_2, in the *unshunted* receiver, then $750 = \frac{1500}{\sqrt{N}-1}$

$$\text{or } \sqrt{N} - 1 = \frac{1500}{750} = 2 \text{ or } \sqrt{N} = 3 \text{ and } N = 9.$$

That is, the audibility of the former signal was nine times that of the latter and the current of the former is three times that of the latter.

Let us apply this formula to the

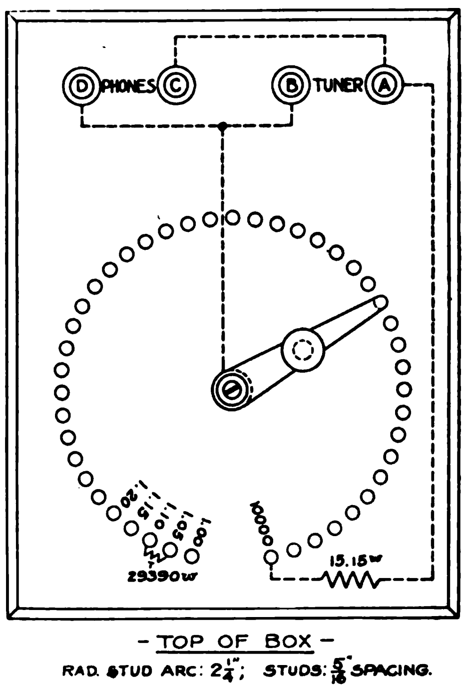


Figure 2, First Prize Article

working out of a table of shunts for a standard 1500-ohm receiver; these values are given in the table appearing on the following page.

If a 1000-ohm receiver were employed the values of the various resistances would be two-thirds those given in the table, and if a pair of 1500-ohm instruments were used the values would be doubled. Frequently, however, a station will possess two pairs of 1500-ohm receivers, in which case they may be con-

TABLE OF RESISTANCES.

Relative Loudness	Relative Current	Shunt for 1500 w phone	Coil Res.	Meters No. 22, 18% GS	Connecting Stud	to Stud
N	$\sqrt{N}$	$\frac{1500}{\sqrt{N-1}}$				
10000	100.	15.15	—	—	A	45
9000	94.87	15.97	0.82	0.82	45	44
8000	89.44	16.95	0.98	.98	44	43
7000	83.67	18.14	1.19	1.19	43	42
6000	77.46	19.61	1.47	1.47	42	41
5000	70.71	21.52	1.91	1.91	41	40
4000	63.25	24.09	2.57	2.57	40	39
3000	54.77	27.89	3.80	3.80	39	38
2000	44.72	34.31	7.42	7.42	38	37
1000	31.62	48.97	14.66	14.66	37	36
900	30.00	51.72	2.75	2.75	36	35
800	28.28	54.99	3.27	3.27	35	34
700	26.46	58.92	3.93	3.93	34	33
600	24.50	63.83	4.91	4.91	33	32
500	22.36	70.22	6.39	6.39	32	31
400	20.00	78.95	8.73	8.73	31	30
300	17.32	91.91	12.96	12.96	30	29
				Meters No. 36, 18% GS		
200	14.14	114.1	22.20	.872	29	28
150	12.25	133.3	19.20	.754	28	27
100	10.00	161.6	28.3	1.11	27	26
75	8.66	195.8	34.2	1.34	26	25
50	7.07	247.1	51.3	2.00	25	24
25	5.00	375.1	128.0	5.02	24	23
20	4.47	432.0	56.9	2.23	23	22
15	3.87	522.0	90.0	3.53	22	21
10	3.16	693.8	171.8	6.73	21	20
9	3.00	750.0	56.2	2.20	20	19
8	2.83	820.6	70.6	2.77	19	18
7	2.65	911.3	90.7	3.56	18	17
6	2.45	1034.5	123.2	4.74	17	16
5	2.24	1213.6	179.1	7.03	16	15
4	2.00	1500.	286.4	11.21	15	14
3.5	1.87	1722.	222.	8.70	14	13
3	1.73	2049.	327.	12.81	13	12
2.5	1.58	2582.	533.	20.09	12	11
2.25	1.50	3000.	418.	16.40	11	10
2.	1.41	3623.	623.	24.43	10	9
1.75	1.32	4644.	1021.	These Coils it is best to purchase	9	8
1.50	1.23	6667.	2023.		8	7
1.25	1.12	12710.	6043.		7	6
1.20	1.09	15790.	3080.		6	5
1.15	1.07	20830.	5040.		5	4
1.10	1.05	30610.	9780.		4	3
1.05	1.03	60000.	29390.		3	2
1.00	1.00	∞	∞		2	1

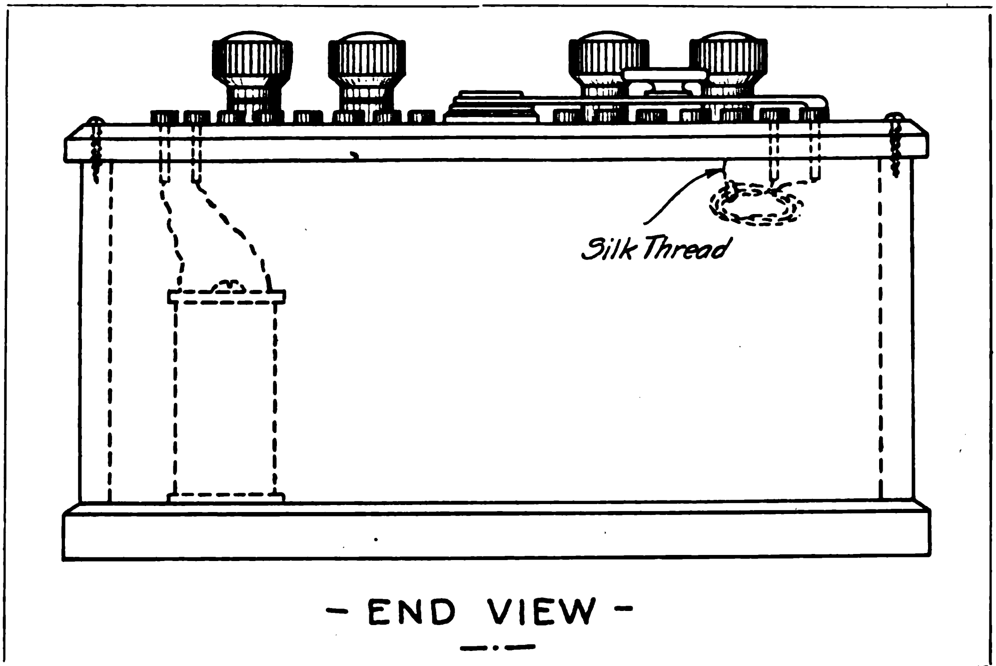


Figure 3, First Prize Article

nected as in Figure 1. In this case since four equal resistances connected, two in series and the two sets in parallel, are the equivalent of a single resistance, the same set of shunts will do in this case as in that of a single 1500-ohm receiver.

It is quite true that in this case the receiver current will be halved and the audibility factor reduced to ¼, at the same time both ears are in use and the aural acuity heightened or, in other words, the two ears acting together give a more balanced and keener perception, and the effect of extraneous noises is diminished. Furthermore, if two experimenters make the test both can listen in, thus deriving the benefit of two independent estimates of audibility. These advantages seem sufficient to justify the use of two pair of receivers even if one is left idle on the table although still connected in circuit.

My audibility meter box was made of seasoned birch, mahogany stain finish, the bottom of a ⅜-inch stock, sides and ends of ¼ inch and the top of ¼ inch hard rubber. The over-all dimensions of the box were 8 inches by 6 inches by 3 inches, which gives a good dimensioned top, with a 6-inch square space for the circle of contact studs, and a 6-inch by 2-inch space for binding posts. The plan of the box and end elevation are shown in Figures 2 and 3. I have not presented the details of the construction of switch arm and stud contacts, as they differ in no way from the ordinary types.

Upon the top of the box are stamped the values of the stud ratios. There are forty-five studs in all. No. 1 stud is left blank and marked 1; between stud No. 2 (which is stamped 1.05) and No. 3 (which is stamped 1.10) is soldered a resistance coil of 29390. ohms. Between No. 3 and No. 4 (which is stamped 1.15) is connected a coil of 9,780 ohms; between No. 4 and No. 5 (which is stamped 1.20) is a coil of 5,040 ohms, and so on, till between No. 44 and No. 45 (which is stamped 10,000) is placed a coil of 0.82 ohm resistance, while stud No. 45 is connected with binding post, A, through the last shunt coil of 15.15 ohms. The binding post, A, is connected with C. The switch arm connects directly with binding post, B, and the latter with D. Then the receiving telephones connect between C and D, and the leads from the receiving transformer circuit between A and B.

As a rule, do not attempt to adjust the resistances of the various coils closer than from 1 to ½ per cent., because the latter is about the best the average man can reach and also because the coil of the telephone receiver is wound with copper which changes resistance by 0.39 per cent. per centigrade degree change in temperature. The average work is certainly not worth making the temperature correction. Neither is it advisable to attempt, unless well skilled, to wind the coils for values in excess of 1000 ohms, as they will be bulky unless made of very fine wire. I advise amateurs to purchase this half dozen large coils from the Leeds Northrup Company of Philadelphia, or a similar concern, asking to have them wound non-inductively on wooden spools to a precision of not more than 0.5 per cent. They will probably be manganin, but if other wire is cheaper they might be thus specified. The cost will rise rapidly as a higher degree of precision is required.

The remaining coils one can easily wind of 18 per cent. German silver wire either silk or double cotton covered, as preferred. Thirty per cent. German silver has a higher specific resistance, but is more brittle and not worth the difference.

No. 36 B. & S. gauge will give 25.5 ohms per meter very closely. The greatest length of this required will be twenty-four meters and forty-three centimeters for the 623-ohm coil. When getting down to the 12.96 ohm coil it will be well to change the size of wire and use No. 22 B. & S. gauge which has a resistance of 0.992 or practically 1 ohm per meter. This change may, perhaps, be made a little sooner if desired; the exact point is immaterial.

Obtain a meter stick and measure off the lengths of wire as closely as possible, double each length in the middle and wind up into a coil about the fingers, tie with silk thread in several places and dip in melted paraffine. Tag each coil as made. The coils as thus determined will be close enough for ordinary work, and will cover all requirements unless one has access to a Wheatstone bridge. Since all colleges and many high schools possess a good bridge in their physical laboratories, the amateur may be able to avail himself of one, in which event he may adjust the value of resistance considerably closer. He should keep in mind that the copper receiver coils change resistance 0.39 per cent. per degree centigrade, while the German silver shunting coils change only 0.1th as much. Furthermore, the manganin coils do not change at all. Since, however, a closer adjustment of the coils gives a more precise ratio between the various shunting values and it is not a very difficult procedure to carry out, I shall present the method.

Each coil should be cut to a length known to be a little too long and then connected into the bridge in the usual way, one end of the coil being soldered

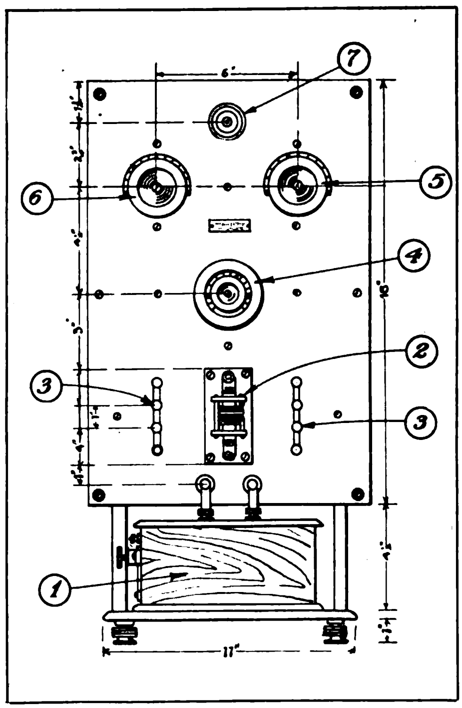


Figure 1, Second Prize Article

to a short bit of No. 20 B. & S. copper wire. A similar bit of this wire is clamped under the other binding post of the bridge and the free end of the coil twisted about it. The bridge ratio and rheostat arms are then set at the proper values, the keys depressed, and if the galvanometer shows a deflection the coil is shortened a bit by winding a little more about the copper terminal wire. It is again tested and the procedure repeated until balance is obtained; then the coil is soldered firmly to the copper lead wire, removed from the bridge and afterward soldered between the proper studs on the shunt box, the short copper leads having negligible resistance.

The work of Austin, Wein, Duddell, Hogan and others have shown the range of power necessary in modern receivers for reading a signal as well as for bare audibility and, as might be expected, it varies with the frequency over the range from about 450 microwatts at low or excessive frequencies to 7.7 at the best frequency, say, about 900. Austin states that 10 microamperes in some experiments gave a signal just audible.

If the set of phones which it is intended to use can now be tested at some standardizing laboratory (say the Bureau of Standards) and the current necessary for audible signals at several frequencies determined, the experimenter will be able to obtain very precise results. In such a case, however, it will invariably be necessary to make temperature corrections for resistances, remembering that the German silver coils in the box change 0.04 per cent. per centigrade degree, that any manganin coils remain practically constant, and that the copper coils of the receivers change 0.4 per cent per centigrade degree. This last change in temperature is not easy to determine because of the heat radiated from the head; therefore it is better to wear them for some few minutes before beginning work and measure their resistance if possible by a bridge immediately on removal. Of course if they were used only for say five minutes they might, without serious error, be assumed to have the temperature of the room.

Specific advice for mounting the coils is not given because some will be quite large and others will have but a few inches of fine wire. If the high resist-

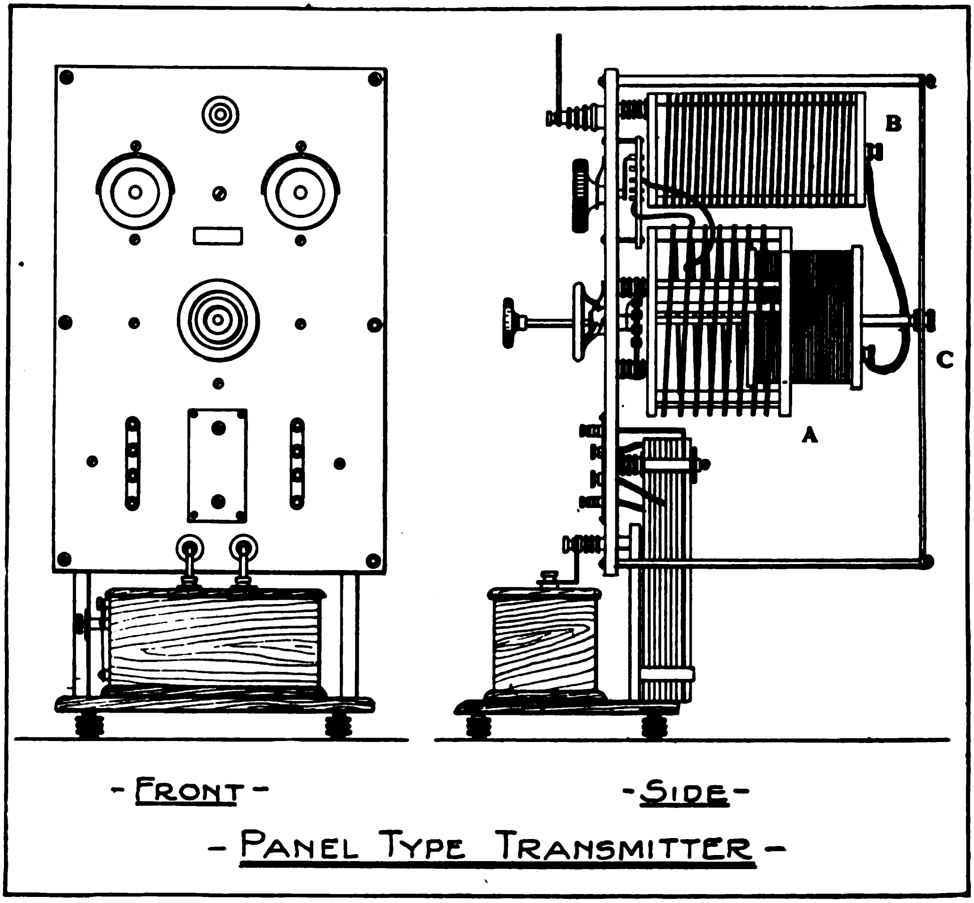


Figure 2, Second Prize Article

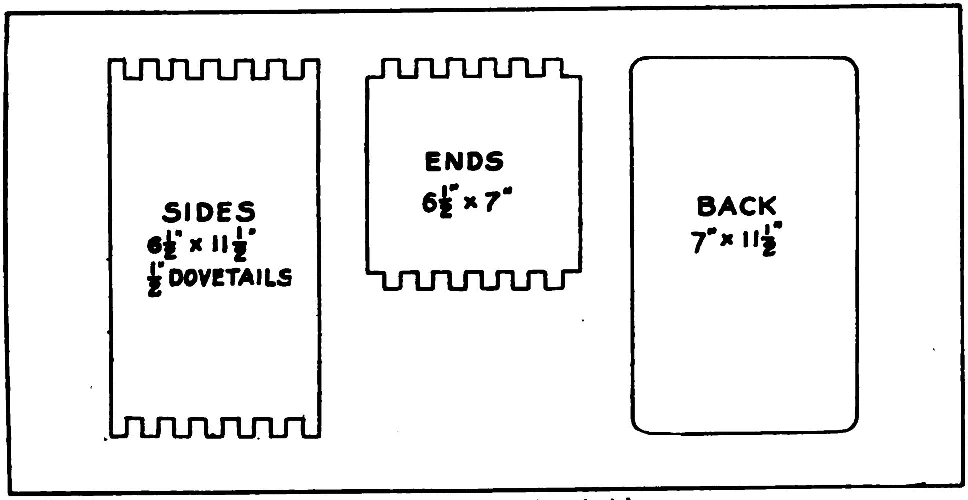


Figure 1, Third Prize Article

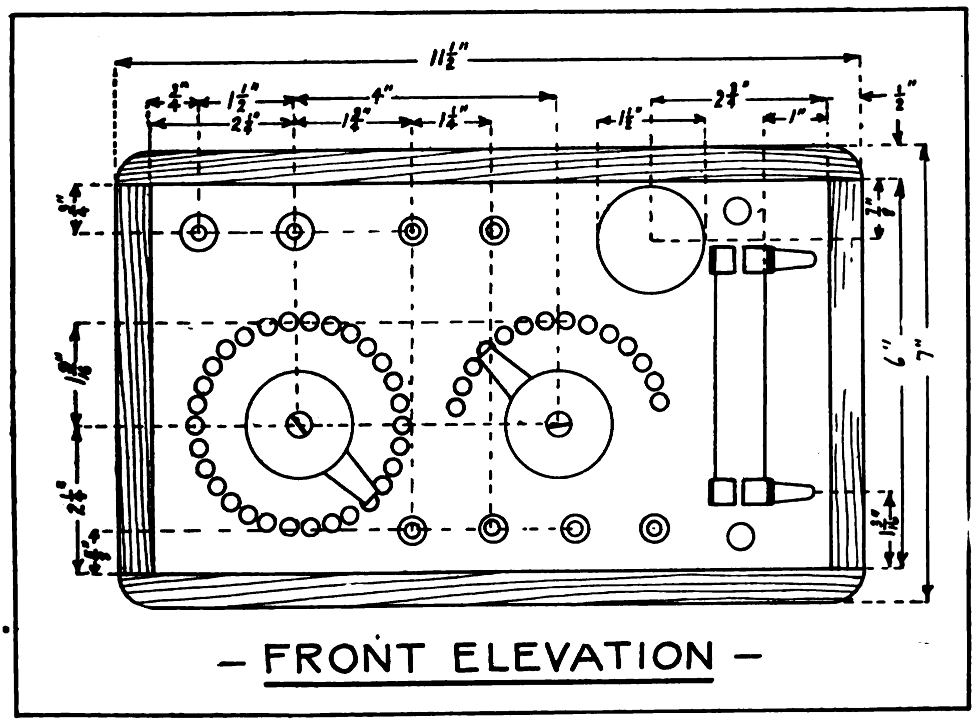


Figure 2, Third Prize Article

ance coils are purchased they will probably be wound on spools which may be fastened to the bottom of the box with a long screw passed down the center. The larger coils, if home-made, may be wound on spools in the same manner and similarly mounted, the copper leads being made long enough to reach up to the studs for soldering. A certain amount of slack should be allowed for convenience. The smallest coils will hang free supported by their own leads, and if there is any doubt as to the safety of this a loop of silk thread tied about the coil and also the end of the stud, will furnish ample support. After all the coils are in place use hot paraffine freely, as it improves insulation and stiffens the coils.

The uses to which the shunt box can be put are diversified. For instance, suppose we have a set fitted with two detectors, one being in, and we find that with the best adjustment possible a signal is just lost when the switch rests on stud 75; in the case of the other detector it is found that the signal similarly disappears when the switch rests on stud 100. It immediately follows that the latter detector is the better in the ratio (100-75)/100 = 25/100 = 25 per cent. under the conditions of this particular set.

Again, in determining wave forms produced in the closed and open oscillating circuits and radiated from the aerial, the detector and receivers shunted by the calibrated box are connected to the wave-meter as usual, the latter being adjusted by listening in on the receivers *unshunted* for the best resonant point, then the phones are shunted to the 10,000-point and the coupling between the inductances of the wave-meter and circuit under test changed till the sound is just on the edge of vanishing. Thereafter the coupling is *not changed*. The capacity of the wave-meter is slightly increased, thus throwing out the adjustment, and it will be found that the sound is lost but again returns when the shunt box is set to, say, 8,000. This then gives a point on the curve at a higher wave-length than resonance. The capacity is again changed and the process repeated. After a sufficient number of points have been thus located, a curve may be plotted in which the abscissas are either wave-lengths or condenser scale readings and the corresponding ordinates the settings of the shunt box.

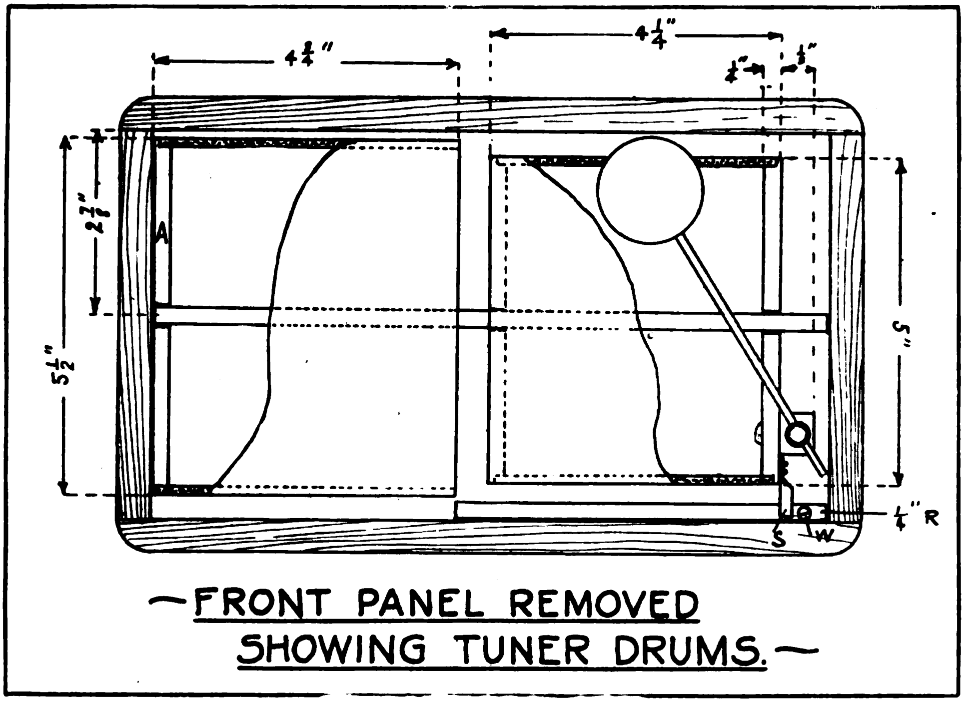


Figure 3, Third Prize Article

These are but two of the many uses to which the box can be put and it will very certainly prove valuable in many other measurements so that the time consumed in its construction will be well spent.

W. Lincoln Smith, *Massachusetts*

SECOND PRIZE, FIVE DOLLARS
A Small Panel Transmitter Which Should Be Popular

Following the adoption of the panel form of transmitter by the commercial companies, amateur experimenters have come to the realization that this arrangement of apparatus is without doubt the most efficient as well as the best appear-

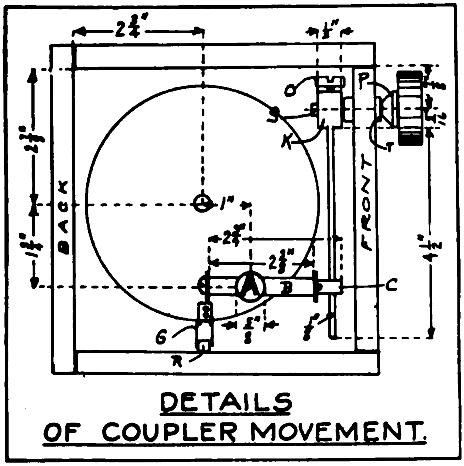


Figure 4, Third Prize Article

ing. The following is a description of a small panel transmitter which was designed by the writer, and has been in constant use for several years. There is probably nothing described which cannot be built by the average amateur at a reasonable cost. The arrangement of the various units as shown is suggested, but even this can be varied by the constructor in accordance with his own ideas.

Figure 1, which is the front view of the panel, gives an idea of the general arrangement of the controlling switches and quenched gap. The panel may be constructed of wood, bakelite or slate, and should be mounted above a small platform as shown. The platform supports the spark coil or transformer, 1. The quenched gap is represented at 2 and can either be made by the reader or purchased ready to mount on the panel for $2.50, from a well known house. Some diversity of opinion has been expressed at various times in regard to the advisability of using this form of spark gap on a small coil or transformer operated on 60 cycles. It might be well to remind those who think that the quenched gap is only fit for 500 cycle work that there is some engineering ability required to adjust the circuits and design the transformer, and this may be responsible for the poor results at first encountered. Too much work is being done with apparatus which is just thrown together without regard for theory or Government regulations. With the quenched gap shown, the decrement of a small spark coil or transformer can easily be kept below the required .2 and at the same time show a high transfer of energy to the antenna. The adjustment of condenser capacity and group frequency is sometimes necessary to obtain a pure note, but with a little patience the gap

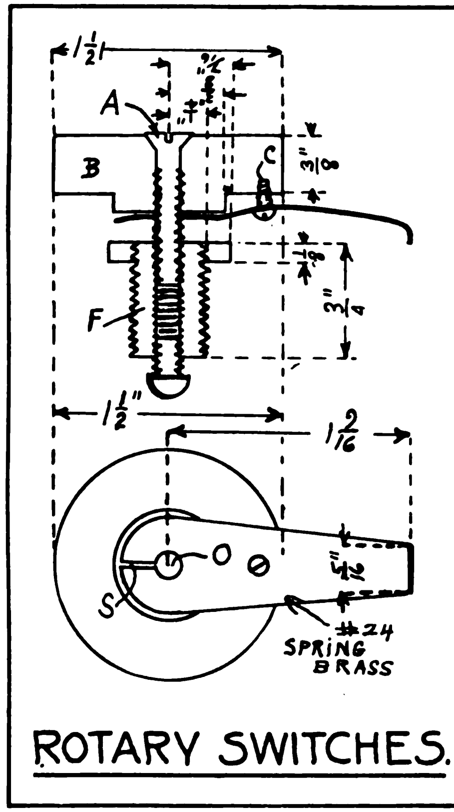


Figure 5, Third Prize Article

can be made to give surprising results. Of course a straight gap may be substituted for the form shown, but as the primary object of the design of this set is to provide a means of reducing interference from small coils due to improper tuning, it is suggested that the form referred to be adopted.

The leads from the condenser are

brought out to two rows of posts, so that the capacity adjustment previously referred to, can be readily made. The condenser used by the writer consisted of two sections of Murdock moulded condenser, each having a capacity of .0017 microfarad. These condensers are very efficient and compact. They showed a resistance to radio currents of .41° as compared to .14° and .28° of the Fessenden compressed air and Wireless Specialty leyden jar in oil. (See L. W. Austin's notes; Bulletin Bur. Standards, Vol. 9.)

The antenna change-over switch and coupling adjustment is represented at 4 (Figure 1). At 5 and 6 are shown the wave-length switches used for varying the wave-length of the closed circuit and antenna circuit. They are well insulated from the panel in order to permit these adjustments to be made with safety during operation. The adjustment of wave-length is made by means of a wave-meter in the closed circuit, and the aerial can be tuned to resonance by means of a hot wire ammeter or thermo-element and mill-voltmeter calibrated in terms of R. M. S. amperes. The antenna is connected to the post marked 7.

Figure 2 shows the front and side views of the apparatus. No dimensions are given as the amateur generally supplies these to conform with the apparatus on hand. The coupling transformer is shown at A. Some criticism of the form of coil shown is expected. A pancake form may be adopted as a means of saving space, but quantitatively no difference in results may be expected. The loading inductance for the antenna circuit is shown at B, and the ground terminal at C. This inductance may be wound with ordinary seven-strand No. 22 copper on the rubber strips. The secondary of the oscillation transformer was wound with ordinary flexible lighting cord equivalent to No. 14. The primary was wound with No. 8 copper wire.

In setting up the apparatus after the construction is completed, the following procedure may be adopted: Adjust the primary radio circuit to the three wave-lengths decided upon. Also adjust the antenna circuit to resonance at these wave-lengths and with all the gaps of the quenched gap in circuit, note the radiation with coupling loose enough to prevent the radiation of two waves. This will be shown on the wave-meter and at the same time the note and pitch of the spark may be determined. Adjust the vibrator on the coil or the captance or reactance of the primary transformer circuit until the note is cleared. If an integrating wattmeter of the indicating type is at hand, this may be placed in the primary circuit and adjustment for maximum indication made, at the same time taking care that the note remains clear.

Now change the condenser to another capacity and repeat the operations just

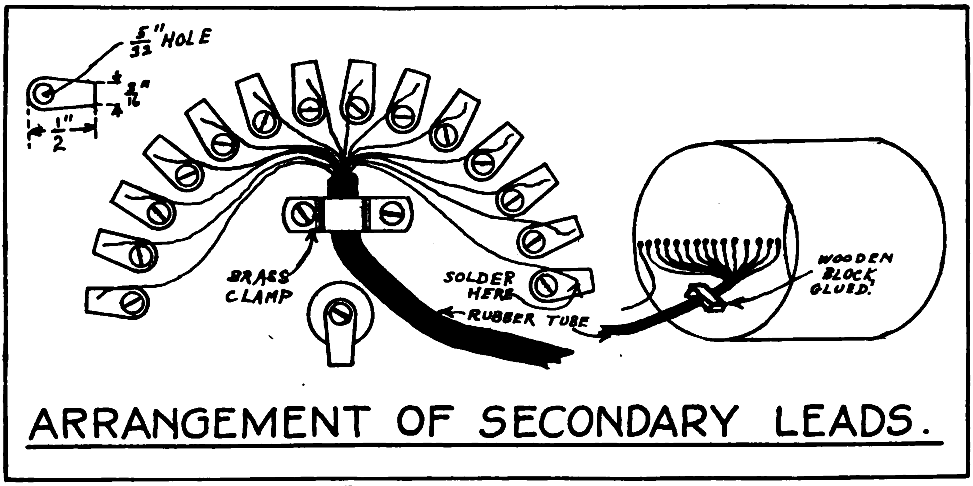


Figure 6, Third Prize Article

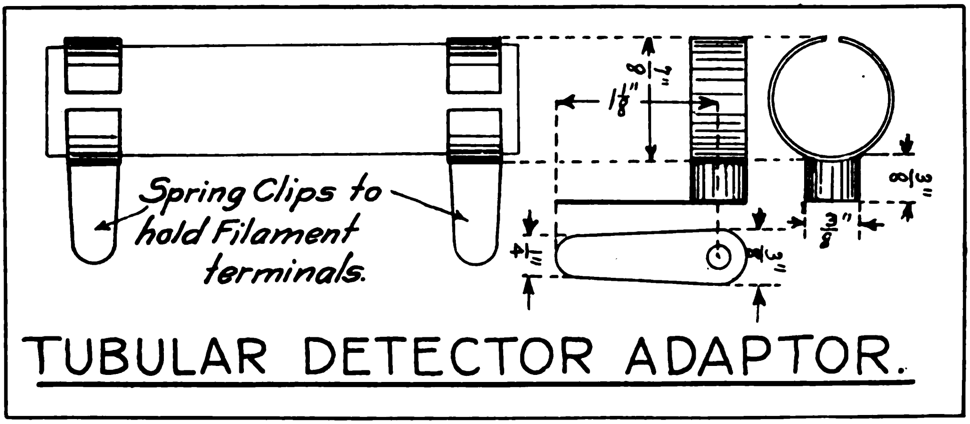


Figure 7, Third Prize Article

performed. Note the antenna current. Do this several times with various capacities and, when the antenna current is maximum and the note is clear, this is about the capacity that is best suited to the circuit used. Of course, this is not an accurate statement, but with the usual facilities of the average experimenter, it may be said to be as accurate as the adjustments themselves.

CHARLES C. BALLANTINE,
Pennsylvania.

THIRD PRIZE, THREE DOLLARS
A Portable Tubular Vacuum Valve Receiving Set

The accompanying drawings show the construction of a portable valve receiving set the writer built a year ago and which has given excellent results. This outfit is intended to be a compact sensitive tuner and detector. It consists of a good sized loose coupler, fixed condenser and any style tubular vacuum valve mounted in a small carrying case.

Some features of the set are described as follows: The case, measuring 7 inches by 7 inches by 11½ inches, outside dimensions, will fit into a handbag, which can be easily carried. The coupling knob throws the secondary drum out of the primary easily and quickly by a turn of sixty degrees of the handle. The set is designed so that without the use of variable condensers it tunes to 2,000 meters and all the switches and terminals are mounted on a hard rubber front which puts all adjustments within easy reach. The vertical position of the rubber prevents dust from collecting easily.

The case is made of any hard wood with the corners dovetailed and glued. Figure 1 shows the dimensions of the pieces to be cut out. Half inch stock is used. When joined, it can be stained, filled, shellaced and varnished to suit the builder.

Then the rubber front is cut to fit in the front of the case. A piece of ½ inch rubber, 6 inches by 12¼ inches, will allow the front to be cut 6 inches by 10½ inches. A piece left over will make all the necessary knobs. The rubber is set in flush with the edges and is held in place by six 8/32 counter-sunk-head brass machine screws passing through the sides and ends of the case. This mounting leaves the entire surface of the rubber available for the switches and so on. All the machine work for this set can be completed on a small metal-working lathe and drill press, together with the tools most amateurs have on hand. Figure 2 shows a front elevation of the set. Figures 3 and 4 show the details of the coupler movement with the dimensions.

The primary of the coupler is wound with No. 25 silk covered wire wound on a cardboard tube 5½ inches in diameter and 4¾ inches in length. Before winding, the tube is painted heavily with thick shellac and the alcohol burned out with a blow-torch which leaves the tube dry and hard. A wooden flange, A, turned from 3/8 inch stock, is bored at the center with a 1/4-inch hole to hold one end of the sliding rod. This flange is glued in one end of the drum. Two small wood screws through this will hold the primary to the inside of the case. The taps on the primary are arranged at short intervals, permitting fairly close tuning. There will be about 160 turns, all told. First wind six taps with three turns each, then six with four turns, six with five, six with six and six with eight. This arrangement can be caried to suit, but should be kept close at the beginning to tune well around 600 meters.

The secondary is wound with No. 32 double cotton covered wire. The drum in 5 inches in diameter and 4 1/4 inches long and is treated like the primary. A wooden flange is made to fit each end of the drum. A 5/16-inch hole through the center of each allows the drum to work on the slide rod which is a piece of 1/4-inch brass rod the full length inside of the case. One end is held in the 1/4-inch hole in the primary flange and the other by an 8/32 machine screw through the end of the case. Fourteen taps are taken from the secondary at points equidistant throughout the windings.

Before attaching the terminals inside the drum, the coupler movement should be installed. This is simply constructed as shown in Figures 3 and 4. A piece of 1/8-inch brass rod draws the secondary drum in and out. This rod passes through the pin, C, which turns in the bearing, B. Pillar A supports the bearing, B. The pin is made of 1/4-inch brass rod and a 5/32-inch hole accommodates the 1/8-inch rod. The bearing is a piece of 1/4-inch I. D. brass tube and the pillar is turned and bored from 5/8-inch rod. The position of the shaft, S, is shown in Figures 3 and 4. This is also a 1/4-inch rod, which turns in a brass bearing made of a threaded piece of 1/2-inch rod fitted into the rubber. A piece of 5/8-inch rod is made into a shoulder that holds the 1/8-inch rod and set screw, O. This should be a good size with a large head and the shaft, S, should be filed flat to allow this screw to be well tightened. The hard rubber handle is 1 1/2 inches in diameter and is threaded onto the shaft and locked tight by the threaded collar, P. A little grease

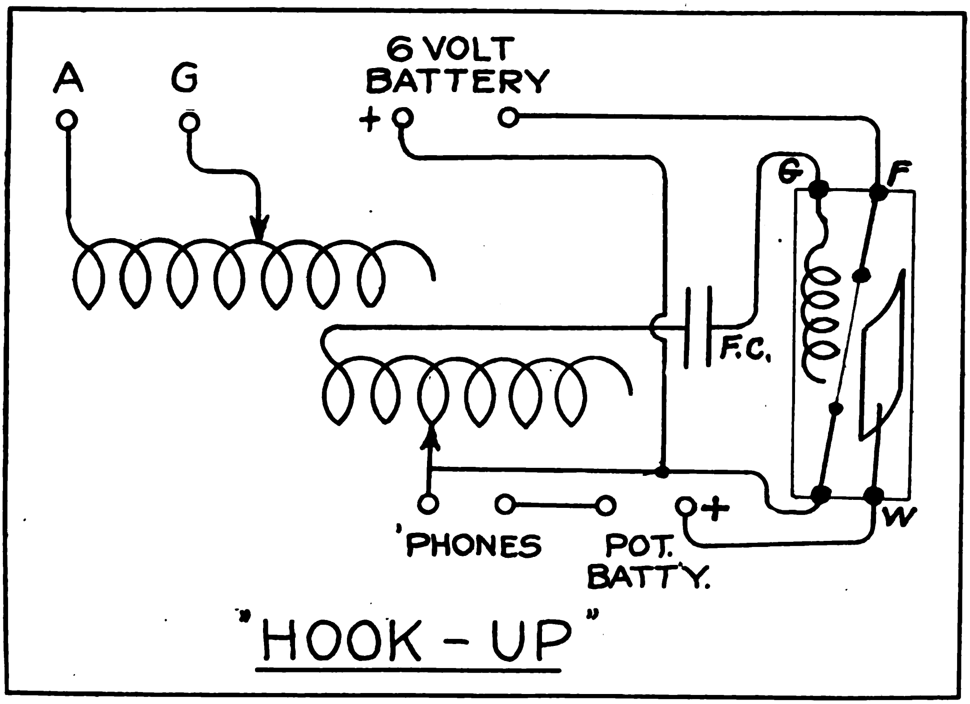


Figure 8, Third Prize Article

on the ⅛-inch rod will make it slide easier. After the coupling adjuster is completed a piece of ¼-inch square brass rod, R, is placed along the bottom inside the case, and under the secondary drum with a small brass guide, G, attached to the end of the drum. This prevents side play. A set screw, W, limits the lengthwise movement of the drum as shown in Figure 3.

Figure 2 shows the arrangement of the switches and Figure 5 shows a switch handle in detail which is very durable. The knife blade, D, is held to the handle by one 6/32 screw and is bored with a 3/16-inch hole, O, at the shaft and a narrow slit, S, is cut. Each side is bent to make a spring washer. The screw, A, is fitted snugly in the handle. The base, F, threads into the rubber. The spring washer effect of the knife, D, amply takes care of the 1/32-inch movement up or down, of the screw, A, when the knob is rotated one complete revolution.

The primary switch has thirty points equally spaced on a 3⅛-inch circle. The secondary contact points are mounded on a semi-circle of 1-9/16-inch radius. 5/32-inch holes are bored to pass 6/32 screws to hold the switch points. All the points are ¼-inch diameter and ¼ inch in length. Forty-four little lugs are then made, as in Figure 6, by boring a row of 5/32-inch holes along the edge of a piece of sheet brass and then cutting to shape with tin shears. One of these lugs goes with each screw to the contacts and the terminals of the winding are soldered to them before the rubber front is put in place. Figure 6 also shows how the leads are brought out from the secondary drum. A fourteen-strand cable, made up of No. 28 D. C. C. wire in a 3/16-inch soft rubber tube, connects from the secondary to its switch. A wooden block glued inside the drum anchors that end of the cable and a brass strap holds the end on the rubber front. The leads are neatly fanned out and soldered. If the wires become crossed, connect a 4-volt battery across the secondary and with a low reading voltmeter you can easily distinguish every lead by the drop of voltage. A single light flexible wire runs from the beginning of the winding to the fixed condenser. This can be purchased or made as desired and fastened in one end of the case.

The primary terminals should be soldered last and any point on the circle can be chosen for the start. It is probably best to take the one nearest the top and solder from left to right. This complete circle arrangement on the primary allows the wave-length to be changed quickly.

Figure 7 gives the details of mounting the vacuum valve. The parts are made from tubing and rod sweated together. Figure 8 gives the hook up. All connections should be well soldered and the brass work polished and lacquered. On top of the case a leather handle is fastened for carrying. It is hardly possible to install the high potential battery in the set, and in view of the fact that a battery needs considerable attention, it is just as well to place it in a separate case. The filament rheostat can be mounted on this.

Such a set as this would be ideal for a launch or boat, where a storage bat-

A view of the portable vacuum valve receiving set described in the Third Prize Article

tery is available. For general work with all spark stations the writer has obtained excellent results and the experimenter would do well to construct a similar instrument.

GEORGE STURLEY, *California*.

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

How to Transmit Efficiently During Hours of Confusion

Since the passage of the government radio regulations all of the amateur stations have been huddled together just below the 200-meter limit. In the vicinity of large cities this has resulted in considerable confusion during the hours when amateurs are free to work their sets. As

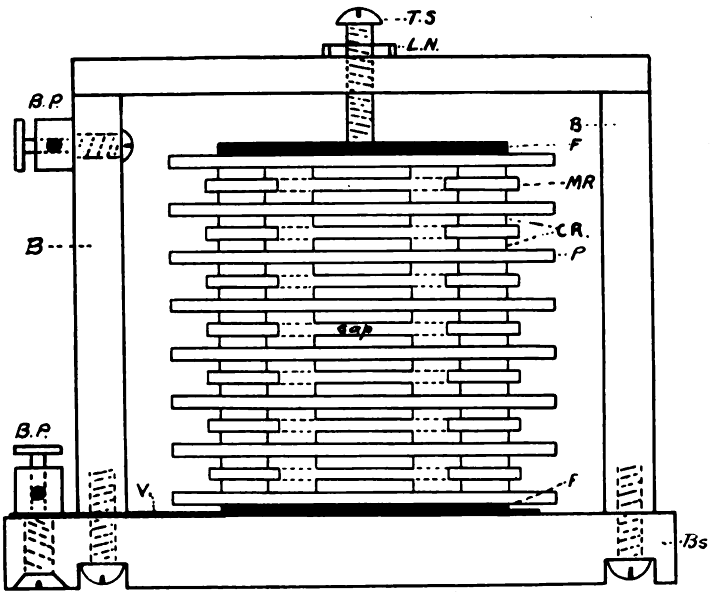


Figure 1, Fourth Prize Article

the law is not to be changed, the amateurs should do the best they can to eliminate this difficulty.

A simple remedy is to avoid the use of excessive power when transmitting. I know of amateurs who are accustomed to use as much as ½ k.w. to communicate a distance of a few blocks. The resultant roar in near-by stations satisfies the sender, but it is an unreasonable and unnecessary form of interference. Another remedy, an all-important one, is sharp tuning. This brings us to the subject of this article; the description of a highly efficient, sharply tuned "town set," which, if generally used, would do away with all unnecessary interference in congested localities.

The essence of this set is a small quenched spark gap, used in conjunction with a spark coil, condenser and oscillation transformer. Everyone being familiar with the last named instruments, we will turn our attention to the workings and construction of the spark gap. The advantages of this form of discharger are numerous. The one with which we are mostly concerned is the fact that a pure wave is emitted. That is, the energy is practically all radiated at one definite wave-length. Besides producing a pure wave, this results in greater efficiency because more energy will be picked up by the receiving station when it is concentrated on one wave-length, than would be picked up if the energy were spread over a series of wave-lengths, with perhaps two maximum points. The reason for this behavior of the quenched gap follows:

When the potential of the condenser is of a certain value, it breaks down the resistance of the gaps and the primary oscillations surge back and forth in the closed circuit. The sparking surfaces of the gaps are rounded; that is, the gaps at the center are shorter than they are at the outer edge as at X, Y, (Figure 2). The first set sparks will pass at X, because they offer the least resistance (shorter); but the electromagnetic action of the magnetic field set up about the discharging current will drive these sparks outward to the location of Y. This lengthens the gap materially and completely damps the primary oscillations and therefore the quenching effect. The high resistance of the spark gaps immediately returns. Let us consider the effect of this on the secondary of the oscillation transformer. The primary oscillations set up similar oscillations by induction in the open circuit. These secondary oscillations soon reach a maximum, and at this point, the primary oscillations are quenched, as explained. See Figure 3, B. This action allows the oscillations in the open circuit to become very persistent, and to radiate the energy at substantially the natural period of the open circuit.

Now what is the effect of these oscillations in the open circuit upon the closed circuit? There is no effect, because oscillations that may be set up in the primary circuit by the secondary are effectually blocked by the high resistance of the spark gap. The closed circuit remains inactive until the condenser has again reached the critical value. This non-return of energy by the open circuit is responsible for the production of a pure wave. It also allows the two cirsuits to be coupled a great deal closer than would otherwise be advisable, which fact alone means a greater transfer of energy and hence increased efficiency.

There are three ways in which the oscillations in the open circuit may become damped: by return of energy from the antenna circuit to the closed circuit, the resistance of the circuit itself, and by radiation. The last-named is the object of the set and is not considered a loss.

A quenched spark gap suitable for use with a 1 inch-2 inch coil, or larger, may be easily constructed. Out of spring copper No. 16-18, cut eight discs 3 inches in diameter, as in Figure 2, P. Next, out of the same material, cut fourteen rings with an outside diameter of 2 inches and an inside diameter of 2 inches. Also cut out fourteen discs 1 inch in diameter (Fig. 2, R). This work may readily be done by means of snippers and neatly finished by the aid of a file. Now solder the 1-inch discs to the centers of the 3-inch discs, placing one on each side of six and one on one side of the remaining two. With a file, shape these 1-inch discs, shown in Figure 2 at YXY, as explained during the description of the working of the gap. Care should be taken not to remove any of the surface at the center, X.

Take the metal rings that were cut and solder them to the 3-inch discs, making sure they are centered. Place them, following out the same methods pursued with the 1 inch discs, that is,

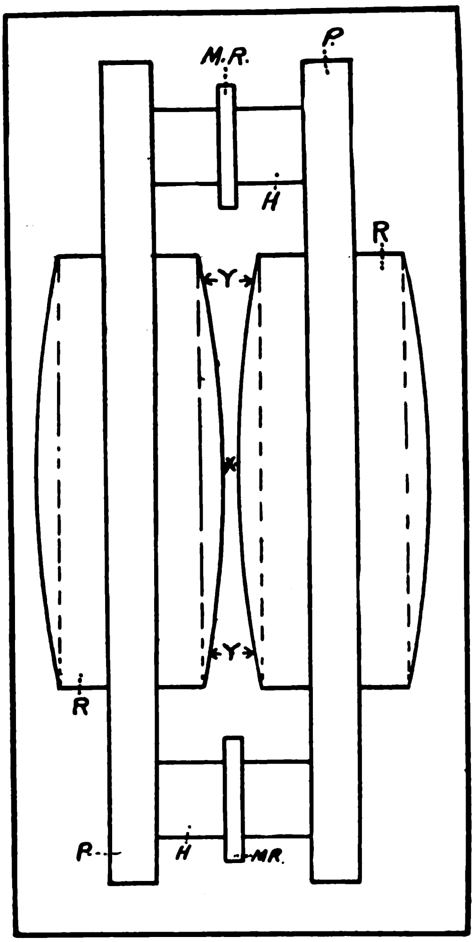


Figure 2, Fourth Prize Article

place one on each side of six and one on one side of the remaining two, selecting the same sides that hold the 1-inch discs. Cut seven rings out of some very thin mica, preferably 0.01 inch thick. The length of the gap is determined by this thickness.

The gap is now ready to assemble, as shown in Figure 1. Stack the plates up, placing a mica ring, MR, between the opposing metal rings, CR. They should be carefully centered, which is easily done by applying a little shellac to one side and sticking the ring in place before stacking. Make a simple frame, as shown in Figure 1. A convenient method is to use three pieces of ¼-inch brass rod and either screw or solder them together. Place a screw, TS, provided with a lock nut, LN, in the center on top. Mount the two binding posts as shown. Place a piece of copper under the post on the base and let it extend to the center of the base in order to make contact with the bottom gap.

Provide a heavy metal disc, F, and place on top in order to transfer the pressure from the screw, TS, to the rings, CR. This keeps the gaps from becoming closed when tightening TS. With all the discs centered and the mica rings in place, press the gaps together with the top screw, and lock with the lock nut, LN. This completes the gap. It will probably be found by tests with a hot wire meter, that the total number of gaps are not required. Any number of plates can be cut out by short-circuiting the adjacent 3-inch discs by means of clips.

The customary hook-up is shown at A in Figure 3. If the vibrator on the coil is now adjusted to give rapid makes and breaks, by means of a rubber band passed around the head of the coil holding the hammer in, or else by stiffening the hammer by introducing paper between it and the core, a high clear tone will be produced, and the wave will be pure and sharp, having the wave-length of the aerial circuit.

K. W. Nicholson, *California*.

HONORARY MENTION

An Improvement on the Average Spark Gap

I do not believe that all rotary gaps described justify the trouble and expense incurred in their construction, but the gap described in this article possesses the advantage of being easily and cheaply constructed and of producing a much clearer spark than that obtained by the usual type. This effect is mainly obtained by causing the spark to jump at one point only, thereby securing a shorter gap and a spark giving only the fundamental tone without the presence of rough over tones, which are often so noticeable when the spark takes place simultaneously at two points.

In the description of my apparatus no dimensions are given as they will depend upon the dimensions of the gap itself and the power of the transmitting set. Referring to Figure 1, D is a piece of stiff brass, about ½ an inch in width and 1/16th of an inch in thickness, bent as shown so that it will fit under two opposite plugs on the wheel. A hole is drilled in each end of this brass strip, D, the two opposite plugs A and B are removed, the brass strip is fitted over the screws, G and H, and the two plugs are again screwed into place.

Care must be taken in bending D to have it correctly balanced or the gap will not run smoothly. E is a piece of

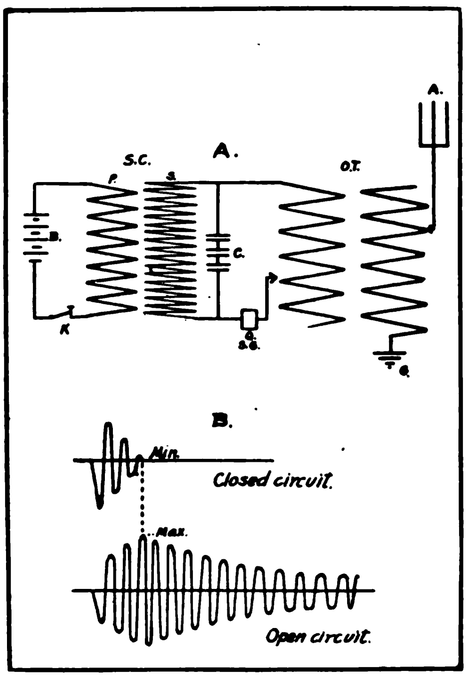


Figure 3, Fourth Prize Article

spring brass, bent as shown in the figure, with a hole drilled in the end, K. The binding post, F, which ordinarily supports one of the stationary electrodes, is removed from the base, E, and is placed over the screw which holds F to the base. Then the binding post is screwed into place over E. The contact surface, I, of E should be no longer than the width of D, namely, ½ an inch, and

(Continued on page 298)

German Portable Sets In The World's War

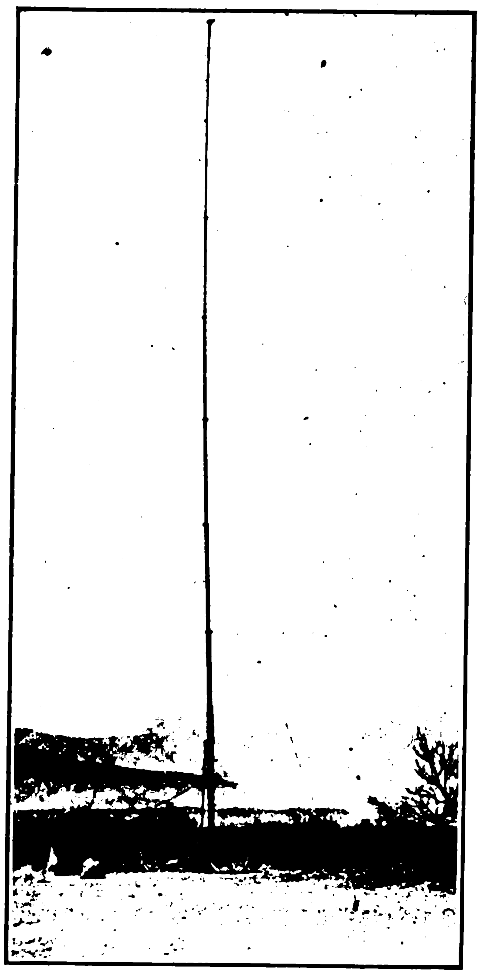
THE accompanying photograph shows a German wireless field set in actual operation on the Macedonian front in the present war. In the background can be seen one of the Balkan mountain ranges. Owing to the mountainous nature of the country, it is necessary to have masts of considerable height. The one shown here is a sectional telescopic mast, each of the eight sections being four meters high, making the height of the mast 32 meters, or 105 feet. Field sets in the German army carry still higher masts, the limit being 45 meters, or 148 feet.

Far more numerous, however, on the Balkan war fronts are the cavalry stations, which are intended to safeguard the most advanced cavalry patrols. These are carried by pack horses, and this arrangement permits of a simple division of loads, whose weight and distribution on the pack saddle is so apportioned that the pack animal is neither overburdened or hampered.

The station is provided with a collapsible military tent, which in bad weather gives shelter to the telegraphers and the apparatus. The sides of the tent are utilized in the packed station for covering the packs. The primary alternating current used by the sender is developed by a light generator, the power being supplied by a benzine motor.

The cavalry station carries a telescopic mast. A horizontal or umbrella antenna may be employed for earthing, the wires being stretched over the ground. These wires are wound up according to a system which prevents the individual wires from being tangled, and in a few seconds they may be stretched out or drawn in.

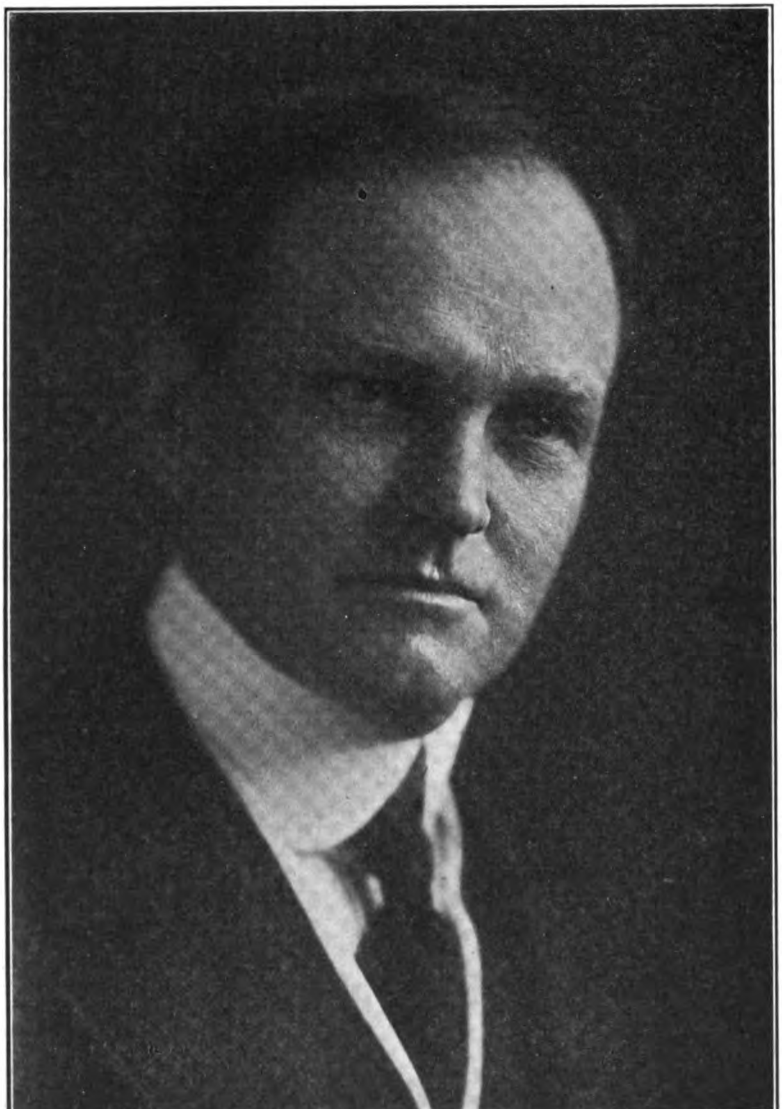
By day, in a flat country, a distance of 100 kilometers can be obtained with large receiving antenna, and at night a distance of 150 kilometers can be obtained. The erection of the station takes from ten to fifteen minutes when four men are employed. The dismantling of the station takes from eight to



View of German field set

twelve miutes. Two men are needed for operating the station. The packs rest tightly on the back of animals, and are subject to a minimum of disarrangement when the latter are trotting or galloping.

New Vice President of N. A. W. A.



Commander David Wooster Todd, U.S.N., Director Naval Communications, and successor to Captain W. H. G. Bullard, has recently accepted an appointment as a vice-president of the National Amateur Wireless Association. Commander Todd, who is one of the most prominent figures in the radio world today, was born in Round Valley, California, July 24, 1874. His sea service comprises assignments to fifteen vessels of the United States Navy. He has served ashore as instructor in ordnance at the Naval Academy, in charge of the Radio Division of the Bureau of Steam Engineering, Navy Department, and as assistant superintendent of the Radio Service. His appointment as Director Naval Communciations dates from August 3, 1916

With the Amateurs

RESULTS OF THE PRESIDENTIAL RELAY ON NOVEMBER 27th

By W. H. Kirwan (9XE),

National Chief of Relay Communications,

NATIONAL AMATEUR WIRELESS ASSOCIATION

THREE hours of real wireless fun and testing of various receiving apparatus was offered you on this night. From the great amount of interest that was shown, we are led to believe that it is the kind of work you like.

For the benefit of a few Doubting Thomases in the east, it is stated that the permission to run this relay was received from the White House, direct from the secretary of the President of the United States. The Acting Secretary of the Navy, the Hon. Mr. Benson, also gave the permission, and it was referred to him from the White House before we received the open order to go ahead.

NAA and NAJ did not send out warnings as planned, because we withdrew the request when it appeared that some were trying to make this a political move.

The relay was started by 9XE sending with a one-half inch coil, connected to a regular oscillation transformer of the pancake type. The coil was going all along, and for a sending wave we had about one-half of the O. T. short circuited by the sending key when it was pressed. This compensating wave passed through the regular telephone wires, and as the receiver was off at 9XE and also at 9XR, two miles away, the wave worked the Hall wireless relay device, which is a sound actuated relay, and automatically sent the message by working a magnetic key at 9XR.

The relay as conducted was perfectly fair, and was open to all amateurs broad enough to see the advantage of it. The main idea of the relay was to get some idea of the real range of the various sending stations under adverse conditions.

Every sending station had a copy of the MSG ahead of time, and had instructions to repeat a certain letter in a certain marked word, and all had different words marked. Not even the writer knew what word or letter would be repeated. Some of the most remarkable distances have been covered, and some good receiving records made.

A great many Government and commercial stations were working at the time of the relay, as well as numbers of amateurs who appeared to be willfully interfering. Throughout, however, the results were most gratifying and interesting.

No special interests were served in this relay, so far as the writer knows, but one or two were ignored because we did not care to have anyone get the credit for running the relay like they did the Washington's Birthday relay of last year.

Please understand that I am not trying to commercialize your interest in relay work, and there is no string tied to the prizes. Neither are you urged into a mad race for subscriptions for THE WIRELESS AGE magazine to earn this prize. It is human nature to enjoy a pat on the back for work well done, and that is what you are getting now. Bigger and better prizes will be offered later on to the best amateur station in the country for all around work, so you had better get busy. And don't forget that the writer is assuming all responsibility for giving the prizes.

INCIDENTS OF THE RELAY

P. Stover, of Marengo, Iowa, claimed to have heard 6SH and 1ATY. The first station is in California and the latter in Connecticut. Not checking the mistakes cost him his chance for a good credit. Chester Sinnett, who lives on Bailey Island, off the coast of Maine, clearly read 8AEZ and 4DI, checking their mistakes and earning two good credits. Station 5DU, in Dallas, Texas, was clearly read by the writer, and did remarkable work.

For sending, the stations are listed as follows in the order of their apparent superiority—8AEZ, 8NH, 5DU, 9ABD, 6SH, 8NF, 9IC, 8JZ, 7YS, 7ZS, 2ZB, 8SK—and we came very near forgetting 9IK, which is really fourth on the list. A look at the list will explain the game better. 9DK—O'Neill of St. Louis—volunteered to take the place of 9ACE, who was called away at the last moment. Emmerton, of Sawtelle, Calif., was listed as 6QJ through an error, his call being 6TQ. Some stations were not heard at all, probably because their sigs were not leaving their spark gap, and there appears to be lots in the country just like this. Some stations like 7YS, 7ZS and a few others, are hundreds of miles away from anyone, and the fact that they were heard shows that they work remarkable distances.

Robert Higgy, late of the Lima High School, in Ohio, was at his new home in Phœnix, Arizona, with the receivers strapped on; as usual he caught the MSG from 5DU and also heard 9NN talking about it with 5DU. This is the kind of sending, boys, you want to do, and don't let anyone tell you that this is freak work.

One good thing about these relays is that we are interesting the amateurs in the south and west where good stations are needed.

Publicity relays are the only kind of relays that are going to be any good to you until you are officially recognized by the Government as a factor in its third line of defense.

The prize winners are published in this issue. Some of them are old war horses at the game, and we are all glad to see some new faces looming up over the horizon. Keep right after these old timers, boys, and make them work.

There was the usual number of boneheads who have stations for their amusement and not for work, but the least said about them the better. But don't forget that we have their names on file. The station getting the greatest number of credits later will be given one of the largest prizes ever offered to any amateur for faithful work.

For instance, station 8NH received 6 credits for checking six stations, as did also 9MK, and all these will count in the final round-up to award the prize to the best all around station for sending and receiving.

We collected some wonderful data about aerials and fading sigs during this last relay, and all we need now is for all the stations that participated to send me all the dope on their aerial, particularly height, shape, size, wires, kind, and how the aerial bears with the compass. If you haven't a compass, better borrow one, and let me know how it runs with the compass; also state if it is level, on top, or inclined, and how much. Radiation is not important unless you have a calibrated wave-meter. If you will send this dope at once it will be turned over to the experts of the Institute of Radio Engineers and all the discussions concerning it will be published for your benefit. Before we get interested in the schedules and so forth, don't forget that the writer thanks you one and all for the interest you are taking in this work, for your most kind assistance, and for the thousands of kind letters that have been received.

Some of you wanted immediate replies and even enclosed a stamp, but it is a physical impossibility for one man who is obliged to work as hard as any of you to find the time to do so. More than 100,000 signatures were received to the relay MSG, and nearly all of them were counted by the writer.

THE PRIZE WINNERS

8YZ—Peabody High School of Pittsburgh, Pa., is awarded the second prize of one tubular audion panel, assembled with two filament bulb, rheostat, and ready to be connected up for use, for getting 1,893 signatures of American citizens. This panel has been donated by the National Electric Mfg. Co., Mallers Bldg., Chicago.

2AGJ—J. K. Hewitt, of Albany, N. Y., turned in 861 signatures and receives the 3,000-ohm pair of phones, 55 type, unconditionally donated by the Wm. B. Murdock Co., of Chelsea, Mass. This is the third prize.

The Ames Radio Club, of Ames, Iowa, turned in 777 signatures and evidently had a lucky combination of figures; to this organization is awarded the fourth prize; a pair of 2,000-ohm phones, 55 variety, made by and donated by the Wm. B. Murdock Co. This is the new club just formed by some very progressive amateurs and you will doubtless hear more from them later.

9HQ—Owen R. Terry, Stoughton, Wisconsin, gets the fifth prize for turning in 716 signatures to the MSG. This will be one two-filament tested electron relay, donated by the Pacific Research Laboratories, of San Francisco, Cal. This company would not consider any other arrangement but that the writer permit them to give ten of these prizes to the lucky winners.

The following will therefore get an electron relay from the Pacific Research Laboratories:

J. I. Greene, Rock Falls, Ill., 714 sigs. A newcomer in the game.

9RD—F. M. Bailey, Clinton, Iowa, 554 sigs. An old war horse, with a son twenty-one years old.

9NY—R. O. Strock, Polo, Ill., 502 sigs. An ardent worker. Watch him for results.

Glenn Fordyce, Anita, Iowa, 338 sigs. This little fellow is a "newsie."

9IK—R. W. G. Mathews, Chicago, Ill., 315 sigs. A pleasant fellow, hard worker and A1 amateur.

9ACM—A. E. Jeffrey, High School, Goshen, Ind., 281 sigs. A busy school teacher who finds time for a little recreation that also interests his pupils.

1IZ—Robt. T. St. James, Grt. Barrington, Mass., 279 sigs. A bright star in the east.

8ACK—Russell Blair, Norwood, Ohio, 245 sigs. Chock full of grit.

5CW—H. L. Ansley, Birmingham, Ala., 213 sigs. Our little Southern brother.

The following did well, and will get a prize of a three months' subscription to THE WIRELESS AGE. If you are already acquainted with this wonderful magazine, you will have the date for renewal of subscription advanced three months:

6SI—Leander S. Hoyt, Hayward, Cal.
9QF—C. E. Lockwood, Waterloo, Iowa.
8NH—Mrs. C. Candler, St. Marys, Ohio.
3ST—R. R. Chappell, Richmond, Va.
3GX—G. S. Robinson, Richmond, Va.
1ASI—E. W. Merrow, Worcester, Mass.
1ATY—H. Holcomb, Windsor Locks, Conn.
9MK—E. H. Gittings, Lanark, Ill.
9OM—C. P. Finley, Cedar Rapids, Iowa.
9GF—H. G. Eytt, Denver, Colo.
J. A. Goorish, Chicago, Ill.
L. P. Englund, Moline, Ill.
9ACO—E. Wittick, Moline, Ill.
E. A. Smith, Oakville, Wash.
8ALE—H. Alexander, Grove City, Pa.
D. K.—Kent Bros., Dewitt, Iowa.
W. S. Rothrock, Winston-Salem, N. C.
Eric Austin, Sacramento, Cal.
St. Martins College, Lacey, Wash.
8AEZ—M. B. West, Lima, Ohio.

The prize winners listed will please write to THE WIRELESS AGE, send their correct addresses at once, and they will get the magazine. I compliment you all.

Commercial stations that were called QRM by a great many stations who were trying to pick up the MSG; WHB, NAO, NAI, WRU, NAJ, WGO, WUF, WGV, WNU, and a few others.

Amateur and special stations that were called QRM by many amateurs: 8YO, 5AM, 2AGJ, 2DA, 4CL, 9TZ, YJ, 9XN, 6BJ, 5ZC, 1ON, 9AKH, 9KU, 9UN, 8XA. There is a possibility that a great many of these were not read correctly, and our apologies are offered to those that are not guilty.

THE FIRST PRIZE

The one KW, new type, Thordarson transformer, offered by the Thordarson Electric Mfg. Co., of Chicago, is still safe at last reports. Kenneth Briggs, of Rochester, N. Y., and J. N. Simpson, of the same city, were on the watch and had located Mr. Hughes at the Hotel Seneca in that city. As soon as each of them received the MSG, he went with all speed to the hotel, and Mr. Briggs evidently arrived first. He relied on the clerk to give the MSG to Mr. Hughes and the clerk forgot it. Mr. Simpson arrived soon after and the clerk told him that someone else had been there ahead of him and he left without verifying it. Both these young men had a good chance, and will probably always remember that hotel clerks are in a class by themselves. A later letter from another amateur states that a dandy fire escape outside of the building would have permitted both of them to hand the MSG to the Presidential candidate and given him the surprise of his life.

The Stations that Received the Message

Following is a list of stations that received the MSG and checked the mistakes. Each credit means that this station checked the mistake from one certain station; those with six credits, for instance, checked six different stations:

	Credits
8NH—Mr. and Mrs. C. Candler, St. Marys, Ohio	6
9MK—E. H. Giddings, Lanark, Ill	6
9DK—D. H. Oneill, St. Louis, Mo	5
9ADT—G. Hartman, Wauwatosa, Wis	5
8AEZ—M. B. West, Lima, Ohio	5
4DI—W. S. Rothrock, Winston-Salem, N. C	5
8ALE—Alexander Bros., Grove City, Penna	4
9IK—H. G. Mathews, Chicago, Ill	4
Chester Sinnett, Bailey Island, Me	3
9FW—K. B. Warner, Cairo, Ill	3
1IZ—R. T. St. James, Grt. Barrington, Mass	3
DK—Kent Bros., Dewitt, Iowa	3
9WS—Coy V. Patterson, Kansas City, Mo	3
9KF—J. A. Goorisich, Chicago, Ill	3
9ACO—E. Wittick, Moline, Ill	3
7YS—St. Martin's College, Lacey, Wash	2
9RD—F. M. Bailey, Clinton, Iowa	2
8CO—H. W. Harmon, Grove City College, Pa	2
2ZB—W. L. Brooks, Schenectady, N. Y	2
5OX—D. Simmons, Shreveport, La	2
7DJ—H. W. Blagen, Hoquiam, Wash	2
3RD—R. Dimling, Baltimore, Md	2
9HQ—D. R. Terry, Stoughton, Mich	2
6SI—L. L. Hoyt, Hayward, Cal	1
3RO—W. T. Gravely, Danville, Va	1
IZF—H. C. Bowen, Fall River, Mass	1
9VS—Parker Wiggin, Kansas City, Mo	1
3ST—R. R. Chappell, Richmond, Va	1
3GX—G. C. Robinson, Richmond, Va	1
6PN—Paul Nesbitt, Acampo, Cal	1
3ZS—C. H. Stewart, St. Davids, Pa	1
9YE—W. S. Ezell, Wichita, Kan	1
6AS—Eric Austin, Sacramento, Cal	1
2AGJ—J. K. Hewitt, Albany, N. Y	1
6WS—W. Ford, San Diego, Cal	1
6SR—R. O. Shelton, San Diego, Cal	1
1UN—J. W. Peckham, Middleton, R. I	1

5DU—B. Emerson, Dallas, Texas.. 1
3WL—R. Davis, Washington, D. C.. 1
6TQ—A. Emerton, Sawtelle, Cal.. 1
3QZ—C. A. Service, Bala, Pa.. 1
9FA—L. A. Walker, St. Joseph, Mo.. 1
8CM—K. Briggs, Rochester, N. Y.. 1
7ZC—A. C. Campbell, Lewiston, Mont.. 1
5CQ—Ray Atkins, Groesback, Texas.. 1
9IC—G. A. Greenleaf, Woodstock, Ill.. 1

These received the MSG but forgot to check mistake:

6DM—Robt. Higgy, Phoenix, Ariz.
1EAA—T. H. Gavin, Fall River, Mass.
8AAK—C. R. Pardridge, Saginaw, Mich.
5BV—J. M. Clayton, Little Rock, Ark.
9TZ—J. A. Gardner, Eureka, S. D.
9TZ—E. R. Isaak, Eureka, S. D.
9RW—H. J. Pourhop, Sheboygan, Mich.
1DX—S. Sandreuter, Stamford, Conn.
9ZL—Cecil Bridges, Louisville, Ill.
J. T. Moorehead, Greensboro, N. C.
J. N. Simpson, Rochester, N. Y.
R. Ray, Park Rapids, Mich.
F. Jameson, Leavenworth, Kan.
B. Emerson, Monroe City, Mo.
S. D. Darley, Jacksonville, Ill.
W. L. Galloway, Xenia, Ohio.

There were hundreds of others who merely stated that they had received the MSG, and did not state from what station and did not check mistakes.

The following is the list of sending stations that worked on the relay and also the stations that read them and checked their mistakes:

9XR—Heard by: 9LP-9PY-9NY-9JT-9FW-1ZF-9RD-9WS-9VS-9ACO-9ZL-9FA-9IC-9LW-8AOZ-9IK-DK-2AGJ-9KF.
9YA—Heard by: 9LP-9MK-9YE-9NY-9JT-9FW-5DU-9RD-9DK-9WS-9ACO-9FA-9TZ-8ACK-9IC-DK-9GY.
9ZS—Heard by: 9LP-9PY-9MK-9NY-9JT-9FW-8AAK-9RD-9WS-9VS-9ACO-9ZL-9FA-8NH-9LW-9IC-9ACM-9IK-5OX-DK-2AGJ-9GY-9KF.
9IK—Heard by: 9BJ-9NY-3RO-9JT-9FW-1ZF-8NH-9DK-9ZL-1DX-8ACK-3ZS-9ADT-9LW-3RD-8ALE-9IC-9KF.
9ADT—Heard by: 9IK and 8NH. There seemed to be a fading from this station on relay night.
7ZS-7DJ-7YS—All heard each other, and if you will refer to the map you will see what great distances were covered.
9BD—Heard by: 9MK-9JT-9FW-8NH-9PD-9DK-8ACK-9LW-1IZ-9IC.
8JZ—Heard by: 4DI-9JT-9FW-8NH-9RD-8ACK-8ALE-5BU-8CM-9IK-2AGJ-9GY.
8ADE—Heard by: 8NH and 9IK, but the latter station said that his sigs were faint.
8SK—Heard by: 9BJ-9ADT-8NH-8ALE-1IZ-8ARB-2ZB-9IK-2ALI-9GY.
9ZF—Heard by: 9LP-9ADT-9MK-9JT-9FW-9RD-9VS-7ZC.
8YI—Heard by: 9BJ-9LP-8ALE.
8AEZ—Heard by: 9BJ-9LP-9FA-3RO-4DI-9JT-9FW-8NH-1ZF-9MK-9MY-9NY-9RD-9GY-9DK-8AAK-1UN-3RD-8CO-9ADT-8ALE-3ST-3GX-5 BU -1IZ-9IC-2ZB-1ASI-9IK-9ACM-5CW-9LW-8ACK-2ALI-4CK-3QZ-9HQ-8QG.
2ZB—Heard by: 8YI-8NH-9RD-9IC.
9QF—Heard by: 9LP-9MK-9RD-9VS.
8NH—Heard by: 9BJ-9LP-9NY-3RO-4DI-9MK-3RD-8AAK-9RD-9DK-8ALE-

8CO-8QG-9IC-5BU-1IZ-8ACK-8AOZ-9IK-5CW-9GY.
9ABD—Heard by: 9BJ-9LP-9ADT-9MK-8NH-8ALE-4DI-9RD-9DK-8CO-9IC-8ACK-5BU-8AOZ-9IK-5OX-5CW-5AA-9GY.
5DU—Heard by: 9BJ-8NH-9JT-9FW-9ADT-5CQ-9RD-9DK-9VS-9IC-6DM-8ACK-5BU-5BV-5EK-9IK-5OX-5CW-5AA-9GY.
9FA—No one reported that they heard these sigs.
6SL—No one reported that these sigs were heard.
6SH—Heard by: 9LP-9ADT-6AS-6PN-6WF-6SR-6SL-7YS.
1ATY—Heard by: 9LP claims to have heard this station, but did not read his mistake.
9KT—Heard by: 9LP-9IC-9VS.
9IC—Heard by: 9BJ-9RD-9ADT-9DK-8CO-5BV-9IK-9LW-8ALE-8NH-8AC 8ACK-9HQ.
9RK—No one reported hearing this station.
9DK—Heard by: 9ADT-5BV.
8CO—Heard by: 9BJ-9DK-3ST-3GX-3RD-8ALE.
3RD—No one reported this station.
6TQ—Heard by: 6SH-6WF-6SR.
5OX—No one reported the sigs from this station.
4DI—Heard by: 8ALE and the station at Bailey Island, Me., as well as lots of local stations, and 3GX-3ST, in Richmond, Va., heard this station.

The writer extends his thanks to the three bureaus of information: F. B. Chambers Co., of Philadelphia; Illinois Watch Co., of Springfield, Ill.; Mr. G. S. Johnson.

6SH—Our Western friend, MacQuarrie.

This was a splendid chance to wish some hard work on them, and we feel sure they will have some excuse about serving on the next relay.

If the prize winners will write to the donees of their respective prizes and give their address they will receive the prize.

Refer in your letter to the Presidential Relay, and to the fact that your name is published in The Wireless Age.

If anyone has any trouble at all write to:

Cordially yours,

9XE,
Davenport, Iowa.

It has been announced that the San Francisco Radio Club will publish a forty-eight-page magazine, The Pacific Radio News. The first issue of the magazine, ready for distribution on December 15, will contain full details of the proceedings of the Club during the last three months and also many instructive articles, including "Capacity Tuning." The current Pacific coast news and diagrams of various systems of apparatus operated by members of the Club, will also be published. The price of the magazine will be ten cents a copy.

At a meeting of the Club held recently, C. S. Zelk, operator on the U. S. S. Raleigh, delivered a lecture, describing in detail the various types of radio systems used aboard battleships. His lecture was followed by an instructive paper on "Storage Batteries," delivered by Sergeant T. J. Ryan.

P. R. Fenner was elected manager of the Pacific Radio News to succeed H. R. Lee, who resigned because of the fact that his time was so fully occupied with his duties as secretary and treasurer of the San Francisco Radio Club.

The initiation fee for members and associates will be increased to $2.00 beginning January 1, 1917, the dues remaining at twenty-five cents per month. A membership campaign has been begun in order that the names of 100 members may appear on the directory by the end of the year. At present seventy operators are active members of the organization.

Drifting

An Actual Experience Narrative of Adventure, the Scenes of which are Laid in Tropical Seas

By Alexander Schneider

IF you follow the sea long enough you'll surely meet with adventure. That has always been my contention and fact bears it out. So when I found myself in the perils described in the following recital I was not greatly surprised.

My story has to do largely with the D. N. Luckenbach, an American freighter, which had been sent to a drydock in New York, and there refitted with oil-burning engines. I joined the ship in New York in sole charge of the wireless equipment which had just been installed. Then we left for Norfolk, where we picked up a cargo of coal, and cleared for Rio de Janeiro. The voyage to South America passed pleasantly enough.

We left Rio on the northbound trip without an ounce of cargo or ballast in the holds. Abreast of Pernambuco we found a favorable current that bore to the northwest at a speed of three knots an hour, which, added to our own rate, made a snug little total each day of distance covered.

On the night of June 5th, at eleven o'clock, I rose from my set preparatory to turning in, when I was arrested by a strange tremor beneath my feet. This was followed by a crashing and jolting which drove me out on deck to seek the trouble. I peered down the engine room grating and then looked at the decks which seemed in the darkness to be heaving up and falling back like the inflation and deflation of a toy balloon. With a final rending crash that staggered me the vessel came to rest, rocking gently in the trough of the waves.

Immediately officers and crew tumbled out on deck inquiring regarding the trouble. The engineers soon found out that a propeller shaft had been broken. In fact, it was the extreme end section, the tail-shaft, which had been fractured. A scaffold was rigged over the stern and preparations were made to remove the broken shaft and replace the broken section. If this plan had been feasible, there would be but little to relate. But it was not, the chief engineer declaring that extensive repairs were impossible on the open sea.

The accident had occurred sixty miles off Cayenne in French Guiana while we were headed for Trinidad, 800 miles away to the northwest. The three-knot current continued in our favor and we drifted toward that port at rates of speed varying from twenty miles one day to 120 miles on another. The last record was made with the aid of the wind, an offshore breeze that we caught in crude sails made of the tarpaulin hatch covers. Rigged to the stays and booms, they bellied out nicely. They were a constant source of worriment, however, for sudden squalls ripped them down on more than one occasion.

Seventeen feet of water had been admitted into the forward hold in order to weight that end of the ship down and bring the after end clear of the water so that repairs might be carried out over her stern. This helped not at all, as we lacked tackle heavy enough for moving the propeller, which, with the broken section of shaft, had been pushed and jammed securely against the rudder-post. We swung about on the bow of our ship as if on a pivot, and it became plain that a strong wind might capsize us. An attempt was made to empty the hold of water, but the pumps were clogged with the residue of the coal dust that had sifted to the bottom from our southbound cargo. Then the boson and a sailor, defying the heavy timbers that washed about in the hold with each surge of the water, dove repeatedly to the bottom, and in two days succeeded in freeing the pumps. This accomplished, we were soon clear of the danger of capsizing.

All this time I was far from idle, going on watch at seven in the morning and often retiring after one o'clock the next morning. My first message was to the owners in New York. This was sent via the Barbados wireless station, 900 miles away, and ordinarily out of my communicating range. During the week that followed the captain was busy considering salvage and towing offers.

Arrangements were finally made with a firm in Trinidad and we gave our probable position for the following noon. Then we settled back and waited for the tug which, we hoped, would bring us into port two days after it arrived. But the next day dawned and passed without any signs of our tow. Meanwhile an attempt was made to attract attention by sending up columns of smoke during the day and burning colored signals at night. And still we drifted. When the island of Tobago came into sight a swift current swept us quickly sidewise toward the Grenadine Shoals, a low-lying group of coral reefs consisting for the most part of small islands.

As we drifted, the lead was heaved and when bottom was finally found at twenty fathoms, over went our anchor. Fortunately it held and, with the nose of the vessel headed out to sea, the ship's company felt that the peril was lessened. However, the dangerous current broke and swirled past the vessel. the coast of Little Martinique, seven miles distant, being in view all day.

The author of this article reclining on the canvas cover of a lifeboat aboard ship

That night the tug appeared. She had made several searches for the Luckenbach and on one occasion had put into St. George's to obtain our position by cable from the wireless station in Trinidad.

Our troubles were at an end, however, for the tug, after bucking the current for a full day, steamed off with the Luckenbach in tow, headed for Trinidad. Then life once more resumed its normal proportions and I was free to rest after my long vigil in the wireless room.

Our drifting totalled more than 760 miles and extended over a period of almost two weeks. While the stock of food had been sufficient for a longer time, the question of how long our water supply would last had begun to worry us, and, although none of the ship's company had suffered privation, all were glad when the Luckenbach was once more in a safe haven.

Vessels Recently Equipped With Marconi Apparatus.

Names.	Owners.	Call Letters.
Lackawanna	R. Lawrence Smith	KOP
Mundale	Munson Line	KUJ
Fordonian	American Star Line	(Not assigned)
Viking	Compania Navegacion Del Sureste	(Not assigned)
Samuel Mitchell	Huron Transportation Co.	WEJ
Alpena	Wyandotte Transportation Co.	WCS
Huron	Wyandotte Transportation Co.	WCH
Wyandotte	Wyandotte Transportation Co.	WCO
Car Ferry No. 6	Ann Arbor Railroad Co.	WDQ
S. Y. Nirvana	Rodman Wanamaker	(Not assigned)
Capto	B. Stolt Nielsen	LGL
Adalia	Hall Line	(Not assigned)
Chariton	George M. Embiricos	SVO

IN RECOGNITION OF OPERATOR HEBDEN'S LOYALTY

A letter expressing the regrets of the officers of the Marconi Wireless Telegraph Company of America because of the death by drowning of Percy Burdon Hebden, an operator in the Marconi service, has been sent to Miss Florence Hebden of Philadelphia, his sister. Accompanying the letter was a check for $500, sent in accordance with the Marconi Company's plan for providing life insurance for its employes. The letter follows:

November 16, 1916.

Miss Florence Hebden,
3300 D Street, Philadelphia, Pa.

Dear Miss Hebden:

It was with deep regret that the officers of the Marconi Wireless Telegraph Company of America learned of the death, by drowning at Rio Janeiro, of your brother, Percy Burdon Hebden.

His record of service, dating from September 13, 1913, shows that he had earned a name for devotion to duty, reliability and steadfastness of purpose—characteristics which will be associated with memories of him for years to come. He was one of those who kept vigil on the sea in calm and storm, facing hardship, peril and privation with unflinching eyes, in order that he might protect the lives of others. For these reasons the Marconi Company is particularly proud to have had him in its service, and it is not too much to say that he well exemplified in various ways the ideal which it seeks to maintain.

The loyalty which Marconi operators give prompted the Company to provide life insurance for them, and in accordance with this plan, you as the beneficiary named in your brother's policy, will receive $500. You will find enclosed a check for this amount.

With assurances of our sincere sympathy because of your bereavement, we are

Yours very truly,
E. J. NALLY,
Vice-President and General Manager.

Miss Hebden wrote in reply:

November 19, 1916.

Mr. E. J. Nally.

Dear Sir:

Your letter of November 16 reached me yesterday, also the check for five hundred dollars, for which please accept our sincere thanks.

As I am now the only support of my parents, this money will be very acceptable.

It has given us great pleasure to have your letter and we shall always keep it as a memorial to my dear brother.

Percy was an ideal son and brother, and his loss is keenly felt by all of us.

Again thanking you for your prompt attention in this matter and for your much appreciated letter, I am, with best wishes for the success of the Company and yourself,

Sincerely yours,
FLORENCE HEBDEN.

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.

S. R. H., New York City, inquires:

Ques.—(1) When employing a 2 k.w. transformer operating from a sixty-cycle source of alternating current, which do you consider the better method of connection: placing the spark gap in parallel with the secondary winding, or the condenser in parallel with that winding?

Ans.—(1) Either method may be used with practically equal results. It has been stated that placing the spark gap in shunt to the secondary winding, protects the secondary pancakes or windings of the transformer from puncture which might be occasioned by the reactance voltage of the condenser. Thus during the period the condenser discharges across the spark gap, the secondary winding is practically short-circuited and is thereby protected from the oscillations of radio frequency.

Ques.—(2) What should be the capacity of a condenser to operate at 425 meters, the secondary voltage of the transformer being 16,500 volts?

Ans.—(2) A capacity of .02 microfarad is about the correct value.

Ques.—(3) On page 42 of the book "How to Conduct a Radio Club" a diagram is given of the connections for measuring the wave-length of an aerial. Should not the secondary winding of the oscillation transformer be included in the circuit to get the wave-length under operating conditions?

Ans.—(3) Yes, but the method presented was merely intended to show how the natural or fundamental wave-length of an antenna system can be obtained. The actual increase in wave-length, due to the secondary winding, must, of course, be taken into account when the set is to be operated on a stated wave-length.

Ques.—(4) On the hypothesis that the vacuum valve is operated by changes of potential and that the voltage component of the energy in the antenna system is a minimum at the earth connections, would it not be better to place the loading coils on the ground side of the tuner, rather than on the aerial side?

Ans.—(4) The correct position for this loading coil and the resulting potential depends upon other factors, such as the general over all distribution of current in the antenna system, which, of course, can only be approximately calculated. It may be that in certain cases the apparatus will give better response by connecting the loading coil in series with the earth, but examples could be cited where the statement does not apply. Several variable factors enter into this problem which would require an exceedingly lengthy discussion and a statement of facts in a particular instance. Why not satisfy yourself by carrying out the experiment?

* * *

P. B. B., Statesville, N. C., inquires:

Ques.—(1) Please state the approximate wave-length of an aerial consisting of 4 No. 14 copper clad wires, 100 feet in length with an average height of 60 feet, the wires being spaced two feet apart. The lead-ins are 50 feet in length.

Ans.—(1) The wave-length of this aerial is approximately 200 meters.

Ques.—(2) Also please state the natural wave-length of an aerial consisting of four No. 14 aluminum wires, 100 feet in length. 40 feet in height, the wires being spaced 23 inches apart. The lead-ins are approximately 25 feet in length.

Ans.—(2) The approximate wave-length of this aerial is 170 meters.

Ques.—(3) Both of these aerials are of the inverted L type. Could I hear the station at Arlington, Va., and Guantanamo, Cuba, with the small aerial?

Ans.—(3) Provided your station is equipped with the proper type of receiving apparatus, you should have no difficulty during the night hours in receiving signals from either of these stations.

* * *

O. S., Bonner Springs, inquires:

Ques.—(1) What would be the receiving range and approximate wave-length adjustment of the panel receiving set described in the Third Prize Article in the October, 1916, issue of THE WIRELESS AGE, when connected to a single wire aerial, 600 feet in length and 35 feet in height, with a lead-in 40 feet in length?

Ans.—(1) The equipment described in that issue will not respond to wave-lengths in excess of 1,600 meters, although you may be able to receive signals from Arlington by reason of forced oscillations in the tuning circuits. For example: Your aerial system may respond to wave-lengths of 2,500 meters with the variometer connected in series, but the secondary circuit would not be in resonance with the aerial circuit.

* * *

J. D. D., New Castle, Pa., inquires:

Ques.—(1) Please state the call letters of the Eiffel Tower Station in Paris.

Ans.—(1) The official call letters are FL, but we are not certain that they are being used at present.

Ques.—(2) What type of oscillation transformer is considered best for ½ k.w. transmitting set?

Ans.—(2) The inductively-coupled oscillation transformer is generally preferred because it permits the coupling between the primary and secondary windings to be easily adjusted. Practically equal results can be obtained with the auto transformer, but in order that the coupling between the primary and secondary windings may be varied over a considerable range, the helix must be fitted with 3 contact clips.

Ques.—(3) What is the approximate wave-length of an aerial 200 feet in length, comprising 4 wires spaced 2½ feet apart? The average height is 67 feet from the earth.

Ans.—(3) The fundamental wave-length of this aerial is approximately 367 meters.

Ques.—(4) Will a seventy-five-ampere fuse installed between the lightning switch and the aerial switch, affect the receiving range of a station?

Ans.—(4) No.

Ques.—(5) What is the wave-length of WCV, the Marconi station at Cape May, N. J.?

Ans.—(5) The standard wave-lengths of 300 and 600 meters are in use.

* * *

A. E., Covington, Ky., inquires:

Ques.—(1) What would be the most advantageous method of constructing an aerial to be erected between a 125-foot pole, 50 feet distant from a 15-foot pole, the latter mounted on the top of a 30-foot house, making the total height of 45 feet?

Ans.—(1) A flat top aerial comprising four wires spaced 2 or 3 feet apart, stretched from the top of the high mast to the mast atop of the house, the lead-ins being extended from the lower end to the apparatus, will give the best results.

* * *

H. E. W., Valley Station, Ky., inquires:

Ques.—(1) Could the apparatus described in the Third Prize article in the October, 1916, issue of THE WIRELESS AGE be employed to receive the time signals from Arlington? If so, what would be the dimensions of an aerial for use in connection with it and also what should be the resistance of the phones and the capacity of the fixed condenser?

Ans.—(1) This apparatus will not respond to the wave-lengths of Arlington without the addition of loading coil in the antenna circuit and a similar loading coil in the secondary circuit. The resistance of the telephones should be approximately 2,000 ohms and the fixed condenser should have a value of approximately .005 microfarad.

* * *

F. R. B., Omaha, Neb.:

By reference to page 108 of the November, 1916, issue of THE WIRELESS AGE, you will see that the natural wave-length of your aerial is slightly under 150 meters and the addition of the secondary winding of your oscillation transformer in series will not increase the wave-length beyond 200 meters. However, the capacity of the condenser in the closed circuit is excessive for this wave-length. You should cut out one section of the moulded condenser, thereby lowering the capacity to a value of .0085 microfarad. The primary winding of the oscillation transformer then requires no more than 1½ to 2½ turns to obtain the wave-length of 200 meters. In fact, we believe that the emitted wave of your station is close enough to 200 meters to escape complaint on the part of the Government Authorities.

* * *

A. P., Lawrence, Kas.:

The statement made in another publication that the secondary winding of the 3-inch spark coil should have 1½ pounds of No. 30 enameled wire, is a typographical error. The actual secondary voltage of an induction coil depends upon the action of the vibrator as well as upon the over-all design of the windings and core. On this account, different manufacturers have cores of different dimensions for given spark lengths.

The 3-inch coil to which you make reference should have from one and one-half to two pounds of No. 36 enameled wire in the secondary winding. This should be divided up into either two or three units.

The average 3-inch spark coil consumes from sixty to eighty watts direct current.

The condenser of large capacity you desire can be constructed of two sheets of tin foil, 90 feet in length, 6 inches in width. These should be separated by a thin sheet of paraffin paper placed between the two sheets of tin foil and another sheet of paraffin paper placed on the outside. The entire unit is then rolled up in circular form and the connections are brought out from the iside and outside sheeting of tin foil to the binding posts.

* * *

C. W. L., Canton, Ohio:

Possibly you may be able to cut down the flickering of the lights caused by the operation of your transmitter by readjustment of the condenser capacity at the secondary winding or by placing a reactance coil in series with the primary winding. In some sets a reactance coil is placed in shunt to the telegraph key and a portion of the load is taken by the transformer at all times, but there is not enough current to cause the spark to discharge across the gap. When the sending key is closed, full value of current flows to the primary winding and the spark functions. Transformers equipped with a magnetic leakage gap give the least trouble in this respect.

* * *

V. V. V., Lodi, Cal.:

Presuming that you intend to use a vacuum valve detector in connection with your receiving tuner for 10,000 meters, the following dimensions are applicable: The primary winding may be 10 inches in length, 7 inches in diameter, wound with No. 24 S. S. C. wire. The secondary winding should be 6 inches in diameter, 6 inches in length, wound with about 830 turns of No. 36 S. S. C. wire.

* * *

W. A. A., Louisville, Ky.:

You should keep in mind the fact that a wireless telephone transmitter like that described in the May, 1916, issue of the Monthly Service Bulletin of the National Amateur Wireless Association requires a receiving set adjustable to the wave-lengths lying between 6,000 and 8,000 meters. That is to say, you could not connect a microphone in the oscillating circuits of the vacuum valve detector and expect to receive the signals on an ordinary tuner and crystalline detector, the probable wave-length adjustment of which is no more than 2,000 or 3,000 meters. In other words, after having constructed a wireless telephone transmitter according to the design given in that issue, a similar set should be installed at the receiving station. In fact, the same battery of vacuum valves can be employed for reception as well as transmission. A hissing sound in the head telephones does not indicate that oscillations are taking place at radio frequencies. It requires considerable experience on the part of the experimenter to properly adjust a circuit of this type.

* * *

G. A. S., Mobile, Ala.:

We have no information at hand concerning the origin of the peculiar undertone you have observed in the spark of the stations referred to.

For the handling of large powers, the rotary spark gap is preferred and is always employed where a 60 cycle source of current from a city power house is available.

The 3-element vacuum valves are not supplied to the amateur market since a recent court decision. Amplifier bulbs, however, can be purchased.

* * *

L. C. R., Marlette, Mich.:

The variometer inductance described in connection with the receiving set shown in the January issue of the National Amateur Wireless Association Monthly Service Bulletin was not intended to give a large increase in the wave-length of the antenna circuit. It merely gives a fineness of adjustment between the taps of the multi-point switch connected to the secondary winding. In fact, this variometer does not increase the wave-length of the antenna system more than 125 to 150 meters Hence, you can judge for yourself approximately the dimensions of an ordinary loading coil to take its place.

* * *

J. J., Brooklyn, N. Y., inquires:

Ques.—(1) How can I construct a compact and neat fixed resistance of 1,800 ohms for the Perikon detector circuit as described on page 79 of the second edition of the book "How to Conduct a Radio Club"?

Ans.—(1) You might take a spool of No. 36 German silver wire and wind it non-inductively on a wooden core to the correct value, or you might purchase from an electrical supply house a graphite resistance rod, having approximately this value of resistance. This may be mounted on a spring clip base, such as supplied by the Marconi Company for use in its sets in the marine service.

Ques.—(2) What is the correct value of battery voltage necessary to operate this detector successfully?

Ans.—(2) Generally a single dry cell is all that is required.

Ques.—(3) What is the natural wave-length of a four-wire aerial, 60 feet in length, with an average height of 40 feet? The lead-in is 35 feet in length.

Ans.—(3) The natural wave-length is approximately 130 meters.

Ques.—(4) Please give the dimensions of an inductively-coupled transformer to be substituted for the auto transformer in a single step amplifier described on page 86 of the second edition of the book "How to Conduct a Radio Club."

Ans.—(4) The primary winding may have approximately 3½ pounds of No. 34 S. S. C. wire, which is covered with a sheet of Empire cloth, and the secondary winding may have about 4½ pounds of No. 36 S. S. C. wire.

Step-up transformers of this type can be purchased from the Manhattan Electrical Supply Company, Park Place, New York City.

* * *

J. R., Washington, D. C.:

A gas igniting coil is of no value whatever as a loading coil in the antenna circuit of a receiving set, due to the high self-inductance of the winding and the presence of the iron core.

Your aerial, 70 feet in length, 60 feet in height, has a fundamental wave-length of approximately 150 meters, and the receiving set you describe in your third query has a possible wave-length adjustment of about 3,000 meters and should permit a night range of at least 1,000 miles.

A 1½-inch spark coil connected to your transmitting aerial should give you a range of from three to ten miles in daylight.

We do not understand how you propose to operate a rotary spark gap in connection with an induction coil.

J. R. H., Winnipeg, Man., inquires:

Ques.—(1) I have constructed a receiving set like that described in Figure 70 in the second edition of "How to Conduct a Radio Club" and should like to know whether this tuner could be used for the reception of undamped waves, if loading coils of proper dimensions were constructed?

Ans.—(1) The loading coils described for the long distance receiving set on page 92 of the same publication have approximately correct dimensions for use in connection with this coupler. For waves of 10,000 meters the dimensions of both loading coils should be slightly increased.

* * *

P. E. H., Barberton, O.:

The fundamental wave-length of your aerial, described in your first query, is about 240 meters and is may be reduced to the wave-length of 200 meters by attaching the lead-in wires of the aerial to the center of the flat top or by constructing a short wave condenser of two plates of glass, 12 inches by 12 inches, covered with tin-foil, 10 inches by 10 inches. These plates should be connected in series and then in series with the antenna circuit. The better method for raising the wave-length of the antenna circuit to 600 meters is to purchase a wave-meter and to add inductance in the antenna circuit until a wave-length of 600 meters is indicated.

You will not be able to use the full power consumption of your Blitzen transformer at the wave-length of 200 meters and you should use no more than five sections of the moulded condenser. The antenna current will lie somewhere between two asd three amperes.

* * *

H. H. Sayre, Pa., inquires:

Ques.—(1) Referring to the description of a heterodyne receiving apparatus described in the February Monthly Service Bulletin of the National Amateur Wireless Association, can coils Nos. 1, 5, 8 and 10 be made of bunched windings instead of drum windings without lowering the efficiency of the apparatus?

Ans.—(1) The drum windings are preferred. Several experimenters report good results with multi-layered windings, the adjacent coils being separated by about 1/4 or 1/2 an inch. Windings have been made up of three or four concentric coils and a very great value of inductance obtained in a minimum of space. Concerning the degree of efficiency with this winding, we have no definite data and cannot reply.

Regarding your second query: This apparatus can be mounted in a receiving cabinet provided the precaution is taken to keep the high potential ends of the coils at a distance from one another. Also place the aerial tuning inductance at right angles to the primary winding and the loading inductance in the secondary winding at right angles to the secondary proper.

Coils 3, 5, 6, 7, 11 and 12 may be fitted with multi-point switches, if desired, and the number of taps taken may vary according to the discretion of the builder. Generally for the longer range of wave-lengths a large value of inductance can be selected in all circuits and the necessary change of wave-lengths effected by means of the variable condensers only.

* * *

F. N. W., Jr., Elyria, Ohio:

Whether or not the aerial you have described will fulfil your requirements depends upon the radio stations from which you desire to receive signals. You of course understand that aerials 600 or 700 feet in length cannot be used for the reception of signals from amateur stations at the wave-length of 200 meters, but are particularly suitable for wave-lengths on the order of several thousand meters. Offhand we see no advantage in constructing an aerial after the designs you have given; in fact, if you will take careful note of your diagram you will observe that the loops of wire attached to the galvanized iron span wire are more or less non-inductive. At any rate, unless you desire to receive signals from stations at the wave-length of 6,000 or 8,000 meters, an aerial of the dimensions you have given is not necessary.

* * *

G. E. W., Kansas City, Mo.:

The troubles you experience in the lighting circuit of your house are due to electrostatic induction from the wireless aerial and the only remedy we know of is to place this aerial at right angles to the power wires or place the power wires in conduit under ground. Some part of the aerial system must be in very close inductive relation to your power circuits to cause a puncture of the insulation in the primary winding of the transformer, and the trouble can only be remedied by removing the aerial to a distance or by removal of the lighting circuit.

* * *

J. A. W., Jr., inquires:

Ques.—(1) Why does a synchronous rotary spark gap give a higher discharge frequency than that obtainable from the frequency of the current source of supply?

Ans.—(1) Because the speed of the disc and the number of electrodes is such that the charge placed in the condenser by each alternation of the charging current is discharged from two to four times per alternation depending upon the number of discharge paths presented by the disc per alternation of current.

Ques.—(2) Using the formula $C = \frac{W}{NV^2}$ I find that the required capacity for my condenser is .006 microfarad, with a transformer having a secondary voltage of 13,200 volts. Is this value correct?

Ans.—(2) This is about the correct value and should give very good results on 200 meters. The formula is only approximate, but is sufficiently accurate for preliminary determinations in any circuit.

Ques.—(3) Would four sections of Murdock moulded condenser connected in parallel withstand the voltage of this transformer?

Ans.—(3) Yes.

Ques.—(4) Where can I procure diagrams of systems using undamped waves?

Ans.—(4) Such systems are described in previous issues of the proceedings of the Institute of Radio Engineers, copies of which can be obtained from the Secretary, No. 111 Broadway, New York City.

Ques.—(5) Is there a transformer on the market by which sixty cycles alternating current can be stepped up to 500 cycles A. C.?

Ans.—(5) No such transformer exists.

* * *

S. B., Liberal, Kan., inquires:

Ques.—(1) I have an inductively coupled receiving tuner with a primary winding 4 inches outside diameter, wound with No. 24 S. C. C. wire. The secondary winding is 5½ inches in length, 3½ inches outside diameter, wound with No. 32 S. C. C. wire. It is 5 inches in length. What is the upper range of wave-length adjustment approximately?

Ans.—(1) The upper range of wave-length adjustment is about 3,000 meters.

Ques.—(2) Approximately what is the wave-length of an aerial comprising two wires, 150 feet in length, with an average height of about 35 feet? The lead-in is 25 feet in length.

Ans.—(2) About 270 meters.

Ques.—(3) Can you estimate my receiving range with an electrolytic detector, galena and silicon crystals, with the necessary associated appliances?

Ans.—(3) At nighttime you should hear commercial stations on the Atlantic Coast and in the Great Lakes District during the favorable months of the year.

Ques.—(4) Which is the more sensitive, fused silicon or crystal silicon?

Ans.—(4) Practically equal results are obtained with either grade.

Ques.—(5) With which of the receiving detectors could I obtain the best long distance results?

Ans.—(5) With the vacuum valve.

* * *

L. W., Portaupeck, N. J.:

The dimensions for a loading coil of a 10,000 meter receiving transformer cannot be furnished unless the inductance and capacity of the antenna with which it is to be employed is definitely known. There is no such thing as a 2,000-meter loading coil, because the actual effect on the wave-length of an antenna by the insertion of a given amount of inductance depends upon the capacity and inductance of the aerial system. The dimensions for a transformer of about the capacity you desire are given in the December, 1916, issue of The Wireless Age.

The receiving condenser to which you refer should have a total of 144 square inches of foil on one side and a dielectric medium of thin paraffin paper. This will give a capacitance of close to .01 microfarad.

C. W. B., Anaheim, Cal., inquires:

Ques.—(1) Why do so many commercial ship stations employ the carborundum detector exclusively?

Ans.—(1) Because it is the most practical of all crystalline detectors for commercial working due to its inherent stability and ease of adjustment.

Ques.—(2) Why are certain call letters listed in the Government Call Book with the corresponding ship's name missing?

Ans.—(2) These letters are reserved for ships under construction and since, according to the International Convention, a certain number of reservations are made for each country the permissible call letters are inserted in the Call Book and when they have been assigned to a definite vessel the owner of the book can fill in the blank space.

M. W. C., Jr., Hoboken, N. J.:

The fact that you are only fourteen years of age would not prevent your securing an amateur station license, providing you can pass the necessary Government examinations. We cannot quote the possible wave-length adjustment of your receiving apparatus without knowing the dimensions of the antenna with which it is to be employed. If you can furnish us with this data we can give you an approximate calculation.

From and For Those Who Help Themselves

(Continued from page 282.)

E should be carefully adjusted so that it makes good contact with D.

The action of the gap is as follows: Current from the condenser passes through E and G to the copper gasket, D (Figure 2), which connects all the revolving electrodes together and jumps from the moving point as they pass the single stationary electrode, D (Figure 1).

This type of spark gap can be used with transformers of almost any voltage. In the case of a low voltage transformer, the advantage lies in the short single gap obtained; with higher voltages a spark having the characteristic of both the rotary and quenched gap is secured by connecting a quenched gap of suitable dimensions in series with the rotary gap.

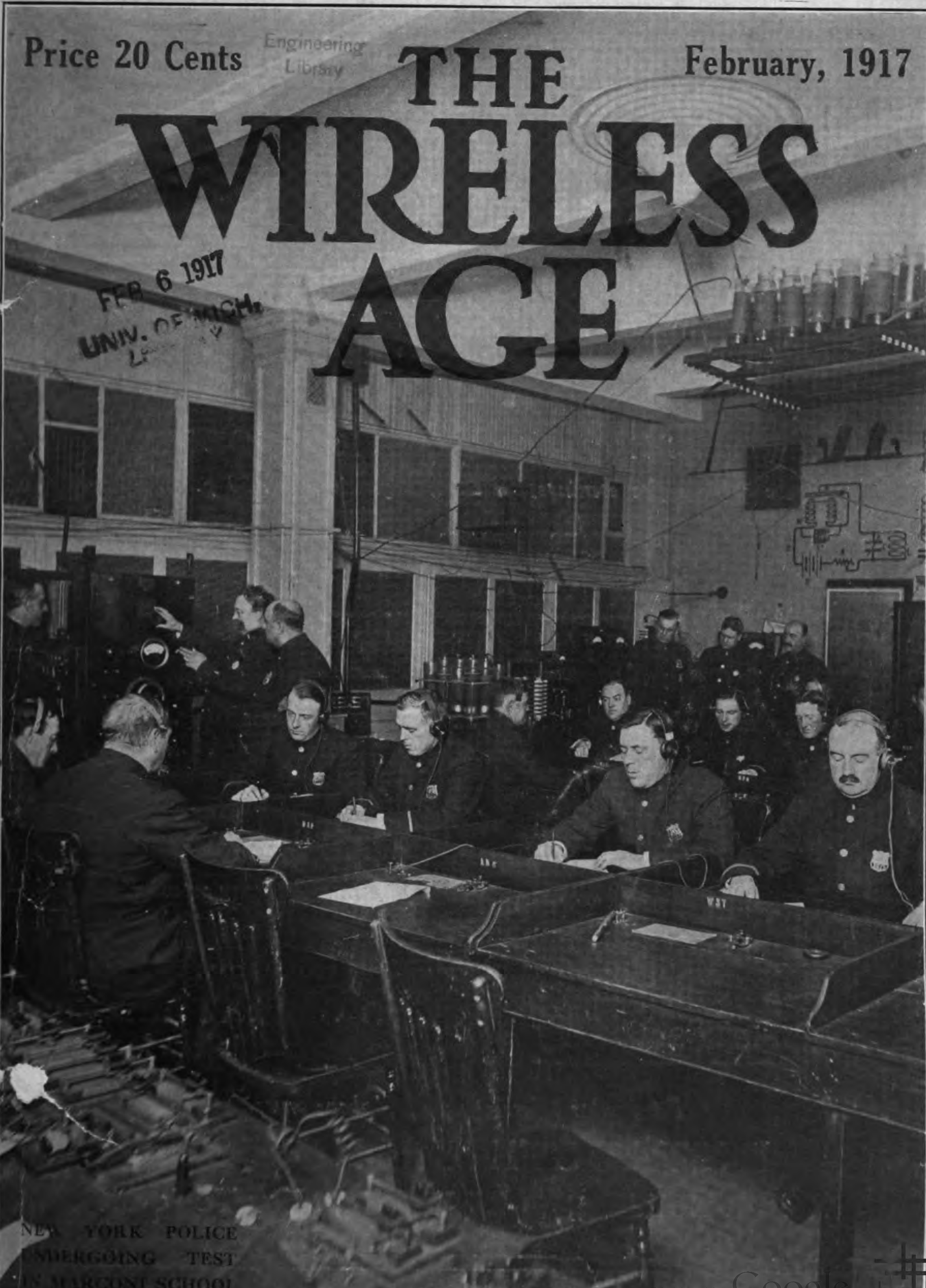
During the first tests of this gap many amateurs inquired as to the manner in which the spark note had been improved. The fact that an overland distance of 425 miles has been covered on several occasions with an aerial less than 60 feet in height and a transformer input of only ½ k. w., testifies to its efficiency.

Byron B. Minnium, *Pennsylvania.*

Price 20 Cents

February, 1917

THE WIRELESS AGE



NEW YORK POLICE UNDERGOING TEST IN MARCONI SCHOOL

THE WIRELESS AGE

Owing to the fact that certain statements and expressions of opinion from correspondents and others appearing in these columns from time to time may be found to be the subject of controversy in scientific circles and in the courts, either now or in the future, and to sometimes involve questions of priority of invention and the comparative merits of apparatus employed in wireless signaling, the owners and publishers of this magazine positively and emphatically disclaim any privity or responsibility for any statements of opinion or partisan expressions if such should at any time appear herein.

FEBRUARY, 1917

Government Ownership of Wireless

The Navy Comes Out Openly for Government Ownership—Sayville Citation an Argumentative Boomerang—The Invitation to Foreign Reprisal—Recommendation to Take Over Coastal Stations Based Upon Misinformation—Marconi's Economical Proposition Refused Under Taft Administration—Military Necessity of Monopoly Refuted by Experience of Other Nations—Encouragement and Aid to Private Enterprise Abroad—Difficulties of Government Operation With International Marine and Transoceanic Stations—The Spirit of Preparedness Under Existing Conditions

As reported in the January issue of THE WIRELESS AGE, the new legislation proposed for the regulation of radio communication and apparently designed for Government ownership and control, has been vigorously pushed forward by the Navy. As we go to press the Bill is in the hands of the Committee on the Merchant Marine and Fisheries, Hon. J. W. Alexander, chairman. The provisions as submitted show only minor changes from the text as printed in full in the January issue.

The proponents of the measure began their presentation of arguments before the Committee on January 11th, those in opposition, one week later. It is announced that all hearings will be public and interested persons may attend as many as may be convenient.

That the Bill has been designed to invade the existing commercial field is definitely disclosed in an official letter from Secretary Josephus Daniels, of the Navy Department, under date of December 26th.

"The bill," says Secretary Daniels, defining the attitude of the Navy Department, "covers the purchase of coastal stations only, that is, only those used to communicate with ships, and, by permitting the Navy Department to open all of its stations to commercial business, discourages the extension of any existing commercial systems or the organization of new systems.

"The department strongly recommends that the committee provide for the purchase of all stations used for commercial purposes. In some cases the status of existing stations is constantly changing, and decisive action at this time will result in a saving of public funds. I recommend that Section 6 of the bill provide for the purchase, through the Navy Department, of all existing coastal and commercial stations in the United States, Alaska, Hawaii, Porto Rico, and the Swan Islands within two years at reasonable valuation, and that no license be granted to any such station for operation after two years from the date of the passage of the bill."

Secretary of the Navy Openly Advocates Government Monopoly

Secretary Daniels indorses the other provisions of the bill, especially those relating to the ownership, the licensing, and the control of stations by the Department of Commerce.

Mr. Daniels explains that the Navy Department "is convinced that Government operation and control of all stations used for commercial purposes, other than those on board merchant ships, is necessary on account of the mutual interference between stations.

"One station or system," he says, "must wait for another to finish; there are many chances for disputes which sometimes are carried on between operators by radio, especially when the operators are not under strict control, adding to the time wasted; there is needless duplication of effort, and in cases of distress the confusion resulting from many interests attempting to render aid, get news, or satisfy curiosity, is very dangerous.

"Since only by the closest regulation can the best use of this art be obtained, not only for commerce and safety at sea, but for military purposes, radio telegraphy is a strict Government monopoly with the larger number of foreign nations, and in those foreign countries where commercial stations are permitted the Government control is generally so strong as to amount to a monopoly.

"Authority to take over and operate or to close commercial stations in time of war will not suffice. The stations must be in full Government operation before the first hint of possible hostilities."

Citation of Sayville Case In Support of Navy's Contentions

Following the publication of this letter, Mr. Daniels added informally:

"I am firmly convinced that Government control of wireless is absolutely necessary to the best interests of the nation. I deem the matter most urgent. Delay only will increase the difficulties under which we are working; delay also will mean an increased outlay to the Government when the step finally is decided upon."

The Navy Secretary and others, although refusing to comment publicly on certain phases of what Government controlled wireless means to a nation, privately pointed to what absolute control of wireless has meant to Germany and the Central Powers, "which otherwise would be completely and totally cut off from the rest of the world, except for their submarines."

This drew a published reply from Edward J. Nally, Vice-President and General Manager, Marconi Wireless Telegraph Company of America, substantially as follows:

How the Sayville Incident Actually Disproves the Government's Case

The Administration measure for Government ownership of all wireless stations, as advocated by the Navy Department, is now being revealed in the light of its true purpose, a monopoly in Federal hands, rather than domination of the public-serving utility by legislative "control." In hearings on the bill held in Washington before the Committee on Merchant Marine and Fisheries it has been represented that effective operation of Government and commercial wireless stations is not possible under present conditions, and only through the acquisition of private stations can national security be obtained.

The selection of radio as the opening wedge in a campaign obviously designed for eventual Government ownership of all communication lines in the United States, appears to be based principally upon the supposition that the advocacy of a radio monopoly for the Navy will have a fair chance for success by reason of the present popularity of the preparedness plans for the department. The proponents of the bill, and notably the Secretary of the Navy, argue that the necessity for Federal ownership is supported by the assumption that had it not been for absolute Government control of wireless by Germany and the Central Powers, these nations "would be completely and totally cut off from the rest of the world, except for submarines." It is at once obvious that this reasoning is faulty. Germany's ability to maintain communication by wireless with the United States today is in fact due to the establishment and maintenance, before the war, of the station at Sayville, Long Island, as a commercial plant operated by the Atlantic Communication Company, a private business enterprise, incorporated under the laws of the State of New York. This company transacted commercial wireless business with Germany in the usual way, using the Telefunken system which originated and had been developed in that country. With the outbreak of hostilities, the Sayville station was placed under rigid censorship and has since been operated under the supervision of the United States naval officers, in much the same way that the regulations provide for the conduct of any station owned by any American company. That a United States Government license was issued for the Sayville plant—without which no wireless station can operate in this country—is a direct refutation of the contention that control of its wireless by the German Government kept that nation from being "cut off" from the rest of the world in wartime. For it is not credible that our Government would have issued a license to erect and operate the Sayville station on United States territory had it been represented that the equipment was owned and operated by the German Government. It is thus readily seen that the existence of Germany's connecting communication link with the United States today is entirely due to the fact that the German nation, instead of monopolizing its field of wireless communication, encouraged development under private enterprise. In direct contravention to the lesson to be learned from this significant incident, however, the Navy Department sees a supposed necessity for wiping American commercial companies out of existence.

Real Preparedness Found In Wartime Availability of Commercial Enterprise

The weak structure of argument that points to national security being possible only by enacting the present Bill and placing all stations in the United States under Government ownership, undertakes to ignore the abundance of laws now on the statute books for the control of radio stations in time of war or public peril. Since 1912, all ship and shore stations have been operated under the control and supervision of the Department of Commerce under powers so broad that it is difficult to imagine any emergency which the present Government regulations would not meet.

Voluntarily placing the highly developed equipment and skilled operating staff of the Marconi Company at the disposal of the nation in time of public peril, constitutes a preparedness measure of immeasurably greater importance than control of wireless stations by Government monopoly. For many years the Government has been a large user of wireless, yet it has not contributed any of the important advances which have been made in the art during that time, the invention itself and all important refinements of apparatus being the result of private experimenting of a purely scientific nature or in the interests of commercial companies. In time of national peril, this country should have the best wireless equipment obtainable, and it is obvious that with the market for private enterprise removed by wireless becoming a Government institution, most of the incentive for scientific effort toward further development will be removed.

The Policy of Other Nations and the Danger of Reprisal

The high efficiency to be obtained by encouragement of commercial development has been recognized by other nations. The direction of England's fleet in the present war is principally conducted through the Marconi station at Carnarvon, in Wales, taken over by the Admiralty at the commencement of hostilities. Great Britain had Government-owned stations before the war, just as we now have them, yet it is a matter of record today that the most important wireless work of the nation is being done by commercially owned and developed stations turned over for the nation's use in emergency.

The short-sightedness of the proposed American legislation is further revealed in the fact that the Bill undertakes to exclude from the United States "any company of which any officer" or more than one-third of the directors or stockholders "are aliens." Mr. Marconi, to whom humanity owes an enormous debt of gratitude, being an alien, is thus to be deprived of his just reward as a shareholder and prevented from continuing as an officer in the management of his own company. To enact this Bill would therefore not only deprive this country of the benefits of future Marconi inventions, but in discriminating against the distinguished alien inventor, invites a reprisal from other nations in the form of legislation directed against Americans. All of the cable companies of this country, for example, are dependent upon foreign countries for landing rights, and England could say to the Western Union and Commercial Cable companies that because they are controlled by aliens they are not entitled to do business in England.

Full Government supervision over wireless, or any other industry, is perfectly proper and in order with the progressive spirit of the times. This is provided for, however, in the present laws governing radio communication. For the United States to go a step further, as the present Bill advocates, and make radio a Government monopoly, is not only a dangerous proceeding and one in violation of the rights of American citizens, but a proposal that calls for additional taxation to conduct a wireless telegraph business in time of peace, now more efficiently and cheaply handled by commercial interests.

When the public realizes the true state of affairs, a vigorous protest against the present Bill will be registered. Setting aside considerations of a dollar and cents aspect, it is not likely that Americans will sit idly by and see the possible destruction of the valuable humanitarian asset represented in Marconi's recorded service in safeguarding life at sea.

The Proposal to Take Over All Coastal Stations

Mr. Nally further supported the arguments of the Marconi Company that Government ownership is impractical, by appearing before the Committee in Washington on January 18th, at which time he presented undeniable facts in the following words:

It is recommended in this Bill that the Government be permittted to acquire and operate all commercial coast wireless stations; that the Government, through the Navy Department, assume a monopoly of the commercial radio business of the coasts of the country, which means as well all ship to shore communication.

"It is conceded in the recommendation that the Government now owns and operates sufficient radio stations, and has ample Congressional authority for the construction of others for its entire needs. Congress has also permitted certain of the Naval radio stations to do a commercial business. This commercial service feature was adopted to meet commercial needs, particularly in Alaska, and at some other points where no commercial stations had then been established.

The Navy's Assumption That Commercial Coast Stations Are a Burden

"The Radio Bureau of the Navy reports that it has handled this commercial service entirely to its credit and benefit. In recommending the extinction of commercial competition, complaint is made that the operation of the commercial companies prevents the naval operators from obtaining the requisite amount of telegraphic practice."

The Vice-President and General Manager of the Marconi Company then drew attention to Section 5 of the Bill which provides for the opening by the Government of its radio stations to general public business, and noted that if this provision is enacted into law, it will create a condition of competition between Government and private interests, resulting in a heavy financial loss to commercial companies, which have spent considerable sums of money and years of labor in the development of efficient radio stations, so as to provide a satisfactory commercial wireless telegraph service to the public.

"Section 6 seems to anticipate the condition referred to in the preceding paragraph," Mr. Nally observed, "in that it provides that, 'The Government, through the Navy Department, shall have authority to acquire by purchase, at a reasonable valuation, any coastal radio station now in operation in the United States which the owner may desire to sell.'

"Much has been said during the hearing given by this Committee to the proponents of this Bill, about the willingness, even the anxiety, of the commercial companies to dispose of their coastal stations to the Government.

"So far as the Marconi Company is concerned, no one has been authorized to make any such statement," he stated with emphasis, "and I can only think that, with the Navy Department, the wish is father to the thought.

The Value of Shore Equipment and the Relation of Commerce to Development

"It is not stated who shall determine on the reasonableness of the valuation which the Navy Department may wish to place on property belonging to commercial interests.

"The values which have already been stated by the spokesmen for the Navy before this Committee are perfectly ridiculous in the light of the Marconi Company's investment, and the figures which they mention as being adequate for the purchase of the coastal stations and high power stations of the entire country represent far less than the investment of the Marconi Company alone.

"The Marconi Company's principal business is that of selling service. While it does manufacture some apparatus for sale, yet this branch of its business is merely collateral, and is not its principal object, which, I repeat, is to sell service.

"For this reason it does not sell apparatus to ships, but it sells ships certain service for a certain sum per month, just as the telephone company, or electric light company, sells its service to a customer.

"In order to give perfect service and to make the apparatus which it installs on ships serviceable in the greatest degree, it has erected and maintains land, or coastal, stations, from the most Northerly point on the Atlantic Coast to the most Southerly point; also on the Gulf, on the Great Lakes, and on the Pacific Coast north to Alaska.

"These stations were erected, and are maintained, as the essential, indeed, vital link in ship and shore service, and the long list of rescues at sea, and of lives and property saved because of the ready response which ships in distress at sea have been able to obtain by reason of these coastal stations, co-operating with other ships at sea, makes a long and honorable record, of which any company may well be proud. And this tremendous service in the salvation of life and property, already rendered by wireless, has earned for it at least the right to be developed and made useful and available to the fullest possible extent.

"Such development can only come through private enterprise," insisted the commercial authority. "It is impossible to formulate legislation which will foresee and provide for the future usefulness of radio communication. It is just as impossible to formulate legislation which will place on the Navy Department, or any other Government organization, the responsibility for increasing the commercial use of radio communication in its present state of availability. If the Navy Department had been given a monopoly of the telephone, when that means of communication was first developed, would the United States today have, as it has, the greatest telephonic development of any country? And yet the telephone has not supplanted the telegraph. It occupies an entirely new field created for it by the persistence of private enterprise.

A Definition of the Relationship of Shore Stations to Marine Service

"It is true, as the proponents of the Bill have stated (although they lay entirely too much stress and make too much of the fact), that these coastal stations, *per se*, are not money makers for the company, but as part of the complete service they are essential, and what they contribute to the service is vital.

"Are not telephone exchanges vital to the telephone service?

"Are not terminal stations vital and necessary to the conduct of railroad service?

"Do telephone exchanges, *per se*, or railroad terminal stations, *per se*, or the great main operating rooms of the different telegraph companies, *per se*, earn money for the telephone, the railroad, and the telegraph companies?

"They all contribute the vital and necessary service to make the whole service complete. Who would think of separating the central exchange from the work that it performs for the subscriber, or the terminal station from the railroad; or the main operating room of the telegraph company from the customer, or the branch office through which the customer deals? No one, save the Government.

Unbusinesslike Proposals of Government Contrasted with Offer to Supply Stations for Its Use

"The Government could do such an unbusinesslike thing, because the Government is not in business. The Government has not the experience to be gained only in business getting. The Government's sole function is to spend; it does not have to earn money before it can spend it. Its method is a complete reversal of business methods. It can spend money that it does not earn. Commercial companies must earn so that they can spend.

"In 1912, when the plans of development of wireless telegraphy in contemplation by the Marconi Wireless Telegraph Company of America were being discussed, President Taft accorded the Honorable John W. Griggs, president of the company, an interview, at which he explained the company's plans to the President and representatives of all the Government departments, as well as the military.

"At this interview he made the Government the following proposition:

"That in connection with its scheme of transoceanic wireless commercial service, the Marconi Wireless Telegraph Company of America would enter into a contract with the Government to build, in the Canal Zone and in the Philippine Islands, at its own expense, under the direct supervision of Mr. Marconi, and to be equipped with the most approved apparatus known to the art, high power wireless stations, capable of communicating 3,000 miles, and the Marconi Company would agree to operate same, under an arrangement with the Government as to rates and service that would be just and fair, giving preference at all times to Government messages; agreeing that the employees and operators connected with the stations should be so attached to the Government service as to be subject to impressment at any time the Government might take over the operation and control of the station; and also agreeing that at any time, on notice by order of the President of the United States, the Government, in case of riot, tumult, disorder, war, accidental catastrophe or other emergency, might take over the control and operation of the stations, for such time, as, in the judgment of the President, the public interest might require.

"It also agreed to erect these stations within such a reasonable time as the judgment of the Government might require; and generally, agreed to such terms and conditions in the carrying on of commercial business by arrangement with the Government, as might be found reasonable and just.

Marconi Proposal Not Considered and Expenditure of Public Money Since

"At this same meeting it was explained to President Taft that the Government of Great Britain had entered into a contract with the British Marconi Company, whereby that company assigned to the British Government the right to use the patents and inventions of Mr. Marconi, and agreed to build a chain of high power stations between Great Britain and her various dependencies in Europe, Asia, Africa, and Australasia. A system of high power long distance stations thus constructed would insure the benefit of direct and friendly communication with stations to be erected for the British Government.

"Our proposition in connection with the Canal Zone and the Philippine Islands was not given consideration. The Government has since gone about this work independently, and at great expenditure of public money.

Commercial Service Cheaper and Better and Arm of Government in War

"Since 1912, the Marconi Wireless Telegraph Company of America has completed great stations on the Pacific Coast, and in Hawaii, for service between this country and the Hawaiian Islands and Japan. The service with Hawaii was opened up on September 24th, 1914, and with Japan on November 15th, 1916. The delay to the latter service was owing to the delay in completion by the Imperial Japanese Government of its high power stations near Tokio.

"The American Marconi Company also completed high power stations of the same type as those constructed on the Pacific Coast, in New Jersey—the transmitting station at New Brunswick and the receiving station at Belmar, for service with Great Britain. But before these stations could be operated for commercial service; indeed, while they were being tested out, the great European war broke out and England took over the stations in Wales which were to work with the New Jersey stations.

"The Marconi Company has about completed similar stations, of great power, in Massachusetts, the transmitting station at Marion and the receiving station near Chatham, Cape Cod, for transatlantic service with Norway and Northern Europe. The war has also interfered with this service; Norway was unable to complete its station, and England would not permit the shipment out of the United Kingdom of the high power apparatus which was being manufactured abroad, under Mr. Marconi's personal eye, for the Marion, Massachusetts, station.

"The Marconi Company insists upon its ability to handle long distance business for the Government, and for the public, cheaper and better than the Government can do it.

"It repeats its offer to constitute its staff, its equipment and its general organization, as an arm of the Government in times of war, or stress, or peril.

"It asks, in the meantime, that is, in times of peace, to be permitted to conduct its commercial service and to continue its development and extension of the art."

Mr. Nally expressed the conviction that his company recognizes in the radio service there exists a potent power for defense in time of war, and in preparation for war.

"On this point," he said, "it is acknowledged that in time of war, military necessity should not be under the slightest obligation to take into account the industrial or commercial welfare of the nation, but serious consideration is asked when it is proposed, on the ground of military necessity to legislate the Government into the permanent monopolization of an industry.

"Particularly weak must be the claim of military necessity to monopolize the commercial wireless business, inasmuch as Congress has but recently provided for more complete Federal control over radio communication than has been taken over any other industry. This control goes to the extent of providing that no radio station may be erected without a Federal license; the operation of any station may be suspended under Federal authority, and any and all stations may, by order of the nation's Executive, be placed completely under the control and operation of Federal employees. Complete censorship may also be maintained by the Government over all international communication.

Experience of Other Nations Proves Monopoly No Military Necessity

"Every one of these methods of control has been exercised by the Government during the present European war, and no lack of authority is complained of, It is a fair statement then, that the present request to have the Government take a monopoly of the commercial coast wireless business is not justified on any ground of military necessity."

He emphasized the fact that other great nations recognize that commercial companies have contributed to the value of the art. "While England and Germany, and France, and Italy, and Canada, and other countries, have and are making the most of radio possibilities," he said, "still they have left the development of the art to commercial companies, even assisting them by subsidy, and financial allowance.

Result of England's and Germany's Encouragement of Private Enterprise

"England, for example, encouraged private companies to the extent that the Marconi Company, for instance, was able to build up an immense works at Chelmsford, employing thousands of men, which was immediately taken over by the Government for military purposes, and there practically all of the wireless apparatus needed for the war has been constructed.

"England also took over a large part of the staff, having held them in reserve for this purpose.

"Germany has done precisely as England did. Germany has encouraged the private companies, leaving the development and manufacture of apparatus to such great concerns as the Siemens & Halske A. C., the Siemens Schuckertwerke G. m. b. H. and the Allgemaine Elektricitats Gesellschaft, utilizing their skill and product for its military purposes.

"Canada not only leaves the operation of the coast stations to the Canadian Marconi Company, which practically has a monopoly of the business in the Dominion, but has assisted the company by generous subsidy and allowance.

"The Marconi Company of America has never asked for subsidy, or assistance of any kind, except the right to carry on business and develop the art, just as other telegraph and telephone and other public utilities, are doing.

"Radio communication is in the very infancy of its possibilities, yet there is already an investment of forty millions of dollars in its commercial development in the United States.

"Rightly considered, all of this investment, representing the latest and most powerful stations and trained organizations, is an adjunct to the Government in times of military necessity. If opportunity for development is left open, this investment, this equipment and the personnel will increase, *and all are completely at the disposal of the Government in times of need!*"

In view of these considerations, Mr. Nally noted, it would seem that "where the development of an industry which lends itself naturally and completely to the possible military necessities of the country, and over which the Government is exercising complete control, there exists not a single valid reason for making such an industry a Government monopoly.

"There is also an important international phase of the radio problem, the solving of which requires the development of extended control of equipment standards, operating practice and language qualifications. If the ships of the sea are to develop among themselves and to the shore, universal intelligible communication, which is undoubtedly within the possibilities of radio development, a Government department, it will be admitted, can hardly be qualified to insist on the disciplining of an operator on a foreign ship who may be lax in duty or deficient in qualifications. There are daily possibilities here for the development of unpleasant and embarrassing international complications."

The Cumbersomeness of International Marine Regulation

The Committee's attention was called to the fact that private enterprise is already rapidly working out this problem through the means of equipment contracts, binding ships to employ only operators possessing standardized qualifications as to language, etc., and amenable to a central discipline as to the observance of certain mechanical and operating regulations.

"The abandonment of the ideal of the universal intelligibility of wireless is to abandon its future development," said the Marconi executive, "but such abandonment is inherent in a Government monopoly of the art, as can readily be seen from the limitations of the jurisdiction of a Government, and the cumbersomeness of its international representation."

A good deal has been said at the hearing, by the proponents of the Bill, as to the need for taking over existing high power stations. Mr. Nally remarked that it is not clear whether they wish them solely for Government work or to do a commercial business in competition with the cables.

Impracticability of Government Entering Transoceanic Business

"If, for example," he argued, "this Government were to take over our New Jersey stations, how could it operate them for commercial service with Great Britain, except through a connection with the Marconi Company of England, which owns the corresponding stations in Carnarvon and Towyn?

"If it takes over the Sayville and Tuckerton stations, now the property of private companies in America, would they continue to work with the privately owned stations in Germany? And in what way would the Navy, or the Government, benefit by such an arrangement?

"From every possible point of view, there is not a sound reason for placing the Government in the commercial radio business. There are controlling reasons of every character why this should not be done."

Marconi Company's Repeated Emergency Offers of Staff and Service

In closing, Mr. Nally asked the Committee to consider that it is a matter of record that the Marconi Company has repeatedly offered to place at the disposal of the nation, its stations and its operators, "even going so far," he noted, "as to secure from its operating personnel, individually signed expressions of readiness to enter Government service in event of war, which records were all turned over to the Navy.

"The Vera Cruz incident also brought forth a voluntary offer for the free use of Marconi stations for the battleship fleet, tendered to the Secretary of the Navy, and accepted."

The address concluded with this important statement as to national preparedness: "Before leaving New York I arranged, at the request of Rear Admiral Worthington, to furnish him with a list of all employees engaged in our Aldene Works, with the idea of constituting the entire force, including the official staff, a Naval Reserve, to be called upon by the Navy in time of emergency."

Your Obligation to the Wireless Field

The attention of all readers of the Magazine is directed to the Navy's advocacy of Government ownership of wireless. Without exception, all scientists and active workers in the art have opposed this dangerous proposal. The existence of the entire field of experimentation is threatened in the Bill dicussed in the foregoing article, and in its provisions the people of the United States are brought face to face with a crippling of the communication resources of the country, instead of a preparedness measure, as the supporters of the new legislation have described it. The enactment of the Bill into law must be vigorously opposed. Every reader of this Magazine should write a protest immediately to the Congressman representing his district at Washington. Write a personal letter, attacking the Bill (H. R. 19350), using the arguments presented in the above article, expressed in your own language and according to your convictions. *In addition to the letter to your Congressman,* write also to any member of the Committee who may represent at Washington the State you live in, as shown in the following list:

JOSHUA W. ALEXANDER, Missouri, *Chairman*.

RUFUS HARDY, Texas.
MICHAEL E. BURKE, Wisconsin.
EDWARD W. SAUNDERS, Virginia.
PETER J. DOOLING, New York.
HENRY BRUCKNER, New York.
LADISLAS LAZARO, Louisiana.
WILLIAM S. GOODWIN, Arkansas.
JAMES F. BYRNES, South Carolina.
JESSE D. PRICE, Maryland.
CARL C. VAN DYKE, Minnesota.
OSCAR L. GRAY, Alabama.
DAVID H. KINCHELOE, Kentucky.
WILLIAM S. GREENE, Massachusetts.
ASHER C. HINDS, Maine.
GEORGE W. EDMONDS, Pennsylvania.
WILLIAM A. RODENBERG, Illinois.
LINDLEY H. HADLEY, Washington.
FREDERICK W. ROWE, New York.
GEORGE M. BOWERS, West Virginia.
STANLEY BENEDICT, California.

The Fascination of the Wireless

Day-by-Day Incidents in the Life of the Man of the Key

By Edward Gwaltney Maxwell
Operator s. s. H. H. Rogers

WHEN a ship gets into trouble nowdays and her wireless apparatus plays an important part in the rescue of those aboard, we hear much of the operator and his heroism. But of the thousands of vessels that are going about in safety, and of the duties and life of the operators on them, only brief mention is ever made. This story is written mainly for those who spend their lives ashore and who, perhaps, would be glad to get a glimpse of the little things that are all in the day's work of a wireless man afloat. In it are included some incidents that took place aboard a Standard Oil tanker on a voyage to Argentina.

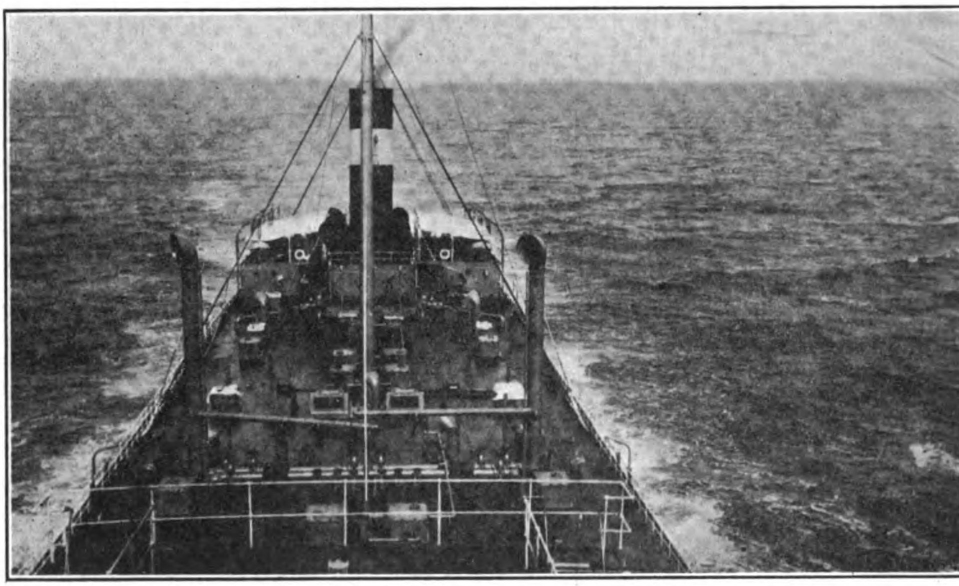
The operator occupies a unique place on shipboard. He is the only member of the crew not directly in the employ of the owners; answers solely to the Captain for his deeds or misdeeds; is permitted to roam around almost unchallenged; and, as the one link with the rest of mankind, is cultivated and cajoled.

Life on a tramp is always slow, but generally worryless and untroubled. When reading tires, one goes back aft to listen to the crew's complaint about the First Mate and the food; to hear the Chief tell his four old stories again; then up forward to watch the flying fish and an occasional Portugese man-'o-war. Sometimes the wireless man borrows a length of sailmaker's twine and a piece of pork from Cooky and tries to catch a gull, or else, with the Skipper's consent, relieves the quartermaster at the wheel for an hour. However, the everyday routine is eat, sleep and listen in.

An Argentine fishing boat with lateen rig on the River Plate

To the operator whose wireless experience has been limited to the Northern Hemisphere the working of South American stations is extremely novel. The International Regulations are not so strictly observed down on the Brazilian coast as around Sea Gate, and the oldtimer is reminded of the days when it was permissible to send almost anything through the air. Latin-America is very curious: it wants to know who you are, where bound, and all the rest of the QR's whenever you pres sthe key. It likes to exercise its little stock of English and its greater stock of politeness. After giving one of the Lloyd-Braziliero boats a full account of ourselves he acknowledged, amid a chorus of HI's from the Americans in range, as follows. "Thank I you my dearest friend." These wireless men of the Tropics do not lack skill by any means as regards the ability to pound a key; their failing lies in their lack of knowledge in the handling of traffic.

In Argentina, at one of whose ports we touched, they have that troublesome habit of sealing your operating room. A young naval officer who came abroad to do the work, was affability itself. We became well acquainted as time passed, the friendship being more firmly cemented by the transfer of a couple of Mexican cigars from an American to an Argentinian hand.

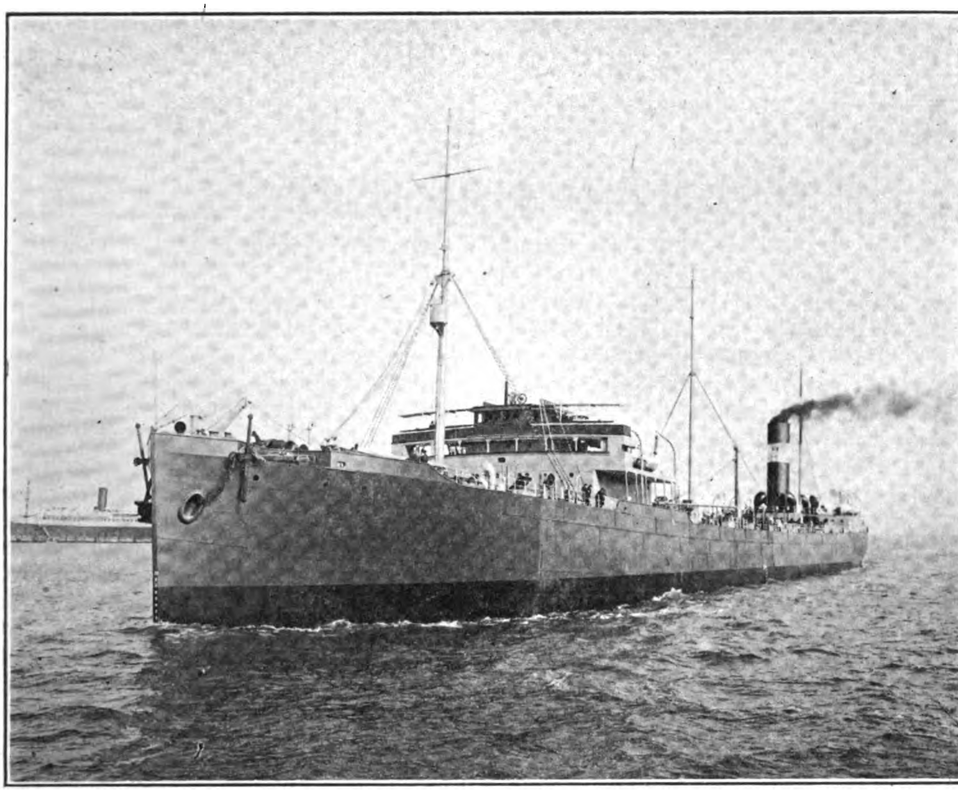


The H. H. Rogers, taken at sea from the crow's nest

Throughout the voyage I was struck by the remarkable system of press relaying. An instance of this is found in the fact that Arlington's output is likely to be flashing about Rio Janeiro the night following its original transmission.

The feeling of proximity to persons far distant which wireless conveys was brought forcibly home in a pathetic way. Two days' run ahead was an American-Hawaiian ship, and at a corresponding distance was another vessel of the same fleet. The master of one of these craft had brought along with him a nine-year-old boy, evidently the son of an officer of the steamship company, who was stricken with appendicitis. Each night an account of the boy's symptoms and condition was wirelessed back to the other skipper way up to the Northward, who returned suggestions regarding treatment. A score of English-speaking operators in the neighborhood were as much concerned as the captains and helped to relay between the two ships when static interfered. This exchange of messages went on for perhaps a week until, one night, word was flashed that the youngster was much better and that the contemplated stop at Pernambuco for medical aid seemed unnecessary. The next morning, however, came word of a relapse and subsequent messages told of the boy's death and burial at sea.

Although this recital, strictly speaking, has to do only with wireless, it would not be complete unless the untimely ends of some pet animals on the ship were chronicled. First a mongrel



The H. H. Rogers, one of the largest tankers afloat, as she looked on her trial trip in Hampton Roads

puppy, after biting an oiler's hand, was thrown overboard. Then Martina, a queer little Mexican squirrel, bought from a Tuxpam boatman for two bits Americano, accidently slipped over the side soon after finishing his exploration of the ship, including the three mastheads. Hardly had the excitement due to this incident subsided when Vasco da Gama, fifteen ounces of pitch-black kitten, was foully murdered by an enemy and the officer's messboy, proven guilty of the deed, became an outcast.

A sea bird with unbelievable wingspread, half heron and half gull in appearance, with a long, round bill like four inches of a marlinespike's business end, broke the spell of ill-luck which surrounded the ship's pets. Coming aboard the vessel in mid-ocean, he perched on the upper bridge and stared fearlessly at all who came near him. He was as tame as the proverbial kitten, but notwithstanding he declined to become domesticated in so far as it involved accepting food from the members of the ship's company. Instead it was his custom to fly away from the vessel on foraging expeditions, returning to jockey for a landing on the bridge rail. Like an aeroplane in a gale he would circle about until he finally accomplished his object. For almost a week he made his quarters on the ship and at the end of that time he darted away to the westward and never returned.

In conclusion it should be said that there is something about the life of an operator, the peculiar fascination of existence on shipboard, that haunts the mind in after years. We may break away from the business, go ashore to live and seemingly forget it; but every now and then some reminder of the past crops up. It may be only the sight of an amateur's aerial or just the printed word "Marconi," but the memories brought back refuse to stay covered up. It's a great game!

General Advice for the Amateur Experimenter

By Eimer E. Bucher

A REVIEW of the radio situation throughout the United States shows that the amateurs' problems, regardless of the locality, are more or less alike and that considerable confusion and misunderstanding prevail regarding the operation of apparatus, the design of equipment and general knowledge of the art. The experimenter about to take up wireless telegraphy would do well to purchase an elementary textbook on the subject and study the fundamentals of radio, for in this manner he can save himself considerable trouble.

A question frequently discussed among experimenters has to do with the type of receiving apparatus the beginner should construct or purchase. This question cannot be answered unless the stations from which the amateur desires to receive are definitely known. It should be remembered that transmitting stations throughout the United States employ both damped and undamped waves, long and short waves, high and low powers, and that their possible range is a somewhat variable factor. An amateur in the central part of the United States should first construct a receiving set for 200 meters to communicate with stations in the immediate vicinity of his installation and a second set for the reception of undamped waves up to 10,000 meters. With these equipments he will be able to receive signals from any station within the range of the apparatus.

Receiving equipment of both types is fully described in the book "How to Conduct a Radio Club," in previous issues of the Monthly Service Bulletin of the National Amateur Wireless Association and also in the Proceedings of the Institute of Radio Engineers. The September, 1915, proceedings of the Institute give an explanation of the Armstrong oscillating circuit, but do not contain the dimensions of the coils, nor the capacity of the variable condenser. This information, however, is contained to a measurable extent, in the book "How to Conduct a Radio Club."

Then, too, there is the usual misunderstanding between some manufacturers and the amateur, the former supplying to the market a receiving equipment that does not actually respond to the wavelengths for which it was advertised, principally because the equipment was designed by guess work, rather than by the application of a few scientific principles. With knowledge of the art within reach of everyone this condition should not prevail.

There is no reason why the amateur in the United States should build a receiving tuner for use with a crystalline detector to be responsive to the wavelength of 10,000 meters, because no spark stations within range operate on this wave-length; hence, a receiving set responsive to damped waves, exceeding the 2,500-meter wave of Arlington, is practically useless. Of course, this tuner can be made to respond to undamped waves by means of a tikker or an oscillating vacuum valve, but the latter requires additional apparatus and complications of circuits which makes the tuner an expensive proposition. Again, one not familiar with the fundamentals or the handling of receiving equipment, should not attempt to work apparatus of this type during the first weeks of experimentation.

The questions, "How shall we know about the design of a receiving tuner?" "How can we calculate the dimensions of the coils for a given wave-length?" and "How shall we determine the wavelengths of stations within range?" frequently come up.

We can answer the third question by

stating that a list of radio stations of the world is published by The Wireless Press, Inc., 42 Broad street, New York City, and a call list of the stations in the United States by the Government Printing Office, Washington, D. C. The very latest amateur calls issued by the Department of Commerce also appear in the Monthly Service Bulletin of the National Amateur Wireless Association.

Designing A Receiving Tuner

In designing a receiving tuner the constructor should begin with the secondary winding. It should be understood that the secondary winding of a receiving tuner to be used with the vacuum valve detector should be designed so that at the upper range of wave-lengths the maximum capacity of the variable condenser is shunt to this winding does not exceed .0002 to .0003 microfarad, but in the case of the carborundum crystal or other crystals, capacities of .0006 to possibly .0008 seem to give good results. All of which means that for the vacuum valve detector the secondary winding for a given value of wave-length should possess greater values of inductance than in the case of the crystal. This statement, however, should be qualified, for with certain types of windings, the crystalline detectors respond best in circuits where inductance predominates and the capacity values are as low as those with the vacuum valve detector. Assume, for example, that the experimenter has decided to construct a tuner responsive to 3,000 meters in order that the time signals from Arlington may readily be received. The necessary value of inductance may then be calculated by the following formula, namely:

$$L = \frac{\lambda 2}{3552 \times C}$$

Where L = the inductance of the circuits in centimeters

λ = the wave-length in meters

C = the capacity of the secondary condenser in microfarads

Substituting these values we have:

$$L = \frac{3000^2}{3552 \times .0002}$$

giving roughly a value of 12,600,000 centimeters or 12,600 micro-henries.

The required value of inductance having thus been obtained, the dimensions of the coils corresponding to this value are next in order. By referring to pages 81 and 82 of the second edition of the book "How to Conduct a Radio Club," you will find a table showing first the diameter of the various sizes of bare and insulated wire in the B. & S. gauge from No. 20 to No. 40; also a simple formula whereby the inductance of a coil of given dimensions can be determined. To make this calculation we must know the mean radius of the coil in centimeters or inches, the over-all length and the number of turns composing the windings. Rather than reverse this formula, it would perhaps be better for the experimenter to first assume a secondary winding, let us say of No. 32 S. S. C. wire of given dimensions, and calculate its inductance, thus finding out whether or not a coil of increased dimensions must be employed for the value required. If, of course, the value obtained by direction calculation is in this particular case in excess of 12,600 micro-henries, a coil of smaller dimensions must be substituted. Using the same formula, the correct value of inductance for various values of wave-length can thus be determined and, if desired, a dead end switch inserted at the correct point.

Obtaining Closeness of Adjustment

There need be no argument concerning the number of taps to place upon this winding because all experimenters will understand that the greater the number of taps, the closer will be the adjustment for a given wave-length, but generally it is not found necessary to have less than fifteen turns between each set of taps, the necessary closeness of adjustment between the taps being obtained by the shunt variable condenser. The amateur market is well supplied with small variable condensers which will give on the first few degrees of the scale, a capacity of .0003 microfarad.

To determine the value of inductance for the primary winding of this tuner we must first know the inductance and capacity of the antenna with which it is to be employed and to obtain these data, the experimenter should refer to page 107 of the November, 1916, issue of The Wireless Age, tables 1 and 2, where the total inductance and the total capacity of various dimensioned aerials are given. Even if the experimenter's antenna does not duplicate the dimensions and the spacing between wires assumed in these tables, he should select the values nearest to it, which will be sufficiently accurate for general calculation.

The Antenna System Inductance

The inductance of the antenna system is composed of the distributed inductance of the antenna and the localized or concentrated inductance comprising the primary winding inserted at the base. While we may use the same formula as in the case of the secondary winding for the determination of the inductance value, it will be plain from the article by A. S. Blatterman in the October and November issues of The Wireless Age, that the formula for calculating the wave-lengths of the antenna system is somewhat modified, the ratio of the distributed inductance of the antenna to that of the concentrated inductance of the coil being considered.

However, in cases where the inductance of the coil is large as compared with that of the antenna, the amateur experimenter may, for practical calculations, ignore the inductance of the latter. We might state then, briefly, that for the value of L in formula No. 1, we may add the inductance of the antenna to that of the coil and for the value of C, we substitute the capacity in microfarads as obtained in tables 1 and 2 of the November issue of The Wireless Age.

In designing the receiving tuner there is always difference of opinion regarding the size of the wire, and whether or not it should be single silk covered or double silk covered. Experiment seems to indicate that a primary winding made of No. 24 S. S. C. wire and a secondary winding of No. 32 S. S. C. wire, give the highest degree of efficiency, but if wires of this size are not immediately available, other sizes, such as No. 26 and No. 28, can be substituted for the primary and No. 30, or perhaps No. 34, for the secondary.

In a similar manner the experimenter may determine the correct dimensions for a tuning coil of increased range of wave-length and, if desired, the entire inductance of the primary and secondary may be included in a single set of windings or a smaller coupler employed and the necessary inductance values obtained by loading coils.

Another point regarding which there is considerable difference of opinion is the effect of the condenser in shunt to the primary winding. According to tests reported in the Proceedings of the Institute of Radio Engineers, while the use of this condenser may assist in tuning under certain conditions, it is detrimental to the strength of signals and louder signals can generally be obtained by a properly designed loading inductance.

Calculating the Antenna Natural Wave Length

The calculation of the natural wave-length of an antenna from its dimensions is an ever-present problem to the amateur and unless he has had the proper technical training to enable him to solve the problem by the formulæ generally presented, he gives it up in despair. If, however, he will refer to the article by Mr. Blatterman on pages 108, 109, 110 and 111 of The Wireless Age, he will have no difficulty in selecting an antenna suited to his requirements or in calculating the wave-length on an antenna which has already been erected. It should be remembered that this formula does not take into account the presence of near-by conductors and consequently an antenna of similar dimensions to those given in the tables may not upon measurement possess the natural wave-length indicated by the data; at any rate the result given by the curve will be near to the actual value.

A set of curves of considerable value to the amateur experimenter is that appearing on pages 110 and 111. Here the natural wave-length of aerials of given dimensions is presented with an inductance coil of 10,000 centimeters inserted in series at the base. This inductance may represent the secondary winding of an oscillation transformer and is generally of sufficient value to permit the absorption of energy from the primary circuit. The experimenter may calculate the dimensions for a coil of this value of inductance by making use of the formula appearing on page 106 of the same issue; thus he may construct an inductance of just the required value for any other wave-length. The entire set having been designed in accordance, an antenna may be selected from the curves that will radiate a wave-length very near to the value of 200 meters. The formula given for the calculation of inductance may also be employed for determination of the dimensions of the primary inductance and if the capacity of the closed circuit condenser is definitely known the formula $\lambda = 59.6\sqrt{LC}$ may be at once applied.

Transmitting Apparatus Troubles

Two points in connection with transmitting apparatus give constant trouble to the experimenter in some localities, one being the blinking or flickering of the lights and the other induction troubles when the power wires of the house are near to the antenna wires. In the first place a transmitting aerial should never be erected parallel to a power line as inductive disturbances are bound to be set up which may injure the circuits of the power line; furthermore, there are only two methods by which this trouble can be overcome, one being to place the power wires in conduit under the earth or to remove the antenna and erect it at right angles to the power wires; or, what is better, to remove it to a distance of several hundred feet if possible. Many experimenters are under the impression that, even though the transmitting aerial sets up disastorous inductive influences in the power line, these induced potentials may be conducted to earth by means of protective condensers, but nothing could be further from the fact. Generally, when the potentials are high enough to damage considerably the meters, let us say, of a power circuit, they will also puncture the dielectric medium of the protective condensers and the only remedy in this case is to take down the aerial or remove the power line.

The flickering of the lights at a transmitting station is generally due to the fact that the transformer is improperly designed and does not possess sufficient magnetic leakage. When the spark discharges across the spark gap the secondary winding of the transformer is practicaly short-circuited and unless there is a certain amount of magnetic leakage in the core of the transformer the self-inductance of the primary winding drops to a very low value; in consequence an excessive value of current takes place which causes the lights in a given vicinity to flicker. Sometimes the effects may be obviated by means of a reactance coil inserted in series with the primary winding, or by a change of capacity at the secondary condenser or a decrease in the length of the spark, but the most effective method is to design the transformer so that it will have a certain amount of magnetic leakage, such as may be provided by the ordinary magnetic leakage gap.

Another method is to shunt a reactance coil or resistance coil about the transmitting key and cause the transformer to take a portion of the load at all times. Then, when the key is closed, normal value of current flows and the spark discharges cross the gap.

Flickering of the lights is due many times to the fact that the house transformer has insufficient capacity to take care of the load and therefore a second transformer installed specifically for operation of the power set will offset the difficulty.

Overcoming Disturbing Effects

In cities where the telephone lines are *not* placed underground, amateur transmitting sets often set up disturbing inductive effects which may interfere with telephone conversations. One experimenter overcame this difficulty in the following manner: Instead of bringing in the twin conductor from the telephone pole to the house in the ordinary manner, a triple conductor was employed. Two of the wires completed the ordinary telephone circuit, while the third was connected to earth. In this manner the potentials due to electrostatic induction were completely eliminated.

In employing the formula for the calculation of the capacity of a condenser the amateur frequently finds considerable discrepancy between the results obtained and the actual measurements of the capacity by some of the well-known methods. This is due to the fact that the specific inductivity of glass varies widely according to the grade and the textures of the glass, the value lying somewhere between six and ten.

We may state generally that a single plate of glass, 14 inches by 14 inches, covered with tinfoil 12 inches by 12 inches, the glass being approximately 1/8 of an inch in thickness and varying from this value to 3/32, will have a capacity of .002 microfarad and similarly, a sheet of glass eight inches by ten inches covered with tinfoil 6 inches by 8 inches, will have a capacitance of about .00066 microfarad. Since the capacity in a closed circuit of an ampere set to be operated at the wave-length of 200 meters cannot exceed in any case .01 microfarad and is preferably .008 microfarad, it is easy to arrange a parallel or a series parallel connection of plates whereby the desired value of capacity can be obtained. For example: Four of the 14 inch by 14 inch plates connected in parallel will have a capacity of .008 microfarad, but if a series parallel connection is required to reduce the strain on the condenser, sixteen plates will be required, eight plates in parallel in each bank and the two banks connected in series. In other words, a series parallel connection always requires four times the number of plates of a single parallel connection.

Some grades of glass 1/8 of an inch in thickness will withstand a potential of 15,000 volts, but ordinarily pressure in excess of 10,000 volts should not be applied; when the transformer has a potential in excess of 10,000 volts a series parallel connection should be used.

(To be continued)

THE WIRELESS AMATEUR

Some may not know that, through amateurs in wireless operation, communication betwen the Government and the cities and towns of the country is established. And, too, this method of communication is instantaneous and thoroughly reliable at all times. In every city and town of the United States there is always someone that is experimenting with wireless. A great many of these experimenters become, after a few months, competent operators. They include all manner of persons, young and old of both sexes. In fact, one of the widest known and most efficient dabblers in the art is a young woman, of St. Mary's, Ohio.

At ten o'clock every night in the year, the amateurs sit down to their wireless tables and "listen in" for Arlington, the largest of the Government wireless stations, situated just across the Potomac River from Washington, to send standard time signals and weather reports. Here, then, is the medium of communication with the rest of the country, which the Government may at some time find very valuable. Arlington could, in the case of sudden need of energetic action in an emergency, send out directions and even orders to members of the militia or to any other officials.

The objection may be raised here that the average experimenter would be unable to copy these messages. But such is not the case. It takes but very short time for a clever boy to become able to copy these signals as sent out from Arlington, and, besides, there would be several copying the same message in a great many towns and cities. It certainly would constitute a very effective means of getting instant action in an emergency.

The Government can foster this important adjunct to its national defense, or it can destroy it. It must seem likely to every person that such a valuable mode of communication should not only be tolerated but encouraged. It is to be hoped that Congress, if it intends taking any action at all, as has been at various times reported, will see the wisdom of regulating the wireless amateur and not of abolishing him.—From the Rochester (N. Y.), Union and Advertiser.

The Fowler Radio Club of Cleveland is carrying on a campaign to obtain more members.

Crossing the Equator

Impressions That King Neptune Made on a Wireless Man

WE of the aging generation whose boyhood ambitions were fired by the fantastic narratives of writers, prefer to remember their romantic descriptions while we forget the hardships and privations that must have been undergone by their heroes and heroines. Even our own griefs and disasters become less memorable as the years pass. The pleasant things of life are far easier to remember than the unpleasant. Thus it is natural that the romance of the old sea tales should linger in our memory long after the hardships are forgotten.

We must not forget, however, that sixty years of steam navigation have greatly altered the character of sea travel. No longer are voyages entirely dependent upon the vagaries of ocean winds. No longer are voyages unduly delayed by adverse gales and long-protracted calms. Sea-going is now a business, an affair of furnaces and boilers, of engines and propellers. Voyages are matters of such definite calculations that the date of arrival can be predicted with accuracy before the vessel sets sail.

Yet there are some incidental features of the old-time deep-sea life that have survived. Here and there, in over-sea journeys to the antipodes and such distant parts, a few events crop out that hark back to the days of the old square-riggers and their clouds of billowing canvas.

One characteristic observance of the old-time sailors has survived the decadence of the others. This is the peculiar ceremony held on shipboard during the crossing of the equator, when all sea-going novices, and all "land-lubbers"—often including the passengers—who have never passed at sea from the northern to the southern hemisphere, or vice versa, are introduced to King Neptune and his court. The event is a seaman's frolic, projected and carried out by the crew, with the consent and assistance of the officers. Originally it was intended for the initiation of sea-going apprentices, and sailors who had never before "crossed the line." During recent years, however, large passenger steamships have been employed in antipodean voyages and in cruises around the world. Upon these ships there have been hundreds of cabin passengers, whose interest in this unique sailors' prank stimulated them to participate in it. At first the participation of passengers came from their own initiative and request. The sailors took no liberties with the passengers and went no further than the passengers themselves desired. But the latter looked upon the affair as no end of a lark, as a chance to play jokes upon one another, as a diverting incident in a long and otherwise uneventful voyage, until now passengers as well as sailors and wireless men are regularly initiated and welcomed to his domain by King Neptune as a matter of course.

Previous to the inauguration of the ceremonies a large, water-proofed canvas tank has been rigged up on deck, with a "boatswain's chair"—minus a back—fixed at its forward end. This is filled to the depth of three or four feet with sea water, and in it, during the ceremonies, stand two burly minions of his nautical majesty. The purpose of the tank and the offices of these satellites will be disclosed later.

In the meantime one member of the crew has been chosen to represent King Neptune, being made up in crude fashion with royal robes, a crown and a long beard—the latter being usually constructed out of oakum or rope yarn. His Consort, Queen Porsperine—another of the crew—is appropriately clothed as befits her station, and her long flaxen hair is also of oakum. There are various court attendants in fantastic garb, among whom the royal barber occupies an important position.

Upon the day of crossing the equator, before the ceremonies begin, those who are to undergo the initiation are gathered together, and told to prepare themselves for the trial, which preparation consists principally in putting on

An active period during the visit of King Neptune

some of their old clothes—as few as possible—and those that water will not injure.

At the beginning of the ceremonial, Neptune and his court appear on deck and take their places at the opposite side of the open space before the great canvas water tank, at the end where the boatswain's chair has been rigged, the king seating himself upon his throne, and the queen placing herself beside him. The court attendants group themselves on either side. (In the old days Neptune and his court always boarded the vessel over the side, but this part of the royal arrival has been moderated and is frequently omitted on modern steamships.) The court herald announces that his royal master has learned that there are on board a number of culprits who have invaded his domain without his royal sanction, and these are ordered before his majesty in order that proper punishment may be meted out to them, and that they may be duly initiated, and later accepted as his subjects.

The row of victims is lined up before the king, who addressed them, asking them why they came to sea and why they have invaded his dominions, and finally sentences them to be shaved by the royal barber, and also to undergo other attentions at the hands of the two strapping attendants standing waist-deep in the canvas tank.

The first-selected culprit is seized and dragged to the chair, into which he is thrust with no gentle hand. The barber's assistant, armed with a huge paste brush and provided with a bucket of lather—in these days and in the case of passengers it is made of soap, but once upon a time and in the days of sailing ships it was composed of that unsavory compound known as "slush"—daube the face of the victim all over, not forgetting to cover up his eyes and fill up his ears and, if possible, his mouth. The barber seizes the victim by the hair of the head, and proceeds to shave him with a large wooden razor, or saw-edged cleaver. The operation is artistically and quickly done, though not delicately. Then the barber or his assistants grasp the victim by the legs and dump him over backwards into the canvas tank, where he is instantly seized by the two attendants who have been waiting for him, and by whom he is soused three times under water. If the initiate takes his sousing philosophically and does not struggle, the immersions are quickly over, and he is released and allowed to scramble out of the tank amid the laughter of the lookers-on. If he put up a resistance, however, all the worse for him. The two attendants have been selected for their ability to accomplish what they are expected to do. Resistance is futile, therefore, and only prolongs the infliction.

The first victim out of the way, the next is brought forward, to undergo the same treatment, and so on until the list is completed. The king and court afterward take their leave, first having held a reception during which they welcome the initiates and wish the captain a prosperous voyage.

Ladies among the passengers are usually exempt from the ceremonies attending the crossing of the equator, but occasionally some of them elect to be initiated. These self-chosen victims thereupon undergo the same treatment allotted to the male contingent, but it is usually noticeable that the royal barber and his associates do not handle them with any unnecessary roughness.

Upon some modern passenger steamships in recent years that have been engaged in vacation voyages, the passengers have not been satisfied with the old-time observances of crossing the equator, and have introduced some modifications of their own. These are usually in the nature of "horse-play," and, while they are frequently very diverting, they are examples of spontaneous gayety rather than any real part of this unique and time-honored marine pageant. For instance, upon an American steamship which has made voyages through the Panama Canal and down the west coast of South America, passengers had the hose laid which is used to flush down the decks of the ship, and went about with this, seeking unsuspecting victims upon whom to turn a stream of water. In this pastime they did not give their victims any warning or any opportunity to prepare for the infliction by a judicious selection of clothing. They caught them as they were, and wherever they happened to be on deck—whether asleep in a steamer chair, alone in some quiet corner absorbed in an engrossing book, or in a small group engaged in intimate converse. All, alike, were soused, and all, alike, fled shrieking from the unexpected drenching. It is only fair to say, however, that in the tropics the temperature of the water is too agreeable to make even an unexpected drenching objectionable, and when all are subjected to it indiscriminately, few are likely to take serious offense at the infliction.

Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE II

5. (b) **CAUSES OF SPEECH DISTORTION IN RADIO TELEPHONY.** In radio telephony we are, of course, vitally concerned in preserving faithfully the exact quality of speech from the speaker to the ear of the person receiving the message. That is, the wave form of the original sound (as shown in Figure 3 and also in the dotted outline in Figure 6) must be in no way distorted in transmission and reception. This requires considerable care in the various stages of the process of radio telephony, as will appear from the following review of the causes of distortion and their remedies.

To begin with, there is a type of distortion which may be termed "fly wheel" or inertia distortion. It arises in a fashion which can be made clear from a mechanical analogy. If we have a fly wheel in rapid rotation, there is a marked and well-known tendency of the wheel to maintain a constant speed because of the large amount of energy stored in its rotating mass. If we attempt to change the speed of the wheel very greatly in an exceedingly brief time, we shall meet with almost insuperable opposition. The "inertia reaction" of the wheel will be very marked. If, on the other hand, we attempt to change the speed slightly in a considerable longer time, we shall find the task a much easier one. In other words, the fly wheel resists, markedly, rapidly recurrent changes in its speed of rotation but permits, fairly well, slow changes in its speed. Of course, the same effect exists with any mass. If we attempt to start and stop a heavily-loaded freight car a thousand times per second, huge forces will be called into play if the to-and-fro swing of the car is appreciable. If we attempt to start and stop the same car only once per second, the opposition will be but a thousandth as great.

The application of this principle of inertia reaction to the telephone transmitter diaphragm and the telephone receiver diaphragm is not far to seek. It is clear that there will be much more difficulty in getting the telephone diaphragm to respond proportionately to the higher overtones of the human voice than to the lower pitched components. This is one reason why a high-pitched voice generally fails to get over a telephone line with complete satisfaction to the listener. We may say, then, that the telephone transmitter diaphragm smooths out the high overtones of the voice, with the result that crisp, clear enunciation is in part lost. The obvious remedy is to have light transmitter diaphragms without much pressure on them from the carbon grains behind the diaphragm. We are much limited in the design of a transmitter by other considerations, so that it is generally necessary to use the normal transmitter. As regards the receiver diaphragm, there have been made a number of attempts to use thin small sheets for this purpose, and it has been noted that they respond much more readily to the present-day 500-cycle spark signals than did the older, heavier diaphragm receivers. On the other hand, it is desirable to avoid receivers in which the diaphragm is markedly resonant to any frequency within the normal range of speech, else this frequency will be relatively exaggerated out of all proportion to its actual magnitude. The result will be an extremely annoying "howling" whenever the resonant frequency occurs in the speech.

There is another possibility of a sort of "inertia" distortion due to the fact that the radio frequency generator (arc, bulb, alternator, etc.) will not supply sudden violent changes in output. Consequently, a similar smoothing down of the higher overtones will occur unless the radio frequency generator is without "electrical inertia" (that is, has small inductance) and also is operated by a powerful generator.

It is well at this point to indicate clearly what is meant by "electrical inertia." The behavior of an ordinary inductance when an alternating electromotive force (voltage) of various frequencies is applied at its terminals is as follows: The current which passes through the inductance is inversely proportional to the frequency; that is, the inductance acts like an electrical mass and does not permit the ready passage through it of the higher frequency currents. It is to be noted further that the effect of a capacity is exactly the opposite in that it exaggerates the passage of higher frequency

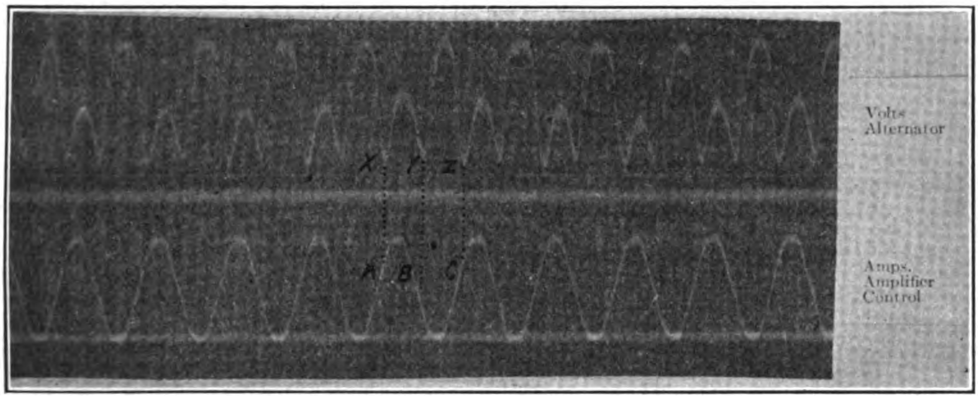


Figure 5.—Oscillogram showing distortion when range of linear proportionality is exceeded

while relatively retarding those of lower frequency. This is the basis of ordinary tuning, which is nothing more than balancing the choking action of an inductance at a given frequency by the opposite effect of a capacity.

It is clear enough then that high inductance in any of the circuits in which speech currents flow will produce an objectionable smoothing out of the overtones in speech so that the speech will become "drummy" through the exaggeration of the basis tones. An excess of capacity in any speech circuit will exaggerate the overtones, and the speech will become "squeaky." A little practice in telephony soon enables the skilled observer to tell which type of distortion he is getting.

A smoothing-out effect, causing drummy speech, is also obtained when a highly persistent antenna is coupled to the sustained wave generator or when a highly persistent receiver secondary is coupled to the antenna. This is due to the fact, first shown by Bjerknes, that with loose coupling a persistent secondary will not follow the sudden variations in the primary oscillations except with a time lag and diminution in the abruptness of change. It is this effect which has led Poulsen and others to use entirely aperiodic secondaries in their radiophone receiving sets. In this way, the persistency distortion in coupling is avoided, though at the cost of loudness of signal and selectivity, *i. e.*, freedom from interference from other stations. These matters will be further considered under receiver design.

A fairly prolific source of speech distortion, or rather speech destruction, is that curiously imperfect instrument, the carbon microphone as used in the ordinary telephone transmitter. This has been shown by de Forest, who states that when speech from an ordinary transmitter is very greatly amplified, it is found to be fairly teeming with crackling and hissing sounds caused by small local arcs or mechanical disturbance effects in the microphone. This is not astonishing when the nature of the variable-resistance carbon contact is considered. The alternative suggested by de Forest, namely the use of an ordinary Bell receiver ***as a transmitter of the induction type*** is feasible only if one is willing to amplify greatly the extremely small output of such a transmitter. On the whole, the investigator will in general be bound to use carbon transmitters with small currents so as to avoid "packing," hissing, and other disturbances.

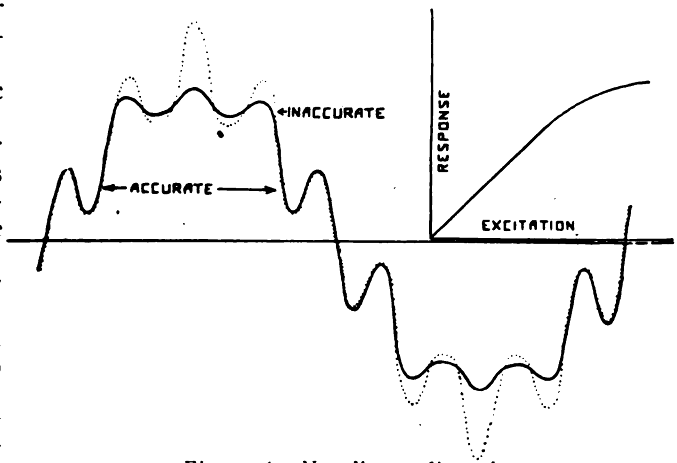


Figure 6.—Non-linear distortion

If iron cores are used in the coils of transmitting circuit (e. g., in magnetic amplifiers, or speech-controlled frequency doublers), a further distortion will arise because of the "saturation" effect in the iron. That is, iron core coils do not have a constant inductance at all, and the change in their inductance is particularly marked when heavy currents are passed through the coils thus saturating the iron. An interesting example of the distortion produced in a magnetic amplifier is taken from E. F. W. Alexanderson's paper in the April, 1916 "Proceedings of the Institute of Radio Engineers." The lower curve of this figure shows an oscillogram of the current (amplified speech current) passing into the magnetic controlling amplifier. The upper curve shows resulting voltage of the controlled radio frequency alternator. The distortion is seen to occur not between points X and Y (corresponding to A and B in the lower curve) but between points Y and Z (corresponding to B and C in the lower curve). That is, the distortion occurs for the high current values in the iron-core amplifier control winding between B and C. Of course, such effects are avoided by working the iron on low field density so that the flux is at all times proportional to the magnetising current and the control range is not exceeded. This can be accomplished, though sometimes at the cost of great amplification and large output.

It will be noticed that in discussing the saturated-iron distortion, we have encountered a case of non-linear amplification, and resulting distortion. Non-linearity of amplification is sufficiently common and important to warrant detailed consideration.

(c) **NON-LINEAR AMPLIFICATION AND SPEECH DISTORTION.** Let us consider again an ordinary phonograph record of speech, and let us suppose that the record in question is to be "amplified" mechanically. That is, we wish to produce a record similar in all respects except that the up-and-down ripples in the groove are to be accurately magnified to a definite extent in their vertical dimension but their length is to remain unchanged. Such a record would produce a sound of much greater loudness but with the pitch or frequency unchanged. (We are here referring to a vertical cut record, of the cylinder type.) This amplifying procedure would be quite satisfactory if the mechanism that cut the new record always followed the original record accurately, and faithfully multiplied every vertical dimension by the same amount. Then, in Figure 6, the new record would have the cross-section of the dotted line in the figure. If, however, the amplifying mechanism magnified accurately only for displacements near the axial line but responded disproportionately feebly for portions of the curve lying at considerable distances from the axial line, we should get the type of distortion shown in the full line of Figure 6. It will be seen that the overtones are blurred at the upper portion of the curve, which is accordingly labeled "inaccurate." In the lower portion of the curve, where linear proportionality is obtained, the curve remains accurate. The whole matter is shown in a different way in the right hand diagram of Figure 6, where input of the amplifier or "excitation" is plotted horizontally against output of "response" vertically. It will be seen that, for the accurate portion of the wave, the response-excitation curve is a straight line, hence the name "linear amplification." Up further it flattens out, somewhat like an iron saturation curve and it is here that the distortion occurs. Speech of this type would generally be called "drummy."

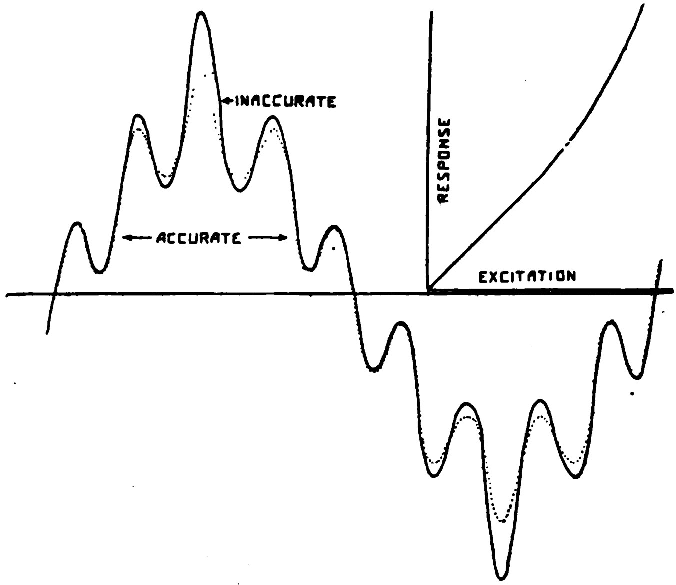


Figure 7.—Non-linear distortion

In Figure 7, the reverse type of error, leading to what is usually termed "squeaky" speech, is pictured. It will be seen that the amplification is linear for low excitations, and that consequently the lower portions of the wave near the axial line will be accurately amplified. On the other hand, the greater excitations produce a disproportionately great response, and the overtones are exaggerated near the peak of the wave. The result is a high tinny quality to the speech.

In Figure 8 is shown a sort of combination effect of these two, which is not uncommon. It consists of a disproportionately feeble response for small excitations, a proportional response for moderate excitations, and a disproportionately feeble response for great excitations. The resulting wave is, as will be seen, accurate only for moderate values, but flattened as to overtones near the axis and far from the axis. This would be badly blurred or "muffled" speech.

It is quite clear that we should use linear control systems in the radiophone transmitter and linear amplifying systems in the radiophone receiver. With the magnetic amplifier for transmission, this implies lower iron fielddensities, and with the audion receiving amplifier it implies working far below the saturation current point.

(d) **SECRECY OF COMMUNICATION IN RADIO TELEPHONY.** If a frank expert were to be asked whether "complete" secrecy could be obtained now with radio telephony, he would be compelled to answer in the negative. If he were of a cynical turn of mind, he might add that secrecy was no more obtainable in radio telephony now than in wire telephony or any other form of communication, a remark which recent revelations as to the comparative prevalence of official "wire-tapping" would more than justify. Of course, any wire telephone line can be tapped, and with remarkable ease under most conditions. At one time, the telephone companies judged it necessary to maintain wire communication from New York to Boston over one line and return communication from Boston to New York over another line traversing an entirely different route from the first. In this way, even the adroit interloper would hardly be likely to tap more than half a conversation. As a matter of fact, the drastic expedient suggested was not adopted since it was unnecessary then and will probably continue to be so. A combination of severe laws against tapping, and an efficient corps of radio inspectors would practically solve the problem, at least in communities no more law-defying than those of the United States.

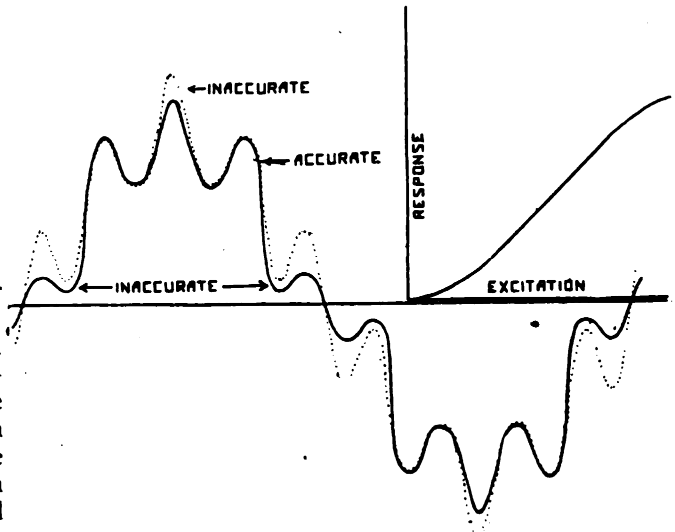


Figure 8.—Complex non-linear distortion

As an illustration of the ease of tapping an ordinary (non-twisted, though regularly transposed) telephone line, it may be mentioned that there is much used abroad a simple secondary coil, which, when placed suitably near the line, picks up ordinary conversation without any visible physical connection, premanent injury, or other trace. Even the effect on the transmission would be practically infinitesimal.

It is to be expected, on the other hand, that when radio telephony becomes commercial and widespread, we shall have stringent laws against "listening-in" on commercial wave-lengths, and these laws will be adequately enforced. By the use of a number of modified waves or by other technical methods under development at present, unauthorized "listening-in" will become exceedingly difficult, and possible of attainment only by persons of expert ability. Such persons, however, are easily known and can be supervised in their activities; much as is now the case with excessively skillful engravers of bank notes. In fact, systems can be imagined whereby "listening-in" would be futile unless the listener had a code combination whereby the peculiar material sent could be automatically re-converted into clear speech. This indicates a possibility of complete secrecy.

In short, while secrecy in radio telephony involves more inspection than for wire telephony, it can be brought to the same or even a greater degree of certainty by technical and legal measures.

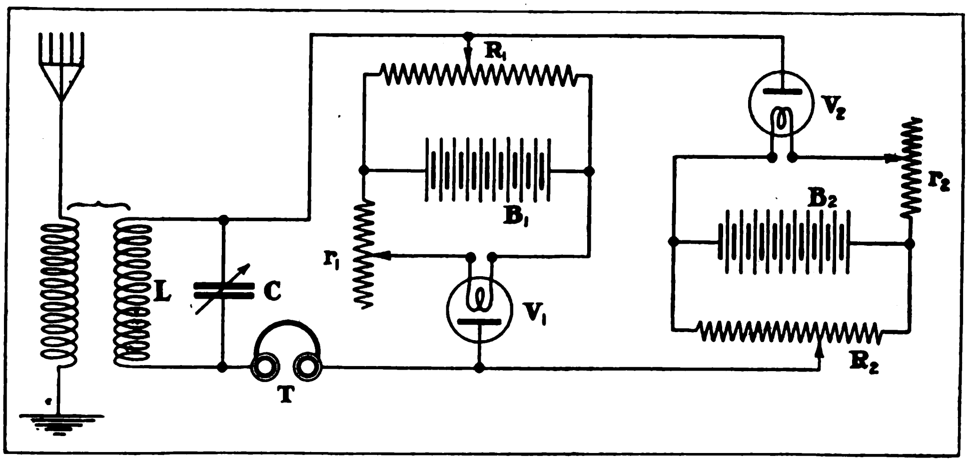


Figure 9.—Marconi Company Round balanced valve receiver

(e) **STRAY INTERFERENCE IN RADIO TELEPHONY.** One of the most serious outstanding problems in radio communication is the elimination of atmospheric disturbances and stray electromagnetic waves. To begin with, under normal summer conditions, particularly in the tropics, the effect of strays is practically to prevent stations from working at all, part of the time. Aside from the six-to-one to ten-to-one ratio of signal strength in favor of winter time, the strays complicate the problem of reliable transmission vastly. As a result, most radio stations work with a "factor of danger" rather than the normal engineering "factor of safety." Whereas an engineer will normally design, for example, a bridge so as to stand five or ten times the maximum load which it will be called on to bear, (that is, with a factor of safety of ten), the radio engineer is unable to guarantee transmission over great distances, particularly in the tropics, without the use of exorbitant and commercially unprofitable amounts of power. The result is that a compromise is always made between absolutely reliable service (and no profits) and moderately reliable service on a financially feasible basis.

If, however, ninety per cent. of the strays could be eliminated in reception, the effect would be virtually to increase by ten times the power of every transmitting station and to render communication entirely reliable even where it had been previously fairly uncertain. It has, indeed, been estimated with probable correctness that in the absence of strays (or their practical elimination) communication from Germany to the United States could be carried on with about ten kilowatts in the antenna, or even less. When it is considered that at present a power of two hundred kilowatts in the antenna at Nauen is really not always sufficient, the importance of stray elimination is made increasingly evident.

Radio telephony has one great advantage over radio telegrapy in the matter of stray elimination. It is well known that speech can be carried on, after a fashion, even under very serious difficulties; for example, in extremely noisy localities. The ease in understanding speech under such conditions is due particularly to our lifelong practice, since it is rather unusual (in cities at least) to carry on speech under conditions of even approximate silence. Then, too, there is what may be termed the "assistance of context." By this is meant the ability of the average listener-in "filling in" lost words in a conversation by judging what word, placed in the gap, would give sense to the entire sentence. This assistance is much greater than is usually believed, as can be easily shown by the common experience in listening to names over a telephone. Whereas, ordinary conversation is carried on over normal telephone lines without any particular difficulty, the moment names or figures (that is, material lacking assisting context) are given, great difficulty is experienced and the percentage of errors rises markedly.

There is no doubt, therefore, that understanding a telephone conversation through comparatively heavy strays is a simpler achievement than taking down telegraphic signals under the same conditions.

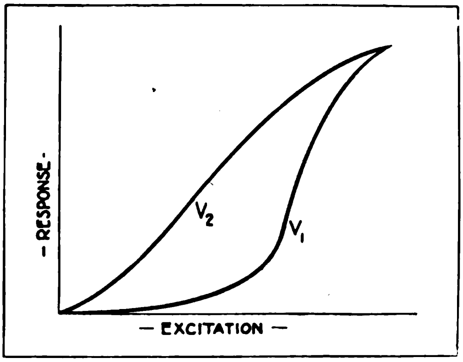


Figure 10.—Valve characteristics with different auxiliary potentials

There are known to-day a number of methods of reducing somewhat the disturbing influence of strays. The chief of these are:

(1) Loose couplings between antenna and receiver.

(2) Sharp tuning with circuits of low damping.

(3) Beat reception (generally not applicable to radio telephony).

(4) Balanced crystal or valve detectors, which prevent excessive crashes of sound reaching the ear.

(5) Dieckmann electrostatic shields around the antenna.

(6) Special methods given under later headings.

The first three of these methods are commonly known. A simple circuit diagram illustrating the balanced valve receiver (as due to H. J. Round of the Marconi Company of England) is given in Figure 9. Here *LC* is the secondary of an ordinary receiver, and *T* a telephone receiver. The two hot-electrode rectifiers (Fleming valves) V_1 and V_2 are connected as shown. The batteries B_1 and B_2 serve not only to light the filaments through the appropriate controlling resistances r_1 and r_2 but also to provide a supplementary potential difference in the plate circuits through the potentiometer control resistances R_1 and R_2. It is well known that the curve connecting excitation (that is, incoming signal currtnt) and response (that is, rectified current) depends, in these valves, on the supplementary potential in the plate circuit. Hence we arrange that one of these valves shall have a favorable value of this potential, giving it high sensitiveness for weak signals. This will be valve V_2, and its sensitiveness curve is shown in Figure 10. The other valve, V_1, is run with a low supplementary potential, so that its sensitiveness for weak signals is very low. For extremely loud signals, however (because of the current saturation effect) its response is no greater than that of V_2. It will be noticed that the valves V_1 and V_2 are connected in opposition or differentially so far as the receiver *T* is concerned. Hence weak signals will be readable, since V_1 will not neutralize V_2

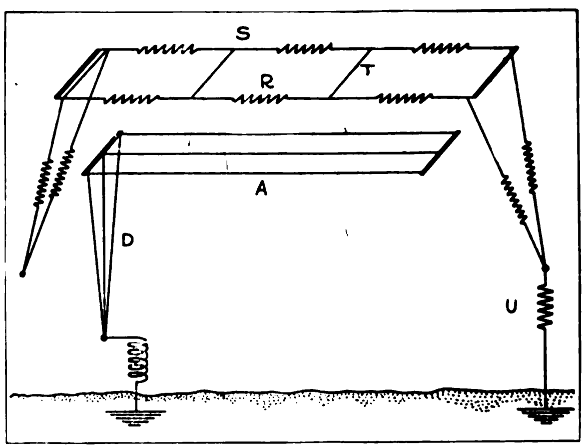


Figure 11.—Dieckmann shielding cage for stray reduction

in this case. Strong crashes due to strays will affect both valves equally, and hence will not be heard in *T*.

An alternative scheme, proposed by Dr. L. W. Austin, is to connect a silicon-arsenic detector direct between antenna and ground as a shunt to the primary of the inductive receiving coupler. This detector is claimed not to affect weak signals, but to become conductive for extremely powerful disturbances, thus shunting them to ground and protecting the ear sensitiveness of the receiving operator.

A Dieckmann electrostatic shield for a flat top antenna is shown in Figure II. The purpose of such a shield is to prevent the electrostatic field of the earth or of the atmosphere from reaching the antenna, by an action similar to that of a Faraday cage. At the same time, the shield must be so arranged that the incoming electromagnetic waves can pass through readily, as in the case of a Hertzian polarizing parallel-wire screen. In Figure II, *A* is the actual antenna with its down lead *D*. The actual shielding wires are *T* and those parallel to it. The wires *R* and those parallel to it are merely equalizing connections, and include inserted resistances so that the entire shielding system is aperiodic; that is, incapable of being set into resonant oscillation by the incoming energy. This is an obvious necessity. The shielding system is grounded at *U* through a large inductance or resistance. In practice, Dieckman found that the reception was *louder* when the antenna *A* was shielded than when it was not (because of increased capacity when the shield was present). Naturally, this type of shield protects strictly against "static" but not against all strays, since distant electromagnetic waves can pass through it. In practice, however, Dieckmann found it to be of marked asistance very frequently, a fact since verified by other careful investigators. The further developments in this direction will be considered under "reception."

The Author has suggested in the past the use of a completely covered antenna wire, the insulator being smooth and non-hygroscopic, thus preventing charged air and water particles from giving their charges by contact to the antenna, with the resulting disturbance of reception. Such a method should be of assistance at times, though it would naturally not be as efficient a protection as a Dieckmann shield, since it would fail entirely to guard the antenna against aperiodic sudden changes in the earth's electrostatic field.

This is the second of a series of articles on "Radio Telephony" by Dr. Goldsmith, an eminent authority on the subject. Various types of arc generators for radio telephony will be discussed in the third paper, to appear in the March issue.

A Summary of Dr. deGroot's Paper

Additional details regarding the paper on "The Classification and Elimination of Strays," by Dr. C. J. deGroot, head of the Radio Service in Holland, Dutch East Indies, which was presented at a recent meeting of the Institute of Radio Engineers as told in the January issue of THE WIRELESS AGE, are contained in a summary of his remarks. The paper was read by Dr. Alfred N. Goldsmith and discussed by Messrs. Weagant, Armstrong and Alexanderson.

Following a general discussion of radio versus submarine cable telegraphy, Dr. deGroot's paper described the work of the radio division of the Dutch East Indian Service. The wireless chain installed for this service was described in considerable detail, and the failure of the original contractor to provide stations covering the distances (which would have required six to eight times the actual available power) was critically considered. The choice of locations of stations and precautions against earthquakes was also discussed.

The paper gave a description of the origin and nature of strays and their classification as well as a number of methods for their elimination, the Eccles theory of a tropical thunder storm origin of all strays in this connection being disproved. There was a recital also of some special methods of reducing strays.

Flashes From Five Vessels In Distress

The Powhatan's People Rescued Following a Collision—Three Ships Missing after S O S Calls—The Stranding of the Sumner

WIRELESS calls for aid from the steamship Powhatan following her collision with the British tank steamship Telena early in the evening of December 13th, in Chesapeake Bay, near Norfolk, Va., summoned four vessels to the scene of the crash. In this instance the wireless served not only as a means for rescuing the pasesngers of the Powhatan, but also to provide surgical aid for four firemen on that vessel who were injured when a boiler burst as a result of the crash.

The Powhatan, which was bound for Boston, had only been out of Norfolk a few hours when the collision occurred. Her promenade and boat decks were partly cut away on the starboard side, only a strip about six inches in width being left in front of the wireless room. On the Powhatan were Senior Marconi Operator A. F. Bowers and his assistant, O'Day. Two minutes after the two vessels had crashed together the captain of the Powhatan called Bowers by telephone and directed him to send the S O S, giving the position of the craft as "three miles below Thimble Shoal Lighthouse." The calls were answered by the coast guard cutter Yamacraw and the steamships Jamestown, Jefferson and Nantucket, as well as the Virginia Beach station.

Meanwhile, the Powhatan was racing toward Thimble Shoals, where she sank in twenty-one feet of water. Her upper works were not submerged, however, and those on board found some comfort in this fact. The Yamacraw reached the wrecked ship at about fifteen minutes to twelve o'clock and took off the passengers, conveying them to Norfolk. After the injured firemen had been treated by the surgeon from the Yamacraw they were placed aboard the United States hospital ship Solace and taken to Norfolk.

The collision worked little damage to the wireless set with the exception of the fact that one of the braces was knocked off, the table disjointed and wrenched loose from the wall and the battery box displaced. However, part of the Telena's hull cut off the light from the window of the wireless room and blocked the doorway, so Bowers moved the key and the telephone receivers to the smoking compartment, adjoining.

But the troubles of the Powhatan's company were not yet at an end, for on December 18th a severe northeast storm swept over the Chesapeake, shifting the pumping machinery and large iron pipes on the main deck about so violently that the bulkheads on both sides were broken. Immediately the vessel began to ship water over the main deck, the latter and the lower saloon being flooded. Soon afterward, she sank six feet farther into the sand. As the night wore on the storm increased in fury and Bowers wirelessed the Yamacraw, asking her to come again to the aid of the Powhatan. Thirty minutes after the appeal had been flashed the seas broke into the wireless room, causing the floor to collapse and sweeping away the contents of the cabin with the exception of the charging panel which was screwed to the bulkhead. At half-past two o'clock the next morning the Yamacraw arrived on the scene of the wreck and stood by until those left on the Powhatan had been taken off in lifeboats and transferred to the coast guard cutter.

"Help. Our position, latitude 39 (north), longitude, 67 (east)." This was the wireless message flashed by A. B. Nickerson, Marconi operator on the steamship Maryland, 150 miles east of Sandy Hook, at fifteen minutes after twelve o'clock on the morning of December 26. The appeal was picked up by stations along the Atlantic coast, among those which received it being the Marconi station at Siasconset. The latter sent out a general call and soon the coast guard cutters Seneca, Acushnet and Gresham were speeding toward the distressed ship.

The peril of the situation on the Maryland was revealed by the following wireless which came from the vessel about an hour after the first appeal had been flashed: "Engine room flooded and ship sinking slowly. Help us." Word was flashed to the sinking vessel that the Gresham was proceeding at full speed to the scene of the wreck.

The coast guard cutters spent many hours in combing the seas in search of the Maryland. They could not find any trace of her, however.

The Buenos Aires, bound from Barcelona and Cadiz for New York, was 700 miles from the Spanish coast on the afternoon of December 4 when she received an S O S call from the Pio IX, a freighter, which was steaming from New Orleans to Valencia, Spain. Another wireless from the Pio IX said, "Have sprung leak. Northwest gale raging. Danger of our sinking." These appeals sent the Buenos Aires speeding toward the position given by the sinking vessel and toward morning those on the rescued ship received this message: "Fires out. Wireless on auxiliary. Ship helpless in trough of sea."

It was sunset when the Buenos Aires sighted the freighter which was fast settling in the seas. The weather was too rough to launch boats and nine of the shipwrecked men made their escape on rafts. At one o'clock in the morning came a wireless from the Pio IX saying, "We are sinking fast. Water over the decks. Goodby," and when daybreak arrived there were no signs of the wrecked craft. In the afternoon the Buenos Aires received a wireless from a French transport that she had picked up a number of men from the Pio IX adrift on a raft. From the information obtained, it is believed that forty persons were lost.

A newspaper report from London says that the American bark Manga Reva, with Marconi Operator George A. Geare on board, sent out a wireless on November 19, while in the Atlantic Ocean off the coast of France, saying, "Come as quickly as possible. Am drifting before the wind with no boats." This message was received by the Dutch steamship Ryndam, which replied that she was hastening to the distressed craft. The Ryndam also wirelessed the American steamship Rockingham, which was the nearest vessel to the disabled craft, to steam to the rescue of the latter. The Rockingham proceeded directly to the position where the Manga Reva was supposed to be and the Ryndam later received a message from the former vessel saying that she could not find any signs of the distressed craft. Both the Rockingham and the Ryndam then proceeded on their voyages. Before departing the Rockingham sent a wireless saying a French auxiliary cruiser was looking for the Manga Reva.

The United States Army transport Sumner, bound from Panama for New York, ran hard aground on the beach at Barnegat, N. J., during a fog on the night of December 11. Wireless messages conveyed the news of the vessel's plight to New York City and the cost-guard cutters Mohawk and Seneca and several steamers started to her assistance. All of the passengers, principally army officers, their wives and children, and 190 enlisted men, 232 in all, were taken ashore in lifeboats.

Wireless signals of distress from the Swedish steamer Scandinavic, three times repeated, and the last call very faint, were picked up on January 19 by the British freighter Star Point, her officers reported upon arrival in Boston from Liverpool. As the Scandinavic's calls gave no position, and as the Star Point at the time was battling with a gale, no attempt was made to reach the distressed vessel.

Besting Typhoons in Oriental Waters

How the Wireless, in a Race against Time, Showed That It Was Faster Than the Wind

By D. M. Taylor

WHEN the Pacific Mail liner Korea steamed away from San Francisco on July 3, 1915, I realized that we would reach the island Empire of Japan, pass Formosa, proceed through the China Sea and voyage up and down the Chinese coast at the height of the typhoon season, the bugbear of both seamen and travelers whose business makes it necessary for them to undertake a cruise to this part of the world during the months of July and August.

For the benefit of the uninitiated it should be said that the typhoons, consisting of strong gales of wind traveling at the rate of from eighty-five to 125 miles an hour, usually originate in the mid-Pacific and speed in a westerly or northwesterly direction. The tornadoes are generally accompanied by heavy rains and mountainous seas. Frequently they start off Guam, the Marianas, or in the vicinity of the Philippine Islands, and take a northwesterly path across the China Sea, spending their fury on and along the China coast.

During the typhoon season the weather reports, signals and storm warnings are watched with keen interest and no little anxiety by those voyaging in the storm zones, much of the peril from the typhoons being done away with by the notices broadcasted by the observatories at Guam, Marianas, Manila, Hong Kong, Siccawei, near Shanghai, and Weihaiwei. These observatories make special observation and gather data on the actions of typhoons.

The observatory at Manila, which is the central office of the Philippine Weather Bureau, was founded in 1865 by the Jesuit Order, trained members of which are enrolled in the Civil Service and still conduct the work. It is a long-established meteorological and astronomical institution, being noted for its activities in connection with typhoons and earthuakes. The Siccawei Observatory, at Shanghai, which is also conducted by the Jesuit Fathers, distributes daily weather reports containing special data on typhoons. The new observatory was built in 1890, supplanting the old one, which was built in 1870.

Our voyage across the Pacific was uneventful. We arrived at Yokohama, Japan, on July 20th, and left the next day for Kobe, which port, after a three-day stay, we left for Nagasaki, arriving there on July 26th. Crossing the Inland Sea of Japan, we touched at Nagasaki and then steamed for Manila. After leaving Japan, we received daily weather reports which are sent out by wireless broadcast to ships at sea. This weather service is rendered free by most of the Government wireless stations throughout the Orient, and is practically the same as that maintained by the United States Government stations.

For several days previous to our arrival in the typhoon waters tornadoes had been reported from various weather observatories. These weather warnings were received on the Korea and reported immediately to Captain Nelson, the commander of the vessel.

Leaving Nagasaki, southbound, at half past four o'clock in the morning on July 26th, our first storm warning was received four hours later. It told of a typhoon moving in a northwesterly direction. We were then steaming in a southwesterly direction on our regular course from Nagasaki to Formosa, which would make us skirt the Formosa coast, pass between the Island of Formosa and Northern Luzon and thence proceed southward to Manila. The following morning I received a long typhoon report, containing explicit information as to the whereabouts of the storm. Captain Nelson, therefore, immediately ordered our course changed somewhat to the Southeastward and away from the Coast of Formosa.

According to our position and course and the position and direction of the typhoon, we were bound to meet and clash if we continued to steam on our route as planned. Therefore we were only saved passing through the typhoon, accompanied by its probabilities of dangers and accidents, by the timely reception of the wirelessed warning.

The change in our course was approximately 220 miles, which was overcome by steaming behind the typhoon, and cutting across to Northern Luzon, thence southward to Manila. The distance our ship traveled was approximately the same, but we steamed 220 miles away from the Formosan Coast, in which direction the typhoon was directly headed, thereby escaping it, although we were compelled to ride heavy seas, resulting from the cyclonic storm which had just passed. This typhoon, which was one of the severest experienced in many years, swept over Shanghai on July 28 and took a course up the Chinese coast, causing widespread death and havoc.

Mention should be made in conclusion of the excellent accomplishments of the wireless. On the Pacific we averaged 3,000 miles every night and while in the typhoon zone, at the height of adverse atmospheric working conditions, the Korea's daylight communications averaged 400 miles with Shanghai (CFS). The night communications averaged 900 miles with Corregidor (WVN), Manila Bay, the Philippines, and we also worked Hong Kong (VPF), 650 miles away, through heavy static.

Such is the recital of my voyage on the Korea through the typhoon zone. Although it is not filled with exciting incidents it exemplifies at least one fact—that wireless travels not only with the speed of a flash of lightning but is also faster than the wind.

The new illuminating system for the Statute of Liberty was inaugurated recently, President Wilson operating a searchlight signal by wireless.

ACKNOWLEDGED WITH THANKS

THE WIRELESS AGE is the best magazine on wireless that I have ever seen. There are one or two others which claim to be an authority on this subject, but they do not compare with yours.

L. A. KERN, *Illinois.*

I renewed my subscription to THE WIRELESS AGE, because it is so valuable in quality.

L. BAKER, *New York.*

Four months' trial have convinced me that I cannot do without it. (THE WIRELESS AGE.)

J. VANDERVEER, *Michigan.*

It (THE WIRELESS AGE) has in it all and more things that go to make a fine magazine.

C. H. PICKETT, *Wisconsin.*

It (THE WIRELESS AGE) is the last word in wireless.

P. M. BUNGART, *New York.*

Purely from an experimental and scientific standpoint, I enjoy the AGE very much. The "Queries Answered" columns afford splendid information.

W. T. GRAVELY, *Virginia.*

THE WIRELESS AGE is a dandy magazine.

LAWRENCE FITZPATRICK, *California.*

I have tried almost every so-called radio magazine published, but none are as complete as THE WIRELESS AGE. No amateur should be without it. This is the view of my friends, and I would just as soon stop radio work as stop taking THE WIRELESS AGE

ANTHONY L. WEBER, *Illinois.*

I take great interest in THE WIRELESS AGE. I have volumes I and II bound, and consider them a valuable addition to my library. ADOLF SEEBE, *Texas.*

The National Amateur Wireless Association is a wonderful organization, doing wonderful things. The MONTHLY SERVICE BULLETIN is full of interesting features.

GEORGE E. BEECHER, *Massachusetts.*

A Word From a Rip Van Winkle of Wireless

By CLYDE JAMES APPLEGATE

THE original Rip Van Winkle has nothing on me, although I have only been asleep for eleven years.

Wonders upon wonders, what a revelation to a pioneer in the wireless world!

I dare say that nine out of ten readers of this article cannot date their experience back to the year 1902, when I entered this wonderful field. I continued in it until 1905. I have been asleep since that time, so far as advancements are concerned. You, on the other hand, are all familiar with the present, therefore I will deal with the state of art previous to 1905.

My credentials first. Read the accompanying letter from the Chief Signal Officer of the United States Army, and observe the date.

My attention was first attracted to wireless when working for the Postal Telegraph Company in New York City, by a very small article in one of the dailies; it referred to experiments being carried on in a small office located on the roof of a building on State Street, that city. It simply stated that a man was working with a mysterious electrical wave which he would flash out into space; this same signal could be picked up at a great distance through the aid of a wonderful machine which would be affected by the impulse, wire connections being unnecessary between the two points.

The item passed from my mind, along with other seeming impossibilities which had been printed to interest the public; but later the papers printed a flaring announcement that started the entire world thinking: Marconi had flashed the letter S across the Atlantic Ocean! From this date, wireless was current news; but no companies started handling commercial work which was to put the telegraph companies entirely out of business in the near future, as the newspapers had predicted.

I was interested. As a telegrapher, I did not wish to awaken some morning and find myself out of a position. So to keep pace with the times, I went to the State Street address. I found that another station had been erected on Staten Island, and when weather conditions were good, the distance of possibly three miles could be spanned and messages exchanged between the two offices by repeating the same word three or four times. This made it look hopeful for the commercial companies, for a few years anyway.

The headphones were placed to my ears and a sizzling noise greeted me; it sounded like someone dropping water into hot grease. I could not read a letter, yet Staten Island was sending good Morse, I was told. I shook my head skeptically, saying that it sounded like a ham sizzling; I was not accustomed to the single stroke.

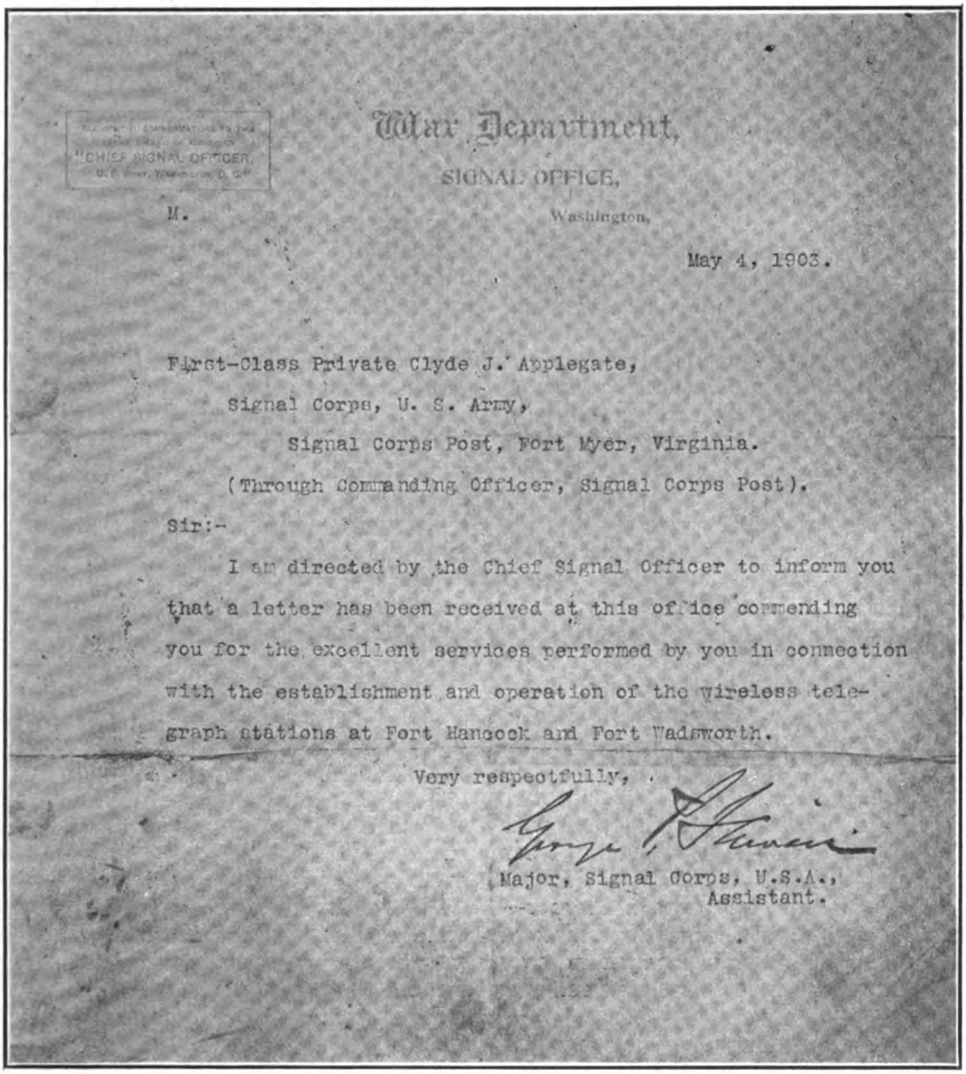
After several visits to this glass house way up on the roof I managed to read the signals; and no wonder, for each word was repeated several times!

One day I heard a noise that did not resemble the familiar spark; this one punctuated the air similar to the way a period looks; I was told that this was the Marconi system, and that he used continental code altogether. I was not familiar with this at that time, so what passed through the air was as Greek to me.

But the wireless ether wave had me in its grasp, and when an officer in the Signal Corps informed me that the Government was experimenting with the new communication method, and that the chances for experience and advancement would be excellent, I enlisted, for it was evident that if Uncle Sam took the matter up he would not stop this side of success; besides, I would be able to dig into the very heart of those mysterious instruments.

My enlistment took place October 15, 1902; now read the date on that letter again and see if I did any digging! Remember, I said that Staten Island was about three miles distant from State Street; that letter refers to Fort Wadsworth and Fort Hancock, which are twenty-two miles apart. Listen to what instruments this achievement was accomplished with, and you will marvel just as I have, as to how it happened.

A motor-generator of 500-volt capacity, a small oil transformer, four leyden jars, a key with the contact points emersed in oil, and two pieces of brass made into a spark-gap, made up the sending side. A sewing needle drawn by a spring against two pieces of aluminum, two sheets of tinfoil between oil paper two by four inches, an induction coil the size of a sewing machine bobbin, topped off by a pair of head phones—that was the receiver.



"CHIEF SIGNAL OFFICER,"

War Department,
SIGNAL OFFICE,
Washington,

M.

May 4, 1903.

First-Class Private Clyde J. Applegate,
Signal Corps, U. S. Army,
Signal Corps Post, Fort Myer, Virginia.
(Through Commanding Officer, Signal Corps Post).

Sir:-

I am directed by the Chief Signal Officer to inform you that a letter has been received at this office commending you for the excellent services performed by you in connection with the establishment and operation of the wireless telegraph stations at Fort Hancock and Fort Wadsworth.

Very respectfully,

George P. Scriven

Major, Signal Corps, U.S.A.,
Assistant.

The letter which the author of this article received, referring to his excellent work as a wireless man

The aerial, or "harp," as it was called

in the early days, was made from two strands of electric light drop cord, separated by short spreaders; it extended from the top of a fifty-foot mast down to the insulator leading into the station. The aerial gave me more trouble than anything else at the Wadsworth test.

L. E. Harper, stationed at Hancock, who, by the way, is still in the Government wireless corps and a master electrician, would call Wadsworth hour after hour; I could not hear a vibration nor could he receive my signals, but both of us could hear a station which had been located at Coney Island, so we used this station as a relay.

Finally, one day I took a pair of strong glasses and went high upon an embankment, back of which the large disappearing guns were located, and looked longingly toward Hancock; as I turned toward my station I discovered that the top of my mast was below where I stood. It gave me an idea; I cannot say what inspired me, but I hooked up the small receiving set described, and ran up a single strand of wire on the flag staff, which was on the high embankment. When the headphones were placed upon my ears I could hear Harper calling!

One mystery was solved, and just by accident too, for we did not think about "in the clear" those days. An additional length of pole was spliced onto the fifty-foot mast, and then—day of all days—communication was established.

A newspaper article stated that two forts were bombarding each other with wireless messages—and we were. I can honestly say that I was the proudest person on earth; and my partner, Harper—well, he just hugged himself. Think of it readers: all of this enthusiasm over a twenty-two mile wireless achievement!

At this time very few steamers had wireless apparatus on them for other than experimental purposes. I well remember the first message I ever read sent for a steamer; she was the Cromo, from New York bound to Havana, and on board were Major Harrison and Miss Alice Roosevelt. The telegram was going to the President from his daughter. Harper and I got it, but the operator at the Coney Island station had lost the pace of the Cromo operator, who seemed nervous and in a hurry to get his business off before he got out too far; in part the missive read: "Going at fifteen knots. Weather beautiful." Another read: "Left my keys on desk, take charge until my return." Right here the real value of wireless presented itself to me.

The United States Government saw in wireless an auxiliary to the cable laid between Port Safety, which is twenty-two miles east of Nome, Alaska, and St. Michaels, which lies 112 miles across a corner of Behring Sea. Each year when the ice would "go out," it would take the cable with it and this would mean months of delay to the telegraph business of Nome, which was becoming a very important point.

So it was decided to give wireless a test across this stretch of unruly telegraph outlet to the outside world. The same location for the station at Port Safety was decided upon, owing to the fact that the engineers thought that a high hill known as Cape Nome, eight miles west of Safety, would interfere with the ether wave in its passage between St. Michaels and Nome. Later, this theory was found to be groundless and the station was moved to Nome. Height of mast was taken into consideration and 212 feet was the altitude decided upon. Three lengths of Oregon pine stepped together gave the desired measurements.

The proposition which presented itself then was, just how these monster sticks could be transported from Seattle to Northland; for there were to be twelve in all, as a double mast was contemplated to overcome the tendency of the aerial wires to wrap themselves around the single pole.

The steamer Tacoma took the contract to tow them, and I recall the captain's remark after his journey: that he had to cut this raft adrift several times during storms, or it would have foundered his vessel.

On account of our success, Harper and I were sent with a detail of five men each to worry out the puzzling question of hurling a signal 112 miles! Remember that this was in 1903.

I was assigned to Port Safety, and when we six soldiers were landed upon its barren sands the sight was anything but inspiring. It was in September and the masts were partly erected. We could see but one house, the old galvanized cable station which consisted of but two rooms. The six of us with our equipment took possession; we were informed that a house was being unloaded for us. It proved to be a portable one, such as are used at summer resorts!

My heart held misgivings when the engineer, who was erecting the masts, laughingly observed, as he pointed at the pile of sections: "That house will be pleasant. It only gets sixty below up here."

I pictured the man who had ordered this house sent up to Alaska, seated in a deep leather chair enjoying a cigar. He was looking at the photographs of a portable house catalogue, and estimating advantages in quick construction.

Strange to say, though, after this house was lined with building paper throughout, and well banked with sand outside, we were able to keep very comfortable in the coldest weather, so my mental vision of the gentleman in Washington eventually was kindlier.

Our first night in that iron covered cable house was a memorable one. It does not get very cold at this point in September—to those acclimated—but to our little band it was a most miserable experience. We had just about settled for the first night when a dismal howl resounded, quickly followed by others. It was the mournful wail of dogs, and to already sickened hearts it was terrible to hear. One of the boys said that when a dog howled it was a sign that death was in the neighborhood, or would be soon. This being the case, there were enough of these howls to have exterminated hundreds.

After about an hour we could stand it no longer and decided that it was up to us to justify the superstition by action. Several skirmishes were held and daylight revealed nine dogs stiff on the sands. We discovered then that we had to pay the Eskimos in cold cash for them, and this was a very good lesson as to the value of a canine in Alaska.

When the instruments were unpacked, no oil-emersed key could be found. Leyden jars were absent, a spark-gap was also missing. The latter was easy to make, however, and battery jars were substituted for Leyden jars. A telegraph sounder with a long rubber handle made the set complete, adding a file to keep the brass points clean.

This sounds all very simple and easy to the reader, but remember this all took place in Alaska, twenty-two miles from nowhere. Jars, tinfoil, brass and machinery to do the work had to be found. Nome was searched for several days before suitable material was located.

A six-horsepower gasoline engine was belted to a 500-volt generator, the current running through a 20,000-volt transformer, thence into the crude Leyden jars.

The "harp," or aerial, had thirty strands of No. 14 bare copper wire, 180 feet long, swung vertically.

In November navigation closed and the station was ready for the try-out. A certain time each day had been decided upon, when we would call each station. Day after day the chug-chug of the gasoline engine exhaust, which at first caused the natives to dart into their *igloos* in fear, was the only vibration I heard, for weeks and then months. Still no answer came to my calls for St. Michaels.

The first mail which arrived by dog team over the snow trail, informed me that the armature had been burned out at the Michael station; later this was repaired by the men at that point, a feat which cannot be overlooked.

Our tests were made by taking the dog team and going several miles from Safety, the temperature sometimes standing at forty below. A hole would be chiseled through the thick ice and our ground wire dropped into the water, my little home-made receiver (which I will describe later) was used, and an aerial was swung from a short mast fastened to the sled. Tests up to fourteen miles proved successful, but that was as far as we could get until the following summer, when new instruments were sent up to replace the home-made ones.

A beautifully constructed instrument known as a Muirhead responder had been sent North with us to try out. This machine registered the dots and dashes upon tape; ink flowed through a small glass syphon which was fastened to a piece of metal that swung backward and forward in a magnetic field. A small wheel turned in a rubber cup which was filled with quicksilver; the wheel revolving caused the de-cohering. The aerial wire was attached to a jack-plug, which fitted into a socket. When ready to receive, the plug was inserted, and when a vibration passed down the aerial it would cause a bell to ring; then a switch would be thrown that would start the tape running. The syphon would make a quick upward movement for a dot. For a dash, the glass tube would dart upwards to the top of the tape, remaining there as long as the wave continued, then drop to its level. This instrument worked perfectly, so perfect was its action in fact, that when the telegraph sounder in an adjoining room would click, the vibration would register on the tape. The slightest electrical disturbance registered, so this machine was a failure in the wireless world, so far as I was concerned.

As I remarked before, my little Wadsworth pet, the sewing machine needle receiver, had been overlooked by the men who packed the instruments. One had to be made. The wire from a buzzer and telegraph sounder magnets furnished the material for the induction coil. Oil paper from a cracker box and tinfoil from the top of beer bottles made a fine condenser. The cover from an aluminum souvenir collapsible drinking cup made the two points against which a needle was sprung. Binding posts were plentiful, so we had a Wadsworth receiver once again.

One evening late in November, as I sat at my table amongst my instruments, after a very hard day's work testing, my head dropped forward and rested upon my arms which were crossed upon a mass of wire, tools and experimental metal. The boys had gone to bed, saying that it was a shame to awaken me. How long I remained asleep I cannot say, but suddenly a shock brought me to my feet. My first thoughts were that the engine had been started and someone had depressed the key. I realized an instant later, though, such was not the case, for all was quiet.

I had received a severe shock, of this I was sure.

I reseated myself, placing my arms as before, and received another jolt that made me flinch. Finally, I discovered that my arms had been between the aerial and ground wires and that static had done the work. Tests made by putting a piece of cardboard between the two wires proved that the impulse was so strong it could drill a hole through the card.

Upon going outdoors a most beautiful sight greeted me. The Northern Lights illuminated the heavens. It seemed that the strips of color were ten feet broad, and so vivid in themselves that it seemed as if I were looking at a painting. The static continued strong for several hours and gradually decreased as the display rapidly disappeared. The record book of the Port Safety station shows data on the wonderful freak, under date of Nov. 15, 1903.

In the consignment of new instruments which arrived the following summer was a helix, in the center of which was a spark-gap and around it the coils of wire upon which the clips for tests were fastened were wound. Many other new improvements were laid before me; they were all pictures.

The aerial was now cut down to about fifty feet and suspended horizontally. A ground made from galvanized iron was buried, and hundreds of feet of chicken netting laid upon the sand.

When the engine was started for the test out, and the key was depressed, high above the crash of the spark-gap came the howls of natives. Looking through the window one could see human figures flying over the level sand. Several Eskimos watching the men at work on the outside had been standing upon the chicken neeting; the bottoms of their skin boots were damp and the current stirred them into wonderful activity—for an Eskimo.

In September, 1904, communication by wireless telegraph was established between St. Michaels and Port Safety, Alaska. The achievement was heralded with delight by the Nome business men. The land line which connected Safety with Nome was kept busy. The charges were $7.50 for ten words to Seattle; here the message would be turned over to some commercial company and their additional charge to destination would be added to the Government's toll charge. It was expensive, but that was a minor consideration.

I could relate hundreds of incidents which sorely tried our little band of six soldiers during those long dark days, when we were practically isolated from all white persons; suffice to say, that although fed well and warmly housed, we passed an eight months' nightmare while navigation was closed.

In October, 1904, I left for Caldez, going then to San Francisco on account of an affection of the eyes, which led to my discharge in March, 1905.

At that time I went out of the wireless world altogether.

A few days ago a wireless magazine was read to me. Its contents awed me and the names of up-to-date instruments, the terms and the indications of the developments of the art caused this article to be written. For somehow I feel proud that I was in wireless in its early days, and I like to think at that time I did some little bit toward the beginning of radio, which I feel has only started its wonderful career.

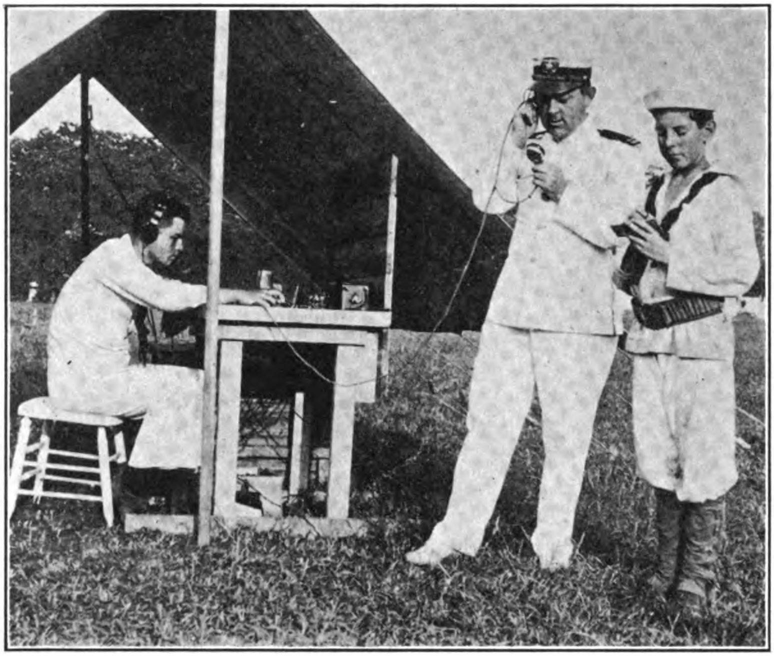
The Camp of The Junior Naval Reserve

By Cadet Francis Scallon

Camp Dewey, illustrated in the accompanying views, was instituted with the purpose of founding a merchant marine school in the vicinity of New London, Conn. Before commencing the camp, it was understood that tents were to be procured from the U. S. Marine Corps and boats for the nautical instruction were promised by the Secretary of the Navy. The latter official was very cordial and seemed to show great interest in the camp; later, however, he was unable to keep his promises as to assistance. The Executive Committee of the Junior Naval Reserve, although discouraged, did not hesitate to procure funds for the necessary equipment. On account of the large expenditure for equipment, tents and arms, the wireless outfit purchased was not all that it should have been.

When the camp opened, July 15, 1916, cadets who had experienced military training were

Receiving wireless messages over the phone at Headquarters, Camp Dewey



Lieutenant E. N. Cochran, D. R. C., U. S. Navy, telephoning wireless messages to Headquarters, Camp Dewey

designated as acting cadet officers. Owing to the lack of instructors, the courses promised in astronomy, Spanish, history and geography could not be accomplished, so most of the time was employed in laying a good foundation of military instruction.

Three cadets from the office boy staff of the Marconi Wireless Telegraph Company had charge of the wireless situation and with a great deal of labor erected spars for the receiving wires and installed their instruments. These young men also ran the field telephone system around the post of the wireless station. One was installed at the kitchen; one at the Commandant's office and one at the wireless station. All the work at Camp Dewey was done by the poorer cadets, and as a matter of fact was completed by the fatigue work of the boys.

CHIEF SIGNAL OFFICER SCRIVEN RETIRED

Secretary Baker has granted application for retirement of Brigadier General George P. Scriven, chief signal officer of the United States army, to be effective February 14. General Scriven has been in the service since 1874, when he was appointed to the Military Academy from Pennsylvania. He probably will be succeeded by Lieutenant Colonel George O. Squier, acting assistant chief signal officer and now in charge of the aviation service.

Using the SOS In War Stratagem

A despatch from Amsterdam says that German submarines are now sending out S O S wireles signals to lure British vessels to destruction. The Telegraaf declares that it learned from an officer of a large steamer of an important Dutch line that while on a voyage from the Dutch East Indies he received while in the Bay of Biscay an S O S message. The ship immediately rushed to the place indicated, and found a German submarine which was not in distress.

NEWS OF DEWEY'S DEATH BROADCASTED BY WIRELESS

Admiral George Dewey, the victor of Manila Bay and by priority-of-grade the ranking naval officer of the world, died at his home in Washington at 5:56 o'clock in the afternoon of January 16th, at the age of 79, after an illness lasting six days.

The President and Secretary Daniels were notified at once, and the news was flashed by wireless to American naval vessels and stations all over the world. The message carried orders that all flags be half-masted.

President Wilson gave out this statement: "The whole nation will mourn the loss of its most distinguished naval officer, a man who has been as faithful, as intelligent, and as successful in the performance of his responsible duties in time of peace as he was gallant and successful in time of war.

"It is such men that give the service distinction, and the nation a just pride in those who serve it."

To pay sufficient tribute to the memory of America's naval hero is a task taxing the resourcefulness of the most talented obituary writer. When we Americans are in a patriotically boastful mood and disposed to claim most for ourselves, we imagine a being supremely capable, competent, resourceful, master of every emergency, quiet, unassuming, before whom difficulties flee in rout, and we call this imaginary character typically American, as one journalist has remarked. Well, George Dewey was that man in real life. He lived to be an octogenarian, and in eight decades he never did anything that was not well and completely done, done quickly, quietly, and consummately; there never was a rough edge work. Whether he dealt with men or things or events, whatever he did was done in the least possible time, with the least possible noise, and without leaving any room for argument about the method or the result.

At twenty-six, taking the crew off the sinking Mississippi at Port Hudson under a hot fire and twenty-five years later in the command of the Asiatic Squadron, with war at hand, with only 60 per cent. of the ammunition with which the Navy Department should have supplied him, with a Secretary of the Navy who was too busy with Cuba to remember that there was anything going on in Asia, he went ahead without orders and made his own arrangements for the conduct of the war on and off that continent. Before Secretary Long had given him any precise information about the probability of war and no orders of any value, he had picked out an unknown spot for a coaling base and had arranged for supplies enough to cover any event.

There were mines in Manila Bay, but useless ones. He did not know whether there were or not, but he went ahead like Farragut, because it was the only thing to do. The Spaniards fired more shots than he did, but they did not shoot as straight. That, too, he could not know in advance. He paraded up and down in front of them and shot them to pieces as if he had been firing at a clay pigeon. "You may fire when you are ready, Gridley," is all that anybody remembers of any speeches he made during the battle. He did not raise his voice; his tone was that in which he would have said, "Give me my hat."

After the battle came the Germans, pro-Spanish, destitute of sea-manners, interfering with his blockade, annoying and provoking him by every means in their power. He set forth his demands to Admiral Von Diederichs, with a clarity and simplicity that seemed intended for the understanding of a six-year-old child. The German disregarded them. Dewey fired a shot across a German bow. Immediately one of Von Diederich's officers, Hintze by name, appeared on the Olympia seeking an explanation. It was what Dewey wanted; he could not use real language to an Admiral in a note, but to a junior and in a dialogue he could. What he said contained the word "war," repeated several times. Hintze went back indignant, reported the conversation faithfully, and Von Diederichs never offended again.

Commanding Officer Jr. American Guard

Brigadier General George Rathbone Dyer, commanding 1st Brigade, National Guard, N. Y., was placed in command of the Junior American Guard on December 5th. In accepting the presidency of that organization General Dyer announced that he would be very active in promoting the welfare of the movement to create a third line of defense for the nation. Signal Corps units developed along the lines advocated by the National Amateur Wireless Association will receive the full co-operation of the Military Committee and arrangements are now being made to muster in those units which are uniformed and drilling according to army regulations. The General's record of military service appears in the accompanying article

Brig. Gen. Dyer in Command of Junior American Guard

Commander of First Brigade New York Militia Named as Successor to Late General Zabriskie—The New President's Record and Views

SIGNAL Corps enthusiasts who are drilling or organizing various units for national defense, under the plan advocated by the National Amateur Wireless Association, have signified their intention to vigorously campaign for many more recruits, as a testimonial to their new commanding officer, Brigadier General George R. Dyer.

General Dyer assumed command of the Junior American Guard on December 5th. His first order re-appointed Major William H. Elliott, a vice-president of the N. A. W. A., Adjutant General of the organization. This order added: "I wish to express to the present organization my appreciation of the loyalty and faithfulness to their late Commander, Brigadier General Andrew C. Zabriskie, and to extend my sincerest wishes that the future development will be continued along the same efficient lines. Officers and members are assured hearty co-operation from headquarters, and careful consideration will be given to all communications directed through the proper channels."

That same evening the Junior American Guard's new commanding officer attended a review of St. George's Battalion at the 69th Regiment Armory, New York. Major General Leonard Wood, U. S. Army, the reviewing officer, impressed by the efficiency of this cadet organization, volunteered to address the young men and spoke for fifteen minutes, before a hushed assemblage of seven thousand spectators, telling the members of the battalion that in years to come they would be able to look upon themselves as pioneers in the education of the great American public to the necessity for universal military training. The Commander of the Department of the East expressed full satisfaction with the personnel and spirit of the organization and signified his willingness at all times to assist its expansion.

Commendatory expressions were also given by the various officers of the reviewing staff, among whom was Colonel Lorillard Spencer, Military Secretary to the Governor of the State of New York.

General Dyer's acceptance of the presidency of the Junior American Guard has been heralded as a notable step forward for the nation-wide activities of the organization. Many men prominent in military and civic life are now in communication with the Military Committee of the N. A. W. A., seeking preliminary instruction for the formation of Signal Corps units in nearly every State in the country.

General Dyer has a host of loyal supporters in military circles, having been a prominent figure in militia activities for the greater part of his twenty-eight years of service. His rapid rise to the rank of Brigadier General is looked upon as a record that will not soon be surpassed. In June, 1889, he enlisted as a private in Co. K., 7th Infantry, and within three years became 2nd lieutenant in the 12th, rising then successively to the ranks of 1st lieutenant and Captain of Co. G, in less than a year; six years later, shortly after the close of the Spanish-American War, he was commissioned to the rank of Major, and five years ago, on February 28, 1912, became Brigadier-General in command of the First Brigade, N. G. N. Y., which high office he still holds.

"During the recent crisis on the Mexican border," says General Dyer, "it was conclusively proven that the United States has need for a trained citizen soldiery, one that is able to mobilize quickly in emergency and give material support to the regular army establishment. In direct refutation of the criticism leveled at the militia, is the undeniable fact that these men responded promptly to their country's call last Summer, and with their arrival at the border the Mexican attacks ceased. It is obvious that the Guard has its part and place in the economy of the State. It must be maintained with the fullest confidence of the public, and it must continue to be the principal support of the army. All thinking people are striving to bring about universal military training and service, and the Guard will do all in its power to create a condition where the sober, serious minded young man may not be required to bear all the burdens and make all the sacrifices. And in this connection, a worthily patriotic organization such as the Junior American Guard deserves the fullest support of the country at large, for in its cadet companies the spirit of service will be inculcated, and young men brought to a realization of their future obligation as citizens pledged to defend the sanctity of their homes. I intend to be very active in promoting the expansion and welfare of the organization, and see in its rapid growth to date many favorable signs for the creation of a force some day to be reckoned with as a third line of defense for the nation."

General Dyer believes that training in Signal Corps units of the Junior American Guard will be invaluable to those who later contemplate securing militia commissions. In a signed statement, he says:

"During the last thirty years there has been a constantly increasing desire on the part of both officers and enlisted men for opportunity to study the greater questions of military education and instructional training. Steady advancement has been made through field maneuvers, problems in the administration of large camps in connection with the betterment of physical conditions and the promotion of health.

"With few exceptions officers and men of the National Guard have served without remuneration and have derived no pecuniary benefit, except for short periods when on active duty.

"The service of the Guard on the border has been both honorable and efficient.

"The units are gradually being returned home, and all deserve full appreciation for the example they have set to the country at large. These Guardsmen have proved themselves fine, manly men, who at their country's call accepted unhesitatingly the entirely new service conditions imposed by the National Defense Act, a strange and untried piece of legislation

"Before the State troops arrived on the border many lives of both Americans and Mexicans had been taken and much property destroyed, but after the arrival of these troops not a life was lost or a dollar's worth of property destroyed."

Through the Junior American Guard, the General believes, two necessary objects may be attained for the country: Young men trained in early years for the more advanced military instruction to be had later in the National Guard, and the spirit of universal military training and service promoted over the length and breadth of the United States.

The invitation to communicate with N. A. W. A. headquarters is renewed on behalf of General Dyer, and the Military Committee of the Association has announced that it will co-operate fully at all times with those desiring to organize Signal Corps companies.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

A Transmitter of Compactness at Reasonable Cost

The transmitter described herewith, incorporates at a minimum of expense the unquestionable advantages of an oil immersed condenser, quenched rotary gap, and the neatness and convenience characteristic of a compact assembly. While designed primarily for radio work, it makes a very handy unit for exciting the Tesla coils so popular among amateurs. It may be used for either purpose alternately without extensive changes in the connections. As the design is adaptable to all sizes and powers it is obvious that one set of dimensions throughout would hardly apply to different builders' needs.

The box (Figure 1) is constructed preferably of hard wood and is of sufficient size to accommodate the transformer and oil condenser. Two pieces, ¾ of an inch thick, serve as supports for the transformer and prevent the condenser from shifting.

The spark gap construction is clearly shown in Figure 2. A bicycle sprocket wheel makes an ideal rotating member when fitted with a suitable bushing to the shaft. The hole cut in the main body should leave a ¼-inch clearance from this wheel. Number 8/32 threaded rods form the stationary members, but if more than ¼ k.w. is used it is advisable to tip these with larger sparking surfaces.

These electrodes extend through battery-nuts soldered to brass strips which in turn run down the sides of the gap and by means of spring clips make connection on the bus strips inside the box. A knurled check nut serves to keep each electrode in permanent adjustment. If old motor bearings are not at hand suitable ones are made in the form of a simple flanged bushing. These are fastened to the circular side pieces as shown in Figure 1. When the gap is ready for the final assembling, drill the side pieces for wood screws and fasten one to the main frame permanently; short pieces of fibre tubing or washers slipped on the shaft take up any side play which may develop. The other side is now placed on the shaft, in position against the frame and held temporarily with a clamp. Adjust this side by lightly tapping the edges until the bearings are in alignment and the shaft turns freely without removing the clamp. This side is now screwed to the frame and the gap is complete. A simple sketch of the wooden parts will assist any cabinetmaker or wood-working shop to make these pieces at a slight expense.

The oil condenser is simple yet rugged and does away with the nuisance of creeping oil. A box of sheet tin, with corners soldered oil tight, of suitable size to accommodate the desired condenser is made, allowing ½ inch spacing between the glass plates and the side of the box and about 2 inches from the plates to the rim; this spacing is maintained by wooden spacers as shown in Figure 3. A wooden cover about ¼ of an inch thick, is cut to fit snugly inside, and ⅜ of an inch below the rim. Through this cover are passed the conductors which should allow two or three changes of capacity without necessitating the removal of the cover. A ½-inch hole, over which is tacked the screw cap of an old varnish can, serves for the admission or removal of oil. Next in order, a good sealing wax or beeswax and paraffin, equal parts, is poured into the recess at the top after calking with bits of twine any chinks which would permit the wax to run through into the case.

The increased efficiency offered by this type will amply reward the builder. The motor may be belted to the gap, but direct coupling is neater and takes the side thrust from the bearings of both. A short piece of fibre tube with a slot at each end (see Figure 1) will do very nicely; a small pin driven through holes in each shaft fits into the slots and forms a neat and effective drive.

No oscillation transformer is shown owing to the varied opinions of amateurs, but leads for it are brought to suitable bushings as shown. These may be made on a small turning lathe, of maple, and given a coat of clear varnish. Binding posts may be located wherever the builder desires to accommodate the primary of the transformer as well as the motor.

Carl H. Biron, *Massachusetts.*

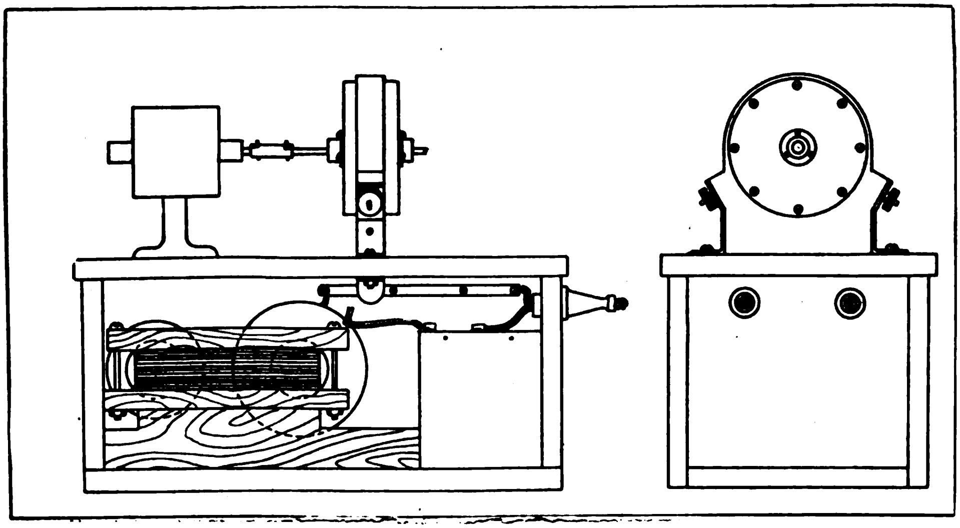


Figure 1, First Prize Article

SECOND PRIZE, FIVE DOLLARS

A Universal Receiving Set for Damped and Undamped Waves

This is a description of a receiving set responsive to both damped and undamped oscillations, having a wide range of wave-lengths. In addition this apparatus is fitted with a one-step vacuum valve amplifier which can be purchased complete or by individual parts.

I wish to make plain at the start that a circuit diagram of connections is not included, because the average reader of The Wireless Age is already familiar with the circuits of such apparatus. However, a general design for the receiving equipment is given, showing the relative positions of the apparatus and the probable overall dimensions.

For the front of the cabinet, indicated in Figure 1, a piece of hard wood, 36 inches by 8¾ inches by 8¾ inches, is required, which should be drilled for the necessary holes previous to sandpapering and painting. I find the best results are obtained by using No. .00 sandpaper followed by a coating of Johnson's pure black wood dye. If a soft finish is required the operation should end here.

The side pieces are 14 inches by 7¾ inches by ¾ inch and the top and bottom pieces are 36 inches by ½ inch in thickness. I advise the constructor of this apparatus to assemble it previous to applying the stain to make sure that a snug fit has been obtained.

A description of the lettered parts in Figure 2 follows:

A is a primary loading coil consisting of a tube 16 inches in length, 7 inches in

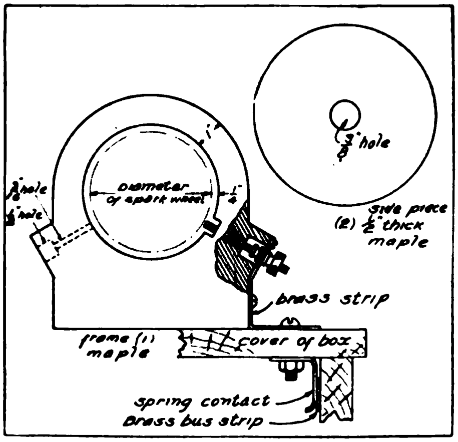


Figure 2, First Prize Article

diameter, wound with 15 inches of No. 26 S. S. C. wire, leaving ½ inch at either end of the winding. After the first 3 inches are wound, taps are taken off every 2 inches until the winding is completed, totaling seven taps. The tube is fastened upright on a piece of wood, 8 inches by 10 inches, by 1 inch, and the front panel of the loader on which is mounted the switch, X, is a piece of wood, 7 inches by 4 inches by 1 inch. More explicitly, switch X is 4 inches in length, the knob 2½ inches in diameter and is made from a round piece of hard wood. The eight switch points are copper nails 2 inches in length, the heads being used for contacts. Two binding posts are mounted on the base for making connections. Coil B is identical with coil A, but is placed in series with the secondary winding.

Detail C is an inductively-coupled receiving transformer of the Murdock type No. 341. This type is not absolutely essential, but I have found it gives marked results with this circuit. The rheostat, D, is for vacuum valve No. 1 and is of the regulation porcelain base type which sells on the amateur market for 60 cents.

The switch, E, is connected to the high potential battery of vacuum valve No. 1. The knob of this switch is 1½ inches in diameter and is constructed of hard rubber. The switch blade is 2 inches in length and is made of a brass strip ⅜ of an inch in width by 1/32 of an inch in thickness. The contacts here are copper nails 2 inches long. Fifteen will be required, because every other one is disconnected from the battery so as not to short-circuit the individual group of cells whenever the switch handle is turned.

The switch, F, is employed to cut in and out the primary loading coil. It is constructed of a strip of the same dimensions as E, but is 2¼ inches in length. The contacts are of copper nails.

G is a variable condenser connected in series with the earth leads. The standard 43-plate type variable is preferred.

H is either a Clapp-Eastham, Arnold or Bunnell rotary condenser of the large type. It is connected across the secondary in the usual manner. While the capacity of this condenser is smaller than that of the small 43-plate type, it is much more rugged and has a greater current between plates.

I is a single pole, single throw switch

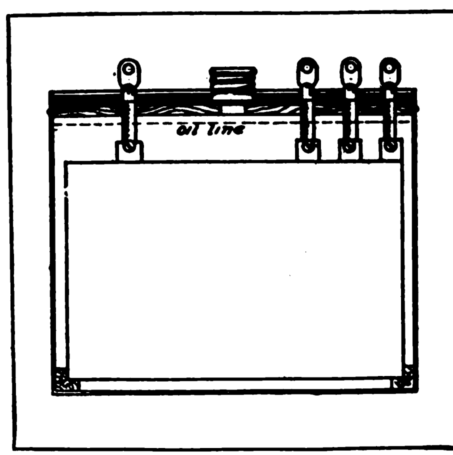


Figure 3, First Prize Article

of the battery type for short-circuiting condenser G when it is not required for the shorter range of wave-lengths.

J is a variable condenser of the same type as G and is connected across the head telephones when the amplifier is not employed.

K is a single pole, single throw switch

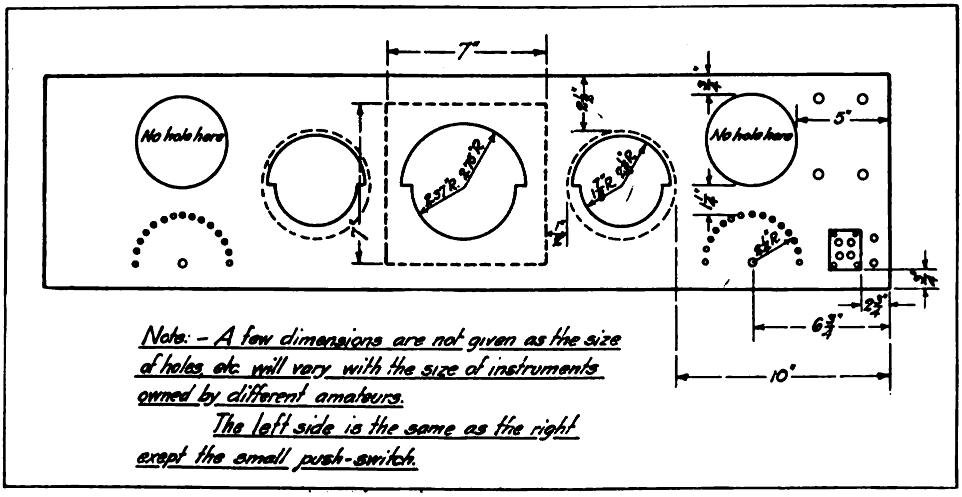


Figure 1, Second Prize Article

of the same type as I, but is used to cut out the impedance coil of the amplifier when the amplifier is not in use.

L is the switch for cutting in and out the loading coil of the secondary and its construction is identical with F.

M is the rheostat for the amplifying vacuum valve.

N controls the high voltage battery in the local circuit and is identical with switch E.

G is the miniature push button switch for turning the current on and off to the vacuum valve bulb. It is of the double type.

The telephone binding posts for the single vacuum valve are indicated at P, while Q is the mounting for the first vacuum valve.

R is the mounting for the second vacuum valve and S, the corresponding telephone post. The terminals for the aerial and ground are indicated at T. The grid condenser is made of two pieces of foil 1½ inches square with a thin sheet of mica as the dielectric.

The impedance coil of the vacuum valve is the primary and secondary of a 1-inch spark coil, which I have found to give good results.

With a set of this type I have performed the following work:

Stations 300 and 400 miles distant, such as 8-AEZ, 8-N-A, 8-YZ, 1-ZL, 1-IL 1-KV, 3-AIN, and stations from Portsmouth, N. H., down to the coast of Florida, are copied. When conditions are favorable, the radio station at Nauen, Germany, has been heard.

Stuart Sandreuter, *Connecticut.*

THIRD PRIZE, THREE DOLLARS

Advantages of an Inductively-Coupled Receiving Tuner

Readers of The Wireless Age may be interested in a description of an inductively-coupled receiving transformer where the inductance of the primary and secondary circuits is altered on the variometer principle. The advantage of the coupler is the absence of multipoint switches or sliding contacts for variation of the inductance, the elimination of the losses due to dead-ends and the necessity of variable condensers for closeness of adjustment between the contact points of either the primary or secondary windings. The construction of this tuner will not be found difficult and if the details are followed closely, a first-class instrument will result.

A general idea of the construction is given in Figure 1 and an end view in Figure 2. First let it be observed that there are four inductance coils, the primary having two coils sliding within each other as also has the secondary. These are mounted on two ⅜-inch brass tubes which are attached to the end block as usual. Coil No. 2 is permanently fastened to the base of the instrument, but coil No. 1 slides within it for variation of the self-induction. Coil No. 4 slides within No. 3 and No. 3 telescopes into the stationary primary winding No. 2. The winding of coil No. 2 is made on a paper or cardboard tube 5 inches in diameter, 5½ inches in length, wound for 4½ inches with No. 22 S. S. C. wire. A space of ½ inch is left at each taken into account that the coils 1 and 2 are wound in the opposite direction and so connected that when they are completely concentric, the inductance is at its minimum value, but when, for instance, coil 1 is withdrawn, the inductance is at a maximum value.

Coil No. 3 is 4 inches in diameter, and 4¾ inches in length, wound for 3½ inches with No. 24 S. S. C. wire. The supporting block for this coil is 1

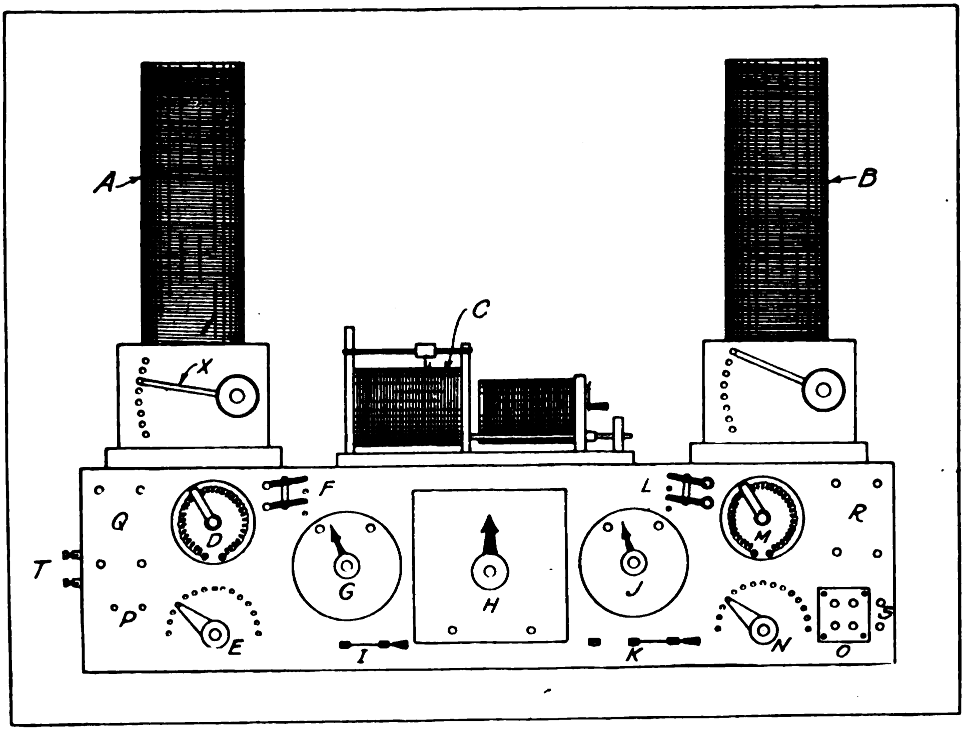


Figure 2, Second Prize Article

end of coil No. 2 in order that it may fit in the end pieces of the containing box.

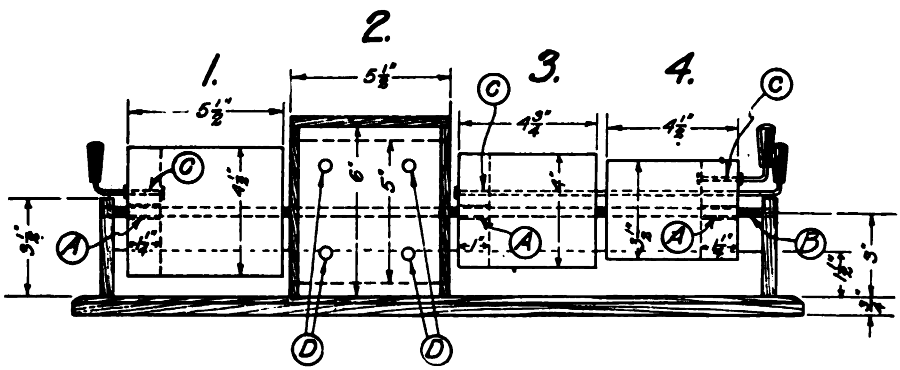
Coil No. 1 slides on two brass rods and has a supporting block on one end which is 1¼ inches in thickness. This block is screwed tightly in place within the cardboard tube after boring the necessary holes for the sliders and the handles. It will be observed from the drawing that this block serves as a support for the coil and the sliders, as well as for a handle. It is made on a tube 5½ inches in length, 4½ inches in diameter and is wound for 5 inches with No. 22 S. S. C. wire. It should be thoroughly inch in thickness and is constructed so that it may be moved in and out of coil No. 2. This winding should begin ¼ of an inch from the open end of the tube and stop 1¼ inches from the closed end so that the supporting block will not interfere with close coupling of the primary and secondary turns.

Coil No. 4 is 4½ inches in length and 3½ inches in diameter, wound for 4 inches with No. 24 S. S. C. wire. A space of ¼ inch is left at each end. The supporting block for this coil is 1¼ inch in thickness and is placed in the end furthest away from the box. These coils are also wound in opposite directions and are connected in series. All the wooden supporting blocks should be fitted with brass tube bearings, 3/8 of an inch inside diameter, to facilitate adjustment and prevent swelling of the wood with consequent sticking of the tube.

The handles for changing the relative position of the coils are made from an ordinary 110-volt switch handle which may be purchased from any supply house and will be found to serve the purpose excellently. The handles are mounted on mounted be made of polished hard rubber. The details for the base of this apparatus are included in the drawings, although they may be changed if desired.

The best appearance will be obtained if oak or cherry wood is employed, as it will take a good finish and amply repays the energy expended. The total cost of the instrument I have described should not exceed $5 and the result will be a highly efficient tuner that any operator will be proud of.

F. Schuyler White, *Massachusetts.*



Tubular bearings at (A) on sliders (B) - 3/8 inch brass.
Handle fixtures at (C)
Binding posts at (D).
Coils 1 and 2 = Primary; 3 and 4 = Secondary.

— Effective Windings: —

Coil	Distance	Size Wire	Kind
Coil No. 1	5 inches	22	Enamel or Silk Cov'd.
" " 2	4½ "	22	" " " "
" " 3	3½ "	24	" " " "
" " 4	4 "	24	" " " "

Figure 1, Third Prize Article

3/16-inch brass rods of convenient length as at C, Figure 2, and are threaded for nuts at the other end to make secure connection with the supporting blocks. The connections to the coil may either be made of flexible conductor or by means of the brass bands on the two long rods. The box enclosing coil No. 2 should be made of ½-inch stock, but its appearance would be improved if the side upon which the binding posts are

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

Good Advice Regarding the Construction of an Electrolytic Interrupter

Many of the electrolytic interrupters supplied to the amateur market at this date are notably freakish in action and after days of experimenting, the amateur is apt to discard them as a nuisance. I found after a number of trial experi-

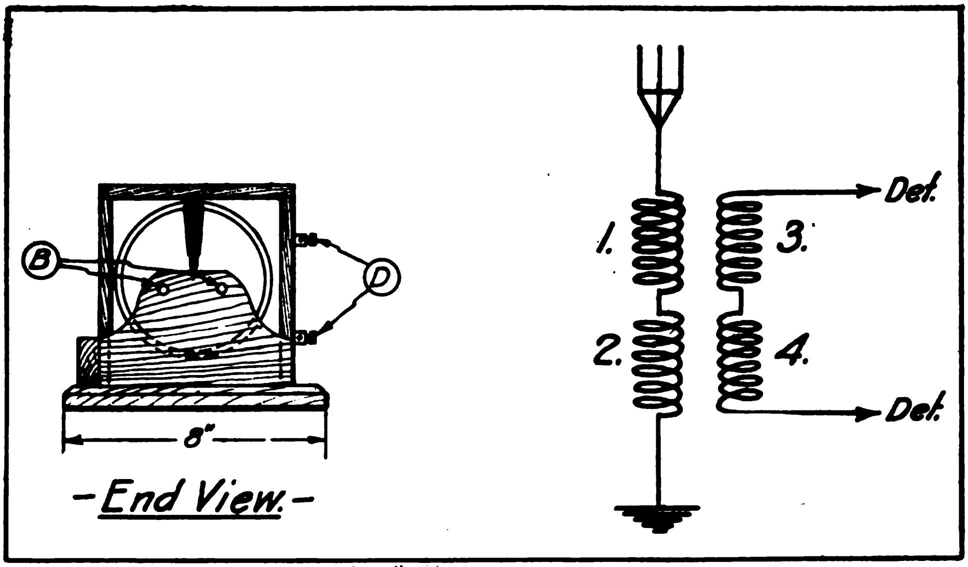


Figure 2, Third Prize Article

ments that a satisfactory interrupter could be constructed along the following lines as shown in Figures 1 and 2. A receptacle for the electrolyte can be made by breaking off the top of several General Electric Company's 100-watt carbon filament lamps. The tops of these bulbs may be broken off by first scratching a circle with a file, the tip having been cut off with a pair of pliers. The top part of the lamp is then heated with an alcohol flame and while still hot, a few drops of water are allowed to trickle on the part to be broken. If the scratch is filed deeply enough, a fairly uniform hole should result.

The sharp edges of the break can be eliminated by heating them over a gas flame until the glass runs. After this process has been gone through, the carbon filament should be detached, leaving both of the platinum wires exposed to the action of the electrolyte.

If the reader wishes to construct a single interrupter to experiment with, the lamp bulb, after having been detached, should be mounted in a regular lamp receptacle and attached to a wooden base with binding posts protruding for connection. A strip of sheet lead, ½ inch in width and about 6 inches in length, is bent in the shape shown in Figure 1 and hung over the top edge. The electrolyte, which is made of one part of sulphuric acid to ten parts of water, should come within ½ inch of the top. One good method for making the preliminary adjustment is to partly fill the bulb with water and add acid to the water until the desired volume of spark is obtained at the spark gap. Care should be taken to connect the positive wire to the platinum electrodes at the base of the bulb. Either of these may be used, depending upon the amount of current required for the operation of the induction coil.

Owing to the fact that quite a bit of heat is given off when this interrupter is in continuous use, the bulb had best be placed in a jar or container, surrounded by water for cooling purposes, but care should be taken that the water level does not exceed the top of the bulb, otherwise the action of the interrupter will be destroyed.

I find that the better arrangement is to construct several water-cooled interrupters and use them alternately so that when one heats up the other is thrown into the circuit. An arrangement of this kind is shown in Figure 2. Here the interrupters are grouped in an oblong tank of water, but they could be grouped on a circular base and lowered into a battery jar as well. Two insulated leads are brought from each receptacle and connected to a switch whose contact arm is broad enough to bridge two contact points.

The lead strips are mounted on a paraffine coated piece of wood and connected in parallel. For lower values of power the switch is placed on the first contact, thus using but one bulb, but by moving the switch to bridge the first two contacts, two electrodes are in use. If still greater power is desired, two interrupters may be connected in parallel, but I have found that when a single interrupter with two electrodes 1/8 of an inch in

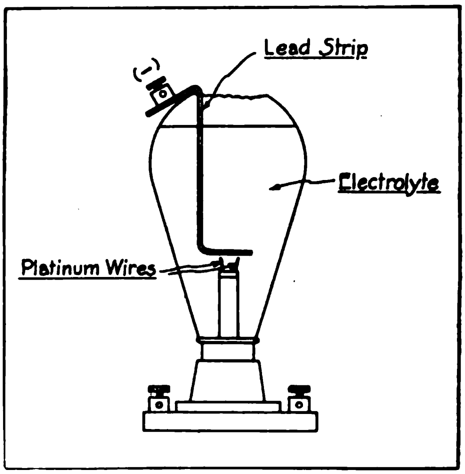


Figure 1, Fourth Prize Article

length is connected in parallel, the current consumption of a small coil is 6 amperes at 110 volts.

The second interrupter shown in Figure 2 is an auxiliary and the third one has its platinum wires shortened to give a spark note of a different pitch.

The tone of the spark increases as the amount of the platinum exposed to the electrolyte diminishes and the note also depends, to a certain extent, on the concentration of the electrolyte. The adjustable resistance indicated in the drawing aids considerably in obtaining a pleasing spark note.

It is a well-known fact that two electrolytic interrupters connected in series practically double the spark length of a given coil. If this experiment is tried the two solutions should, of course, be of the same concentration and the same size electrodes should be employed.

When the apparatus is arranged, as in Figure 2, the operator can, while sending, vary the tone of the spark, change the amount of power, or change from one interrupter to another without interruption of transmission. This interrupter can also be employed for use in connection with alternating current, but the results obtained are inferior to those possible with a direct current source of supply.

A. F. Murray, *Massachusetts.*

HONORARY MENTION

The Work of the Amateurs in the West

Judging from the scarcity of articles on the subject, the wireless situation in the Pacific Northwest is a rather hazy affair to your readers in the East and Middle West. Therefore I trust that a few words on this subject will not be out of place.

I have had a wireless station in Seattle for the last three years and it was certainly a revelation to me to find the interest displayed by amateurs throughout this section. I have owned and operated several amateur stations for the last seven years, three of which were spent in the state of New Jersey, but I have never noticed such a remarkable growth of amateur stations in so short a period as in this district.

During the winter of 1913 I spent six evenings a week at my apparatus continuously for a period of three months and my log book shows an average of three new stations opening per week. Of course, many of these were of the kind that work a few nights signing any call letter which came easy, but it showed a desire on the part of many to break in with the "7" fellows. At present however, we seldom hear an amateur sign anything but an occasional "7-?" which shows the willingness to obtain a license and obey the law.

As to the commercial end of the game, we are also pretty well advanced. Eighteen miles from Seattle is the Bremerton Navy Yard station with a 5-kw. set. The call letters are NPC. Then at the head of the Straight of Juan de Fuga is the government station, located on Tatoosh Island (call letters NPD), approximately

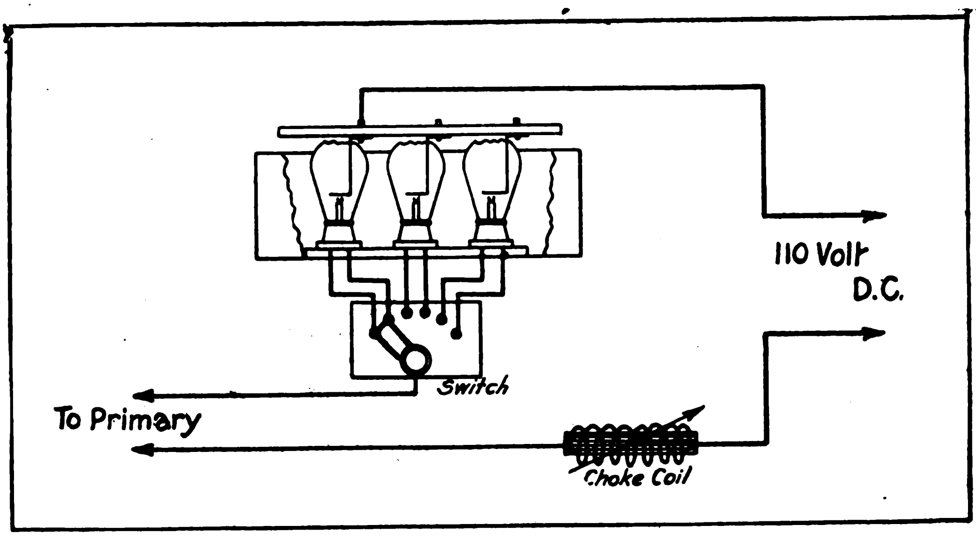


Figure 2, Fourth Prize Article

110 miles distant. There is another station located at North Head at practically the same distance, its call letters being NPE.

We also have the Marconi station in the forty-two story L. C. Smith Building at Seattle, which is fitted with a 1-k. w. and a 5-k. w. set, while Astoria, Ore., has a high-power Marconi station located practically 300 miles southwest of this point.

Seattle also has two factories manufacturing wireless telegraph apparatus and the Y. M. C. A. conducts a school with complete Marconi equipment.

The radio inspector for the Seventh District has his headquarters in Seattle and there are numerous steamships equipped with radio, sailing and docking every day. The conditions for employment are also very good and none of the graduates of the Marconi school have had trouble in obtaining positions.

As for distance work, there are several amateurs in this vicinity who think nothing of picking up the radio stations more than 2,000 miles away, while the reception of signals from San Francisco is a regular occurrence.

One station here has repeatedly copied OUI (Hanover, Germany), Colon, Panama and other far distant stations.

With all these facts before us, it will readily be seen that the western part of the United States is quite as up-to-date as the eastern part.

Howard S. Pyle, *Washington.*

UNSOLICITED BUT WELCOME

I have found the Monthly Service Bulletin (of the National Amateur Wireless Association), of great value in locating new stations.

Many weeks ago my N. A. W. A. equipment arrived. I had hoped to write you sooner about it, but I can truthfully borrow this remark: "I started in reading immediately and have been reading more or less ever since." Indeed, I am not only very much pleased with, but also very proud of the equipment to say nothing of being a charter member of the N. A. W. A.

Ian Campbell, *Oregon.*

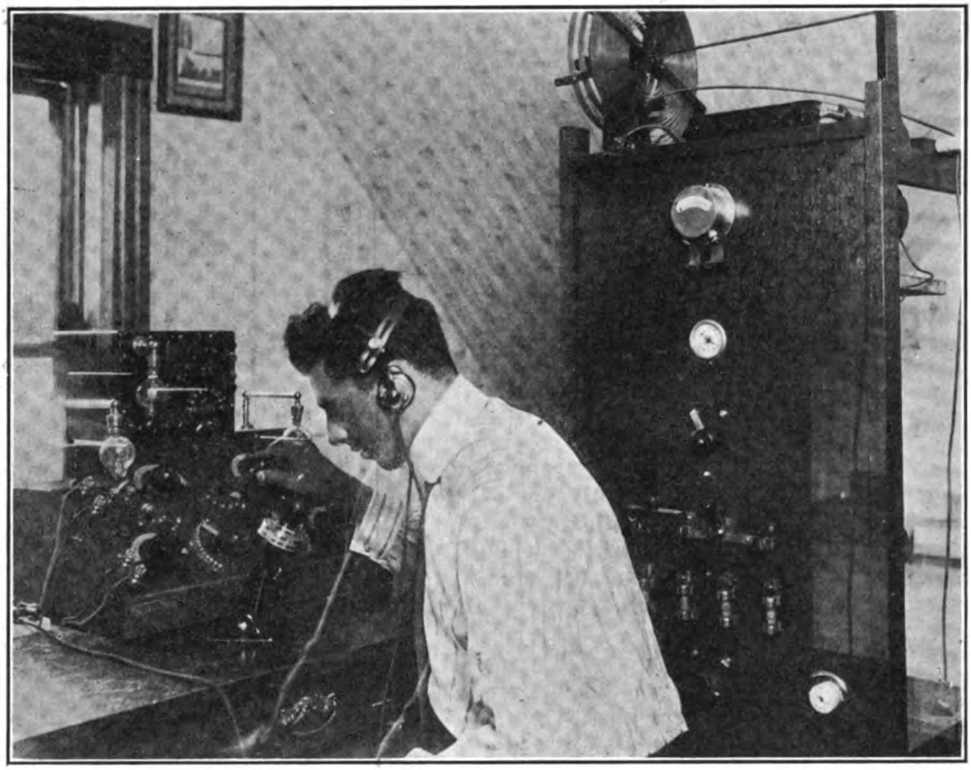
The N. A. W. A. is just the thing.

Vergil Sullivan, *Illinois.*

The organization (The National Amateur Wireless Associatiton) is splendid and every amateur should be a member.

Fred. Swain, *Nebraska.*

With the Amateurs



Clarence D. Tuska, of Hartford, Conn., who is interested in wireless telephony. By making his victrola a part of his transmitter circuit he has been giving wireless concerts for the benefit of amateurs in and about Hartford. This photograph shows Mr. Tuska at his telephone

The Baltimore Radio Association has been formed, its membership being limited to those sixteen years old or more who hold a first-class amateur operator's license. Meetings are held every other Saturday night at the rooms of the Southern Wireless Institute, 22 St. Paul Street. The officers are: President, D. L. Primrose; vice-president, E. B. Duvall; secretary, C. E. King; treasurer, R. M. Hart; board of governors, N. B. Falconer, William Bernhard, J. Holloway and C. R. Lamdin. A Relay Committee is developing trunk lines with the West, North and South.

The meetings are devoted to discussions and lectures. At a recent meeting, O. H. Curtis, senior operator on the steamship Kershaw, lectured on the reception and recording of wireless waves through a mineral detector by means of the "Ionic Relay," an invention of his own. This instrument was demonstrated as a call bell and also reported time and weather from NAA on a recorder. The Association has been granted a charter by the National Amateur Wireless Association.

A debate was conducted by the San Francisco Radio Club at its club room, 350 Frederick Street, on the evening of November 25. The subject of the debate was: "Resolved, The Audion Is Superior To The Crystal Detector."

D. B. McGown was the chairman of the affirmative side, with E. W. Radford, and H. R. Lee as speakers. P. R. Fenner upheld the negative side with S. S. Foster and H. C. Brown as speakers.

Excellent arguments were presented by the negative side but the decision was awarded to the affirmative side by the judges, Sergeant T. J. Ryan, W. M. Griffith and E. G. Mahn.

A paper on Motor Fields was read by C. P. Altland of the Pacific Gas and Electric Company. The club room was filled to capacity, almost 100 radio enthusiasts being present.

The radio exhibit at the Kansas Electrical Show at Wichita on December 6, 7 and 8, attracted considerable attention. The exhibit was in charge of The Cosradio Company of Wichita. A complete sending and receiving station was in operation, the receiving set being arranged for both damped and undamped waves. Messages were received and read to patrons of the Electrical Show.

A wireless club made up of students of the Phillips Academy, Andover, Mass., has been formed. The Club has installed a 1-k.w. transmitting set and a vacuum valve receiving set is under construction.

The Radio Association of Western New York has elected these officers: President, John G. Rieger; secretary, Edgar C. Steel; board of supervisors, Herbert I. Goodale, John Haderer and Norman Badina. The Club name has been changed from Radio Association of Buffalo to Radio Association of Western New York, owning to the large out-of-town membership. A review of the year's work was given by the retiring president, Albert J. Carver, who predicted a still more prosperous new year. The Club expects in a short time to have apparatus and rooms of its own.

The Radio Club of Tacoma has been formed with the following officers: President, Howard Reikhardt; vice-president, Dwight Mason; secretary, Edwin Moe; treasurer, Alvin Stenso.

Business meetings are held every Thursday evening at eight o'clock. The Club would like to hear from amateurs and any relay message will be handled. Address all communications to the secretary, Edwin Moe, 4118 No. 16th Street,, Tacoma, Wash.

The Fowler Radio Club of Cleveland, O., recently elected the following officers:

President, John Sokutis; vice-president, Edward Werner; chief advisor, Charles H. Bell; secretary and treasurer, Frederick R. Franklin; chief operator, Carl F. Paul.

The Club is carrying on a campaign to obtain more members. There are 420 wireless amateurs in Cleveland, but only a part of these are licensed. An attempt is being made to get in touch with these amateurs.

A meeting of the Union County Radio Association was held recently at the home of Warren J. Mayer, 157 Elm Street, Elizabeth, N. J. The election of officers for 1917 resulted as follows: President, Frank Broome; vice-president, Carl Mueller; secretary, Elson Timbrook; recording secretary, Warren J. Mayer; treasurer, Earl Adams; press agent, Willis Allin; chief operator, Robert Horning; assistant operator, in Elizabeth, Warren Mayer; assistant operator, in Roselle, Harry Sutton. The next meeting was scheduled to be held at the home of Harry Sutton, in Roselle Park.

A radio club formed in Newark, N. J., under the leadership of Milton Dryfus, is known as the Essex Radio Club. New members are wanted, it has been announced. Prospective members should communicate with the corresponding secretary, G. Taub, 482 Twelfth Avenue, Newark, N. J.

At a meeting of the wireless club of Bayonne, N. J., the election of officers was held. Louis Macchi was elected president; George Oliver, vice-president; Ernest Ruhlmann, secretary-treasurer, and Paul Gallien, press agent.

At a meeting of the St. Paul's Amateur Radio Association of Rochester, N. Y., it was decided to send out the weather report every night at half past ten o'clock. The report will be received from Arlington, Va., and sent out for the benefit of amateurs unable to receive from stations as far away as Arlington. Only the high-power stations of the Club will send out the report. They are: 8-RL, 8-AQK, 8-VUBF.

Plans are being made to relay a message from Rochester to Scranton, Pa.

The new officers of the Club are: President, F. Alexander; vice-president and treasurer, R. VanDeCarr; secretary, A. Frankel; chief operator, William Kane. The chairmen of committees are: Membership, C. Oliver; purchasing, G. Whitley; finances, C. Swanton; publicity, E. L. Alexander. Communications should be addressed to A. Frankel, No. 289 Barrington Street.

A wireless club has been formed at the University of Kentucky. The officers are: President, Horace Miller Clay of Louisville; secretary, Thompson Guthrie of Mt. Sterling; treasurer, John Campbell.

Apparatus for the wireless station will be furnished by the College of Mechanical and Electrical Engineering. Students in the College of Mechanical and Electrical Engineering will become members of the Club.

The Rockaway and Queens (L. I.) Wireles Association has organized with fifteen members. The officers are: President, H. Conway; vice-president, Seth Kelley; secretary, William Fisk; treasurer, A. Gay.

The Hoosier-Scout Radio Club, Indianapolis, Ind., has been reorganized, incorporating into the old Hoosier Radio Club the Scout Radio Club.

The club meets every Saturday night in the Chamber of Commerce building. The officers are: President, Noble C. Hilgenberg; vice-president, Fred Finehout; secretary, Carl Dean, and treasurer, James M. Sommer.

The following is a list of the members of the Club: Verne K. Reeder, Laurence Neidlinger, Marcel Pittes, Edward Talbot, Clinton Hanna, Fred Finehout, Hans F. Geiger, Leo J. Munchof, Wert O'Donnell, Fred Meyer, Meada Cringle, Preston Sargent, Earl Swain, Paul Huston, James M. Sommer, Frank M. Malott, Russell Tilton, Theodore Carnes, Alban Adams, Harold Barton, Harold E. Day, Edward Churchman, C. W. Dean, J. B. Baker, F. F. Hamilton, R. H. Vehling, Raymond Forbes, Myron Newlin, Albert Copenhaver, Ralph Johnson, M. Pettit, N. Hilgenberg, John Taylor, W. Brown, M. Belzer, James F. Sargent, Hilton Crouch, Melville F. Strebe, Samuel Dinnen, Clifford Burwine, Walter Honecker, Evans E. Plummer, William J. Koethe and Eugene Clark.

The Marlboro (Mass.) Radio Club has established permanent quarters in Manning Street. The Club has installed a set in its new home.

Waterbury, N. Y., has a wireless club. The meetings are held every Friday evening at eight o'clock in the Boys' club. E. F. Glavin is the honorary president of the organization; Robert W. Culbert, chairman, and Clinton A. Finch, secretary and treasurer. King Sam, a Chinese operator, is in charge of the press work.

The Club has a modern amateur set consisting of the following: 1-k.w. Thordarson rotary gap, oscillation transformer, condenser, hot-wire ammeter, wave-meter and heavy key. The receiving set is made up of perikon and galena detectors, large coupler, two variables load, and necessary switches; a vacuum valve detector is used in conjunction with a larger coupler for long distance work. The Club call is 1-ABF.

The wireless enthusiasts of Martinsburg, W. Va., met recently and formed what in the future will be known as the Eastern Panhandle Radio Association of West Virginia. The work of the Association will be the advancement of wireless telegraphy. There are now four stations in this city and three in course of construction, with a few more to be added after the holidays.

The two largest stations are owned by W. W. Trout, and H. E. Burns, who holds a government license.

The station installed by Dr. L. K. Rossa and C. A. Allen has a sending radius of twenty miles or more with a receiving range of 300 to 1,500 miles.

The following officers were elected:

President, H. E. Burns, call 8-AGH; vice-president, Roy Frankenberry; treasurer, Hunter Matthews; secretary, Dr. L. K. Rossa.

The Radio Club of New Britain, Conn., which was organized two years ago, holds its meetings regularly at the New Britain, Conn., Y. M. C. A., every Tuesday evening. The Club has a 1-kw. set for sending purposes. For receiving it has a 4,000-meter loose coupler and two vacuum valves which are operated by storage batteries. It also has six pairs of 2,000 ohm phones. The Club has no official call, but has adopted the letters MO.

Walter J. Doyle, vice-president of the Radio Club of New Britain, Conn.

A recent radio display in New Britain held to further the interest in the work of the Club included a replica of Marconi's first set, which sent the first message across the Atlantic; old and modern receivers, transformers, coils, detectors, sending keys and many other parts of apparatus constituting a modern wireless set. Most of the members of the Club are members of various wireless associations and nearly all hold government licenses. The officers of the Club follow: President, Francis A. Mulvihill; vice-president, Walter J. Doyle; secretary and treasurer, George E. McCarthy.

The Club would be pleased to hear from radio organizations and will arrange for tests with them if desirable. Information concerning the Club can be obtained by writing to the vice-president, Walter J. Doyle, 29 Washington Street, New Britain, Conn., or George E. McCarthy, secretary, Belden Street, New Britain, Conn.

At the first meeting of the Y. M. C. A. Boys' Department Club of Lynn, Mass., seventeen charter members were present. The meeting was in charge of Leland L. Stacy, who was assisted by William Bailey of Lowell Textile school.

The following were chosen as officers: President, Clayton Thompson; vice-president, Paul Bauer; secretary, Leonard Folsom; assistant secretary, Harold Hunter; treasurer, Leland Stacy.

It was decided to hold regular classes in mastering the continental code. The dues were also decided upon. The meetings will be held every Tuesday evening at fifteen minutes to eight o'clock.

The following are enrolled as charter members: Albert Allen, Arnold Bailey, William Bailey, Paul Bauer, Vernon Chase, Leo Comtois, Horace Cormack, Harold Fall, Leonard Folsom, Irving Harlow, Harold Hunter, Harold Johnson, Owen Kasparlan, Frank Lindley, Kenneth Miller, Donald Moss, Willis Quimby and Clayton Thompson.

Presidential election bulletins by wireless attracted considerable attention in Bellevue, Pa., on Election Day.

Walter Protzman of 426 Forest Avenue, Bellevue, and Robert Devinney, of 1224 Boyle Street, North Side, members of the Aero Club of Bellevue, installed wireless apparatus on top of the old Episcopal church, at Rogers and Lincoln Avenues and received election bulletins from a New York newspaper and other news sources. The bulletins were shown to a crowd outside the church. The boys were assisted by one of the wireless operators of the U. S. S. Tennessee, who was home on leave of absence.

The World's News Distributed by Wireless

How the Events of the Day Are Flashed to Ocean Travelers by the Marconi Company

ALL ocean travellers know this morning that Greece has accepted the ultimatum of the Allies demanding the surrender of arms and ammunition, that Mr. Lloyd George is improving, that Francisco Villa promises to cease depredations on American property, and that snow covers New York, said the New York Herald of December 15. In short, they know briefly of the same world events that the reader of this morning's Herald has gleaned.

Last night the New York Herald service was flashed to all ships at sea by the Marconi Wireless Telegraph Company under a new arrangement. So, whether the traveller is sunning himself on board the Maracaibo, which left Puerto Rico yesterday and is this morning wending her way through tropical seas, or on board the Oscar II., which is just about nosing into the ice fields hundreds of miles off the Banks, he is just as much informed on world events as the Long Island communter or the bank clerk who travels downtown in the subway.

This news will be literally scattered "to the four winds" from the high powei Marconi station at South Wellfleet, Mass. It was picked up last night by all vessels equipped with Marconi wireless. Last night's news was published this morning in the Marconi bulletins on board the passenger steamships and the service will hereafter be published daily.

Although necessarily in an abbreviated form the news sent out covers a wide variety of interesting topics. To travellers about the world world topics would seem to be the most interesting, but the steamship passengers will also be informed of a fire in Broadway if the interest justifies it.

The first news sent last night was of the weather—always interesting to any traveller. Other items were:

London.—Greece accepted Allies' ultimatum demanding surrender arms, control telegraph and postal systems by allied officials and the guarantee of Grecian neutrality. This acceptance followed a meeting of the Cabinet and Crown Council, King Constantine presiding.

Premier Lloyd George is improving. His physician said his condition indicated he would be able to speak in the House of Commons on Tuesday.

Count Tarnow Tarnowski, Austro-Hungarian Ambassador designated to Washington, has been granted a safe conduct by the Allies at the request of the United States government.

Berlin.—Teutonic forces in Roumania captured Buzen, seventy miles northeast of Bucharest, the last important railroad junction held by the Roumanians in Wallachia.

Washington.—President Wilson and Secretary of State Lansing conferred on course to be followed in reference to peace proposals by Germany. Officials expect President to seek opportunity at early date to participate in peace negotiations.

New York City.—First real snowstorm of the season. Almost foot of snow; trolley lines blocked and steamships delayed.

Halifax.—Torpedo boat Grilse, reported lost, has arrived at Shelburn, N. S. All officers and crew safe except six lost in storm.

Chicago.—Wheat dropped nine cents when news was received that Germany was willing to consider proposals to limit armament.

Then followed long quotations of the closing prices in Wall street.

This and other news was on board the steamships last night by midnight, and many of the Marconi men flashed back "Thanks." The wireless apparatus seemed to be a sort of electric newsboy 'way out in the Atlantic, between four hundred and seven hundred miles east of Sandy Hook, where there was a "flock" of steamships around the time the news was flashed.

The New York, of the American Line, due Sunday morning and about 500 miles east of the Hook, got the word, as did the Cameronia, of the Anchor line, 200 miles behind the New York. The passengers on board the Noordam, of the Holland-America line, are reading it this morning, about 400 miles east of Sandy Hook, as are those on board the Adriatic, 500 miles away. The Caracas, of the Red D line, 145 miles north of Curacao, got the word, and the passengers on the Morro Castle, of the Ward line, off the Florida coast, know that there is snow waiting for them in New York city. Even the Californian, a freighter, 730 miles southeast of Cape Henry, bound from Rio Janiero to New York, got the word and was grateful.

The news sent out by the South Wellfleet station may also be sent out on a lower wave-length, reaching many of the coastwise vessels, such as those of the Old Dominion, Savannah and Morgan lines.

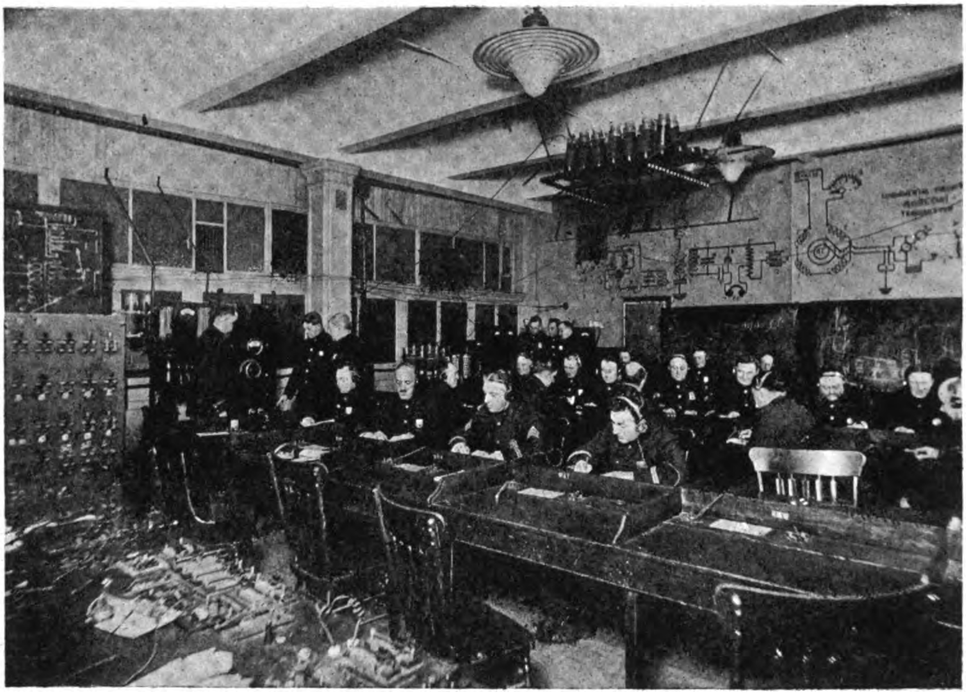
A similar service was established on January 17 to distribute news to ships on the Pacific. The dispatches are transmitted from the Herald office by land line to the Marconi station at Hillcrest, San Francisco. Along the trade routes to Honolulu, down the steamship lanes to Australia, along the watery highways that skirt the Pacific coast, on board mail packet and coaster, to Coast Guard cutter and cruiser, to bulky freighter and graceful yacht, the news goes flashing in the early hours, through the agency of the Marconi station. Relayed by those who picked it up to others less fortunate, the service is scattered along the Pacific, in ever widening circles, until its echoes reach across the ocean depths.

Some of the big vessels that received the news on the day the service was opened were the Great Northern, of the Great Northern Pacific line, which left Honolulu January 15; the Northern Pacific of the same line; the Hawaii Maru, of the Osaka Shosen Kaisha, from Hong Kong, Kobe and Yokohama, bound for Victoria, B. C.; the Venezuela, of the Pacific Mail line, which steamed from San Francisco for Honolulu, Yokohama and Hong Kong, and the great fleet of coastwise steamships plying on the California, Oregon, Washington and Alaska coast and to Puget Sound ports.

In addition the long chain of United States army wireless stations along the Alaskan coasts picked up the news and flashed it from one to the other, so that army officers in their lonely posts at snowbound stations read the news of Admiral Dewey's death at the same time as did naval officers on board cruisers on Pacific stations.

Members of the New Haven, Conn., Radio Club have erected a two-strand aerial, 450 feet long reaching from the Hotel Taft to the Y. M. C. A. building. Six members of the Club have successfully applied for licenses as wireless operators and there is a total membership of twenty-five.

The wireless station at St. Elizabeth's Convent, Convent Station, in northern New Jersey, has a radius of 3,000 miles. The plant was presented to the college by friends as a memorial to Sister Mary Frederica McElligott, a teacher for twenty-four years at St. Bridget's Parochial School, Newark. The station was installed under the supervision of Professor Perley Hyde, of the department of physics of Newark Academy, and the funds for the memorial were raised through the efforts of Chief of Police Michael T. Long, of Newark, and others.



The wireless class of the New York Police Department

Police Test of Wireless

Flashing a Message from Headquarters, New York, to the Various Precincts

TESTS of wireless telegraphy as a practical means of communication for use in the New York City Police Department were made on December 11, 12 and 14. The results of the demonstration showed that excellent speed was made in obtaining answers to the test message sent from Police Headquarters, notwithstanding the fact that in many instances the station houses were a considerable distance from the wireless equipments in the precincts. Members of the class in wireless instruction in the Police Department, which is in charge of Sergeant Charles E. Pearce, served as operators at the different stations employed in the demonstration.

The test message was transmitted from the station on the Police Headquarters building to the commanders of the various precincts in Manhattan, Brooklyn, the Bronx, Richmond and Queens. The communication follows:

Deliver to bearer forthwith for transmission by wireless to Police Headquarters, Manhattan, the names and shield numbers of six patrolmen now on patrol in your precinct.

Commanding Officer.

This message was flashed to the amateur and commercial stations which had been designated for use in the test. Here it was copied and placed in the hands of policemen who conveyed it to the commander of the precinct to which it was addressed. The replies to this communication were rushed to the different wireless stations and wirelessed back to Police Headquarters. A gratifying result of the test was found in the lack of inaccuracy in sending and receiving.

Marconi apparatus played an important part in the trial. The Marconi School of Instruction forwarded the first message from Headquarters and also acted as relay.

Besides the installation at Police Headquarters the following stations were employed:

		Call Letters
	MANHATTAN	
Marconi School,	Elm and Duane Street	2-XR
Wanamaker Store,	Broadway and Ninth Street	WHI
Y. M. C. A.,	153 East Eighty-sixth Street	2-YM
W. H. Reuman,	480 Ninth Avenue	2-RB
	BROOKLYN	
Marconi Co.,	Seagate Station	WSE
David Fozetti,	7421 Narrows Avenue	2-WB
Y. M. C. A.	Broadway and Marcy Avenue	2-AV
	BRONX	
A. R. Boeder,	3430 Duncomb Avenue	2-JD
W. H. Richardson,	Westchester and Bergen Avenues	2-AIO
	RICHMOND	
A. F. Pendelton,	New Brighton, S. I.	2-PH
	QUEENS	
Justus J. Agnoli,	16 Purvis Street, Long Island City	2-VQ
A. H. Grede,	10 Van Wyck Avenue, Jamaica	2-ZV

Interest in wireless in the Police Department has been considerable since the class in wireless was organized on May 29, 1916. Sixty members of the Department now hold first grade licenses. Their names follow:

Lieutenant Altenback, Lieutenant Van Keuren, Lieutenant Quackenbos; Sergeant Kahl, Sergeant Pearce, Sergeant Vosburgh; Patrolman Black, Patrolman Driscoll, Patrolman Ferrick, Patrolman Gaffney, Patrolman Gaul, Patrolman Hanley, Patrolman Hughes, Patrolman Jewett, Patrolman Kepko, Patrolman Lovett, Patrolman Madden, Patrolman Mahoney, Patrolman Moroney, Patrolman Murphy, Patrolman McKee, Patrolman Northrop, Patrolman Ray, Patrolman Seymour, Patrolman Schwartz, Patrolman Upham, Patrolman Valentine, Patrolman James J. Ward, Patrolman John F. Ward, and Patrolman Wolf.

Ship Afire in Mid-Pacific

Marconi Operator W. C. Thompson of the steamship Standard Arrow, while in mid-Pacific, bound from the Orient for San Francisco, picked up distress calls flashed by the Japanese steamship Tsushima Manu at eleven o'clock in the morning on January 3. The Japanese vessel, which was also bound from the Orient for San Francisco, reported that the ship was afire and in need of immediate assistance. The Standard Arrow was at that time apprpximately 180 miles away and she immediately headed for the distressed craft, and stood by her until the flames were under control.

Girl Operators in Commerical Field

The English Marconi Company has initiated the plan of training girls with the object of employing them as wireless operators, this action being due to the fact that its operating staff has been reduced to a minimum and its traffic is constantly increasing. A training school was established and a course of instruction lasting about eight months was introduced. The curriculum included slip reading, punching, record reading, sending on long land lines and the general work of a wireless operator.

The Coast Guards' Wireless Achievements

INTERESTING illustrations of the manner in which wireless is used in the United States Coast Guard service are contained in the annual report, just issued, of that branch of the Government for the fiscal year ended June 30, 1916. It tells of how the art was employed to convey information that poachers were violating the sealing laws in the Far North; of the invoking of the aid of revenue cutters for ships in distress; of the use of radio on a cruise in search of derelicts, and of the summoning of medical and surgical aid by aerial messenger.

H. G. Hamlet, commanding the cutter Unalga, reported that during the voyage of that vessel to Unalaska, in the Behring Sea, a wireless message from the deputy collector of customs at that island, summoned the cutter to Lost Harbor, Ankun Island. "The cutter proceeded to Lost Harbor," says the report of the commander of the Unalga, "where the American codfishing schooner Maweena of San Francisco was boarded and examined and mendical treatment afforded two members of her crew."

When the cutter arrived at St. Paul Island, relates the report, Surgeon Keating went ashore, in accordance with an arrangement previously made by wireless, and assisted in an operation upon a native woman. After the Unalga had left St. Paul Island and was on her way to Unimak Pass to take up the patrol she stopped and took on board from the American ship Bohemia, a fisherman who had been adrift in a dory for ten days. The fisherman, who was suffering from cold and exposure, was placed in charge of the surgeon on the cutter and the incident was "reported to headquarters by radiogram as a matter of human interest."

The next afternoon a wireless message was received from the master of the American sailing ship W. B. Flint saying that near Cape Lutke he had seen the sailing ship Star of Zealand standing inshore and he feared she was in danger as he had not seen her since. Investigation by the cutter, however, proved that the Zealand was in no danger.

No incidents of note marked the cruise of the Unalga until five days later when the following wireless message was received from the deputy collector of customs and United States Commissioner at Unalaska:

"Polar Bear arrived with six shipwrecked Japs that were picked up on Nunivak Island, unable to learn details, no interpreter. When will you be here?"

Captain Hamlet wirelessed that he expected to arrive at Unalaska in nine days and "will go there at once if you need our interpreter before that. Suggest careful inquiry . . . regarding conditions . . . found on schooner wrecked at Nunivak with view to cutter visiting the scene if circumstances warrant."

In this manner was the transaction of official business facilitated by wireless.

The Unalga was about eighty miles from Attu when the following wireless message from Governor Fassett at St. Paul Island was received:

" . . . continuing irregular intervals . . . occasional reports firearms have been heard close St. Paul Island. Weather thick and sea quiet. Nothing seen, but (sealing) poachers believed vicinity."

In response to this message the following was flashed:

"Message regarding supposed poachers acknowledged. Will touch at Attu to land mail and then proceed Pribilofs direct. Keep me advised."

Additional information regarding the supposed poachers continued to reach the cutter by means of wireless from Governor Fassett. One message read:

"Shooting off Northeast Point and English Bay continues with increasing frequency. Strangers recently landed Zapadni and seal harems disturbed.

Have doubled guards Northeast Point and Zapadni. Weather continues thick and nothing seen. . . . Two vessels believed off island. St. George reports nothing seen or heard."

In view of the probability that a modern seal raider would be equipped with a receiving wireless set with which to ascertain the movements of vessels of the Coast Guard, the following message was sent by Captain Hamlet in radio code to the St. Paul station:

"Inform agent advisable to code all messages to me relative vessels vicinity your station."

The cutter arrived at St. Paul Island three days later and an officer was sent to shore with instructions to have the agent come to the landing to deliver a letter arranging for ruse messages if they should be found necessary. The Unalga then left St. Paul and cruised about for several days, but no further developments occurred in the case of the poachers.

The cutter Tampa had been away from Key West, Fla., only a few days, bound on a cruise in search of derelicts, when she received a Marconi wireless from the steamer Alabama that the latter had just passed a dangerous obstruction to navigation in the shape of a dismasted waterlogged hulk. The cutter immediately steamed toward the reported position of the derelict which was eventually sighted and towed to port.

Another instance of the humanitarian use to which the wireless is put by the Coast Guard service developed when the cutter Ossipee, on a winter cruise, received a wireless to the effect that a schooner was at anchor in a dangerous position off the Hunniwells Beach Coast Guard station, Me., and was flying a signal of distress. Within an hour the Ossipee was near the schooner, the Irene Meservey, and the latter was towed into Boothbay Harbor.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names of Ships	Owners	Call Letters
M. S. Pennant	Pierce Navigation Co.	KME
Tito Speri	Italian State Railways.	(Not assigned)
Tug Paul Jones	James W. Elwell & Co.	KVU
Carl D. Bradley	Bradley Transportation Co.	WGN
W. F. White	Limestone Transportation Co.	WGC
Vigo	Transoceanic Steamship Corporation	KMC
Eagle	Standard Transportation Co.	KIR
Tiger	Standard Transportation Co.	KIT
S. Y. Nokomis	H. E. Dodge.	(Not assigned)
Ranenfjord		(Not assigned)
M. S. Selene		(Not assigned)
s. s. Rijswijk		PIT

DIVIDEND DECLARED

The Marconi Wireless Company, Ltd., has declared a dividend of seven per cent on the preferred stock and five per cent interim dividend on the ordinary stock. The Marconi International Marine Communication Company has declared a five per cent interim dividend.

The Auckland wireless station, which has been closed since May, 1915, has been re-opened.

MARCONI ON WILSON'S PEACE NOTE

Guglielmo Marconi, is quoted as follows regarding President Wilson's peace note regarding which there has been so much discussion:

"I sympathize with the attitude of the President. I understand the feelings of the American people, but I think the Central Empires should be the first to make definite proposals. Thus far they have not done so."

AMERICAN MARCONI EQUIPMENT BEST IN WORLD, SAYS CHIEF RADIO INSPECTOR

Interesting sidelights on shipping conditions and a high tribute to the supremacy of American wireless apparatus, are among the distinctive features of the annual report of the Chief Radio Inspector at New York. The following extracts from this document appear in the report of the Commissioner of Navigation:

"The European war has changed to a great extent the character of the vessels entering this port. Practically all of the great liners formerly making trips here have been taken from their routes by their controlling governments for various purposes. A considerable number of them have been lost during the war. Most of these vessels were of a class which brought them under the radio laws. In their place ships have been substituted which formerly ran to less important ports and in less important trade. It so happens that the monthly record of vessells coming under the radio laws has been started only since the commencement of the European war, so that it is hard to tell exactly what effect the war has had on the work of the Radio Service—that is, whether the large number of small boats require more supervision than under normal conditions with the great liners entering into this port where one vessel would carry as much cargo as several of the present class. I am of the opinion that the number of sailings of vessels coming under the radio laws is considerably less than in normal times. However, the poor radio equipment found on the small tramp steamers that now come in and the unfamiliarity of the owners and officers of these vessels with our radio laws necessitate as much work on the part of the Radio Service as the larger number of vessels which would come here in normal times.

"Several vessels came into this port for the first time and were entirely unequipped with the necessary apparatus to enable them to comply with the law, but immediately installed the required equipment upon notification. In cases where the Radio Service was assured that this would be attended to no other notice was left for the master, but the case was followed up and the ship inspected before her departure after being equipped.

"The record also shows an increase in the number of amateur station licenses, but this really represents more clerical work accomplished rather than any technical radio work in connection with these stations, as it is regularly reported to you the radio service in this office as now constituted is absolutely unable to give any effective attention to the amateur stations.

"There has been a vast improvement in equipment on American vessels leaving this port. The Marconi company during the past fiscal year has installed 189 new equipments. Owing to the patent situation there have been very few installations in this district by other companies, but the standard of maintenance and operators has been constantly improved as the shipping companies have become accustomed to higher-grade equipment, so that the situation may be summed up by stating that the radio equipments installed on American vessels now represent a higher and later development of the radio art than those of any other nation trading into this port at this time."

THE SHARE MARKET

New York, January 12.

Bid and asked quotations in Marconi shares today:

American, 2⅞-3⅛; Canadian, 1¾-2¼; English, Common, 12-16; English, preferred, 10-14.

BOSTON WOMEN WANT COMMERCIAL LICENSES

Three Boston women have passed the examination for amateur first grade licenses and are aiming to secure commercial licenses. Miss Charlotte Bayliss, of Commonwealth Avenue, Miss Edith Sigourney of Beacon Street, both Vincent Club members, and Miss Ruth Morton of Arlington are the young women who have obtained the amateur licenses.

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.

G. L. W., Jr., Schenectady, N. Y.:

It makes no difference whether the primary and secondary of an inductively-coupled oscillation transformer are wound in the opposite or in the same direction. There would, however, be a different effect if these two windings were connected in series, because with one connection they would be mutually inductive and with the opposite connection in opposition.

* * *

J. B. Q., New Orleans, La.:

Answers to all questions concerning the natural wave-lengths of four-wire aerials of various dimensions can be obtained by examining the set of curves appearing in the November, 1916, issue of The Wireless Age.

* * *

S. W. Y., Montclair, N. J., writes:

Ques.—(1) Is there any advantage in spacing the wires of an aerial more than four feet?

Ans.—(1) No advantage is derived in further spacing except in cases where the length of the flat top portion of the antenna is limited. Take, for example, an aerial where the length of the flat top portion is no more than 30 or 40 feet. In this case, in order to increase the capacity of the antenna, it may be of value to spread the wires just as far as possible.

* * *

A. X. G. inquires:

Ques.—(1) Which is preferable, a potentiometer made of carbon resistance rods or one of German silver wires?

Ans.—(1) Provided the necessary fineness of adjustment can be obtained, equal results will be secured from either type.

* * *

D. J. R., Hackensack, N. J., inquires:

Ques.—(1) What becomes of a graduate after he has finished his course of instruction in the Marconi School of Instruction?

Ans.—(1) He is assigned as a junior operator in the marine service of the Marconi Company.

Ques.—(2) Can a graduate select the ship to which he is assigned?

Ans.—(2) This matter is left to the discretion of the superintendent of the particular division in which he is employed. Ordinarily operators are required to take an assignment on any ship to which they may be ordered.

* * *

E. M. W., Auburn, N. Y.:

With the sensitive types of receiving apparatus now in use, such as the regenerative vacuum valve and multi-step amplifiers, it has been found possible to load aerials with a natural wave-length of even 300 meters, up to 10,000 and 15,000 meters, with fair results. Of course, stronger signals are obtained with larger aerials, but experiments reveal that there is no particular advantage, even when receiving waves of 10,000 meters, in making the flat top portion more than 3,000 feet in length.

The actual value of capacity of a variable condenser, connected in shunt to a secondary winding depends upon the type of receiving detector in use. Such detectors as the tikker, the Goldschmidt tone wheel, etc., can have large values of capacity in shunt to the secondary winding, but the average crystal detector and the vacuum valve require exceedingly small values of capacity at this point, not over .0002 microfarad.

Full information concerning the Marconi School of Instruction can be obtained from the Instructing Engineer, 25 Elm Street, New York City. We understand that there is a considerable demand for radio operators and that graduates of this school are placed promptly in the marine service of the Marconi Company.

Full particulars concerning the Naval Radio School can be obtained from the Commandant at the Navy Yard in question.

* * *

A. B. R., St. Louis, Mo., inquires:

Ques.—(1) Is there any precedent for believing that there is any difference in the effects of the transmitting or receiving aerial with the high potential ends connected together or left open?

Ans.—(1) In our opinion there is no difference.

* * *

E. N., Milwaukee, Wis., inquires:

Ques.—(1) Would you recommend an oil immersed condenser or one of the regulation glass plate type for use in connection with a 1-inch spark coil?

Ans.—(1) Either type will suffice for the purpose. Increased insulation is obtained from oil-immersed condensers and the brushing of the plates is reduced.

Ques.—(2) Please give directions for the construction and the dimensions of a condenser suitable for this coil.

Ans.—(2) The capacity of this condenser varies widely according to the speed of the vibrator and the general overall construction of the coil. The correct value is best determined by experiment; generally two plates of glass, 6 inches by 8 inches, held with tinfoil, 4 inches by 6 inches, will give the correct value of capacity. These plates need not necessarily be immersed in oil, but to do so may reduce the strain on them. If this does not prove to be of correct value for a good spark discharge try increased or decreased values of capacity or a series in parallel connection until the best possible spark is obtained. A spark coil of recent design having a normal 1-inch spark discharge without condenser required six plates, 6 inches by 8 inches in parallel, for the spark discharge of greatest volume and purity of note.

* * *

W. L. G., East Oakland, Cal., inquires:

Ques.—(1) There has been a good deal of arguing and debating in my district over the international "keep out" signal; some say it is QRM, others BK, and still others QRD. Which is correct?

Ans.—(1) The international "keep out" signal is QRX.

* * *

E. H. S., Rochester, N. Y., inquires:

Ques.—(1) What is the fundamental wave-length of a four-wire aerial, 80 feet in length with an average height of 37 feet, the wires being spaced about 1½ feet apart, as per the accompanying diagram?

Ans.—(1) The natural wave-length of this system is approximately 145 meters.

Ques.—(2) Where can I obtain formulae for calculating the wave-length of an aerial from its dimensions?

Ans.—(2) This calculation was described in a series of articles by Professor G. O. Howe appearing in the December, 1915, and the January, 1916, issues of The Wireless World, of London, England.

Ques.—(2) Which is considered the most efficient type of transmitting oscillation transformers for a ½ k.w. set, an ordinary helix or an inductively coupled oscillation transformer. Is a pancake type as efficient as a comercial type oscillation transformer?

Ans.—(2) Practically equal results can be obtained with all types of oscillation transformers provided they are thoroughly understood. The inductively-coupled type permits the mutual inductance between the primary and secondary circuits to be regulated with less difficulty, but the same regulation can be obtained on a simple helix by the use of three contact clips. There is practically no difference in the efficiency of a pancake transformer as compared to the ordinary barrel type.

Ques.—(3) Please give the directions and diagram of the construction of a reactance coil of suitable design for use with a ½ k.w. Packard transformer.

Ans.—(3) Lacking data as to windings of this transformer, we cannot give the desired advice. You had better communicate direct with the manufacturers.

Ques.—(4) Is asbestos wood or asbestos board as good or better than marble for use as a switchboard panel for high frequency current?

Ans.—(4) Marble by all means should not be employed where the high frequency circuits come in direct contact with the surface of the panel board. Such insulating materials as bakelite, micarta, etc., are to be preferred.

* * *

C. A. M., Atlanta, Ga., inquires:

Ques.—(1) Can the receiving navy set designed by Dr. Cohen having coils 18 inches in length, 6 inches in diameter, wound with No. 28 SSC wire, be used on amateur wavelengths?

Ans.—(1) It will respond to the lower range of wave-length if the inductance coils are fitted with multipoint switches, permitting small values of inductance to be used in the primary and secondary windings.

Ques.—(2) How may the inductance of the coils be varied and if it is accomplished by a multipoint switch, how many turns of inductance should be included between the taps on the switch?

Ans.—(2) The inductance value may be varied either by a multipoint switch or by a sliding contact. The maker of the set can add just as many taps to the multipoint switch as he desires; the greater the number the closer will be the adjustment to any particular value of wave-lengths.

Ques.—(3) Are all variable condensers used in this set necessary?

Ans.—(3) Yes.

Ques.—(4) Can you give a diagram connection whereby either a carborundum detector, a galena detector or a three element vacuum valve can be connected to the secondary terminals of this circuit?

Ans.—(4) You should be able to answer this question with little difficultv. For example: The terminals of the secondary winding should be disconnected from the grid and filament of the vacuum valve detector and connected to the binding post of the carborundum crystal. Also the receiving telephones should be disconnected from the local circuit of the vacuum valve and connected in the potentiometer and crystal circuits of the carborundum set. For the galena detector the head telephones should be connected in shunt to the fixed stopping condenser. By means of three double pole double throw switches the necessary changes can be readily obtained.

* * *

H. B. S., New Hartford, Conn., inquires:

Ques.—(1) My receiving aerial consists of two No. 14 copper clad iron wires, each 350 feet in length, spaced six feet apart, being 35 feet in height at one end and 50 feet at the other end. The lead-in is 60 feet in length from the spreaders and the ground is 10 feet in length. Please give the approximate wave-length.

Ans.—(1) The fundamental wave-length of this antenna is approximately 540 meters.

Ques.—(2) The lead-in of the aerial described in my query is supported by and lies parallel to an iron pipe mast. I wish to erect a small transmitting aerial suspending it at one end from the same mast. I can make the latter aerial perpendicular or nearly horizontal, or I can erect it at an angle of 90 or 180 degrees to the larger aerial if it is placed in a horizontal position. If this aerial lies parallel to the lead-ins of the first named aerial, I fear that considerable energy loss will be occasioned. Would you advise, therefore, that it be placed at an angle or what direction do you consider best?

Ans.—(2) We advise that the second aerial be placed at a right angle to the first aerial and that a parallel position of the lead-ins be avoided.

Ques.—(3) I constructed a high potential battery for a vacuum valve detector after the design presented in a prize article in The Wireless Age. The results obtained were not satisfactory, and the zinc became heavily coated with black slime, due, I should say, to local action. I used a ten per cent. solution of commercial sulphuric acid. What do you believe to be the trouble? Is it caused by impure zinc or by impure acid? Would amalgamating the zinc with mercury help matters?

Ans.—(3) Judging from the coating of slime obtained, it is quite likely that the acid solution was too strong and we advise you to soak up a new set of blotters with a weaker solution. Amalgamation of the zinc would help, but it is not absolutely necessary in view of the fact that the local circuit of the vacuum valve requires but a very small amount of current.

Ques.—(4) Are the old type vacuum valve bulbs more sensitive than the new tubular type having a single straight filament? Can the tubular type of bulb be used for amplification purposes?

Ans.—(4) For the reception of undamped oscillations by the "beat" method the tubular bulb is preferred, but for the reception of signals from spark stations, the old time round bulb seems to give the best results.

Ques.—(5) I recently purchased a type RJ9 vacuum valve detector and at the first test a blue glow would be obtained with 54 volts at the high potential battery and with the filament only moderately bright. Within a week after it had been put into use it became impossible to make the blue glow appear with seventy-two volts at the same battery and a very bright degree of incandescence at the filament. In fact the bulb became practically useless as a detector. I have tried the usual methods of heating the bulb, but have been unable to make this bulb respond.

Ans.—(5) In view of the fact that you have heated the bulb, we have no additional advice to offer, but it is a fact that certain grades of these bulbs recently furnished the amateur market possess a notable degree of insensibility and with a corresponding constant change of vacuum. Heating the bulb is generally a cure for this difficulty, but inasmuch as it did not help matters in your case we have no additional advice to offer. You might find that by the application of 100 or 150 volts to the local circuit that the characteristic blue glow will be obtained. We advise you to return this bulb to the manufacturer.

* * *

W. M. N., Kernersville, N. C., inquires:

Ques.—(1) I am constructing an inductively-coupled receiving tuner for a medium range of wave-length. The primary winding is 4½ inches in diameter, wound for 5⅛ inches with No. 22 enameled copper wire. I use a sliding contact for variation of the primary inductance. Please give dimensions for a secondary winding for this tuner, that is, the size of the wire and the number of taps to be brought from it, etc.

Ans.—(1) Wind up the secondary tube 4 inches in diameter with 550 turns of No. 30 enameled wire and divide them equally between the taps of a multipoint switch employing about fifteen turns to each tap. Your set will then respond approximately to wave-lengths of 3,000 meters and will be particularly applicable for the reception of the time signals from Arlington up to 2,500 meters.

* * *

J. J. C., Brooklyn, N. Y.:

So many queries have been received regarding the number of tap-offs to be taken from the loading coils and primary and secondary inductances of the "beat" receiver described in the book called "How to Conduct a Radio Club" that an answer will be given covering all inquiries. The amateur experimenter of course understands that in any receiving set it is preferable to have just as many taps on a given winding as are feasible from a mechanical standpoint because the closer the adjustment the more accurate is the tuning of a given set. In consequence you can add just as many taps to the windings as you desire, but for the range of wave-lengths between 6,000 and 10,000 meters the coils described on page 82 of the first edition of the book called "How to Conduct a Radio Club" are of such value that the wave-lengths of the secondary circuit and the local telephone circuit of the vacuum valve can be varied by means of the variable condensers alone. Similarly, a smaller value of inductance could be selected in the antenna circuit and if the complete primary circuit is then shunted by a condenser of variable capacity, the necessary change of wave-lengths in that circuit can be obtained by the condenser alone. In other words, the complete tuning is done by means of variable condensers and not by the coils. Of course, for the lower range of wave-lengths a multipoint must be fitted to all coils of the windings.

R. A., Danville, Pa., inquires:

Ques.—(1) Of late the amateurs in and about Danville have been annoyed by a peculiar buzz. This interfering sound is heard continuously except late at night and particularly in wet weather. The interference is so severe that no stations are heard except Arlington and in one instance the time receiving station of a jeweler was completely put out of business. Can you give me any particular advice on this subject and how this interference can be averted?

Ans.—(1) This interference is probably due to leakage on the power lines in your neighborhood and can only be stopped by locating the leak. This is often caused by sparking from a 2,200-volt power line to a tree. To say the least, there is leakage on the power circuits of some sort causing sparking which in turn sets up a highly damped interfering wireless telegraph wave.

* * *

D. W. D., Colorado Springs, Colo., inquires:

Ques.—(1) What is the natural wave-length, capacity and inductance of an inverted L aerial 60 feet in length, 50 feet in height, comprising six wires spaced 2 feet apart?

Ans.—(1) A natural wave-length is 163 meters, the capacity approximately .000267 microfarad and the inductance 41,000 centimeters.

We cannot calculate the possible range of wave-length of your receiving set because you failed to give the dimensions of the tuning coil, the number of turns, the size of the wire, etc., which are essential in order to make the calculation.

* * *

A. B. L., Kansas City, Mo., inquires:

Ques.—(1) Of what value are the data in the set of curves shown in Figure 13, page 110 of the November, 1916, issue of The Wireless Age?

Ans.—(1) These data should be of considerable value to the amateur experimenter because they show the natural wave-length of an aerial circuit with 10,000 centimeters or 10 microhenries of inductance inserted at the base. This inductance may conveniently represent the secondary winding of a transmitter oscillation transformer at any given station. A secondary winding having this value can be calculated by means of the formula given on page 106 of the November, 1916, issue, and use of these data is recommended to the amateur experimenter. Having constructed a secondary inductance with this value, the experimenter may then erect an aerial of the correct dimensions to emit, let us say, the wave-length of 200 meters or any other wave-length desired within the limits of the data given in Figure 11.

* * *

A. B. R., Jersey City, N. J., inquires:

Ques.—(1) How do the operators in the marine service of the Marconi Company keep track of the conditions of the storage cells furnished for the auxiliary radio transmitters?

Ans.—(1) An instrument known as an ampere hour meter is inserted in both the charge and discharge circuits of the battery. When the battery is fully charged the pointer of this instrument rests at the zero position on the scale, but as current is taken out of the battery the pointer moves from the zero position in the direction of the hands of the clock and the scale reading corresponding to any particular position of the pointer indicates the number of ampere hours of energy taken from the battery. The additional care required is merely to keep the cells well filled with water, that is to say, the plates should be covered with electrolyte to a depth of ½ or ¾ of an inch. Lacking an ampere hour meter, the condition of storage cells is noted by taking normal current from the cells and at the same time measuring the voltage. If the total voltage is less than 1.81 per cell, they are said to be discharged and must be immediately placed on charge.

* * *

D. L. I., Curwensville, Pa., inquires:

Ques.—(1) I wish to construct an open rack condenser with glass plates, 30 inches by 11 inches, covered with tinfoil, 28 inches by 8 inches. How many plates would I require? This condenser is to be used with a 20,000-volt transformer varying in capacity from ½ k.w. to 2½ k.w.

Ans.—(1) You, of course, understand that you cannot consume the full input of this transformer at the wave-length of 200 meters and should you desire to use a greater wave-length, the condenser may have the capacity of .02 microfarad. You will require twenty-eight plates of glass, fourteen plates being connected in parallel in one bank and the second set of fourteen plates in another bank. The two banks should then be connected in series and to the terminals of the transformer.

Ques.—(2) My aerial is 170 feet in length, mean height 55 feet, comprising four wires spaced 2½ feet apart. What is the wave-length?

Ans.—(2) About 300 meters.

Ques.—(3) How can it be reduced by means of a series condenser?

Ans.—(3) A condenser comprising three plates of glass, 12 inches by 12 inches, covered with tinfoil, 10 inches by 10 inches, the plates being connected in series, will reduce the wave-length of your antenna to nearly 200 meters, but if you intend to operate this set on 200 meters, the value of capacity for the closed circuit which we advised in answer to your first query should be reduced by one-half, or in other words, the capacity should not exceed .008 or .01 microfarad.

* * *

J. H. D., Greenwich, Conn.:

You experience the same difficulty as many other amateurs who have not looked thoroughly into the matter of electrostatic induction before erection of their transmitting apparatus. A wireless telegraph aerial should by all means not lie parallel to a power circuit and there is only one solution of your problem, namely, that if you desire to prevent the lights in your neighbor's house from burning out, you must remove your aerial completely from a parallel position to the power line, or, as an alternative, you might have the lighting circuit leading to the house placed in an iron conduit under the earth. Of course the latter plan would be rather expensive.

* * *

F. H. U., Weyauwega:

Without making actual tests on your receiving apparatus it is difficult to advise concerning your troubles, but it may be that the enameled wire winding on your tuning coil has a considerable value of distributed capacity and acts in such a manner as to upset the tuning. The action of the equipment, as you describe it, also points to an earth connection of high resistance which may have a considerable damping effect upon the oscillations. The receiving tuner is apparently well proportioned and should give fairly sharp tuning in the reception of the time signals from Arlington.

The use of slate as an insulating material for apparatus of radio frequency is not recommended, particularly in the case of the lighting switch.

It is difficult to say why you do not receive stations operating at the wave-length of 600 meters, but if your tuner has multipoint switches fitted to both the primary and secondary windings and they permit the necessary values of inductance in either circuit for resonance, there is no reason why you should not be able to tune to waves of 600 meters.

* * *

W. S. G., San Rafael, Cal., inquires:

Ques.—(1) I have a ½ k.w. transformer with a 13,200-volt secondary and would like to know the correct number of condenser plates covered with foil, 6 inches by 8 inches, to operate at the wave-length of 200 meters.

Ans.—(1) Twelve plates of glass, 8 inches by 10 inches, with a thickness of ⅛ of an inch should be employed. Each plate will have a capacity of approximately .00066 microfarad and twelve in parallel will give about .008 microfarad, the correct value for the wave-length of 200 meters. If the glass is not able to withstand the potential of your transformer, you would require eighteen such plates, put into two banks of twenty-four plates in parallel in each bank, the two banks being connected in series.

Ques.—(2) Having a motor revolving at a speed of 3,000 R.P.M., what would be the correct number of points for the disc to be used in connection with this set?

Ans.—(2) A disc 8 inches in diameter, fitted with eight sparking points, will give good results.

Ques.—(3) Please publish the correct number of gaps to be used in a quenched spark discharger like that described in the book "How to Conduct a Radio Club."

Ans.—(3) Approximately 1,200 volts are allowed for each gap and consequently ten gaps or about eleven plates would be required.

Ques.—(4) How can I determine the correct value of capacity for the quenched gap?

Ans.—(4) It should not exceed .008 microfarad and the value for the best spark note is preferably obtained by experiment.

Ques.—(5) What is the meaning of the letters "S. V. C." as used in the sending of radio messages?

Ans.—(5) This is an abbreviation for the word service. A service message pertains to the business of the Marconi Company and refers to the tracing down of the delivery of a message or some important point concerning the rates, etc.

* * *

M. S., Swarthmore, Pa., inquires:

Ques.—(1) My experience with an oscillating vacuum valve detector in connection with a small inductively-coupled receiving tuner has been that when the primary and secondary windings were loaded with external inductance coils, a change in the coupling was not required for adjusting to different stations. I intend to construct a panel type receiving apparatus for the reception of undamped stations and I should like to know whether I could use a fixed degree of coupling between the primary and secondary windings without sacrificing its efficiency.

Ans.—(1) To obtain the maximum degree of efficiency from stations operating at various wave-lengths a variable coupling between the primary and secondary windings is necessary, but if you are willing to sacrifice the last degree of efficiency, a fixed coupling will give good results.

* * *

R. C. G., Iowa City, Iowa, inquires:

Ques.—(1) Where can I obtain reliable data and an explanation of the theory and operation of the "regenerative audion"?

Ans.—(1) The operation of this circuit is fully described in the Proceedings of the Institute of Radio Engineers, issued in September, 1915. Back copies can be obtained from the secretary, 111 Broadway, New York City, at a price of $1 each.

* * *

H. I. S., Monticello, N. Y., inquires:

Ques.—(1) What is the wave-length of an aerial 75 feet in length, 100 feet in height at one end, and 75 feet in height at the other? It consists of four wires spaced 2½ feet apart.

Ans.—(1) The fundamental wave-length is about 225 meters.

Ques.—(2) I hear a station that has a peculiar low note, immediately after ten o'clock each evening. Do you know what station this is?

Ans.—(2) It is undoubtedly a station on the Atlantic coast sending messages and press matter to ships at sea.

Ques.—(3) What should be the dimensions of a condenser to reduce the wave-length of the aerial described in the first query to a value of 200 meters?

Ans.—(3) Two plates of glass, 8 inches by 10 inches, covered with tinfoil, 6 inches by 8 inches, both plates being connected in series, will reduce the wave-length to the required value, provided proper variation is made of the inductance of the secondary winding of the oscillation transformer.

Ques.—(4) If unable to get the hot wire ammeter connected in series with the antenna circuit to indicate, where would you look for the trouble in the transmitting set?

Ans.—(4) It may be that there is insufficient current flowing in the antenna circuit to effect the mechanism of the meter. Perhaps the closed and open oscillation circuits are out of resonance.

Ques.—(5) What is the wave-length of the Cape Cod naval station?

Ans.—(5) The standard waves of 600 and 1,000 meters are in use.

* * *

A. D., Louisville, Ky., inquires:

Ques.—(1) What is the longest possible length for the flat top portion of an antenna operated at the wave-length of 200 meters with the secondary winding of an oscillation transformer connected in series?

Ans.—(1) The longest permissible length for the flat top portion is about 105 feet with a vertical height of approximately 30 feet, in the case of the inverted L type; for the T type, the flat top portion may be increased to 160 feet with a vertical height of 30 feet.

* * *

F. J. R., Chicago, Ill., inquires:

Ques.—(1) Referring to the diagram of the heterodyne receiver described in a previous issue of the Monthly Service Bulletin of the National Amateur Wireless Association, where one oscillating vacuum valve is used to generate local oscillations and the other employed to detect the beats so produced in the antenna circuit, please give the necessary dimensions for the coil so that this circuit may be operated at wave-lengths between 600 and 3,000 meters.

Ans.—(1) It is not always possible to keep the vacuum valve detector in a stable state of oscillation at wave-lengths below 3,000 meters, except in the case of a highly exhausted valve. You should have no difficulty in calculating the dimensions of the secondary winding, or the coils of inductance interposed in the wing circuit, if you make use of the Lorenz formula, appearing in the second edition of the book "How to Conduct a Radio Club." To illustrate: The frequency of oscillation in the oscillating vacuum valve circuit is, in the majority of cases, governed by the oscillating period of the secondary circuit of the receiving tuner. Hence, you may assume a value of .0001 microfarad, as the capacity of the condenser to be connected in shunt to the secondary winding, and continue to calculate the necessary secondary inductance for the required wave-length. For example: If the wave-length of the closed circuit is to have a maximum value of 3,000 meters, you may determine the required value of inductance in centimeters by squaring the wave-length ($3{,}000^2$) and divide this by ($3{,}552 \times .0001$). Having thus determined the necessary value of inductance in centimeters, you can make use of the formula in the book "How to Conduct a Radio Club" and determine the exact dimensions of the secondary winding for this wave-length. The loading inductance in the wing circuit of the vacuum valve can have approximately the same dimensions as the secondary winding.

Ques.—(2) In the same description and diagram of the heterodyne receiving set, no mention was made of the use of multipoint switches for variation of the inductance of the large loading coil. Approximately, how many taps are required?

Ans.—(2) For wave-lengths between 6,000 and 10,000 meters, no taps are required, the necessary tuning being effected by the variable condensers alone, but for wave-lengths below 6,000 meters, taps may be placed at various points along the coils, according to the desires of the constructor.

Ques.—(3) Which do you consider superior, the three step vacuum valve amplifier or a single bulb employing the regenerative vacuum valve circuit?

Ans.—(3) The regenerative circuit gives good results, but we have no exact data at hand showing the relative strength of signals to be obtained from either circuit. Offhand we should say that a three step amplifier will give the best signals.

* * *

A. R. D., Boston, Mass., inquires:

Ques.—(1) I note from time to time in the columns of your Queries Answered Department inquiries from amateurs regarding the construction of a receiving tuner responsive to wave-lengths including 10,000 meters which are to be fitted with a crystalline detector. Should I take the pains to construct a set of this type, from what stations could I receive?

Ans.—(1) This is an important query and one which many of our readers should take note of. A receiving tuner responsive to this range of wave-lengths and fitted with a crystalline detector, is only applicable to the reception of damped oscillations, and since there are only three or four stations in the entire United States operating at such a wave-length with damped apparatus, this equipment would only be of value to those amateurs situated in the immediate vicinity. The best known of the high-power stations fitted with damped wave apparatus employ directional aerials and it is difficult to receive these signals with ordinary crystalline detectors, unless the receiving station lies in the direct path of the radiation or is located nearby to the station itself.

Many high-power stations employ undamped transmitters, and in consequence either a tikker detector must be employed or some form of an oscillating vacuum valve circuit, the latter having been fully described in previous issues of THE WIRELESS AGE.

* * *

J. B. L., St. Louis, Mo., inquires:

Ques.—(1) Can I construct a transmitter emitting undamped waves that will operate at the wave-length of 200 meters?

Ans.—(1) We know of no undamped wave generator within the amateurs' means that will function at a wave-length of this value.

Ques.—(2) Will the United States authorities permit an amateur to employ an undamped wave transmitter of any type?

Ans.—(2) This query should be sent to the Commissioner of Navigation, Department of Commerce, Washington, D. C., for direct ruling. Since undamped transmitters operate at wave-lengths in excess of 3,000 meters, a special license, we believe, would be required.

Ques.—(3) Is a license required for the operation of a radio telephone station, experimental or otherwise?

Ans.—(3) Yes.

* * *

B. W., San Francisco, Cal., inquires:

Ques.—(1) What is the wave-length of an antenna 64 feet in length, 50 feet in height and 35 feet at the other, with a lead-in 40 feet in length?

Ans.—(1) Approximately 160 meters.

Ques.—(2) Where can I obtain instructions for constructing an amplifier coil to amplify signals from a galena detector?

Ans.—(2) Assuming that they are to be amplified by a vacuum valve, we refer you to the diagram of connections published in the book "How to Conduct a Radio Club," Second Revised Edition.

The apparatus described in your third query is responsive to wave-lengths inclusive of 7,000 meters, but will not give the maximum efficiency at this wave-length if used in connection with a vacuum valve detector. The maximum efficient adjustment with the vacuum valve is about 4,800 meters.

Regarding your fourth query: A condenser in shunt to the primary winding is not necessary as the loading coil already possesses sufficient value of inductance to place this circuit in resonance with the secondary or receiving detector circuit.

Ques.—(5) Would it help matters if I erected an aerial 400 feet in length, instead of the present one, and would it increase the wave-length to any considerable extent.

Ans.—(5) An aerial 400 feet in length would possess a natural wave-length of about 525 meters and of course would permit the antenna circuit to be adjusted to greater wave-length. Complete dimensions of long distance receiving sets are contained in the book "How to Conduct a Radio Club."

* * *

G. M., Dallas, Tex.:

A complete answer to your queries appears in the book "How to Conduct a Radio Club." The grid condenser for a vacuum valve may be constructed of two very small test tubes or of a piece of lamp cord about 8 or 10 inches in length. One terminal of the twisted cord is connected to the grid of the vacuum valve and the other terminal to the secondary winding of the receiving coupler. The two opposite ends of the cord are of course left open. This makes a condenser of small capacity which can be varied by clipping off the length of the cord until the required value is obtained.

For the fixed condenser cut out twenty-four sheets of tinfoil, 4 inches by 6 inches, and separate them with thin paraffin paper. Connect alternate sheets to opposite terminals. This will give a condenser of about the correct capacity to be used in shunt to the head telephones.

You cannot calculate the possible increase of wave-length to be obtained from a given loading coil, unless you know the inductance and capacity of the antenna circuit in which it is to be employed. These data known, it is comparatively easy to estimate the upper range of wave-lengths. All this is completely described in the book "How to Conduct a Radio Club."

* * *

W. R. G., Newburgh, N. Y.:

Ordinarily a power transformer having a secondary potential of 5,000 volts requires a condenser of at least .02 microfarad capacity for the maximum efficiency, but in order that the set may be operated at the wave-length of 200 meters the maximum allowable capacity is .01 microfarad and a still better value is .008 microfarad. Twelve of your 8 by 10 plates, covered with tin-foil, 6 inches by 8 inches, will give a resultant capacity of about .008 microfarad, but your transformer will not consume ½ k.w. with this value of capacity.

* * *

G. W., Oakland, Cal., inquires:

Ques.—(1) Can you give me the dimensions for a reactance coil so that I can operate a 110-volt sixty-cycle Thordarson transformer on a 220-volt sixty-cycle alternating current power circuit. The secondary potential of this transformer is 20,000 volts and the input 1 k.w.

Ans.—(1) It is difficult to give the exact dimensions of the reactance coil lacking knowledge of the design of the primary winding of your transformer. You should communicate with the manufacturers and inquire concerning the impedance of the primary winding of this transformer and construct a reactance coil of the same dimensions. This will approximately permit your transformer to operate on 110 volts a. c. A better method still would be to construct a step-down transformer, the secondary potential of which is 110 volts. The Thordarson Manufacturing

Company can undoubtedly make up on special order a step-down transformer of the required dimensions.

Ques.—(2) Please give the dimensions for a transmitting condenser to be used in connection with this transformer.

Ans.—(2) Assuming that this is to be operated on the wave-length of 200 meters, the condenser should have a capacitance of .008 microfarad. Sixteen plates of glass, 14 by 14 inches, covered with tin-foil, 12 by 12 inches, eight plates being connected in parallel in a bank and two banks of eight plates in series, will give a capacity of .008 microfarad.

Ques.—(3) Can the tubular vacuum valve bulb be used successfully in the vacuum valve circuits described in the Monthly Service Bulletin of the N. A. W. A.? Is this bulb more sensitive than the former type?

Ans.—(3) The tubular bulb will function in any of the circuits described in previous issues of The Wireless Age and in the Monthly Service Bulletin. The tubular bulb gives better response and is more stable in operation for the reception of undamped oscillations than the former type supplied to the amateur market, but for the reception of ordinary spark signals the old type bulb is to be preferred.

Ques.—(4) What is the approximate wave-length of a two-wire aerial, 65 feet in height, 160 feet in length, with a lead-in of 75 feet? The ground wire is 25 feet in length.

Ans.—(4) Approximately 325 meters.

Ques.—(5) Must an operator be eighteen years old to become an employee of the Marconi Marine Service?

Ans.—(5) Yes.

* * *

R. B., Fort Worden, Wash., inquires:

Ques.—(1) How do you calculate the fundamental wave-length of an umbrella aerial?

Ans.—(1) We have no formula by which the fundamental wave-length of an umbrella aerial can be calculated, that is, a simple formula by which the calculation could be easily carried out. Considerable data covering the subject in general appeared in the December, 1915, and January, 1916, issues of The Wireless World, published in London, England.

Ques.—(2) Why is an umbrella aerial most efficient for receiving?

Ans.—(2) We are not aware that this is the case, nor do we know that any definite experiments have been carried out along this line. The inverted L aerial is generally favored for both transmitting and receiving purposes.

Ques.—(3) I have an induction coil with ten turns of wire in the primary and 200 turns in the secondary. If I receive ten volts in the primary, how many volts will I obtain in the secondary?

Ans.—(3) It will be necessary to have more data to make an accurate calculation, but in a well designed transformer the secondary voltage is very nearly a direct ratio of the turns in the primary to those of the secondary; in your particular case there should be approximately twenty times the potential in the secondary circuit that there is in the primary circuit.

* * *

F. W. S., Jefferson, O., inquires:

Ques.—(1) I have a two-wire aerial, 100 feet in length, 30 feet in height at one end and 25 feet at the other. In connection with this aerial I use a two-slide receiving tuner, 12 inches in length, 6 inches in diameter, wound with No. 22 wire and connected as shown in the accompanying drawing. With this equipment I am unable to receive the Arlington time signals and weather reports, although other stations near-by receive these signals with a much smaller tuner and an aerial of approximately the same dimensions. What is my difficulty?

Ans.—(1) Your tuning coil has sufficient dimensions to be placed in resonance with the Arlington station provided you place a small variable condenser in shunt to the leads extending to the detector circuit. Possibly your crystal detector is not sensitive and this may account for the non-reception of signals.

Ques.—(2) Will a buzzer connected as per the sketch in accompanying diagram, where the earth is connected to one side of the vibrator and the antenna to the opposite side, transmit to a distance of sixty rods?

Ans.—(2) Yes, provided the receiving detector is sensitive.

Ques.—(3) Would a two-wire aerial composed of No. 22 wire, 10 feet in length, have sufficient capacity for transmitting with this buzzer?

Ans.—(3) We do not believe the range of the buzzer with this serial would be more than forty or fifty feet. You had better connect the buzzer to an aerial of ordinary dimensions—for example, your 100-foot aerial would make a better radiator for the buzzer system than one of the dimensions you have suggested.

* * *

H. B. G., Kinderhook, N. Y., inquires:

Ques.—(1) What is the best method for connecting up the following instruments: two variometers, one loading coil, three variable condensers, a de Forest vacuum valve detector, telephone receivers and a fixed condenser if required?

Ans.—(1) We presume that this apparatus is to be used for the shorter range of wave-lengths. One of the variometers should be connected in series with the antenna and ground and a lead from the antenna-connected end of the variometer extended through the second variometer, and from there on through a variable condenser to the grid of the vacuum valve. The second variable condenser may be connected in shunt to the variometer, connected in series with the antenna circuit, while the third variable condenser may be connected across the head telephones and battery of the wing circuit of the vacuum valve.

Ques.—(2) Would you consider a set composed of a loose coupler, a variable condenser, fixed condenser, a vacuum valve detector and telephone receiver more efficient than the one described in my first query?

Ans.—(2) The answer depends upon the range of wave-lengths over which you desire to work and your requirements in general. Offhand we would say that the apparatus described in your second query would permit a wider range of wave-lengths adjustment, give closer tuning and louder signals because the variometer does not deliver a high value of secondary potential. Please keep in mind that variometers of ordinary construction do not permit a large change in the wave-length of a given oscillatory system.

* * *

N. M., Bronx, N. Y., inquires:

Ques.—(1) Do the coils in Figures 1 and 3 in the article "How to Conduct a Radio Club," in the January, 1916, issue of The Wireless Age, overlap each other, or are they placed side by side?

Ans.—(1) These coils are in inductive relation and concentric, one sliding within the other.

* * *

N. J. A., Tacoma, Wash., inquires:

Ques.—(1) Please give the approximate dimensions for loading coils to raise the wave-length of the following described tuner to 3,000 meters: The primary winding is 4 inches in diameter by 4½ inches in length, wound with No. 24 wire, and the secondary is 3½ inches in diameter by 4 inches in length, wound with No. 28 wire. The aerial has five strands, is 65 feet in height and about 50 feet in length. What is the approximate wave-length of the aerial?

Ans.—(1) The approximate wave-length of the antenna is about 170 meters and a loading coil, 4 inches in diameter by about 5 inches in length, wound with No. 24 wire, will raise the wave-length to approximately 2,500 meters. Similarly the secondary winding may be loaded to this value by another coil having the same dimensions as the present secondary winding and connected in series therewith.

Ques.—(2) Does it matter if the loading coils are placed close to the receiving transformer?

Ans.—(2) They should be placed at right angles if possible.

* * *

R. C., Toronto, Ont., inquires:

Ques.—(1) Where can I purchase graphite resistance rods of 10,000 ohms of the type described in the November issue of The Wireless Age?

Ans.—(1) Communicate with the Joseph Dixon Crucible Company, Jersey City, N. J.

* * *

C. H. B., Savannah, Ga.:

The most accurate formulæ for the computation of the wave-lengths of a transmitting aerial will give an inaccurate result for the reason that these formulæ do not take into account the presence of near-by conductors to the antenna, such as smokestacks, steel structures, etc. The natural wave-length of a four-wire aerial, the wires being spaced about 2½ feet apart, varies from 4.4 to 4.7 times the total length of the flat top and the lead-in.

* * *

H. W. C., Dassel, Minn., inquires:

Ques.—(1) What is the approximate wave-length of an aerial 600 feet in length, 150 feet in height?

Ans.—(1) Approximately 1,000 meters.

Ques.—(2) What should be the capacity of a variable condenser to reduce the wave-length of this aerial to 200 meters?

Ans.—(2) It cannot be reduced to 200 meters. The minimum possible wave-length adjustment is about 525 meters. The flat top must be reduced to about 100 feet to obtain the wave-length of 200 meters.

Ques.—(3) Is it necessary to own a complete wireless set in order to become a member of the National Amateur Wireless Association?

Ans.—(3) Not absolutely necessary. The applicant is merely required to signify his intention to become an amateur experimenter at an early date and must also indicate that he is interested in the art.

* * *

J. D. S., Chicago, Ill., inquires:

Ques.—(1) My aerial is 64 feet in length, composed of three wires spaced 2 feet apart and has a lead-in taken 20 feet from one end. This is 34 feet in length and the ground connection is 20 feet in length. What is the approximate wave-length?

Ans.—(1) Approximately 115 meters.

Ques.—(2) What is the upper wave-length adjustment of an inductively-coupled receiving tuner having a primary 4½ inches by 6½ inches, with No. 24 enameled wire and a secondary winding, 4 inches by 6½ inches, wound with No. 28 enameled wire.

Ans.—(2) Approximately 3,000 meters.

Ques.—(3) With proper loading coils and tikker detector could I receive signals from Lake Bluff, Ill., or Arlington, Va., using the undamped wave transmitter?

Ans.—(3) Yes.

Ques.—(4) Are visitors admitted to the Marconi station in Chicago, Ill.?

Ans.—(4) Yes, provided they possess proper credentials.

* * *

R. D., Milwaukee, Wis., writes as follows:

Ques.—I constructed a vacuum valve detector receiving set as described in the article on "How to Conduct a Radio Club" in the January, 1916, issue of The Wireless Age and have obtained excellent results, with the exception that I experienced considerable interference from an arc light system, the wires of which run within five feet of my receiving aerial.

I have picked up numerous amateur stations within a radius of 600 miles and none of them use more than 1 k.w. input for transmitting purposes. The night the famous relay message was sent from Rock Island Ill., I heard it being sent from the original station and then heard 9 HX, which is located in North Dakota, relay it on to another point. Among the stations that I heard relaying this message were 9 NN, 5 VC, 8 AEZ, and many others.

This, however, is not the most interesting feature of my set. By causing the vacuum valve to oscillate I can easily receive signals from the undamped wave station at Lake Bluff, Ill. I would like an explanation of this in view of the fact that the undamped stations transmit a wave-length of 6,000 meters, whereas I am sure my set is not responsive to this wave-length.

In view of the results I have obtained I am looking forward to more articles on the vacuum valve and I trust that I will not be disappointed because I have found in this device one of the most interesting fields of experiment.

Ans.—We know no method by which the interference from the arc light system can be completely reduced except by removing the antenna to a greater distance from the arc light system or vice versa. Our correspondent should know that undamped stations using the arc generator emit in addition to the fundamentol frequency of oscillations several harmonic frequencies which may set practically any oscillating vacuum valve detector circuit into a state of response and the signals will thereby be made audible. Also, our correspondent's station is so close to that of the Government station at Lake Bluff, Ill., that the signals may be received by reason of forced oscillation.

* * *

J. J. W., Brooklyn, N. Y., inquires:

Ques.—(1) What is the approximate wave-length of an aerial 130 feet in length with an average height of 60 feet, composed of four wires spaced 4 feet apart?

Ans.—(1) About 255 meters.

Ques.—(2) Please publish complete specifications for the construction of an inductively-coupled receiving tuner to have a range of from 200 to 3,000 meters.

Ans.—(2) The primary winding may be 4 inches in diameter, 6 inches in length, wound closely with No. 24 SSC wire. The secondary winding is 3½ inches in diameter, 6 inches in length, wound with 600 turns of No. 32 SSC wire. The secondary winding should be shunted by a condenser of .0002 microfarad for the upper range of wave-lengths. The same wave-length can be obtained in the primary winding by the addition of a loading coil 4 inches in length, 4 inches in diameter, wound with 222 turns of No. 22 SSC wire, or the primary inductance can be shunted by a variable condenser of .001 microfarad capacity.

Ques.—(3) Please publish the dimensions of a loading coil that will raise the primary and secondary circuits to wave-lengths of 10,000 meters.

Ans.—(3) For the primary loading coil, wind up a tube 5½ inches in diameter, 26 inches in length, with No 22 or No. 24 SSC wire. For the secondary circuit wind up a similar tube with No. 28 or No. 30 SSC wire.

Ques.—(4) Does the placing of the loading coil in inductive relation to the primary winding of the receiving transformer produce ill effects? Should it lie parallel or at right angles, or should it be placed in an upright position?

Ans.—(4) The loading coil may be placed in an upright position and at right angles to the primary winding.

* * *

N. J. B., Quimper (Finisterre), France, inquires:

Ques.—(1) Are the stations at San Francisco and Funabashi, Japan, able to maintain trans-Pacific communication continuously without relaying at Honolulu throughout the entire year?

Ans.—(1) Communication has been established between San Francisco and Funabashi directly at various times, but no effort so far has been made to maintain continuous communication. For the present, messages are relayed at Honolulu, but at a later date direct communication may be established.

Ques.—(2) Is the station at Funabashi the property of the Marconi Company or is it the Japanese Teisheinsho system? Does the Japanese station employ damped or undamped waves?

Ans.—(2) This station is the property of the Japanese Government equipped with a composite system of wireless telegraphy and employs damped waves.

* * *

F. S. M., Oakland, Cal.:

The reciprocal formula for the calculation of the capacity of condenser jars in series and parallel appearing in previous issues of The Wireless Age are correct and you should have no difficulty in locating someone in your immediate vicinity that could show you how to calculate and obtain a result for the addition of reciprocals. For example: When we have a number of reciprocals to be added together as in the form contained in your communication, we simply find a least common denominator for all fractions and then add them together. Now when a whole number is to be divided by a fraction, we simply invert the fraction and multiply it by the whole number and thus obtain the required result. The method is discussed in practically all text books on arithmetic and should not require a detailed explanation in the columns of this magazine.

* * *

G. O. F., Liberal, Kas.:

You and other readers of The Wireless Age are specifically referred to the article by A. S. Blatterman in the November, 1916, issue of The Wireless Age, wherein curves are given indicating the wave-lengths of inverted L and T types of aerials of the usual amateur dimensions. With these data before you you can easily determine the wave-lengths of your antenna system.

THE WIRELESS AGE

MARCH, 1917

Dangers of the Proposed New Radio Bill

Leading Authorities Point Out Harmful Features of Government Ownership—Private Enterprise Necessary for Development of Wireless Art—Proposed Measure Would Crush Amateur Enthusiasm—How Commercial Companies Encourage Inventors—Experimenters an Asset to Country—History of Wire Telegraphy and Telephony Cited to Prove Case in Point—New Legislation Not Needed—This is Proved by the Offer of the Marconi Company to Turn Its Entire Enterprise Over to the Government in the Existing Crisis

IMMEDIATELY following the published announcement of the break in relations with Germany, Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, telegraphed to President Wilson, placing at the disposal of the Government, for use in any emergency, the entire organization and personnel of the company, including its high-power stations at Marion and Chatham, Cape Cod, Mass.; New Brunswick and Belmar, N. J.; Bolinas and Marshall, California, and Kahuku and Koko Head, Honolulu, Hawaii. Also the company's coastal stations, about sixty in number, located from the most northwesterly point on the Atlantic Coast to, and along the Gulf, and the entire Pacific Coast to Northern Alaska, and on the Great Lakes. Also the company's manufactories, workshops and trained staff, subject to the orders of any particular department of the Government which may need its services.

This occurrence took place practically a week after the closing of the hearings of a Committee of the House of Representatives on the proposed new bill to regulate radio communication, by the terms of which the Government would obtain control of the coast radio stations and operate them in times of peace. The proponents of the measure, chief amongst whom were the heads of the Army and Navy Departments, seemed to be of the opinion that the safety of the country demanded that wireless telegraphy become a Government monopoly. The bill was opposed at the hearings, however, by the country's authoritative experts of the wireless art, who pointed out that a Government monopoly would inevitably crush the widespread encouragement wireless received from the enterprise of the commercial companies and the inventive enthusiasm of amateur experimenters. The heads and managers of the Marconi Company emphasized the detrimental features of the proposed measure, and called attention to the fact that the precautionary features of the bill were superfluous, since the company stood ready at all times to place the machinery of its wireless enterprise, including power stations, organization and factories, at the disposal of the Government in any time of crisis, disorder, war or threatened war that might arise. Their statements and assurances were justified by the facts, when the crisis arrived on February 3, and the offer of the Marconi Company was made and accepted, clearly proving that Government control or Government ownership is not essential to the best interests of the Nation.

Leading wireless authorities gave their opinions at the hearings, and they coincided in the statement that the provisions of the bill, especially the one authorizing the taking over of the coastal stations of commercial companies by the Government, spelled an invasion of the existing commercial field, which would lead inevitably to Government ownership. This eventuality they asserted, would be harmful to the development of wireless telegraphy, in that commercial rivalry and private enterprise, through the investment of capital and the encouragement of invention and improvements, had been instrumental in advancing all means of human communication, as was proved in the history of the development of wire telegraphy and telephony.

Special emphasis was laid on the fact that the thousands of amateur wireless operators and experimenters throughout the country were an asset to the Government in their especial field, since they were responsible for many of the useful wireless innovations, represented a fertile field for the nation's inventive genius, and provided recruits for the Army and Navy in their important branches whenever a public need arose. And it was proved conclusively that the proposed bill would check amateur zeal and enterprise, since the rewards for the inventiveness of the amateurs came, not from the Government, but from the watchful business instinct of the commercial wireless organizations.

The Hon. John W. Griggs, president of the Marconi Company of America, at his appearance before the House Committee, analyzed the provisions of the bill and pointed out what their effect would be on the commercial companies. He reasoned clearly that the measure was decidedly unjust to the commercial companies, especially a great, beneficent enterprise such as the Marconi Company of America. He stated that for fifteen or sixteen years the Marconi Company had been operating to develop wireless and its business enterprise for the purpose of making a profit for its investors —the stockholders. "It has developed," said Mr. Griggs, "what is known as the ship to shore business, so that in connection with its manufacturing of apparatus which is carried on at its factory, it is making at the present time a trifling profit over and above its expenses but not enough to justify a dividend upon its stock. It manufactures apparatus of small capacity and leases it to ships of American registry that trade on the high seas, furnishes the ship with the operator, and gets a monthly rental for that. The law of Congress requires the ships to be equipped with wireless apparatus, and I think almost all of the American fleet on the Atlantic coast is equipped with Marconi apparatus. In order to render this apparatus more valuable to the lessees, the wireless company has established coastal stations at

"What danger is there to this country because Mr. Marconi is the vice-president of the company I represent? Will anybody suggest to me what danger there is to this country because one-third of the stock is owned by aliens either in Great Britain or Italy? The company is amenable to the laws of the United States. And with what face can the American Government, through its telegraph companies, go to foreign countries and ask for a concession to land its cables on their shores? The concession for the Western Union cable to Great Britain will expire in two or three years. Suppose the English Government says, when asked for the renewal of that right, 'Gentlemen, you do not allow any American company that has British stockholders to do business with you. You are an American company. We do not see fit to allow you to renew your concession.' Is that the kind of spirit that you wish to foster between the nations of the earth?"

—The Hon. John W. Griggs, President of the Marconi Company.

various points from Maine to Texas. These stations serve not only as points of communication with ships going up and down the coast and in order to transmit intelligence to or receive intelligence from the mainland; but they also serve as supply depots for the Marconi Company. And the lessees of the apparatus, when they sign a contract, are assured by our company that with these stations at designated points along the coast, at any time they put into the ports where these stations are located, they can get any new parts for their apparatus which they may need, or they can get their apparatus repaired by one of our experts who is there on the ground for that purpose.

> "There is an important international phase of the radio problem, the solving of which requires the development of extended control of equipment standards, operating practice and language qualifications. If the ships of the sea are to develop among themselves, and to the shore, universal intelligible communication, which is undoubtedly within the possibilities of radio development, a Government department, it will be admitted, can hardly be qualified to insist on the disciplining of an operator on a foreign ship who may be lax in duty or deficient in qualifications. There are daily possibilities here for the development of unpleasant and embarrassing international complications."—*Edward J. Nally, Vice-President and General Manager of the Marconi Company.*

Or if their operator has been disabled, has died, or from any other reason is disqualified, we can furnish them with another operator. So you see that the system of coastal communication stations, while there has been some suggestion here that they did not do a toll business with the ships that paid, is as indispensable to our plan of doing business as is any part of the plan. And I may say right here, now, that if the Navy Department were alone allowed to carry on these coastal stations, they would not be able to provide supplies, make the repairs and furnish the additional operators which the Marconi Company does, and which it is a part of our contract to give the lessees of which I think there are now about 500 sailing the Atlantic from one port to another."

Mr. Griggs further asserted that it had been admitted at the hearings by Commander Todd and Captain Bullard, that the object of the bill was to coerce the Marconi Company into letting go of its business, particularly its coastal stations, and that the proposition was to give the Navy Department unlimited authority to do commercial business in competition with men who had put their money into a mercantile venture, and to so conduct the Government end of it that eventually, in five years, they would be glad to sell out.

"They have a provision in this bill," continued Mr. Griggs, "that is so directly aimed at the Marconi Company that I must think it was the bull's eye at which they were shooting. They say that no company shall be licensed, and if licensed, it shall lose its license to operate a wireless station, long distance or any other, if one-third of its stock is owned by aliens, or if any officer of the company is an alien. Will anybody suggest to me, gentlemen, what danger there is to this country because Mr. Marconi is the vice-president of the company I represent? Will anybody suggest to me what danger there is to this country because one-third of the stock is owned by aliens, either in Great Britain or Italy? The company is amenable to the laws of the United States. And with what face can the American Government, through its telegraph companies, go to foreign countries and ask for a concession to land its cables on their shores? The concession for the Western Union cable to Great Britain will expire in two or three years. Suppose the English Government says, when asked for the renewal of that right, 'Gentlemen, you do not allow any American company that has British stockholders to do business with you. You are an American company. We do not see fit to allow you to renew your

"Read the list, an enormous long list, of lives that have been saved from sinking ships at sea! The benefits to mankind and to the world, in saving property and life, of the Marconi Company, are enough for the Government, if it had a right to recognize those things, to give it an enormous bounty. Not only has this enterprise and this company done good to the world, but nobody comes with any charge against it of monopoly and oppression and misconduct."

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concession.' Is that the kind of spirit that you wish to foster between the nations of the earth?

"Read the list," exclaimed Mr. Griggs, "an enormous long list, of lives that have been saved from sinking ships at sea! The benefits to mankind and to the world, in saving property and life, of the Marconi Company, are enough for the Government, if it had a right to recognize those things, to give it an enormous bounty. Not only has this enterprise and this company done good to the world, but nobody comes with any charge against it of monopoly and oppression and misconduct.

"You are asked now to make in time of peace the Navy Department superior in this important branch of communication to the civil interests of the country, to the commercial and business interests. We think the law of 1912 affords adequate legislation as administered, and we do not think it ought to be modified or changed, except we are willing that Congress should make any provision they think is wise, so that in time of war or great emergency or tumult, the stations of a wireless company may be taken over by the Government, and all the employees sworn into the service of the Government. Or, we will go further if it can be worked out. We will agree that every operator in a station on American soil shall be sworn into the reserve service of the United States, so that he is bound to respond to any military law when the exigency arises."

Similarly, Edward J. Nally, vice-president and general manager of the Marconi Company, drew upon his wealth of experience in calling attention to the dangers in Section 5 of the bill, which provides for the opening by the Government of its radio stations to general public business. He stated that if this provision were enacted into law, it would create a condition of competition between Government and private interests, resulting in a heavy financial loss to commercial companies, which have spent considerable sums of money and years of labor in the development of efficient radio stations, so as to provide a satisfactory commercial wireless-telegraph service to the public. Much had been said during the hearing, he continued, by proponents of the bill of the willingness, if not anxiety, of the commercial companies to dispose of their coastal stations to the Government. This was not true so far as the Marconi Company was concerned. By the expenditure of millions, it had erected and maintained land or coastal stations from the most northerly point on the Atlantic coast to the most southerly point on the Gulf, on the Great lakes, and on the Pacific coast to northerly Alaska. These stations represented the essential links in the ship and shore service, and the long list of rescues at sea and of lives and property saved because of the ready response which ships in distress at sea had been able to obtain by reason of the coastal stations, made a long and honorable record of which any company might be proud.

Mr. Nally impressed upon the House Committee the fact that this great service in the salvation of life and property had earned for wireless the right to be developed and made useful to the fullest possible extent, and such development could come only through private enterprise. It was impossible, he maintained, to formulate legislation which would foresee and provide for the future usefulness of radio communication. He referred to the telephone as a case in point, asking whether, if the Navy Department had been granted a monopoly of the telephone when that means of communication was first developed, would the United States today have, as it has, the greatest telephonic development of any country?

"And yet," said Mr. Nally, "the telephone has not supplanted the telegraph. It occupies an entirely new field created for it by the persistence of private enterprise." Coastal stations were not money makers for the commercial companies, any more than the telephone exchanges or the great main operating rooms of the telegraph companies earned money for those concerns. But their function was to contribute the element that made the service complete and comprehensive. He added that the request to have the Government assume a monopoly of the commercial coast wireless business was not justified on any ground of military necessity, since the great countries of Europe, such as England and Germany, while making the most of radio possibilities, have left the development of the art to commercial companies, even assisting them with subsidies.

George S. De Sousa, traffic manager of the Marconi Company, testified before the Committee that no evidence had been produced by the supporters of the bill to show that the commercial companies had failed to conduct properly their commercial wireless telegraph business. He asserted on the contrary that he had proof showing that where the Government stations have attempted to handle commercial business, they have not done so as satisfactorily as the commercial stations, and that commercial operation by naval stations has proved far inferior to that of the purely commercial concerns.

David Sarnoff, commercial manager of the Marconi Company, spoke before the Committee on the subject of interference. This was not complained of by the commercial companies, he pointed out, but by naval operators, who, he asserted, were not as efficient operators as the commercial men. Another point which he emphasized was that when interference does occur, the majority of cases originate from ships, since there are more ship than coast stations, and the proposed bill does not touch on this question at all.

The chief advocates of the bill were Secretary Newton D. Baker, of the War Department, and Secretary Josephus Daniels, of the Navy Department; their official communications definitely disclosed the fact that the bill was designed to invade the existing commercial field. Secretary Daniels strongly recommended that provision be made for the purchase of all stations used for commercial purposes, and he and Secretary Baker indorsed Government control for wireless. Commander D. W. Todd, U. S. N., testified that he believed in total enforced Government ownership and Captain W. H. G. Bullard, U. S. N., also warmly endorsed the measure, which he said was a result of deliberations of representatives of all departments of the Government.

One of the most effective witnesses before the Committee was Professor M. I. Pupin, professor of electro-mechanics at Columbia University and president of the Institute of Radio Engineers. Professor Pupin showed conclusively that development of the wireless art was dependent on individual enterprise, that it was the commercial companies alone that encouraged inventors and others re-

"How does the inventor feel with regard to the Army, and particularly the Navy—I mean the wireless inventor? If the Government owned the wireless, the men who are interested in the development of wireless would probably drop their interest in the subject. I may be wrong, but that is really my opinion.

"In the electromagnetic telephone we had interference between wires. We had cross talk, so that you could hear any number of people at once interfering with other people. And if the Government had owned the telephone wires, they would have simply legislated and would have determined that no telephone wires can be placed at a distance closer, say, than a hundred yards. This would have given a black eye to the telephone art."

—*Professor M. I. Pupin, of Columbia University.*

sponsible for the development and progress of the science, while such pioneers in the science were not alone not aided or encouraged by Government departments, but were absolutely despoiled of the fruits of their labor and genius by them.

"I came here to testify," said Professor Pupin, "for the purpose of demonstrating, if possible, that this bill would be most detrimental to the development of this young art—the wireless art — because it would inevitably lead to Government ownership. Now, it has been represented to you by the heads of our Government departments, namely by the Secretary of War, the Secretary of the Navy, the Secretary of Commerce, Commander Todd, and by other Government officials interested in the national defense, that the Government should control, in fact, that the Government should own, wireless telegraphy. Now I am interested in the national defense as much as anybody, and I am convinced that if we are to use any art, and particularly the wireless art for the national defense, the best thing for us to do is to develop that art. If interferences exist, as has been pointed out in the several depositions here before you, on account of the present imperfection of the wireless art, then these interferences should be eliminated not by legislation but by perfection of the art.

"Take the ordinary telegraphy and telephony by wires. What was their experience in their early history? Exactly the same as we have in the wireless art. From 1845 to 1860 the men interested in the development of electromagnetic telegraphy, spent most of their time in quarreling among themselves on the subject of how to get around the inductive disturbances.

"They had inductive disturbances just as much as we have today in wireless telegraphy, and they were of two different kinds: Inductive disturbances produced in a wire by the operation of other wires and inductive disturbances produced by God. Now what are these interferences which are produced by the acts of God? We did not realize them until electrotelegraphy was invented. And we never realized it to such an extent as we do today, since the wireless telegraphy was invented. Now, what is wireless telegraphy? It is communication between two points on the surface of the earth, or between a point on the surface of the earth and a point in the air, as in the case of the aeroplane, by means of electric oscillations. You create an electric oscillation at the sending station; that electric oscillation goes to the receiving apparatus and creates there an electric oscillation which affects a receiving instrument.

"We know today that these electrical oscillations are produced in the atmosphere by God for purposes that are known to Him. Interference in wireless telegraphy due to static, due to the acts of God, is so serious that sometimes a wireless station cannot receive a message for 48 hours. For days in succession they cannot receive a thing. Not on account of interference of other stations but on account of the static, on account of the electric waves, the electric oscillations, which God sends from an infinite number of stations located anywhere in the atmosphere between the

> "The Navy says, 'We are bothered by interference.' How much better is it for them to be bothered by interference in time of peace than to be bothered by interference in time of war. They say 'Let us have no interference now; let us be comfortable and happy; and let us communicate with each other and with out brother officers on each other's ships.' But when foreign cruisers come over here, will they listen to such proposals? What happened off South America when the English commander, Admiral Craddock, was defeated in that fight? His wireless was jammed by his opponents. If he had had a superior wireless system, he would have been free from all radio hindrance and interference from his enemies."
>
> —*Professor Arthur E. Kennelly, of Harvard University.*

North and South Poles. Now, these are the acts of God, and I do not see that these interferences have even been touched upon in all of these depositions. And these are the most serious interferences that we have, and you cannot get rid of them by any act of the legislature. The only way to get rid of them is by perfection in wireless, by the proper training and bringing up and perfection of this healthy, robust baby, which I call the wireless art.

"But the heads of the Government bureaus propose that this baby should be put into a Government institution. Now, it seems to me that would be almost a crime. We would suffer, the United States would suffer—the people of the United States, the Army and Navy would suffer. When it comes to getting rid of the interference produced by the acts of man through legislation, we can do that to a certain extent by legislation, provided we are legislating against the acts of our own citizens. But what legislation is going to prevent the enemy in time of war from interfering with us?

"It is told by the English wireless operators who took part in the battle off the Falkland Islands that the Germans, as soon as the battle started, went up and down the scale of their wireless sparks for the purpose of making it impossible for the English ships belonging to that squadron to communicate with each other. Now I would lke to know how any act of legislation, how any act of Government ownership, can prevent that!

"If I had my own way I should perhaps proceed in a radical way. I should produce as many interferences as I possibly could, for the purpose of development of the art, so that no ingenuity of man could interfere with a wireless operator when he receives. And that is possible. Things are being done today by well-organized industrial research laboratories. Things are within the reach of those who are studying the situation which will transform the whole aspect of the wireless art. These things, I say, are being done because the Government does not own the wireless. And if the Government owned the wireless, they would not be done. I will tell you the reason why.

"I have proof showing that where the Government stations have attempted to handle commercial business they have not done so as satisfactorily as the commercial stations, and my experience in the wireless telegraph business, which dates over a period of thirteen years, has convinced me that commercial operation by naval stations in the past has been far inferior to the service rendered through commercial stations, and I have no hesitancy in stating that, should all commercial business be handled through Government stations, the service would suffer materially, to the detriment of shipping and the public in general."

—George S. De Sousa, Traffic Manager of the Marconi Company.

"I have the greatest respect for the Army and Navy. I have a great many friends among the officers of the Army and Navy, and I would not for the world do anything which would hurt their feelings. But we are here to be frank, open and aboveboard, and we must say what we think is right, what we think is best for the wireless art and for the people of the United States."

It was at this juncture that Professor Pupin introduced the case of a young wireless inventor, whose experiences, as between the commercial companies and the Navy Department, are an eloquent example of the handicaps that beset human endeavor. The members of the House Committee took a vivid interest in the recital of this young man's experiences, which are of deep concern, naturally, to every wireless amateur in the country. The inventor in question, Edwin H. Armstrong, subsequently gave his testimony before the Committee.

"How," asked Professor Pupin, "does the inventor feel with regard to the Army, and particularly the Navy—I mean the wireless inventor? I will describe it briefly for the purpose of explaining what I mean when I say that if the Government owned the wireless, the men who are interested in the development of wireless would probably drop their interest in the subject. I may be wrong, but that is really my opinion.

"I refer now to a man who made a very beautiful invention. In 1910 Dr. Austin, director of the Wireless Research Bureau of the Army and Navy, and whose station is on the grounds of the Bureau of Standards, published a paper in which he compared the efficiency of various types of receivers. Among the receivers he examined was a new one, the so-called audion, the very audion receiver which is used today almost universally. Dr. Austin found that this audion was one and a half times as good as the best receiver they had prior to that time—one and a half times, mind you. At that time a young inventor, to whom I refer, was a student in Columbia University, a sophomore. That was in 1910. In 1912, when this student graduated, he got a patent—I do not know whether he got a patent that year, but he had the invention anyhow, a very simple thing, consisting in taking that audion tube and by a simple transposition of the circuits, making it 5,000 times as sensitive as the one which Dr. Austin examined. With what result? With the result that everybody is using it today and all the operating companies pay this young man a modest royalty. They cannot afford to pay more than a very modest royalty. But it enables this young man to support his mother and two sisters. The United States Navy uses this invention more than anybody else. According to the information which an officer of the Navy gave to myself, they were using it since January, 1914. And they had it a year ago in something like forty stations. They have not paid a cent to this young man, and they do not intend to. They all tell him, 'You can go to the Court of Claims.'"

> "It is known by all radio men—and I think if they will speak frankly and sincerely, they will bear me out—that the Navy operators are not anywhere near as efficient as the commercial operators. The men in the Navy Department receive their positions by assignment. They have to take an electrical course, and I am not deprecating the value of electrical knowledge, but when a man is a wireless operator, I say he must be a good wireless operator and not primarily a good electrician. Most of the Navy operators are electricians rather than telegraph men."
>
> *—David Sarnoff, Commercial Manager of the Marconi Company.*

Joshua W. Alexander, chairman of the Committee, interrupted the speaker for a moment to inquire whether this action of the Navy department was due to the fact that anyone was contesting the right to the invention. Professor Pupin replied that the right was not contested and the best proof that the invention was valid lay in the fact that the wireless operating companies were paying the inventor a royalty. The latter, however, did not have the means to go to the Court of Claims and press an infringement suit, and his lawyer had advised him against such action, since he would spend all he had and would not know when he could get any returns.

Continuing his discussion of "interference," Professor Pupin said: "In the electromagnetic telephone we had interference between wires. We had cross talk, so that you could hear any number of people at once interfering with other people. And if the Government had owned the telephone wires, they would have simply legislated and would have determined that no telephone wires can be placed at a distance closer, say, than a hundred yards. This would have given a black eye to the development of the telephone art. To day we use inside of a sheathing 600 definite circuits, and we can have 600 different people talking at the same time through these circuits without any cross talk; without any interference at all, whereas if the Government had owned that art from 1876 to 1895, or 1900, we would have had to separate those wires and the art would have never reached that point where it can have in a small space 600 different circuits. That would have been impossible.

"There are certain paragraphs in this bill which we believe will change the status of the amateur, or at least are susceptible of changing the status of the amateur. We would be at the mercy of the Department of Commerce in the administration of the law.

"Now the members of our association have no objection whatever, because they are all patriotic citizens, I am sure, to closing their stations in time of threatened war or public disaster or any similar situation. But any station in our judgment could be closed for successive periods of five years and no redress is provided in the bill."

—*Charles H. Stewart, of the Wireless Association of Pennsylvania.*

"Now if the Government means to take possession of wireless and establish industrial research laboratories and go into the art of manufacture—because that is the only way that you can develop an art—to manufacture yourself and not have somebody else manufacture it for you—then well and good. Then perhaps this bill would have some meaning. But this bill as it stands, with the other conditions—with the other laws and the other historical conditions of Government work existing—this bill means nothing else than a blow to this wonderful art of wireless telegraphy. It does not provide for Government ownership but inevitably leads to it, and the Secretary of War and the Secretary of the Navy and Commander Todd—they all say that it will lead to, and they want it to lead to Government ownership."

Professor Pupin told the Committee that the young inventor to whom he had referred would appear before them and present the facts. As stated, Mr. Armstrong eventually gave his testimony to the Committee. He said that he had invented the regenerative audion receiver, which was the best interference preventer known at the present time, being used throughout the world in commercial and Government stations.

"My particular interest in this legislation," said Mr. Armstrong, "began several months ago, when I was asked by one of the Government inspectors at the port of New York to investigate the question of interference between the Wanamaker station and the Brooklyn Navy Yard, when the Brooklyn Navy Yard was receiving signals from Arlington. Now the conditions of that service are these: The Brooklyn Navy Yard is two miles from the Wanamaker station. They desire to receive signals and messages from Arlington, which is 200 miles away from the Brooklyn Navy Yard. The Arlington station operates on 2,300 meters, the Wanamaker station on 1,800 meters. That is a difference of wavelength of 25 per cent. The power of Arlington and the power of the Wanamaker stations are of the same order. The Brooklyn Navy Yard station cannot receive from Arlington, while the Wanamaker station is transmitting. That is an established fact. The Government inspectors of the port of New York know that, because the Navy has complained of the interference of the Wanamaker station."

Mr. Armstrong related how he had duplicated the conditions under which the Brooklyn naval station was working and set up some amateur apparatus and received messages from Arlington, while the Wanamaker station was sending, without the slightest interference. He then told the story of his negotiations with Government officials regarding the right for the use of his invention. He said that he had met Lieutenant Commander Hooper in Washington, who told him that the department did not pretend to know anything about patents. He received an offer for royalty on the few sets of apparatus which the Government manufactured themselves, but the Government officials refused absolutely to pay any royalty on the use of the apparatus, whether it was manufactured by the Government or by infringing manufacturers. Mr. Armstrong added:

"As I understand it, the length of time which it takes to get a case through the Court of Claims and the length of time which will elapse between the time the

Court of Claims rules and the time the money is appropriated by Congress is such that the ordinary inventor will starve before he can get any relief."

Among the most effective opponents of the measure was Professor Arthur E. Kennelly, of Harvard University, vice-president of the National Amateur Wireless Association, whose reasoning was along practically the same lines as those of Professor Pupin. "I am here," he said, "to urge my contentions that this bill should not be passed for a variety of reasons. in the first place, if there is one thing of which this country ought to be proud, it is that it has taken such a shining position in the world in regard to telephonic communication. I do not mean radio telephonic communication, because that is a very young art, although it is coming along; but I mean telephonic communication generally. It was this country that first established communication with France by telephone and with Honolulu by telephone, and there is no other country in the world that has any such telephonic record. And that has been accomplished because the telephonic art in America has been fostered and developed under free institutions and not under Government control. In those countries of the world where there is Government control of the telephone and telegraph, you will find them in a relatively backward state.

"The Navy says, 'We are bothered by interference. How much better is it for them to be bothered by interference in time of peace than to be bothered by interference in time of war. They say, 'Let us have no interference now; let us be comfortable and happy; and let us communicate with each other and with our brother officers on each other's ships.' But when foreign cruisers come over here, will they listen to such proposals? What happened off South America when the English commander, Admiral Craddock, was defeated in that fight? His wireless was jammed by his opponents. If he had had a superior wireless system, he would have been free from all radio hindrance and interference from his enemies. Now what we must have, for the sake of ourselves and the Navy, for the sake of all of us, is a system which will be free from interference. And you are going to produce a system which will be free from interference by saying in time of peace that there shall be no attempt at interference? It is easy to have no interference where a monopoly exists.

"I can remember, and I dare say my friends here remember, the early days of the telephone. You could not talk to your neighbor without hearing all the neighborhood. And that was a growing trouble. It was the haunting problem day and night of the telephone engineers—'What shall we do to get rid of this eternal eavesdropping of the world? It has been now so thoroughly eliminated you could hardly realize, from using the telephone today that there had ever been such a period. Why? Inventors came forward, all the brightest minds in the telephone art were stimulated to do something to overcome this difficulty.

"We want the Navy to be strengthened. It cannot be strengthened in this way. The right way to do is to have the Institute of Radio Engineers and a lot of bright lads all over the country working on these problems and coming forward and offering various means for

> "There has been some complaint made about the amateur operators interfering with Government stations. If the amateur had as much interference as I have heard referred to here, I thing we ought to drop out of the business. It is nothing for me to sit and hear a couple of little boys—they call them kids—chirping with a couple of little kilowatts a great distance away. I can even hear the League Island calling out 'Q R T,' which means 'shut up,' and 'Q R T X,' which means to 'get out of that.' Now if a little kid with a 1/6-kilowatt transformer can get in touch with the Navy Yard, believe me, I would like to see the Navy Yard talk."
>
> —*Frank B. Chambers, of the Wireless Association of Pennsylvania.*

> "After my patent issued, I received a communication from the Bureau of Steam Navigation stating that the bureau was informed that I was the inventor of a certain form of feedback circuit, and they requested information as to what steps they should take to secure the rights to use that invention. I went to Washington and met Lieut.-Commander Hooper. He told me that the department did not pretend to know anything about patents. He said it was the policy of the department, if possible, to settle claims of inventors. Then we talked business. I found that the policy of settling with the inventor was to offer him a royalty on the few sets of apparatus which the Government manufactured themselves. They refused absolutely to pay any royalty on the use of the apparatus, whether it was manufactured by the Government or by infringing manufacturers."—*Edwin H. Armstrong, Electrical Engineer and Wireless Inventor.*

preventing interference, and saying, 'I have a new scheme.' If it will serve, reward the inventor by giving him encouragement. But if you attempt to do away with interference under the proposed régime, you would stifle that enthusiasm absolutely."

Professor Kennelly pleaded with the members of the Committee for the encouragement of amateurs. "You can have this little army of amateurs," he said, "all over the country, listening in with their little wireless stations and hearing the pulse beats of the world, as it were. All these young men are thinking, and some of them will discover something which will be of benefit.

"I want to speak on behalf of the amateurs. It is not only the vested interests of the people who have put their savings into this enterprise for the benefit of the public; it is not only for the Navy, but it is on behalf generally of the amateurs of the country, for the young fellow who wants to communicate with his neighbors and utilize the atmosphere of the world—the circumambient ether, as it is called. It is he that I am thinking of: you will suppress him, too. So soon as you have scrapped and suppressed the commercial stations, you will still be bothered in the antiquated system in undisputed control of the Navy that no longer has interference from power stations—it will still be bothered by this man here and this little amateur there, and some officer will say he cannot get rid of that interference or that, when 'John Smith is talking in Washington we cannot hear ourselves talking in New York.' And so they will appeal again to Congress to stop the amateur, and there will be no use of the circumambient ether except such as the Navy department or some department of the Government wants."

Able representatives of the amateur wireless operators appeared in the person of Charles H. Stewart, of St. David's, Pa., and Frank B. Chambers, both of whom spoke on behalf of the Wireless Association of Pennsylvania, and also by special request of the radio associations of Germantown, the South Jersey Radio Association, of Collingwood, and the Atlantic City Association. These gentlemen protested vehemently against the bill as being detrimental to the best interests of wireless development, in that it would check the widespread and diversified work done by amateur investigators, whose encouragement would be ended could they not hope to obtain suitable rewards for their labors in behalf of scientific and technical advancement.

"There are a number of men," said Mr. Stewart, "belonging to these various associations that I represent, who are interested in this bill, because for a number of years past they have been operating stations in an amateur way. A great many of them have since graduated from the amateur ranks, some into the ranks of the Marconi Company and some in other lines of similar endeavor. Our association is somewhat at sea regarding this proposed legislation, in view of the fact that Commander Todd stated in the early part of the hearings that in no way was the status of the amateur affected by this bill. If we could agree with him in that particular, of course, we would be satisfied. However, there are certain paragraphs in this bill which we believe will change the status of the amateur, or at least are susceptible of changing the status of the amateur. We would be at the mercy of the Department of Commerce in the administration of the law. I refer particularly to section 14b, which provides for the closing of stations for periods of five months and successive periods of five months, without limit, entirely upon the discretion of the President in time of peace. Now the members of our association have no objection whatever, because they are all patriotic citizens, I am sure, to closing their stations in time of threatened war or public disaster or any similar situation. But the unlimited nature of this paragraph is such that any station in our judgment could be closed for successive periods of five years and no redress is provided in the bill. The question of compensation for the taking over of our stations is one that we had not considered necessary to think about, because in time of war there is no question, I feel sure, that practically all of our members would be a unit in coming forward and helping the Government in every way possible. And remember, gentlemen, that there will be a number of field activities in war time in which we will be needed, for instance, in aeroplane work and Army work and activities of that kind. Remember, also, that the commercial operator is a good Army buzzer and he can jump right into those positions in time of emergency, where there is an absolute need of efficient men in the Signal Corps forces. There are sufficient men in our organization to take care of any army of any size."

Mr. Stewart expressed the conviction that the natural enthusiasm of the amateur was absolutely necessary for the service. "I think," he added, "some of the managers of the Marconi Company know that to be a fact. Now as I understand, there was a letter read before the Committee by Mr. Maxim, of Hartford, Conn. Mr. Maxim is well known, and I believe he approves this bill, but he does not in any way represent the amateurs of our district. I confess I can not understand his attitude in favoring the bill, because of the possibilities. He may have some reason for favoring the bill which is not apparent to me. That is all I have to say."

Mr. Chambers, who appeared before the House Committee, said that he felt that if the commercial companies were put out of the field, the amateurs would lose interest. "If it had not been for the commercial companies in the first place," he asserted, "I doubt very much whether any amateur would have been interested at all. I do not think there would have been many amateurs. The amateur will exist only as long as there is something to be accomplished. The same was true of wire telegraphy when it was first invented. A great many men put up wires from one house to another to see if they could talk to each other and see who could do it best. As soon as the commercial wire telegraph companies arrived at a satisfactory condition, the amateur end of it fell off, and they went to work for these companies.

"I have been interested in playing with wireless sparks for about twelve years. I guess I am familiar with a great deal of the wireless apparatus that is being used to-day. There has been some complaint made about the amateur operators interfering with Government stations. If the amateur had as much interference as I have heard referred to here, I think we ought to drop out of business. It is nothing for me to sit and hear a couple of little boys—they call them kids—chirping with a couple of little kilowatts a great distance away. I can even hear the League Island calling out 'Q.R.T.,' which means 'shut up,' and 'Q.R.T.X.,' which means to 'get out of that.' The little kids have only a narrow field in which to work. I have heard the kids saying that they had caught the navy yard apparatus, and when I called up the navy yard to tell them about it, they would say they did not hear it. Now, if a little kid with a 1/6-kilowatt transformer can get in touch with the navy yard, believe me, I would like to see the navy yard talk. I can go into Philadelphia and pick you out some little boys, between fourteen and eighteen, who are not operators at all; at least they do not know they are operators, but they are. Most of them make their own apparatus. A lot of them find old junk around the house and put it together to make their sets with. I know some of them have made the sliders on their tuning coil out of a tomato can, and their sliding rods out of strips from stairways. If you could see some of that apparatus you would have asked what it was all for. It does not look like electrical apparatus. It looks as though, in house-cleaning time, mother had found a lot of stuff around the house and concluded that it was nothing and threw it aside, and it landed on the table, and the boys had got some wiring and made an apparatus out of it. Those little fellows can sit down there and do work that surprises the men.

"How about when the navies of foreign countries come over here to our shores? Are they coming over with one-quarter kilowatts or two kilowatts? No. They are going to come over here in great big battleships with 6-kilowatt and 10-kilowatt apparatus, such as the British ships have been been using right here in our waters. And suppose they come to our land stations, what is going to happen to our apparatus? Why, gentlemen, these complaints are ridiculous!

"I do not know where the fault lies. It is either with the apparatus or the operators. I know a fellow who was working with the Marconi Company, and he got fired. I asked him, 'What did you get fired for?' He said, 'I could not get the stuff.' Now a fellow reports to the Marconi Company that he could not get his message because the navy or an amateur or a couple of kids interfered with, his work and says, 'Well, I did not do much this week; too much interference.' He is fired. That is the end of him. I do not believe they would let him live a week on the job.

"Of course, that is the amateur way of looking at it. They talk about this amateur business. Let the inventors go along and make all the money they can. If the navy yard fellow will only get busy and get a little buzzer and practice up on this interference proposition, we ought to be able to get back at these Marconi men. That is all I have got to say."

Hiram Percy Maxim, whose endorsement of the bill occasioned such surprised comment by the representatives of large amateur organizations, is himself president of the American Radio Relay League. In his letter to the Committee he stated that he had carefully considered the proposed radio bill and desired to go on record as approving those parts which concerned amateurs, because he believed their enactment into law would reduce radio interference.

"The American Radio Relay League, of which I am president," wrote Mr. Maxim, "is an organization of approximately 5,000 amateur radio station owners scattered in all the states of the Union. I recognize that the proposed bill will confer greater powers upon the Navy Department, Department of Commerce, and upon the President in dealing with us amateurs; but I believe these greater powers will help our work rather than retard it. These authorities can not but appreciate that it is from the ranks of us so-called amateurs that the talent necessary to carry on both Government and commercial radio work is principally drawn; that we amateurs and the many manufacturers whom we support have been the source of several valuable improvements in radio science, and that in time of public need our well-organized relay trunk lines and our very efficient stations in the various states of the Union might easily be of incalculable value to our country."

Mr. Maxim's approval of the bill and his belief that it will be of service to wireless work are inconsistent, in view of the testimony of distinguished expert authority that the taking over by the Government of the commercial stations would lessen the future usefulness of the commercial companies, and the enthusiasm of amateurs in wireless. Mr. Maxim states that he represents practically 5,000 amateurs, but available information shows that the membership of the League does not begin to approximate that number, and it is public knowledge that the National Amateur Wireless Association is stronger than all other amateur organizations combined. He does not say who these 5,000 members are; but they certainly are not members of the League.

On the whole, a review of the testimony delivered before the Committee would seem to indicate that the experts and the commercial men had the better of the proponents of the measure. They demonstrated conclusively that the proposed bill has within it the seeds of radical and untried steps; that it embraces features which have not won the approval of the public, such as Government ownership and confiscation of private property. One of the most telling features of the testimony advanced lay in the acknowledgment that private business enterprise and amateur enthusiasm would be eliminated from the wireless field should the proposed measure eventually become a law.

VESSELS RECENTLY EQUIPPED WITH MARCONI APPARATUS

Names	Owners	Call Letters
Freeport Sulphur No. 2	Freeport Sulphur Transportation Co.	KRG
Santa Rosa	W. R. Grace & Co.	WBO
Tug John Scully	Scully Line, Inc.	KVT
Holden Evans		(Not yet assigned)
Southerner	Southland Steamship Co.	KJH
Sherman	Chile Exploration Co.	KMQ
Maui	Matson Navigation Co.	WMR
Iquitos	Rocco & Miller	OBY
Joaquim Mumbru		ECX
United States	Colonel E. H. R. Green.	KZU
Winterswyk		PIS

THE SHARE MARKET

New York, February 7.

Bid and asked quotations in Marconi shares today:

American, 2⅝-3; Canadian, 1⅞-2¼; English, common, 12-16; English, preferred, 11-15.

The furthest north radio station on American soil now open and doing business, according to a newspaper report, is operated under the auspices of the federal bureau of education at Norvik, on the Kobuk river.

It is reported that the bureau of education has under consideration the erection of another wireless station at Barrow.

TACOMA'S GIRL OPERATOR

The first girl or woman in the Northwest to receive a Federal wireless operating license is little Miss Winnifred Dow, of Tacoma, who is also said to be the second of the feminine sex on the Pacific Coast to receive such a permit.

Miss Dow is fourteen year's old, and a student at the Visitation Academy. She constructed nearly all of her own wireless set, and expects to build a transformer that will give her station a long sending radius.

A dispatch from Salonica says the Greek Government has constructed hastily a wireless station at Larissa, and is in communication in code with Berlin.

The Wireless Storm Detector

Its Influence Upon the Operation of Lighting Central Stations

By W. H. Lawrence, Superintendent Waterside Stations, New York Edison Company

W. H. Lawrence

Note: Unexpected overloads have always been a source of danger to central station apparatus and sudden storms have embarrassed central station engineers to such an extent that some of the largest lighting stations keep a man posted on the roof to give warning of their approach. In this article from the General Electric Review the author, after citing the load conditions in the New York Edison stations, describes a most ingenious storm detector used by that company. The simplicity of construction and the effectiveness of operation are two notable features of this device which employs the principles of wireless telegraphy.

SUCH public utilities as those supplying gas and water are fortunate in that the commodities they distribute are physical materials. During those parts of the day when the demand for their product is small, the excess delivered from the station can be economically stored in a reservoir for use at later periods in the day when the demand is greater than the capacity of the station.

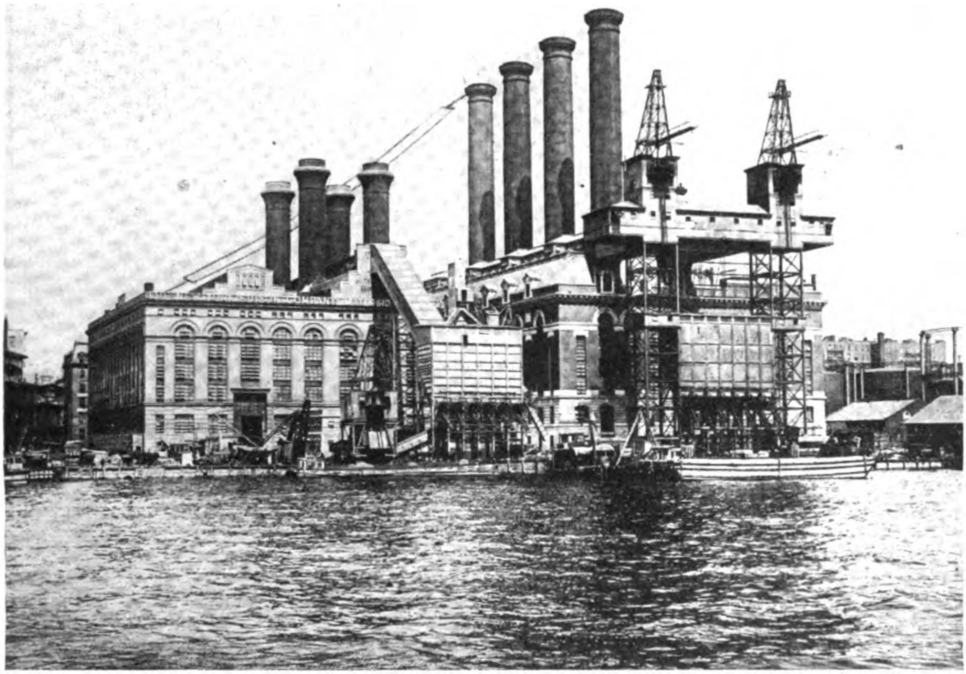
The public utility that distributes electricity, however, cannot be modeled profitably after this plan on account of the properties of the commodity that it handles.

Electricity, like light and sound, is not a physical material and therefore can exist only as long as the influence of its generating source continues. This property renders it impossible to directly store or preserve electricity for future use. Although such an end may be indirectly accomplished by the use of storage cells, which convert the kinetic energy carried by the current into potential chemical energy and later carry out the reconversion, the efficiency of this method is very low. For this reason, the use of storage batteries in supplementing the generation of electricity has been restricted to such purposes as involve the nomically avail themselves of the use of a reservoir which may be charged with the excess energy of the station at light load periods and discharged to assist the station at the heavy load periods, have to be designed with a capacity equal to no less than the maximum demand upon them. This factor of an installed station capacity at least equal to the maximum peak load is the greatest financial handicap to which an electrical station is subjected. That this condition is unavoidable has long been recognized and accepted by our business men and engineers.

The variations in the load which are demanded of a lighting station during the day and the characteristic difference between the summer and winter loads are shown by Figures 1 and 2, in which Figure 1 is a typical load curve for a summer day and Figure 2 one for a winter day. (A typical load curve for the month of March is shown in Figure 3. It will be noted that the time at which the peak occurs lies between the hours of the winter and the summer peak.)

Since it is only during the peak load of the day that the whole equipment of the station is working, it is evident that the return on the entire investment during the remainder of the day must be earned by that portion of the equipment that is then operating.

This is a condition that makes it highly imperative that an electrical station be operated with maximum economy throughout the entire day. Given a certain station equipment, this is mainly accomplished by a strict adherence to a regular daily routine. Thus, at any period of the day only that number of machines is operated which is sufficient to economically carry the load then existing. At times of light load or average load, a steam-driven station will have a large share of its boilers "banked" and a number of its generating units idle. When under such a condition a large unexpected demand for an increased output may



Waterside stations of the New York Edison Company with aerial indicated

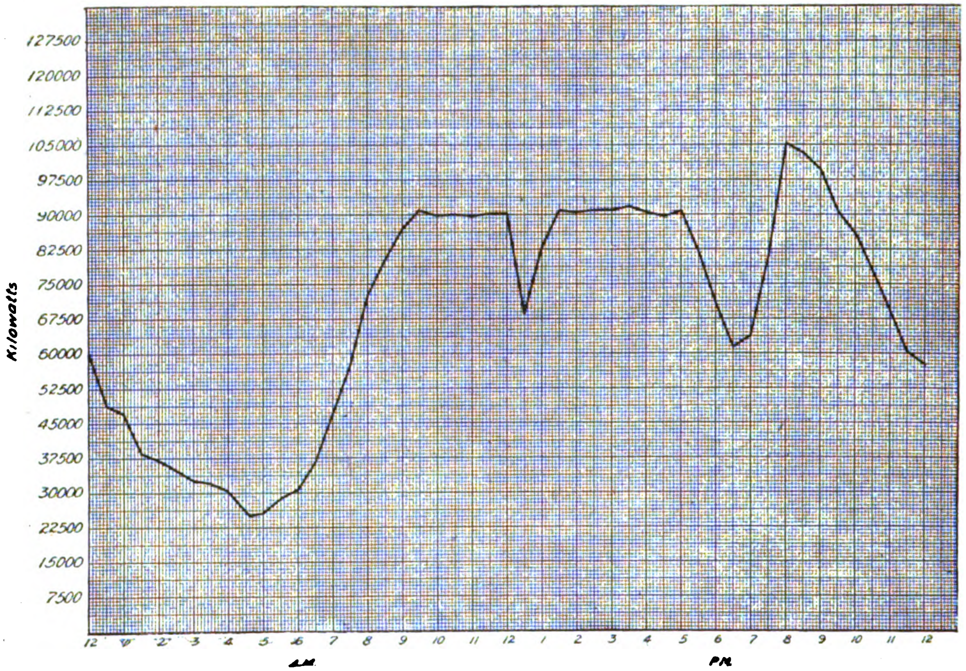


Figure 1.—A typical load curve of a lighting central station for a normal summer day (1913)

furnishing of a reserve to safeguard the service against interruption when some accident temporarily affects the generating, transmission or transforming systems.

Electrical stations, being unable to eco-

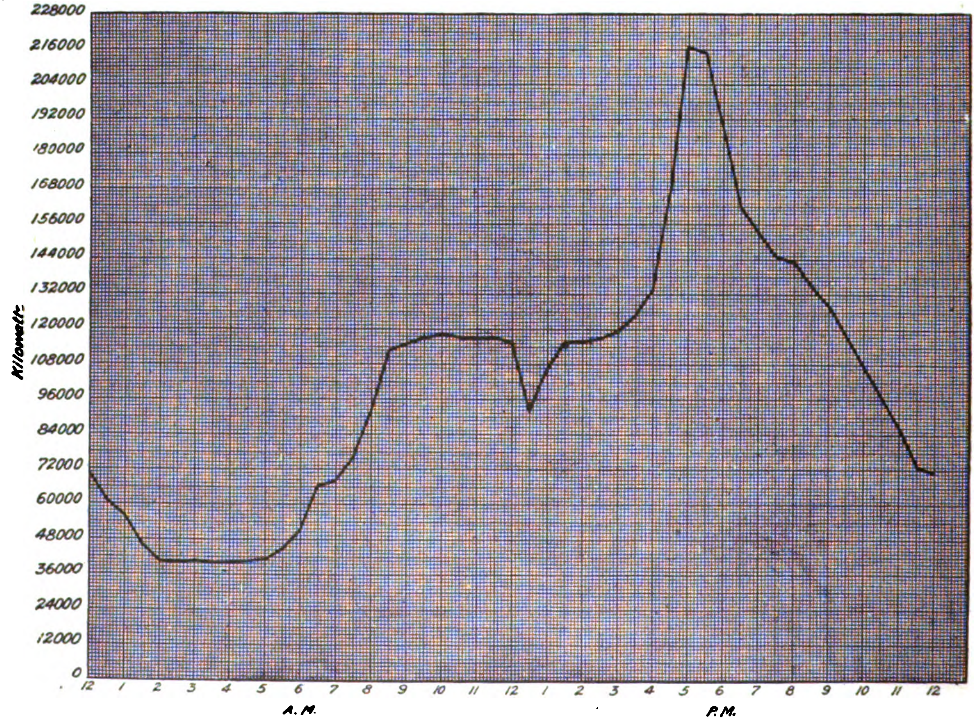


Figure 2.—A typical load curve of a lighting central station for a normal winter day (1913)

be made so suddenly that the number of machines which are operating will be insufficient to carry the abnormal demand, and it is probable that the standard of service will be lowered until such time as reserve boilers and generating units can be brought into service. For this reason it is imperative that the station receives preparatory warning of any abnormal demand.

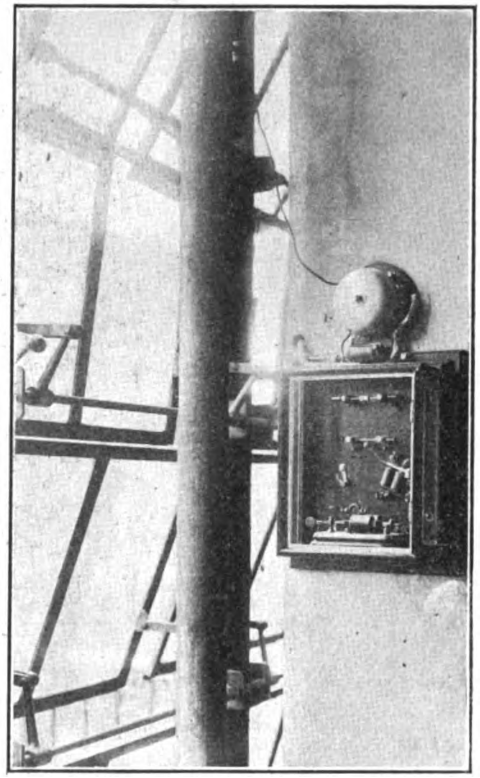
The rapidly moving clouds which accompany a storm constitute the principal cause for the sudden and unexpected increases in the demand for current from a lighting station. The effect which a sudden and heavy storm may have upon the station's output is shown by the sharp peak at the 3:35 p. m. point of the curve in Figure 4. This is a record of an actual occurrence which took place during the month of March, 1911. It will be noted from this curve, and by a comparison with that of Figure 3, that the demand at 3:35 p. m. is 73 per cent. greater than it would have been had there been no storm. An increase of 49,500 k. w., in this instance, was called for in about 5 minutes, which gives a good idea of the severe demands that may arise and which a lighting station must be prepared to meet.

Any device, therefore, that will provide a warning of the approach of a storm, at a time sufficiently far in advance to enable the station attendants to prepare for the exception to their daily routine in a deliberate and orderly manner, would be most welcome.

The storm detector is such a device.

All summer storms, or practically all of them, are accompanied by electrical disturbances in the ether. These cover a field far greater than that over which the storm clouds themselves are visible. By use of antennæ, some of these radiations may be intercepted and by a suitable apparatus be made to give an indication of not only the presence but also the relative proximity of the storm.

The storms that occur during the winter months are usually snowstorms and are of but a weak electrical nature. For this reason, they may perhaps not affect the device. At this season, that is a matter of but small moment. In winter, the load upon the stations during the daylight hours is uniformly greater than during the summer and the demand regardless of the severity of the storm will always be from 20 to 25 per cent. less than the demand which occurs daily between 5 and 5:30 p. m., for which the station is always prepared.



Receiving apparatus of the wireless storm detector

This is evident when it is considered that winter storms have no effect on street lighting and other outside lighting, sign lighting, residence and apartment-house lighting, etc., all of which are on at the time of the daily peak at 5:00 p. m. For this reason, winter storms are of such minor importance that the service of the storm detector is dispensed with during that season.

The various parts making up the detector are an aerial, a short-circuiting switch, a spark gap, a coherer, a relay and battery, a bell (which also acts as a decoherer) and battery, a condenser, and a ground connections. Figure 5 shows the diagram of connection of these parts.

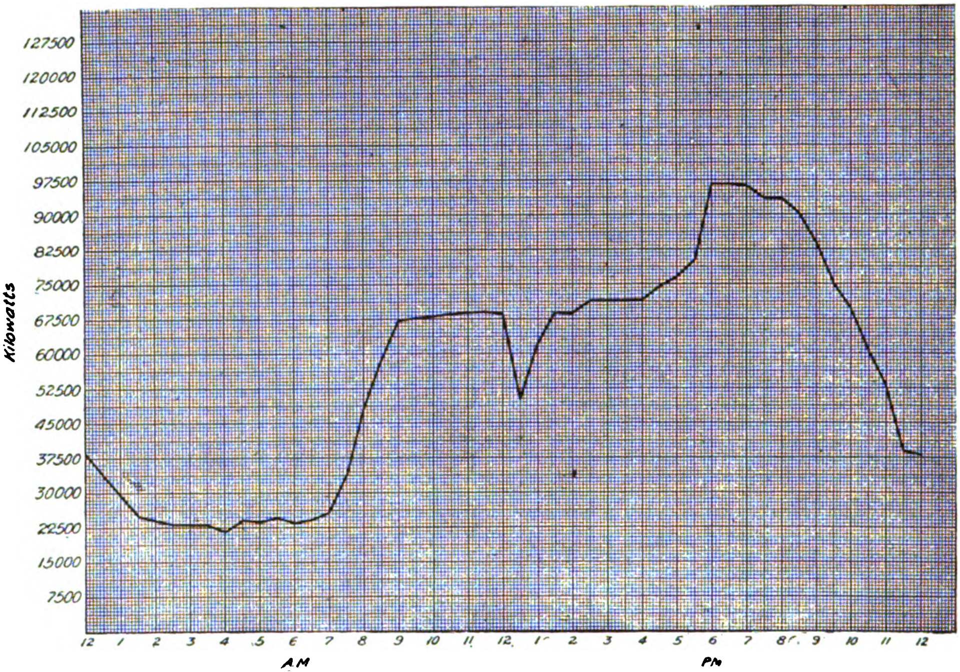


Figure 3.—A typical load curve of a lighting central station for a normal March day (1911)

Aerial: Antennæ, similar to the more simple ones used in connection with wireless telegraph outfits, have been found to serve the purpose admirably. It

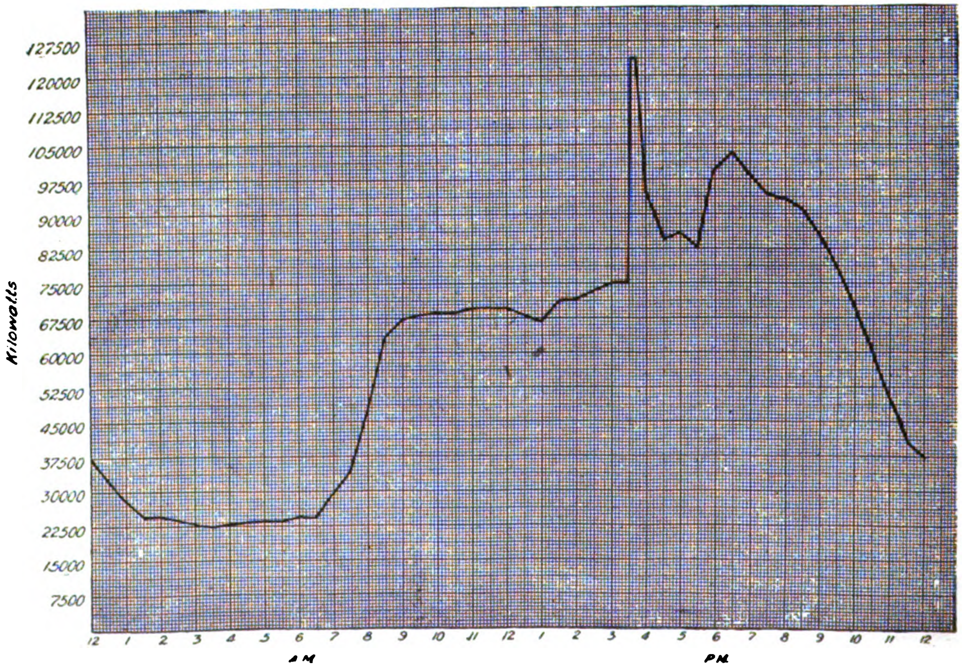


Figure 4.—An example of a load curve of a lighting central station for a March day (1911) *during which a severe unexpected storm took place at 3:30 P. M. But for the abnormal peak occurring because of this storm, the curve would be similar to that of Figure 3.*

is this part of the equipment that receives the ether radiations resulting from the storm.

The oscillating current thus set up travels to and from the ground through the spark gap, coherer, and condenser.

Short-Circuiting Switch: This switch and its connections are shown in Figure 5. Nominally, it is kept in the "open" position. After the alarm bell has begun to ring continuously, it is closed to protect the apparatus from heavy surges and to silence the bell.

Spark Gap: This consists of a simple gap with spherical terminals placed approximately 1/64 inch apart. The purpose of this gap is to prevent those surges that are induced in the antennæ by the radiations emanating from wireless telegraph stations, but which are very weak as compared to the lighting disturbances, from flowing through the remainder of the apparatus and thus causing a false alarm.

Coherer: This is also patterned after the type of the simple ones used in the early days of wireless telegraphy. In brief, it consists of a short section of glass tube of small bore loosely filled with nickel-silver filings. These are connected at each end to the outside circuit by German-silver plugs. The action of such a type of coherer is well known and needs no further explanation than to say that it acts as a high resistance to the low-voltage battery current impressed upon it until a high-frequency discharge current, between aerial and ground, has passed through it. This high-frequency current effectively lowers the coherer's resistance to the battery current, which consequently allows a greatly increased battery current to flow through the tube. The resistance of the tube then remains unchanged until it is violently jarred, at which time the high-resistance property returns.

Relay and Battery: The most effective type of alarm is an audible one, of which the simplest form is a bell. However, as a bell requires a greater amount of current for its operation than that increased amount of battery current which is caused to flow in the coherer by a high-frequency discharge, some magnifying or relay device must be used. The relay employed is one of the ordinary telegraph type and the battery B_1, Figure 5, is of dry cells. The connections are given in Figure 5.

Bell and Battery: The bell is one employing single-stroke connections and is of a size sufficient to be easily heard throughout the system operator's office. (The coherer, relay, condenser and bell are located in this office.) The bell has its own supply battery of dry cells, B_2, and is controlled by the secondary contacts of the relay, as shown in Figure 5.

As the low-resistance condition into which the coherer is thrown by a high-frequency discharge is permanent until the tube is severely jarred, the bell is mounted so that its clapper will strike the tube and thus perform the two-fold function of bell and decoherer. (It is evident that the tube must be decohered, otherwise it would not show the effect of a later high-frequency discharge.)

Condenser: The condenser is an ordinary one and is inserted in the ground wire to prevent stray direct current from flowing in the apparatus.

Ground Connection: This connection completes the high-frequency circuit from aerial to ground.

The operation of the apparatus comprising the storm detector leaves practically nothing to be desired. The manner in which it enters into the activities of a steam station will be described, as it is perhaps to such a station that it is of the most benefit.

It will be remembered that the bell or decoherer, together with the coherer and relay, are located in the system operator's office.

It is the duty of the system operator that he keep continuously posted on the demands that are or may be made upon the station for power and to so direct the disposal of all the generating machinery that the station will afford the highest quality of service and will operate with the maximum degree of economy. In detail, the latter function he performs by orders to the boiler room specifying how many boilers shall be maintained under load and how many shall be carried "banked," by instructions to the generating room as to which machines shall carry the load and which other units and auxiliaries shall be held idle or in readiness, and by orders to the various switchboard operators as to which feeders shall be used in the disposition of the output.

Under the usual daily conditions of operation the demand which will be made upon the station from hour to hour is accurately known, for the variations of the load curve constitute a daily cycle. These regular changes of load, being anticipated and taken care of by orders from the system operator, become a matter of station routine.

In order to secure smoothness of plant operation, the system operator is informed of the unusual departures from the regular load curve that are to be expected, *e. g.*, exhibition lighting, etc., and also of the weather forecasts. All such is of great assistance in aiding good management. Those unusual irregularities of whose coming he is reliably warned present no difficulties. It has been found by operating experience, however, that the weather forecasts come far from providing a reliable and early warning. Further, the reports are not couched in such terms as furnish the system operator with the information that is of paramount importance to him, viz., the rapidity, in hours, of the approach of the storm.

It is true that the number of severe storms which come over a city with extreme rapidity is much less than that of the slower moving storms, but, on account of their tremendous capacity for suddenly deranging the orderly routine of the lighting station and perhaps even affecting the standard of its service, the fast moving storms make it requisite that all are to be guarded against.

Assume, for instance, such a storm to be approaching a city in which is located a lighting station that possesses a storm detector.

At a time varying from 2 hours to 7 hours before the actual storm clouds reach the city (depending upon whether the path of the storm is a direct or a round-about one), the alarm bell will begin to strike at intervals of from 5 to 15 minutes. The system operator regards this merely as the warning of the possible approach of a storm but gives it no further attention, for the storm may change its direction and pass off without molesting the quiet weather conditions of the city.

The disturbing conditions by their further approach cause the bell to ring oftener. With the storm but about two hours' travel away, the bell will strike about once every half-minute or every minute. When this occurs the system operator orders the reserve boilers into service, the auxiliaries of such generating units as he deems may be required

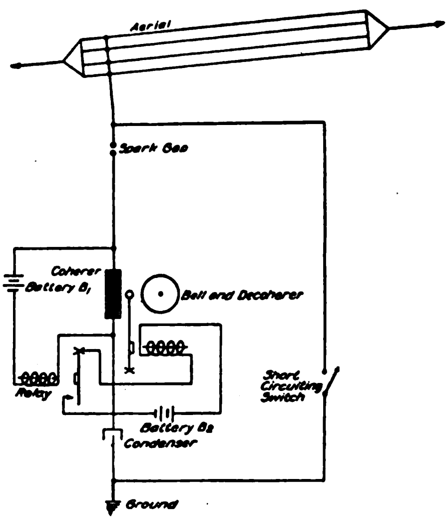


Figure 5.—Complete diagram of connections of the apparatus comprising the storm detector

started, and the generating units themselves run at low speed.

These conditions prevail until that later time when the bell gives an insistent warning by uniting its periodic strokes into a continuous ringing. This will ordinarily occur at about one-half hour to one hour before the storm reaches the city. It has been found quite often that even at this time the sky will remain clear and unclouded to the eye, which shows how much superior are the services of a storm detector to those of a watchman stationed upon the roof to observe the conditions prevailing in the sky. (This latter practice was the best one available prior to the development of the storm detector.) The switch short-circuiting the detector is closed when the bell begins to ring continuously to protect the receiving apparatus, for the storm will now be comparatively close, and to silence the bell for its warnings are no longer needed, since it is positively known by this time that the coming of the storm is a certainty. Simultaneous with this action goes the order to synchronize the incoming generating units with the bus. Everything is now in readiness to supply the increased load which will be demanded in but a matter of minutes.

The following are actual records of the frequency of the bell warnings and the loads existing at various times preceding two storms last year.

July 28.

1:45 p. m., 1 bell.

2:15-3:30 p. m., 1 bell every ½ to 1 minute.

3:30 p. m., bell began ringing continuously, load 96,000 k. w.

4:15 p. m., (very dark, heavy rain storm), load 142,500 k. w.

August 1.

8:25 a. m.-2:00 p. m., 1 bell every 3 to 5 minutes.

2:02 p. m.-2:15 p. m., 1 bell every ½ minute, load at 2:00 p. m., 100,000 k. w. (cloudy).

2:15 p. m.-3:20 p. m., bell ringing continuously.

3:45 p. m., load 150,000 k. w.

The storm detector as described is in service and located in the office of the system operator in the Waterside stations of the New York Edison Company. These stations so far as it is known are the only one possessing a device of the same nature.

The field for such a device among steam-driven lighting stations would seem to be in the larger cities, particularly in those which possess crowded office districts as it is the load derived from such a source that is most sensitive to changes in daylight.

A field in which it would also seem that the device would furnish valuable service is that of keeping the isolated hydro-electric station informed as to the weather conditions existing in the distant cities which it is supplying with lighting current. The places of generation and consumption being so far separated, a visual observance of the weather conditions at the power plant would be of no use. By means of storm detectors located in a few of the widely separated towns, which receive lighting current from the station, the attendants may keep forewarned by a bell in their station as to the irregular demands which may be made on them by storm clouds passing over those distant towns.

AEROPLANE SETS ON VIEW

At the First Pan American Aeronautic Exposition, held in Grand Central Palace, New York City, February 8 to 15, serious consideration was given to radio equipments for aeroplanes and balloons. A large space was set aside for the exhibition of different types of sets, such as are used now in the European countries for directing the artillery from aeroplanes, for interfering with stations and for long distance communication by observers. There were also models of the different types of wireless equipments using direct and alternating current generated by small dynamos which get their power from the air by means of a small propeller. The Marconi Company was invited to exhibit the set which was recently purchased by the Navy Department for hydroaeroplanes. This instrument has 1 k.w. capacity and it is stated that ranges up to 300 miles will be obtained. The total installation weighs within 100 pounds. Other sets were made by the Sperry Gyroscope Company, DeForest Radio Telephone & Telegraph Company, William Dubilier, Wireless Specialty Apparatus Company, Cutting & Washington, Manhattan Electric Supply Company and A. B. Cole. Operators were supplied by the East Side Y. M. C. A.

The government of India, it has been announced, will extend its wireless system until every army post has a station in charge of a trained officer.

General Advice For The Amateur Experimenter

By Elmer E. Bucher

THE article for this series published in the January issue, contained information regarding several important problems met with by the amateur wireless operator, and it may be helpful to continue the discussion, pointing out additional means and methods whereby such vexed questions can be solved.

Beginning with the transmitting aerial, let it be understood that it should never be erected parallel to power, telephone or telegraph wiring. Because of the voltage of current flowing in the transmitting aerial and the corresponding magnetic and static fields set up thereby, rather high voltages may be induced in these wires with consequent injury to the apparatus to which they are connected.

The rule to follow is to erect the aerial as far as possible from all exposed wires and always let the antenna bear a right angle to them. The inductive effects will then be at a minimum, although telephone circuits may still be interfered with. One experimenter, an acquaintance of the writer, had a transmitting aerial parallel to his house telephone wires which not only picked up enough current to interfere with conversations over the telephone, but also interfered with several telephones in the neighborhood as well. The interference of the transmitting set was almost completely eliminated by employing a lead covered twin copper conductor to connect the house phone to the junction box, the lead sheathing being connected to earth.

A means of permanently eliminating induction troubles of this kind is to place all wiring within 300 feet of the transmitting aerial in metallic conduit under earth. This is a sure, although expensive, method. Being well aware that in many instances, this action would not be permitted, even if possible, we can offer but little comfort to the experimenter who must now content himself with receiving experiments alone.

Speaking of the aerial insulation, it is important that the insulators at the far end of the flat top portion of the antenna have considerable length as well as a high degree of specific insulation. Porcelain has not proven satisfactory as an insulator at this point, because of its tendency to absorb and hold water. Glass or hard rubber insulators seem to maintain their insulating qualities over a greater period than other materials and they are therefore favored. It should be remembered that hard rubber rods, 2 feet in length, are used by commercial wireless telegraph companies for insulation of the aerial wires, and the amateur would do well to follow suit. For amateurs' use these rods should be at least 1 foot in length, 1 inch in diameter. One should be attached to each wire and then to the spreader.

There is frequently some argument concerning the spacing of the wires of an aerial. Generally there is no advantage in exceeding a space of 3 feet between wires and therefore, a four-wire aerial requires a spreader about 9 feet in length. This spreader is preferably made of spruce or bamboo. If made of spruce it should be 2 inches in diameter at the center, tapering to 1½ inches at the ends. Very wide spacing of the wires is only of advantage where the flat top portion of the antenna is exceedingly limited in length.

Regarding the insulator carrying the lead-in wires to the instruments: A hard rubber tube protected from dampness by a cone-shaped metal water drip fulfills all requirements. The lead-in wire may be brought out to the center of the tube and made water-tight by filling the space between it and the walls with melted sulphur. When this sulphur hardens it will make the hard rubber tubes water-tight.

Communications are often received from amateurs regarding the performance of this or that make of high voltage transformer supplied to the amateur market. Some of these questions refer to the overall efficiency, the probability of burn-out and whether or not the lights will flicker when the transmitting key is closed. Although we endeavor in the interest of our readers to obtain general information concerning the different types of transformers, we have not always been able to obtain detailed replies. The logical course to take in cases of this kind, is to apply directly to the manufacturer for the desired information. If it is withheld a full report should be made to The Wireless Age and an attempt will be made to obtain it.

Cases in which a 60-cycle transformer was sold to the amateur when the current supply in his locality happened to be 125 cycles, have been frequently brought to our attention. This, of course, resulted in a decrease of efficiency in the transformer and did not give the desired output. The manufacturer is not to be blamed for this error because it is up to the purchaser to first ascertain the frequency of the local current before placing his order. In fact he would do well to study the fundamental principles of amateur wireless telegraphy before purchasing a single instrument, thereby saving himself no small amount of trouble when it comes to the insulation of the apparatus.

Advantage of the Open Core Transformer

The advertising columns of electrical magazines indicate that the general trend of the amateur manufacturers is in the direction of the closed core transformer, but the uninformed experimenter hears a series of arguments from other sources in favor of the open core type and is often at a loss to decide which type to purchase. That this is a much disputed question among the experimenters we have ample proof, and therefore it may interest some to learn our opinion regarding the subject. Properly designed, the two types of transformers are equally efficient, but the closed core type requires less material and is cheaper to build; herein lies the secret of its popularity among the manufacturers. The closed core type, however, is *not* the least difficult for the amateur to construct, as many of our readers have found by experience. Ask any experimenter whether he prefers to cut out a number of iron laminations for the closed core type or whether he does not consider it much easier to construct a straight iron core of a bundle of fine iron wires. He will undoubtedly reply that he not only finds the core of the open core transformer less difficult to construct, but that it is also much easier to place the windings of the transformer in position.

The Ideal Set

Due to the fact that the condenser in the closed oscillation circuit of a wireless telegraph set is limited to .01 microfarad, maximum, and that a more practical value is approximaetly .008 microfarad, we are in a dilemma when designing a transformer for the maximum power rating for use with a 200-meter set. To consume more than ½ k. w. at a frequency of 60 cycles, it is necessary to employ secondary voltages in the region lying between 18,000 and 20,000 volts. The objections to high voltages at the secondary are: (1) the strain on the condenser, (2) the strain on the insulation of all radio frequency circuits, (3) the increased strain on the condenser plate, (4) the necessity for a larger condenser. In addition to the foregoing objections in case a simple plain spark discharger is employed, a spark gap of excessive length is required to keep the spark free from the arc. This introduces excessive damping in the closed oscillation circuit and lowers the efficiency. The last two disadvantages may be done away with by the use of a non-synchronous rotary spark gap which not only helps to eliminate the arc of the transformer, but at the same time permits the use of a short discharge gap. Summing up the foregoing, the reader should have no difficulty in determining what in our opinion constitutes the ideal 200-meter transmitting set. It is one consisting of a ½-k.w. 18,000 to 20,000-volt transformer, a high potential condenser arranged for series parallel connections, a non-synchronous rotary spark gap designed to give about 300 breaks or spark discharges per second, and an inductively-coupled oscillation transformer.

High Potential Transformers

The principal trouble with high potential transformers seems to have to do with the flickering of lights and the failure of the transformer to give a clear spark discharge with capacity of less than .01 microfarad. It is in order for the manufacturers to design a 60-cycle transformer for a capacity of .008 microfarad that will not cause the lights to flicker throughout the entire neighborhood when the transmitting key is closed. In fact they should design a constant current transformer, one whose primary self inductance remains practically constant under the conditions imposed by the discharge of the condenser across the spark gap. Incidentally, the transformer should function independently of an external reactance and the latter should only be supplied in case a variation of the power is required.

We now come to the problem of inside wiring. In the majority of cities the installation of power appartus is governed by the local electrical code which generally requires that the wires be placed in metallic conduit. This precaution not only introduces a factor of safety but also protects the power circuit, the meters, the house wiring fixtures, etc., from electro-static induction set up by the wireless transmitter. Power switches that are apt to arc when the circuit is broken should be enclosed in metallic boxes. Low potential wires should always be placed at right angles to and at a distance from all high voltage circuits. Dangerous parts of the radio frequency circuits should have markers to protect those ignorant of the laws of electrical current from accidental contact.

A considerable number of readers inquire from time to time concerning the size of the wire for connecting up the transmitting and receiving circuits. Data for the wiring of the high potential transformer can be obtained from the local inspector's office in any city. The circuit from the secondary winding of the high voltage transformer to the condenser need have wire no larger than No. 18 bell. The primary circuits of the transformer should be wired up with No. 10, No. 12 or No. 14 single braid rubber-covered wire. The receiving apparatus can be connected up with annunciator wire or rubber-covered No. 18 B. & S. wire.

The circuits of radio frequency should be connected with No. 4 or No. 6 stranded wire while the oscillation transformer should be made of either copper tubing, stranded wire or copper strip. The earth lead for transmitting sets should be one of considerable current-carrying capacity. The underwriters, as a rule, require an earth lead from the lightning switch of No. 4 copper wire, thoroughly insulated from the building. If it is connected to water pipes it must be attached to the street side of the water meter. If No. 4 stranded wire is not available for this purpose, the amateur should wind up a cable of a dozen or more smaller wires, making sure to have them practically of identical length. also the lead-in wires from the flat top portion of the aerial to the apparatus in the station should have conductivity equal to the wires of the flat top portion.

Power wires inside the station carrying alternating current should never lie parallel to any part of the receiver circuit wiring. Otherwise a humming noise may be set up, seriously interfering with the reception of weak signals. Care should be taken to see that the receiver wiring is not placed close to any part of the closed oscillatory circuit as disastrous potentials may be induced therein. It may be said finally in connection with wiring up of a station that simplicity is the keynote of success and that every possible effort should be made to simplify all circuits and connections throughout the entire installation.

Range Determination

There is no better way to determine the range of a wireless station, mathematical formulæ notwithstanding, than by actual experiment. It is a foregone conclusion that an owner of an amateur set has some knowledge of the telegraph code and therefore to determine his receiving range he can do no better than to listen to stations actually transmitting, noting their call letters at the termination of a sending schedule. By referring to the Government call list, the name of the particular ship or shore station is at once obtained; reference to a map permits an approximate measurement of the distance between the two stations and the range is at once determined. The position of vessels can be obtained from the ship's position report, which in some instance is sent twice daily, and this will permit the receiving operator to measure on the map the distance intervening between the ship and his station.

In the same manner the range of the transmitting station is obtained. By reference to the Government call list and the list of additional amateur calls published each month in the Monthly Service Bulletin of the National Wireless Association, nearby stations can be located and a schedule for making tests arranged by letter. These tests can be gradually extended to include greater distances until the maximum possible range is obtained.

In connection with these experiments it should not be forgotten that the range of a 200-meter station is considerably greater after dark than during the daylight hours; therefore to attempt to carry out such tests in the daytime, would be useless.

(To be continued)

License for Carranza's Operator

To a slip of a girl from Mexico—Maria Dolores Estrada—belongs the distinction of winning a commercial wireless operator's license of the first grade. At the age when many girls in this country are just leaving home for boarding schools, Maria was watching men kill each other in frenzy of battle. She has known what it is to languish, starving and without water, in one of those horrible Mexican prisons; and she has hidden, terror-stricken and alone, while the terrible Villa and his more terrible bandit followers, have searched from house to house to find her.


The United States of America
NUMBER 12015
DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
LICENSE
TO
RADIO OPERATOR, COMMERCIAL FIRST GRADE
This is to certify that Maria Dolores Estrada
has been examined and passed, pursuant to the Radiotelegraphic Convention, in
(a) adjustment, operation and care of apparatus;
(b) transmitting and sound reading at a speed of not less than twenty words a minute Continental Morse;
(c) use and care of storage battery or other auxiliary;
(d) knowledge of international regulations and Acts of Congress to regulate radio communication,
and is hereby licensed as required by law a Radio Operator Commercial First grade for two years. The candidate's practical knowledge of adjustment was tested on a theoretical set of apparatus. His knowledge of other systems is shown below
Not tested
Radio Inspector in Charge.
WILLIAM C. REDFIELD, Secretary of Commerce
E. T. CHAMBERLAIN, Commissioner of Navigation
Washington, D. C. October 21,

For two years before she came to Washington she served on the official staff of General Venustiano Carranza, first chief of the de facto government of Mexico and leader of the rebellion against Huerta. When she arrived in Washington, about a year ago, she could not speak a word of English. Her father having died when she was only twelve years of age, she had learned telegraphy and at fifteen was a government telegrapher in Zacatecas.

Eventually she came to the attention of Carranza, who employed her at once as his private telegrapher on his official staff. Then the first chief decided that she should come to the United States to learn English, and she entered the Fairmount Seminary as official ward of the Mexican government.

But Maria wanted more than a knowledge of English. She heard that by using her spare time she could add to her knowledge of telegraphy a knowledge of wireless telegraphy.

How she applied herself is mutely testified to by the certificate which was issued to her on October 21.

Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE III

IT will be seen from the previous treatment of the subject of radio telephony that a complete one-way installation comprises a generator of practically sustained waves at the transmitting station, a means for controlling or modulating the output thereof, an antenna and ground system for radiating a portion of the modulated energy; and, at the receiving station, an antenna and ground system, and a radio receiver with or without suitable amplifying devices.

It is proposed to consider first the various types of sustained wave generators which may be used in radio telephony.

6. **SUSTAINED WAVE GENERATORS. (a) ARCS.** For the sake of completeness, we shall give here a description of the theory of the arc and its historical development from one of our earlier papers:

"The simplest generator of radio frequency oscillations of considerable power is the Duddell-Poulsen arc. In Figure 12 is shown the arrangement used by Duddell. *G* is a direct current generator, *R'* is a resistance intended to control the arc current, and *L'* a choke coil intended to keep the alternating current out of the generator and also to steady the supply voltage. *K* (for the Duddell arc) has solid carbon electrodes. *L*, *C*, and *R* are inductance, capacity, and resistance inserted in the arc shunt circuit. Their values should be carefully chosen.

"If the arc be lit, it is found that an alternating current appears in the shunt circuit, and if the frequency of this current is within the limits of audibility, a pure singing tone will be heard."

The arc differs from ordinary conductors in one essential respect. If we divide the potential difference (or voltage) at the terminals of an ordinary

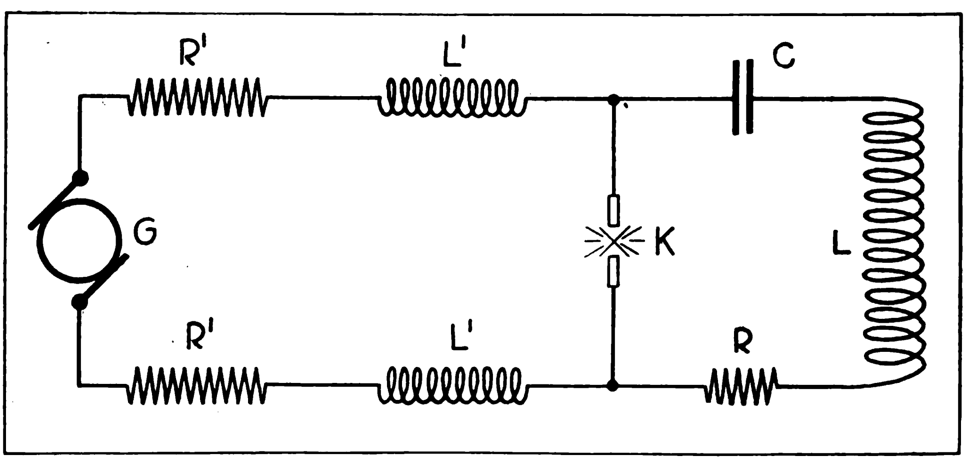


Figure 12—Typical arc circuit

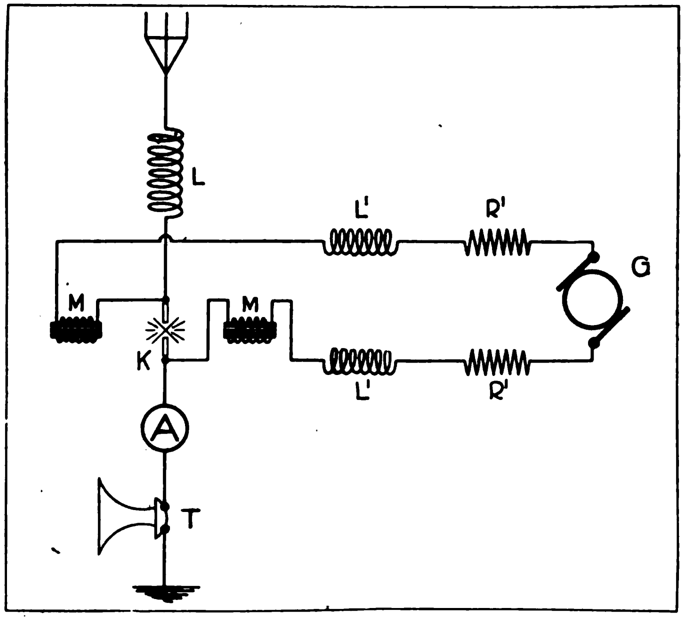


Figure 13—Typical arc radiophone transmitter

metallic conductor by the current flowing through the conductor, the quotient is found to be a *constant* quantity called the resistance of the conductor. This is the case regardless of the values of voltage current (at least, until the conductor becomes heated by the passage of excessive current). In the arc, the quotient of voltage divided by current is by no means constant. In fact, for high voltages the arc resistance is a large quantity and very little current passes through the arc under such voltages. For moderate voltages, the arc resistance is much less, and moderate currents pass. For low voltages, the arc resistance becomes exceedingly small and the arc current tends to increase indefinitely; that is, the arc is unstable and tends to become a short-circuit. We are forced then to the conclusion, that a small *increase* in the voltage at the terminals of an arc causes a small *decrease* in the resultant current; and consequently we sometimes speak of the "negative resistance" of an arc as distinguished from the ordinary or positive and current-limiting resistance of metallic conductors.

"The theory of the action of the singing arc is the following: When the condenser and the inductance in the shunt circuit are connected to the arc, the condenser begins to accumulate a charge, and therefore robs the arc of a part of its current, since the supply current is kept appreciably constant by the presence in the supply leads of the choke coils *L'*. If the current through the arc decreases, it is clear from the foregoing considerations that the voltage at its terminals must increase. Consequently, as long as the charg-

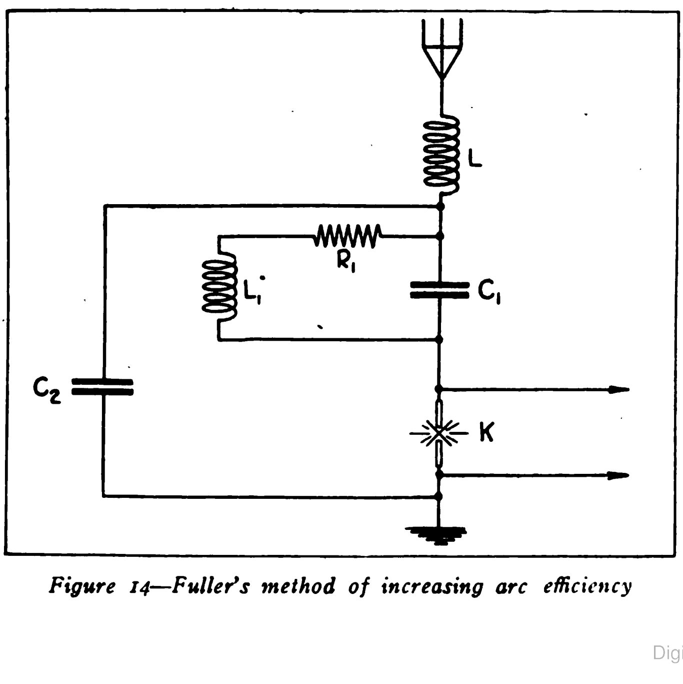


Figure 14—Fuller's method of increasing arc efficiency

ing of the condenser continues, the arc voltage will rise. As soon as the condenser is fully charged, the arc voltage becomes stationary. Then the condenser begins to discharge itself through the arc, thereby increasing the arc current and diminishing the voltage. The shunt circuit being a true periodic or oscillatory circuit, the discharge of the condenser will continue past the point of zero current, and there will occur an actual reversal of current.

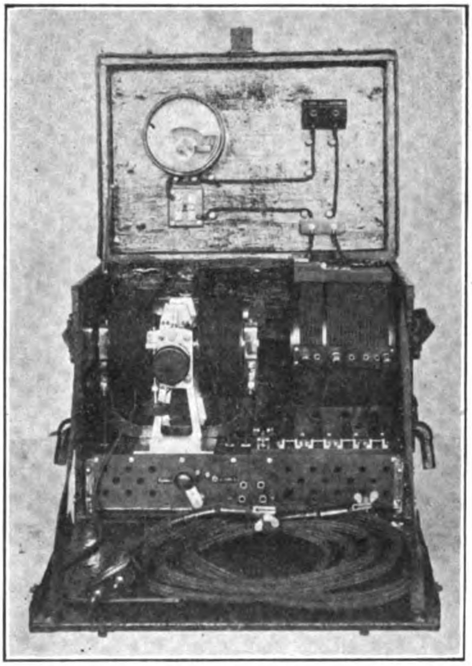


Figure 15—Berliner-Poulsen arc for portable stations

Thus the condenser becomes charged in the negative direction until the arc voltage falls so far that the supply voltage of the direct current generator causes a reversal of the whole action. The cycle is then repeated, and with a frequency related to a certain extent to that of the natural oscillations of the shunt circuit. The mode of vibration which takes place in the arc is thus closely analogous to the action in an organ pipe of the reed type.

In 1903, Poulsen

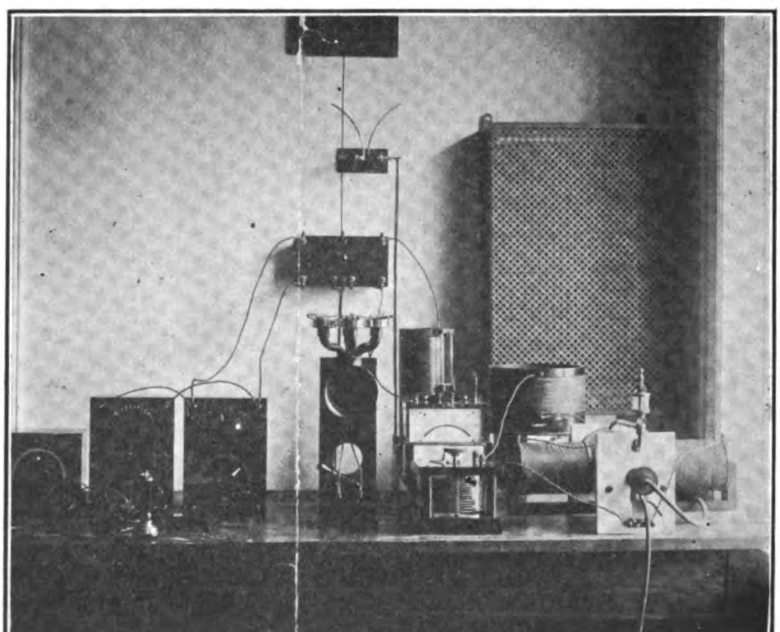


Figure 16—Danish Poulsen arc radiophone transmitter

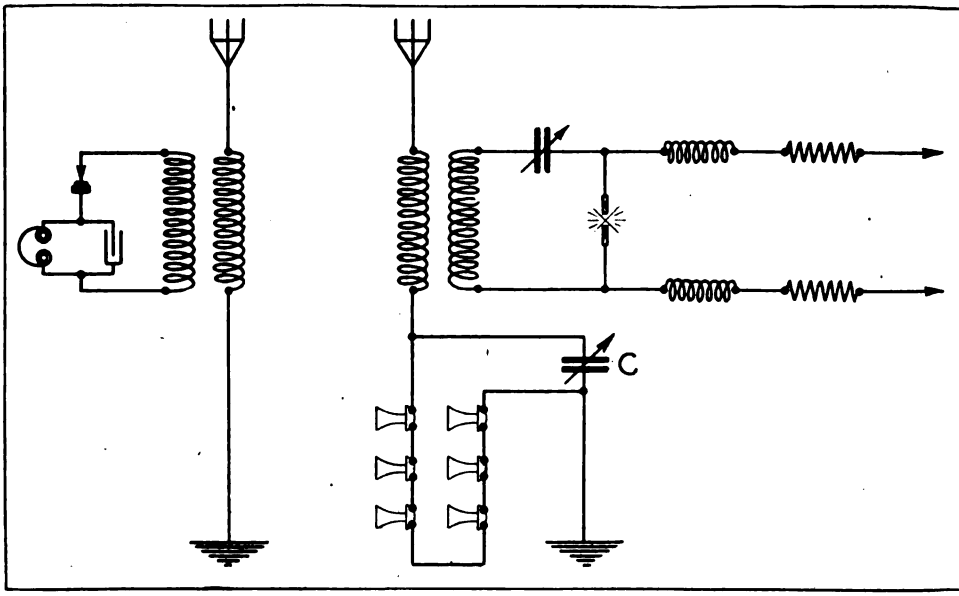


Figure 17—Poulsen radiophone transmitter and receiver

raised the arc to the status of a practically operative generator of radio frequency energy in considerable quantity by the following changes: placing the entire arc in an atmosphere of hydrogen or a hydrocarbon vapor (e. g., alcohol or gasoline), using a carbon electrode for the negative side and a copper anode water-cooled for the positive side, rotating the carbon electrode slowly by motor drive, and placing an intense deflecting magnetic field transverse to the arc. Except for certain constructional and electrical details, this is the Poulsen arc of today.

In Figure 13 is shown a typical arc radiophone station. The arc *K* is shown with the magnetic field due to the coils *M*. *A* is an ammeter for measuring the antenna current, and *T* is a heavy-current transmitter, usually of the carbon microphone type. The control methods which may be used with arcs other than that shown will be considered under another heading. A modern improvement in arc transmitters, and one which results in a great increase in over-all efficiency of the arc, is that shown in Figure 14. This is due to Mr. L. F. Fuller, and the inventor states that very marked increases in output result when it is used. It consists first: in placing in shunt with the arc and the antenna series condenser C_1 the condenser C_2, and second: in placing around the series condenser C_1 an inductance L_1 and a resistance R_1. The chief function of the condenser C_2 is to act as a by-pass for the radio fre-

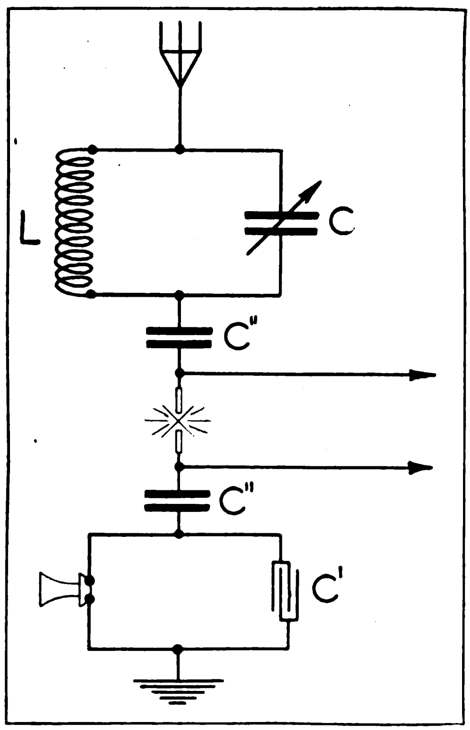


Figure 18—Flywheel Poulsen arc circuit for radio telephony

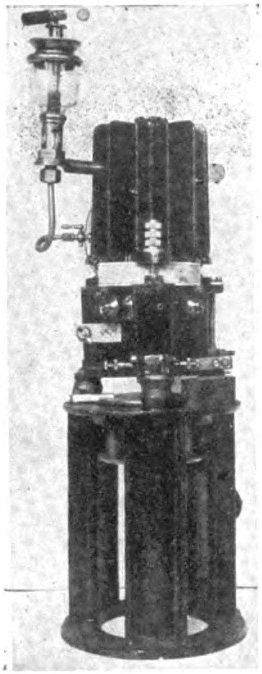


Figure 19—Lorenz-Poulsen arc for radio telephony

quency current, thereby avoiding passing through the arc the entire antenna current as well as the direct supply current. The circuit L_1 R_1 C_1 is tuned nearly to the frequency of the antenna current and thus acts as an absorbing circuit for such currents. It will therefore have the function of a powerful choke circuit for the arc and will assist the condenser C_2 in its action.

Before discussing the actual results obtained by Poulsen arc radiophone transmitters, we shall show the types of construction of such arcs in sizes rated from 250 watts to 100 kilowatts. The first of these, shown in Figure 15, is a small portable military station made by the Telephone Manufacturing Corporation of Vienna. In this case, the carbon is rotated at intervals by hand, and the alcohol feed into the arc chamber is accomplished automatically by the vaporization of the alcohol by the heat of the arc.

As early as 1906, Poulsen established radiophonic communication over a distance of about 600 feet (200 m.) using antennas only 15 feet (5 m.) high. In 1907, with the equipment shown in Figure 16, communication was established between Esbjerg and Lyngby, a distance of 170 miles (270 km.). The antenna height was 200 feet (60 m.), the wave-length 1,200 meters, the arc supply power 900 watts, and the antenna power 300 watts. Later, phonograph music was heard in Berlin after transmission from Lyngby, a distance of about 300 miles (500 km.). In Figure 16, the arc is shown to the extreme right, and the multiple microphone transmitter (six microphones in series) in the middle of the figure. The arc was in its own primary circuit in this case, and coupled inductively to the antenna. At the left, the inductively coupled receiving set is shown. The secondary circuit was made aperiodic by placing the detector directly in series with the secondary coupling inductance and without any secondary tuning condenser. The reasons for this type of receiver will be discussed under another heading. In Figure 17 are illustrated the arrangements used. It will be noted that the microphones are shunted by the condenser C, thereby making the transmission partly one by change of wave-length as well as by change in antenna energy.

When small antennas of high intrinsic decrement are used, an arrangement known as a "fly-wheel circuit" may be employed. This is shown in Figure 18. The circuit LC is inserted in the antenna, L being large in comparison with the antenna inductance. The wave-length of the radiated energy will consequently be approximately that of the circuit LC. In this way, energy may be stored in the highly undamped circuit LC and gradually radiated. The two condensers C'' are not essential to the operation and serve only to keep the direct current supply leads from conductive connection to antenna and ground thereby avoiding the possibility of serious high voltage shocks when touching the antenna. In the case

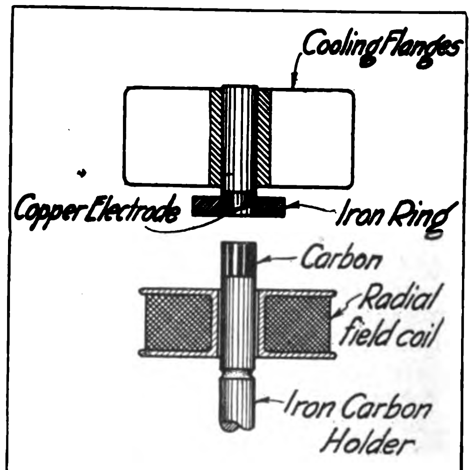


Figure 20—Construction of Lorenz-Poulsen arc for radio telephony

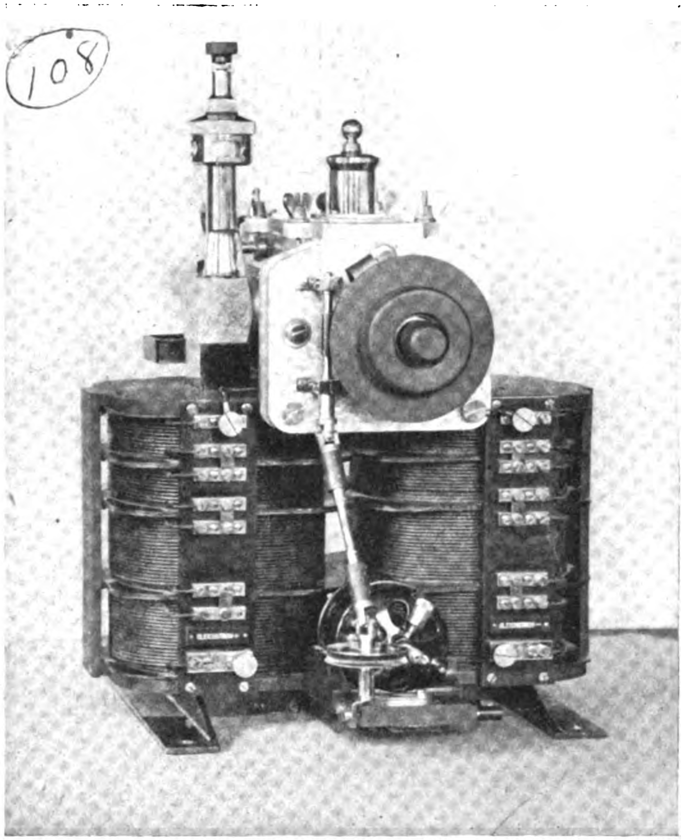


Figure 21—3 k.w. Berliner-Poulsen arc

shown, the microphone-shunting condenser, C' has a value between 0.05 and 0.20 microfarad.

In Figure 19 is given a photograph of an arc rated at about 100 watts output, and built by the C. Lorenz Company of Berlin specially for radio telephony. Its construction is shown in Figure 20. The carbon holder is of iron, and forms an open core of a circular multi-layer coil which produces a moderately strong magnetic field passing directly upward through the carbon. The field then spreads outward to the upper iron ring, passing radially through the arc in so doing. In consequence of the presence of this field, the arc will slowly rotate around the edge of the carbon, thereby causing even wear. The copper electrode is held within the iron ring, and provided with massive cooling flanges. In Figure 19, the alcohol sight-feed cup is seen at the top, and the vertical cooling flanges below and to the right. The insulator between the upper and lower electrodes is a heavy ring with flat faces, made of plaster with asbestos facings. The clamping screws are also visible, as are the two poppet safety valves which relieve the excessive pressure resulting when the arc is first lit and the mixture of alcohol vapor and air explodes. The lower electrode holder and the surrounding coil are just below the middle of the illustration.

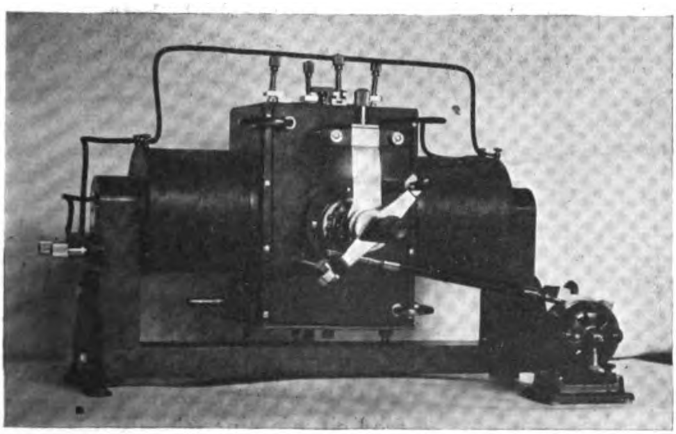


Figure 22a—Continental Syndicate Poulsen arc

One of the defects of these small arcs is the necessity for adjusting the arc length occasionally as the carbon burns away. To overcome this, the Lorenz Company has built a self-regulating arc provided with a mechanism somewhat like the magnetic length-control of an ordinary street lighting arc. The device is supposed to be very effective in practice.

A somewhat larger type of arc of 3 K. W. input made by the Telephone Manufacturing Corporation (formerly J. Berliner), of Vienna, is illustrated in Figure 21. It will be noted that provisions are made here for an extremely intense magnetic transverse field. While this is of advantage in increasing the available radio frequency output, it tends to cause a certain degree of irregularity in the output with a resultant crackling noise or "side tone" in the received speech. This last defect may prove extremely serious, so that magnetic fields on arcs used for radio telephony must be employed with caution, and with associated circuits and outputs which minimize arc unsteadiness. In Figure 21, the small motor which rotates the carbon electrode is seen in the lower central portion, and there are also shown the sections of the magnetic field whereby the field strength may be conveniently varied. The heavy insulation surrounding the push button used for striking the arc at the beginning of operation is a necessary adjunct since disagreeable burns are easily sustained when using high power arcs carelessly. An arc of somewhat smaller output than that shown is guaranteed by the makers for telegraphy over 125 miles (200 km.) when using portable masts, but for only about 12 or 15 miles (25 km.) for radio telephony.

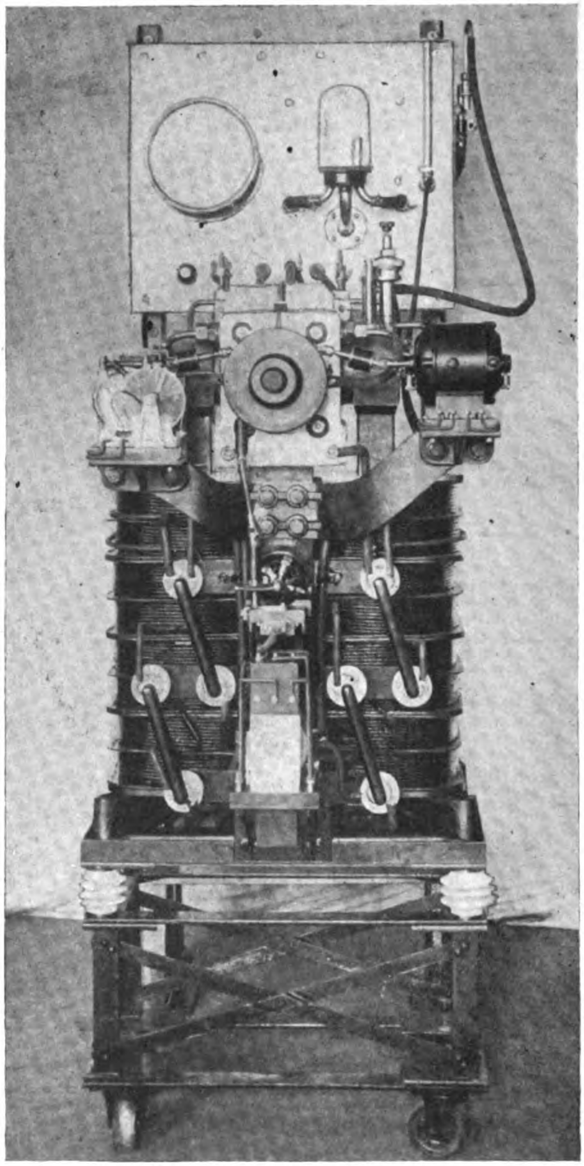


Figure 22b—Berliner 25 k.w. Poulsen arc

A somewhat larger type of arc, built by the Danish Poulsen Company (Det Kontinental Syndikat), is shown in front view in Figure 22a. The massive field magnet coils, the driving motor for the carbon holder, and the arc striking and adjusting knobs are visible. It is to be noted that all arcs giving any considerable output have air core choke coils in the feed circuit, since the distributed capacity of iron core coils gives rise to the possibility of injurious resonance phenomena inside the coils and permits radio frequency currents to pass.

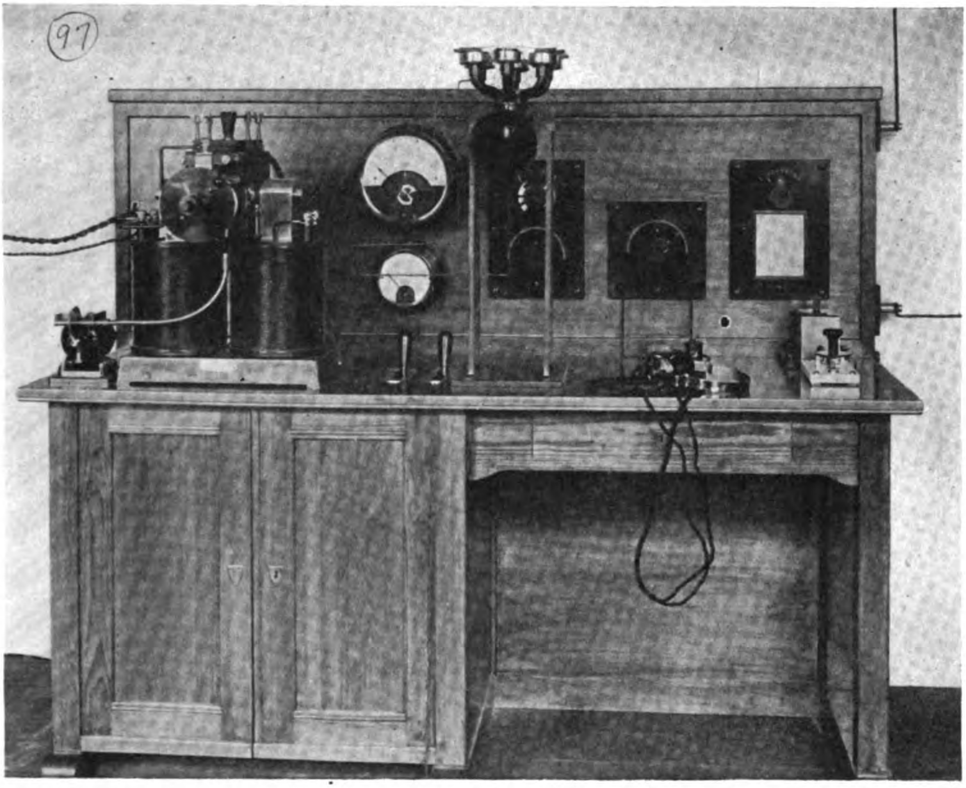


Figure 23—Berliner-Poulsen arc ship radiophone station

Figure 24—Berliner-Poulsen 3 k.w. arc radiophone station

An arc made by the Berliner Company of Vienna, and having an input of 10 to 25 kilowatts is illustrated in Figure 22b. As will be seen, it is provided with an automatic ignition device, a device for the indication of arc length or wear of the carbon electrode, a mixing chamber of glass for the gas used in the arc, and a complete water cooling system for the field magnet coils as well as for the arc.

Some interesting information relative to Poulsen arc radiophones of the type shown in Figure 23 is given by Captain Anderle. Figure 23 is a ship station of a complete type, being used for either telegraphy or telephony. The arc, which is normally rated at about 8 kilowatts input, is shown at the left. For telephony, it is used at reduced power, inasmuch as the multiple microphone transmitter at the right would be incapable of modulating the full output. About 3.5 amperes (and never over 4) are passed through the transmitters, which are placed directly in the ground lead of the antenna. With masts 150 feet (45 m.) high, distances of from 30 to 60 miles (50 to 100 km.), are covered over flat country. The speaker is warned to speak distinctly but not too loudly, with the mouth held near the transmitter. It is recommended to tap the microphones occassionally, or to have alternative sets so that overheating of one set does not occur.

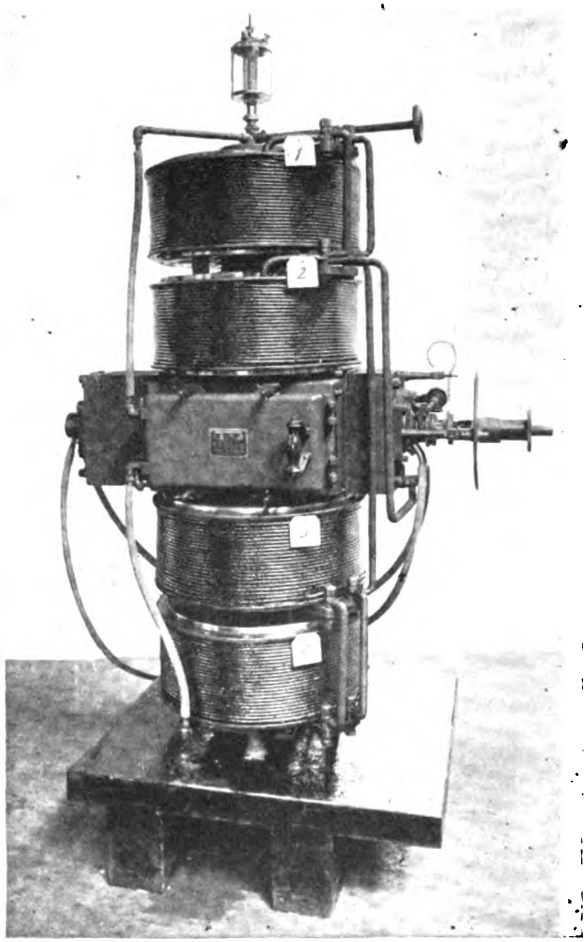


Figure 25a—Federal Telegraph Company 60 k.w. Poulsen arc at Tuckerton

In Figure 24 is shown an unusually complete set of the Poulsen arc type built by the Berliner Company of Vienna. This set is adapted at the same time to ordinary arc telegraphy, multi-tone arc telegraphy, and radio telephony. The arc is of 3 K. W. input, being the same as that given in Figure 21. The telegraphic range of this set is given as 375 miles (600 km.). The receiving set and test buzzer are mounted on the right-hand portion of the long table; the arc and key at the left center; the relay key and transfer switches are to the left of the arc near the variable transmitting coupling and the multi-tone control keyboard. In the extreme left foreground is the large microphone transmitter, to be described hereafter when control systems are considered.

Although the newer, high power arcs are not yet employed for radio telephony because of the great difficulty of modulating the output, nevertheless they form a possible direction of radio telephonic development. Accordingly, we show in Figure 25a an arc of 60 K. W. input made by the Federal Telegraph Company,

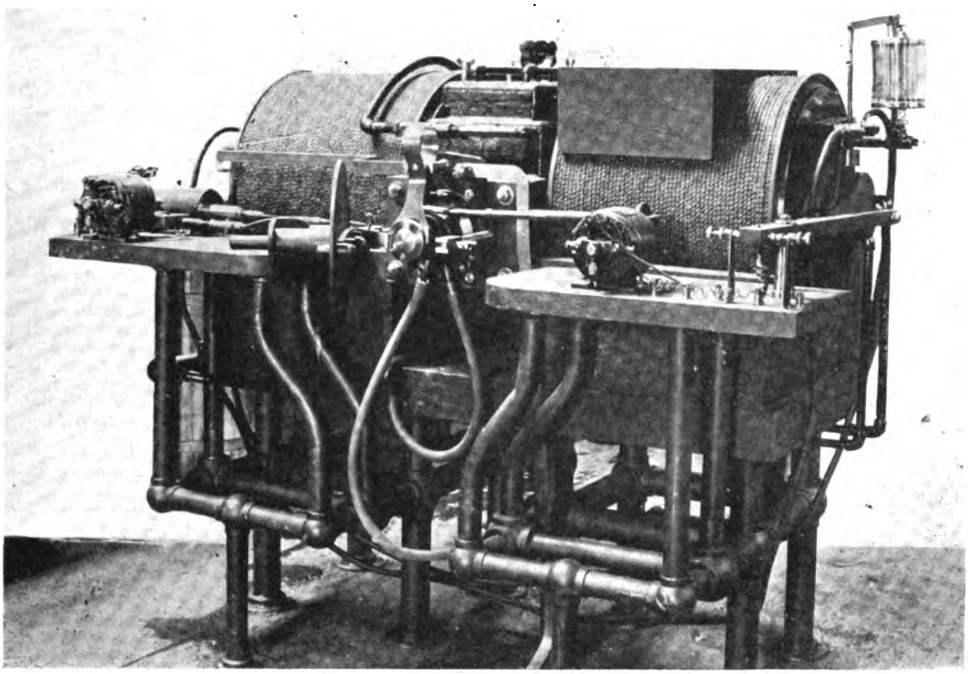


Figure 25b—Federal Telegraph Company 100 k.w. Poulsen arc at Darien

this corresponding to 500 volts and 120 amperes. It is this arc which is carrying a portion of the trans-Atlantic traffic from Tuckerton, New Jersey to Hanover Germany, a distance of 4,000 miles (6,500 km.). In this case, the antenna current is 120 amperes, the arc standing considerable overload. We also show, in Figure 25b, a 100 K. W. arc made by the same Company, and used for communication between the United States Naval Radio Station at Darien, Panama Canal Zone and Washington, a distance of 1,900 miles (3,000 km.). It will be seen that both these arcs are very sturdily designed and provided with an unusually rugged and elaborate water-cooling system.

The Federal Telegraph Company carried on radiophone experiments from 1910 through 1912 between the stations at San Francisco, Stockton, Sacramento, and Los Angeles (all in California). The distance between the two of the first three stations mentioned is 90 miles (140 km.) and between the first and the last station mentioned 355 miles (570 km.). Speech between San Francisco, Stockton, and Sacramento was clear at all times, but between these points and Los Angeles it was weak and indistinct. The antenna heights were 300 feet (94 m.)

Before leaving the subject of the Poulsen arc, it is of interest to give detailed accounts of just what has been accomplished by these methods in addition to the achievements already mentioned.

A remarkable series of experiments were made by Q. Majorana in 1908. The results obtained are best described in the words of Majorana himself:

"The first research was conducted in the Instituto Superiore del Telegraphia in Rome. The antenna was 78 feet (24 m.) high and had four wires. For two years, I have been conducting experiments between this station and a government naval station at Monte Mario, 3 miles (5 km.) away. The antenna at the latter station had also four wires and was about 175 feet (50 m.) high. An ammeter in the antenna at the former station showed under normal conditions of working a reading of about 1.2 amperes. At Monte Mario, using the thermo-electric (crystal) detector, a current of 15 micro-amperes was obtained. Words spoken in Rome could be heard at Monte Mario by the use of a Marconi magnetic detector, but could be heard very much more loudly and clearly by the use of the former detector.

"Because of these results, the Naval Bureau provided a second research station at Porto d'Anzio, 25 miles (56 km.) from Monte Mario, with a four-wire antenna 145 feet (45 m.) high. On the 13th of August, 1908, the experiment was tried, and this showed that with a current strength of 3.5 amperes in the antenna at Monte Mario any words spoken in Rome could be very distinctly heard at Anzio.

"Hereupon the Naval Bureau ordered that these researches should be carried on over longer ranges. The torpedo boat 'Lanciere' was accordingly put at my disposal, and arrived on the 13th of November at the Island of Ponza, about 75 miles (120 km.) from Monte Mario. On this island there is a station for radio telegraphy, with an antenna of four wires about 200 feet (60 m.) high. Using the same receiving apparatus as had been employed at Rome, words spoken in Rome could be heard at Ponza with greater loudness even than at Anzio; the vibrations of the telephone diaphragm could be heard at a distance of 10 or 15 feet (3 or 4 m.). The superiority of these results is to be ascribed to the better location of the station at Ponza.

"On the 14th of November, the 'Lanciere' landed at Maddalena in Sardinia. The nearby station at Becco di Vela, which is similar to that at Ponza, was then used. The station is about 170 miles (270 km.) from Rome in an air line. On that day, at 12 o'clock, attempts to communicate with Rome were repeated and again gave excellent results. The voice at Monte Mario was distinctly audible, and the strength of the speech was not less than it is in the ordinary wire telephone in use in the city. We can, therefore, state that over this range a practically workable radio telephonic service can be provided.

"Finally, I desired to find the utmost range of the radio-telephonic apparatus at my disposal. On the 1st of December, the 'Lanciere' arrived at Trapani, in Sicily, where further attempts were made, using the radio-telegraphic station at Monte San Giuliano. This station resembles that at Ponza, and is 270 miles (420 km.) in an air line from Rome. It took quite some effort to secure sharp tuning here, partly because of considerable interference from a neighboring station, but finally the spoken word from Rome could be heard, even though it was faint and not easy to understand. The intensity in this case was barely sufficient for the trained ear to read. We were here at the limit of the range. This we proved more clearly on the following day. At Forte Spurio is a station which is about as far from Rome as that on San Giuliano, but less favorably situated. I went to Forte Spurio and found that the words sent from Rome could not be heard there.

"The utmost range of my system was by no means reached in these experiments, for the hydraulic microphone was not used to a point even approaching its full capacity." (Majorana used a Poulsen arc generator, but modulated the antenna energy by means of a special hydraulic transmitter which will be described under control systems.)

"I desire to mention one important point in these experiments. After several trials, it was positively shown that the quality of the word was not altered, even at distance of 250 miles (400 km.). That is, the articulation was clear and the fine inflections of the voice were preserved. This is because all the various frequencies contained in the speech suffer the same weakening for equal distances, so that there is no distortion of the speech. With the ordinary telephone lines, on the other hand, the propagation depends largely on the acoustic period; in radio telephony, the period of the electro magnetic radio frequency oscillations is of the greatest importance."

Experiments were carried on at the end of June, 1909 between the large Poulsen stations in Denmark at Lyngby and Esbjerg, the distance between these stations being 170 miles (280 km.). The Egner-Holmstrom heavy current microphone, to be described later, was used directly in the transmitting antenna. Such microphones can carry 10 to 15 amperes, but it was shown that this current was unnecessary for the range in question. In fact, with an antenna current of 6 amperes properly modulated communication of a very good and clear sort ("sehr gut und deutlich" according to the experimenters) was established.

This is the third of a series of articles on "Radio Telephony" by Dr. Goldsmith, an eminent authority on the subject. In Article IV he continues his discussion of arc systems for radio telephony and also takes up radio frequent spark methods.

DISTANCE DETERMINING APPARATUS

The following is furnished by the Bureau of Steam Engineering, United States Navy Department:

The attention of all ships navigating the approaches to New York Harbor is invited to the recent installation on Fire Island Light Vessel of a combined radio and submerged sound signal transmitter which determines the receiving ship's distance from the light vessel. (Call letters, NLS; station, lat. 40° 28′ 33″ N., lon. 73° 11′ 24″ W.)

This apparatus will be in operation during fog, mist, rain, or falling snow. The range of this apparatus is limited to the receiving range of the submarine bell receiving equipment employed on shipboard, and in all practical cases this is within six or seven miles.

The submarine bell strikes six strokes, pause, then eight strokes once every forty seconds. The clock mechanism on the light vessel operates so that about one-half second (the time taken for sound to travel one-half mile in sea water) after the first stroke of the six bell character is made, the ship emits a series of radio dots. These dots are spaced so that the interval between is that taken by sound to travel one-half mile in sea water. Since radio waves travel with the velocity of light, for moderate distances the time for transmission can be neglected. On a receiving ship, you hear the bell strike six, interval eight. About twelve seconds (time depending on distance from lightship) after the last stroke of the eight character, the radio dots start coming in.

In order to determine the distance of a ship from the light vessel it is necessary to count each of these radio dots until the *first stroke of the six submarine signals is received.* The number of dots thus determined gives the distance in half sea miles from the lightship.

Example.—(*a*) Eleven radio dots are received before the first stroke of the bell; the distance is eleven halves or five and one-half miles.

(*b*) Four radio dots are received; the first submarine bell signal appearing midway between the fourth and fifth radio signals; the total number of radio signals received is four and one-half, and the distance is four and one-half divided by two, or two and one-quarter miles.

The most convenient method of receiving these signals is to have one receiver connected to radio and the other receiver connected to submarine bell detector, thereby connecting one ear to radio signals and the other to submarine signals.

These signals will also be furnished in clear weather when requested to do so by radio. It is requested that all passing vessels equipped with submarine signal receiving apparatus familiarize themselves with this apparatus and report success obtained to the Hydrographic Office.

Wave-length used is 600 meters.

Watches are stood as follows:

(1) Continuously during thick weather.

(2) During clear weather, first fifteen minutes of every hour from 8 a. m. to 9.15 p. m.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

The Advantages of a Quick-Acting Hot Wire Ammeter

The difference between the hot wire ammeter that I am about to describe and others designed by amateur experimenters lies in the fact that my instrument has double magnification, while the majority of other designs have single magnification of the expanding hot wire.

Details of the various parts are shown in Figure 1, details of the pointer and axle in Figure 2 and the complete assembly of the instrument in Figures 3 and 4.

The material required for the construction of this instrument is as follows: A piece of brass strip, No. 22 and No. 24 gauge, 8 inches in length and ½ inch in width; five knurled nuts (8/32 thread); two hexagon nuts (8/32 thread); five machine screws (¾ inch in length, 8/32 thread); 1 length of silk thread; 1 piece of fine wire, preferably No. 36 or No. 40 copper (B. & S. gauge); 6 inches of copper wire (B. & S. gauge, about No. 22); 3 inches of brass wire (B. & S. gauge, No. 22); 12 inches of one ampere of fuse wire (lead), ¾ inches steel rod (1/16 inch in diameter); a small quantity of solder, a piece of Bristol board for the dial, and a wood or hard rubber base 4 inches by 6 inches by ⅜ inches.

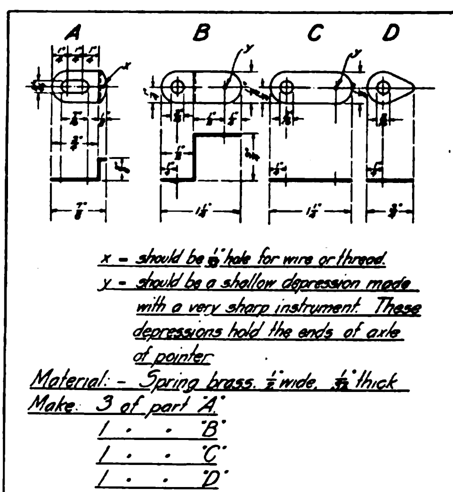


Figure 1, First Prize Article

The majority of the materials required for the construction of this instrument can be found around the average experimenter's workshop; the remainder can be purchased from any electrical supply house dealing in experimental goods.

To begin the construction of this instrument, cut the brass strip into the shapes shown in Figure 1, drilling holes and slots as indicated. Make three pieces after the diagram A, and one each of B, C and D. The bearings for the axle of pointer (Y in Figure 1) may be constructed by sharpening a nail to a very sharp point, followed by making a slight indentation in the brass where the arrow points, as in Figure 1.

The construction of the pointer follows: Take the No. 22 copper wire and wind about four or five turns on the steel rod, which must have its ends sharpened to a fine point, as in Figure 2. Solder the turns of wire to the axle and leave a thin coat of solder on the wires to form the drum for the silk thread. Wind a piece of lead fuse wire around the short projecting end of the pointer until the needle perfectly balances. The pointer end may be beaten into any desired shape by judicious use of a hammer and anvil followed by the use of a fine toothed file. Figure 3 indicates how the pointer is held between the bearings B and C.

The brass wire should be 3¾ inches in length with a loop in one end. The other end is soldered to the projecting part of D, as in Figure 4.

The base should be 4 inches by 6 inches by ⅜ of an inch and drilled to hold the five bolts, as in Figure 4.

The brass parts are assembled as in Figure 4, the fine wire being soldered to A^1 and A^2. The slots in A^1 and A^2 should be adjusted to take up the slack in the expanding wire but not to stretch it. Follow this by tying one end of a silk thread, about a foot long for convenience, to a small piece of wire shaped like a hook and place the hook over the expanding wire in the middle. Tie the other end to A^3 to take up the slack. In the middle of this thread tie the end of another thread which goes twice around the drum of the pointer and then is fastened to a loop of brass wire. Take the slack out of the threads by sliding A^3 towards edge of the base. D should be turned until the brass spring has light tension on the thread at all times. The corrections for variations in temperature are made at A^3.

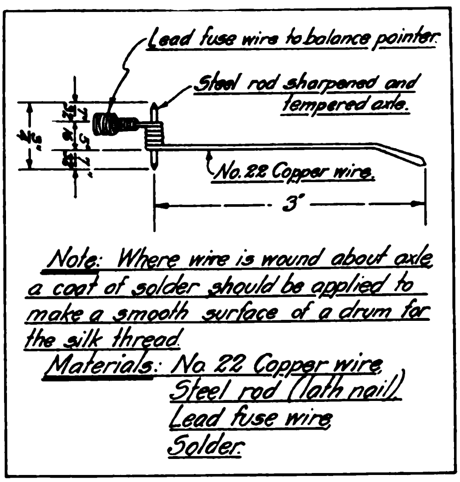


Figure 2, First Prize Article

A dial for this instrument may be made of Bristol board and as readings of maximum current rather than actual values are desired, comparative values can be obtained without calibration of the instrument. If, however, access can be had to an accurate ammeter of the hot wire type, it may be connected in series with this instrument and the deflection of both pointers noted for given values of current. In this way the entire instrument can be perfectly calibrated. If the hot wire is not able to carry the current output of the transmitter it may be shunted by several small wires until the required current carrying capacity is obtained.

PHILANDER H. BETTS, *New Jersey*.

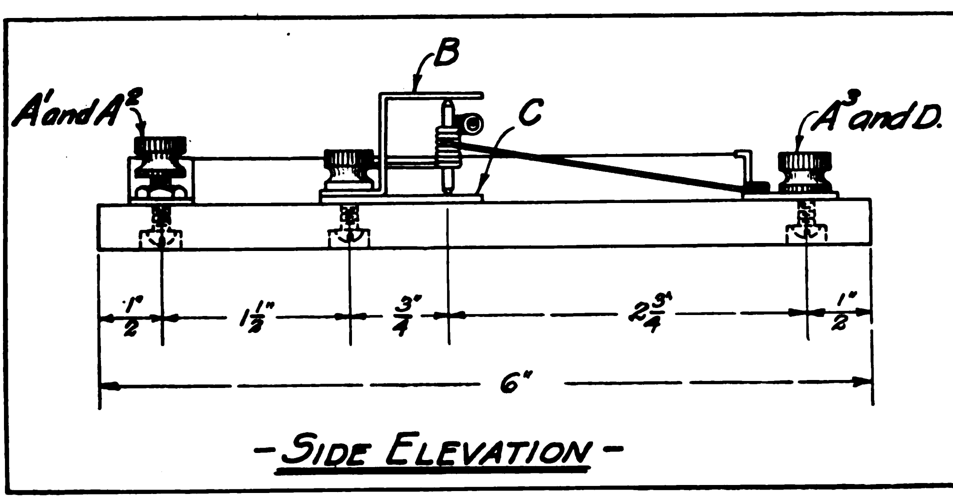


Figure 3, First Prize Article

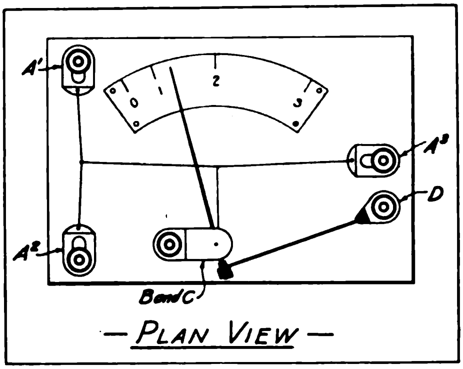


Figure 4, First Prize Article

SECOND PRIZE, FIVE DOLLARS

A Receiving Set Which is Well Recommended

As a general rule cabinet receiving sets are "slapped" together without much thought as to the working abilities of the different instruments included. I might mention at the start that in my opinion a perfect receiving set has not yet been produced, but I thoroughly believe that the one that I have constructed works better than the usual so-called cabinet set. While, of course, anyone can design a receiving outfit, the real object in view should be to improve former types of apparatus in use.

The receiving unit that I am about to describe has several advantages over the usual amateur sets, one of them being that the station which you wish to receive from can be brought in loud enough to copy through practically all kinds of interference, both local and long distance. In fact stations that I never heard before could be read with the greatest ease. The selectiveness of tuning is marvelous.

The operation of this set is simple. Amateur stations can be read more easily when using the small coupler than with the ordinary coupler in the average station. Furthermore, the equipment will copy both damped and undamped waves. Signals from Tuckerton, Arlington and Sayville have been read repeatedly at Indianapolis, Indiana, using an aerial 300 feet in length and 30 feet in height, consisting of 1 single wire.

The construction of this receiving unit is as follows: The case is made preferably from walnut, although any hard and close grained wood will suffice. It is 16 inches in length, 5 inches in depth and 12 inches in height and is made of ½-inch wood throughout.

The front of the set is made of ¼-inch "Bakelite" the dimensions being 14 inches in length by 10 inches in height. All connections are made through the front.

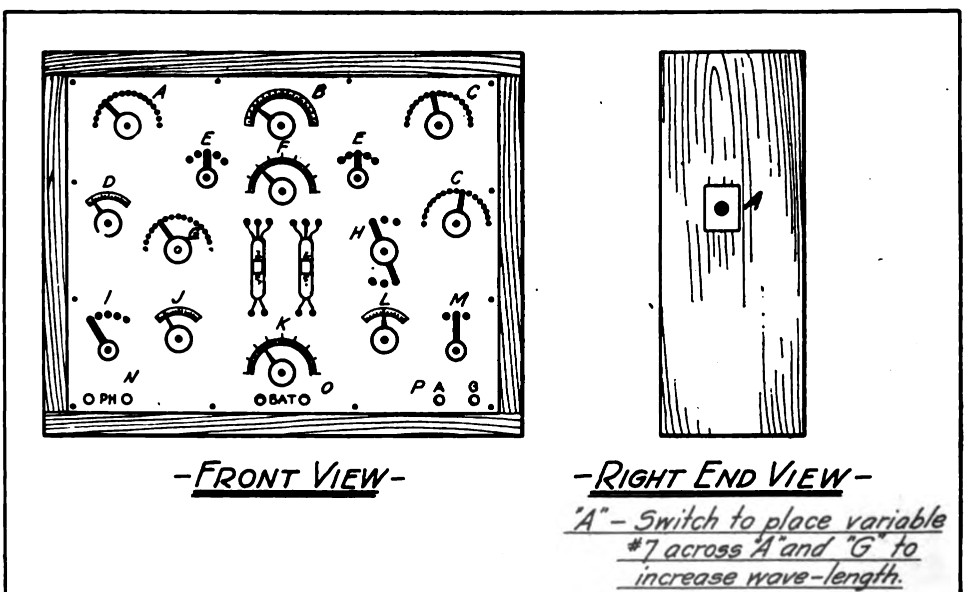
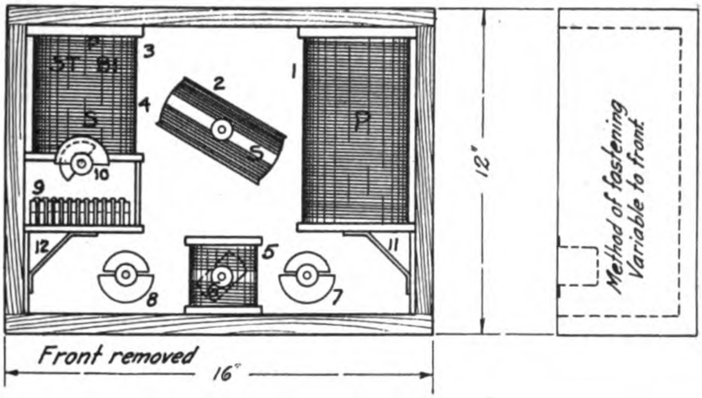


Figure 1, Second Prize Article



1. Primary of large coupler, "3000" meters #26-S.S.C.
2. Secondary of " " " " #32-D.S.C.
3. Stand-by coupler primary, "1000" " #24-S.S.C.
4. " " " secondary " " #30-D.S.C.
5. Primary of "250" (approx.) coupler #24-S.S.C.
6. Secondary of "250" #30-D.S.C.
7. and 8. 43 plate variables.
9. High voltage batteries.
10. Small 'phone variable, 17 plates.
11. and 12. Brass brackets.

Figure 2, Second Prize Article

The back may be made of any soft wood, such as pine or bass. All other measurements for the construction of this set may be taken from Figures 1 and 2, the latter figure showing particularly the layout of the coils and the relative positions within the apparatus.

An explanation of the notations on Figure 1 follows: A is the upper left hand switch of 20 contacts which controls the "Stdbi" primary winding; B is a rheostat mounted at the top in the center for controlling the filament current for the vacuum valve detectors; C C are two switches mounted at the extreme right, one above the other, which control the inductance of the large loose coupler. There are 20 contacts on each switch. D is a variable condenser placed on the extreme left at the middle and is connected across the head telephones.

The two 5-point switches above and at

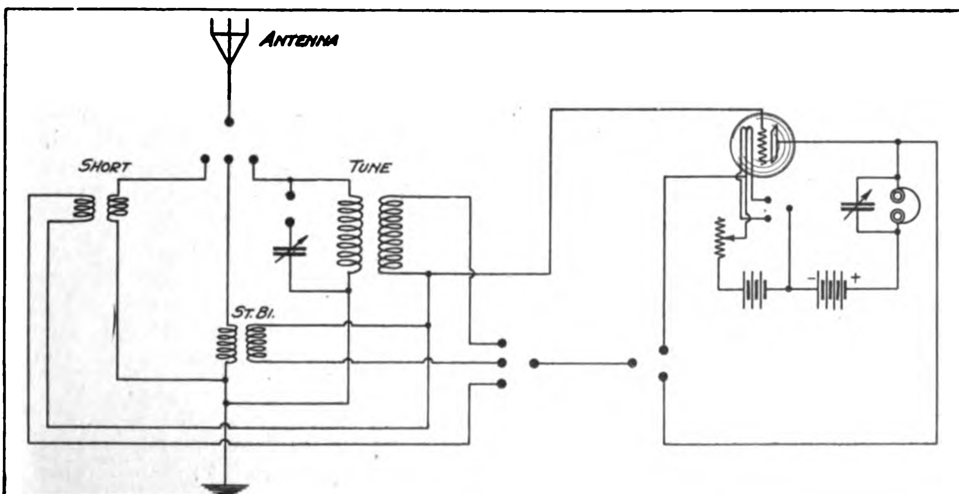


Figure 3, Second Prize Article

the side of the vacuum valve detector are for control of the high voltage battery; they are designated at E. F is a knob placed above the vacuum valve which rotates secondary winding of the large loose coupler. The switch, G, at the left side of the vacuum valve is for the small coupler and has 20 contacts. Switch H at the right of the detector bulbs is employed to control the inductance of both the primary and secondary windings. Switch I in the lower left hand corner connects in the four filaments of the various vacuum valve detectors; J is a variable condenser connected across the primary to increase the wave-length; K is a switch for variation of the secondary inductance of the small loose coupler; L is a variable condenser on the right which is in series with the secondary of the large coupler, or small coupler. M is a switch to change from the "amplifying" to a plain ordinary circuit. At N two binding posts for the head telephone are shown. The low voltage batteries attached to the middle lower binding posts at O and the lower right hand binding posts are for the aerial and earth connections.

I believe that any amateur undertaking the construction of this outfit will be amply repaid for the time and money spent. I should like to hear from experimenters as to the results obtained.

M. B. LOWE, *Alabama.*

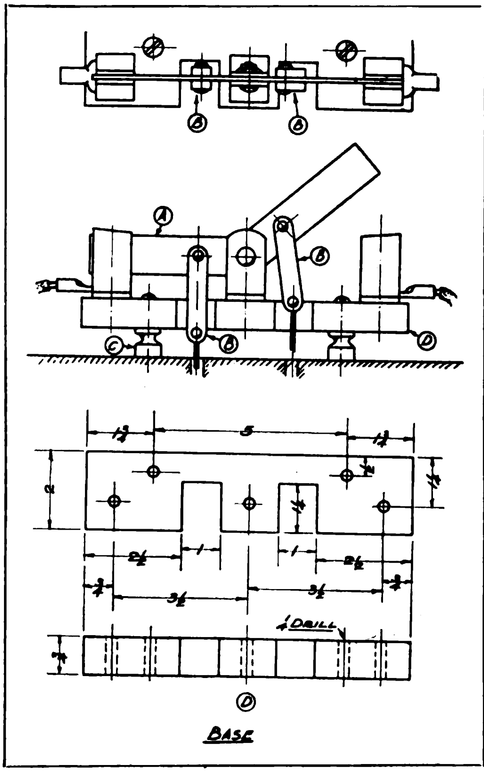
THIRD PRIZE, THREE DOLLARS
A Lightning Switch for the Protection of Amateur Stations

The lightning switch described in this article is intended to be mounted outside of the operating room or at a point remote from the transmitting apparatus of a given station. The complete assembly of the switch is shown in Figure 1, the details of the base in Figure 2, the construction of the knife blade in Figure 3 and the control handle in Figure 4.

The base is made of asbestos and should be cut to the dimensions given in the figure. The details of the operating arm, B, are shown in Figure 4. These are made of hard rubber or fiber in order that the rod may be insulated from the controlling devices.

The copper for the blade of Figure 3 is bent to shape while cold. No attempt should made to bend it while hot as it is apt to snap off.

The switch is worked from the instrument board, as shown in Figure 4. A handle with a pointer is fitted to a ¼-inch shaft with a wooden drum mounted on the back of the board. A 3/16-inch braided rope is next wound around the drum and carried over to the insulators, B. In case this rope is required to run around corners it can be placed on pul-



Figures 1 and 2, Third Prize Article

leys to prevent chafing. With this attachment the operating handle can be placed in almost any position or location from the switch as the rope can be carried around in many different ways.

The experimenter should remember that the law requires that this switch be mounted in a fireproof box; furthermore, it should be constructed to keep out rain and snow.

Small turnbuckles are placed in each rope to take up the slack as the ropes in due time will stretch to considerable extent. After the switch is put in place it requires no more attention and by a slight turn of the handle on the instrument board can be thrown in either the sending or receiving position. With a switch of this type installed in a station, the experimenter need not fear approaching thunder showers, nor is he required to endanger his life by contact with the knife blade.

O. E. COTE, *Rhode Island.*

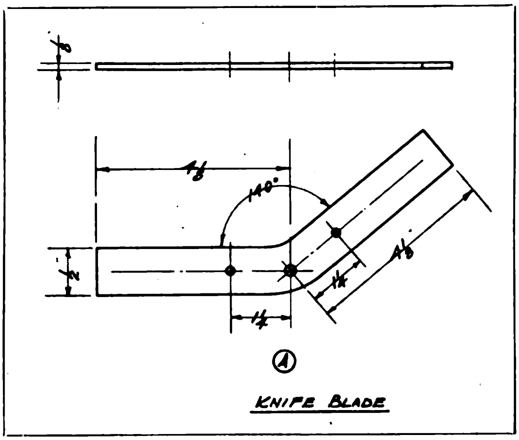


Figure 3, Third Prize Article

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Portable Receiving Cabinet for Amateur Hikes

An inexpensive receiving set that requires a small amount of space, making it particularly suitable for travelling and Boy Scout hikes, is shown in the accompanying drawings, Figures 1 to 5. It is so small that it can be carried in the corner of the motor-car or on the rear of the motorcycle without occupying any notable space. The majority of dimensions for this set are given in the accompanying sketches. A description follows:

The first step of the construction is the box or case, which has dimensions 10 inches by 10 inches by 4½ inches in height. The material is ¼-inch wood veneered to a high polish. The top of the box is held secure to the sides by small round-head brass wood screws, about eight in all being required.

The next in order of construction are the knobs for the primary, secondary and loading coils. These are made of ¼-fiber of vulcanized rubber cut out through a diameter of 2¼ inches as in Figure 2. These knobs can be turned out with a lathe or by hand by means of a hack saw. A hole is drilled in the cen-

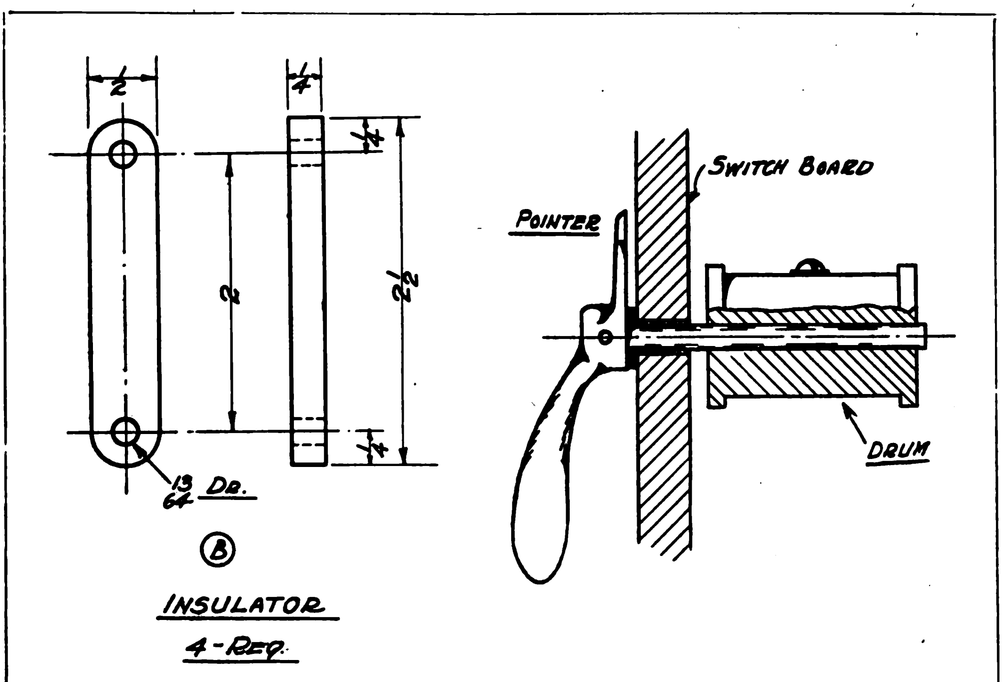


Figure 4, Third Prize Article

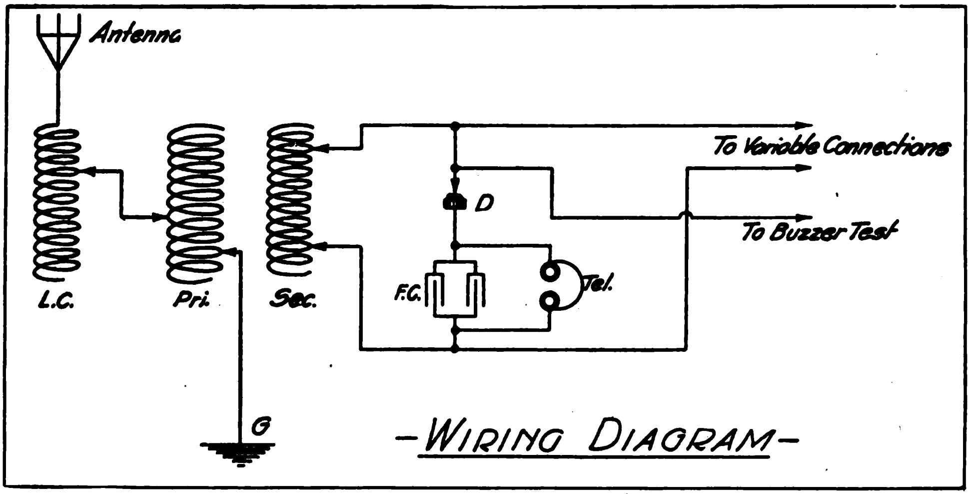


Figure 1, Fourth Prize Article

ter to let an 8/32 stove bolt pass through snugly; then a hexagon nut is screwed up securely against the fiber or rubber to hold it firmly to the bolt. Follow this by securing a piece of spring brass about 2½ inches in length and approximately ¾ inches in width; then drill a hole so as to let the stove bolt pass through it tightly. Bend the brass in a suitable position to come in contact with the taps or points which are connected to the primary, secondary or leading coil inducances. These taps are made of ⅝ inch by 3/16 inch in diameter, round brass rods, which fit tight in holes drilled in the top of the case. Beneath the brass another hexagon nut is screwed up to hold it firmly to the rest of the knob; then beneath this is placed another ordinary battery knob with a washer underneath so that the knob can turn freely on the top of the case. Another washer is placed on the bottom below the top of the case followed by placing another nut in position. The terminal wire is soldered to the latter washer and the knob is thus completed.

The next step is the construction of the coils. The primary is wound with No. 22 enamelled or cotton covered copper wire, which can be procured at any electrical dealer. Then secure about three cardboard tubes, one about 3¾ inches in diameter and 4 inches in length, another 3⅝ inches in diameter and 3¾ inches in length. A third one to act as a loading coil should be 6 inches in length and 3 inches in diameter. On the first tube mentioned start winding about ½-inch margin from the end of the tube

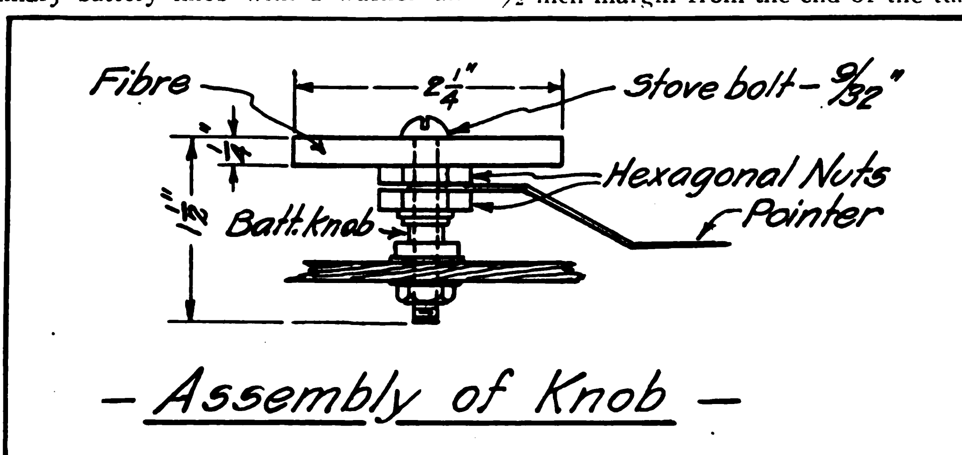


Figure 2, Fourth Prize Article

and take off a lead at every turn. Repeat this operation for ten consecutive turns. After this wind the wire around the cardboard tube ten times and then take off a connection. Repeat this operation until the extremity of the coil is reached, leaving ½-inch margin as at the start. The primary winding is now complete. The secondary winding is made of No. 30-32 or 34 silk or cotton covered wire. A little margin can be given as in the primary winding and the winding then begun.

As noted, the taps can be divided according to the length of the tube. If the tube is 6 inches in length, take one tap every inch and the winding will then be complete.

The loading coil can be wound with No. 22 cotton or enamelled wire, leaving a little margin from the end of the tube. Taps should be taken at every inch and a quarter, thus completing the three coils.

This is to be followed by the construction of the fixed condenser which can be made of two long strips of tinfoil. The latter can be secured from an old one microfarad telephone condenser. First cut out a strip of paraffine paper a little longer and about one-half inch wider on each side; then lay on top of this a piece of tinfoil and follow this by another piece of paraffine paper, and so on. These tinfoil strips should be about 20 inches in length and after all pieces of foil or paraffine paper are put in position, the units should be rolled up in circular form. Two small strips of tinfoil should be brought out from the roll for external connection.

The loose coupler must be fastened securely to the case and it is best to place it on the left hand side of the case as is shown in sketch Figure 5. At one end of the primary tube a round piece of wood is cut to fit snugly. This is fastened to the back of the case and at the front end a small block is placed in position to hold it. In the center of the round board in the back drill a hole through it and the case. It should be large enough to admit a ¼-inch brass rod. The rod should be the length of the case, projecting out ¼ inch on each side. It should have a hexagon nut on

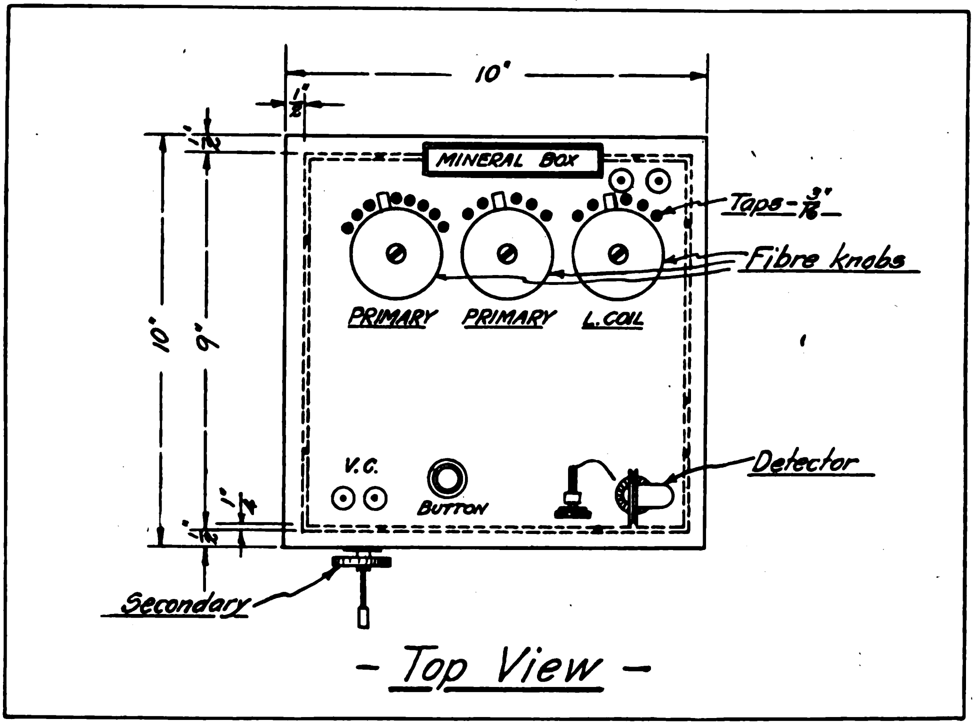


Figure 3, Fourth Prize Article

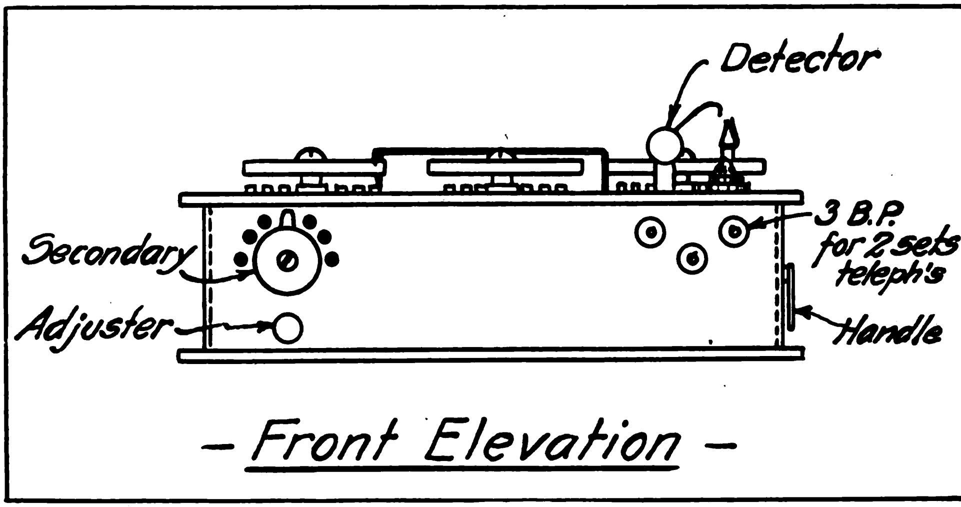


Figure 4, Fourth Prize Article

each side of the walls of the box to hold it in position. It is, of course, understood that this rod is for support of the secondary winding.

To support the secondary tube cut two round ends of ¼-inch wood to fit tightly in the center. Drill two large holes of size sufficient to let the stationary rod pass through freely. On the front part of the secondary end cut a little square hole so the terminals of the winding can pass through to the front of the case. Beneath this on the center of the sliding rod drill a hole a slight bit smaller than ⅛ of an inch. Then thread a ⅛-inch piece of brass about 5 inches in length on each side of the thread. Place a small rubber knob on one end and pass it through the case. Follow this by screwing it into the small hole beneath the sliding rod and the adjuster for the position of the secondary winding is now complete.

It will be noted in Figure 5 that a small test buzzer is mounted inside the cabinet. This is placed in inductive relation to some part of the receiving circuit in order that the sensibility of the receiving detector may be determined. Also in Figure 3, a small cat-whisker detector is indicated in the right hand corner. The construction of this may vary according to the ideas of the builder, and therefore the details will not be given.

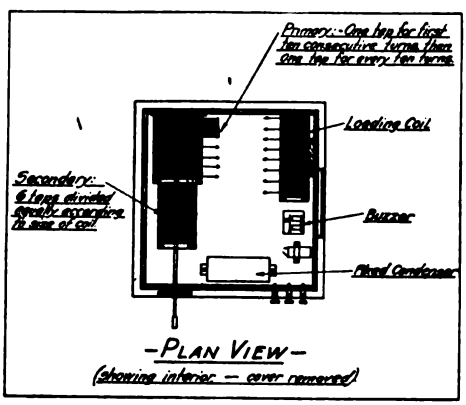


Figure 5, Fourth Prize Article

A small handle or leather strap can be fastened to one side of the case to make it completely portable.

EUGENE LE FEVRE, *California.*

HONORARY MENTION

An Explanation of the Mast Shown in Photographs

Just to show the amateurs of the North that those of the South are alive and awake, I call attention to the three photographs (on the following page) of the wireless telegraph mast constructed by me personally.

Figure 1 shows a nearby view of the base and will aid some in obtaining an idea of how it was erected.

Figure 2 shows in detail the base and a section of the mast, while Figure 3 gives all details, from the top of the base to the top of the mast itself. This mast has just been completed and as soon as the aerial is in place I expect to work.

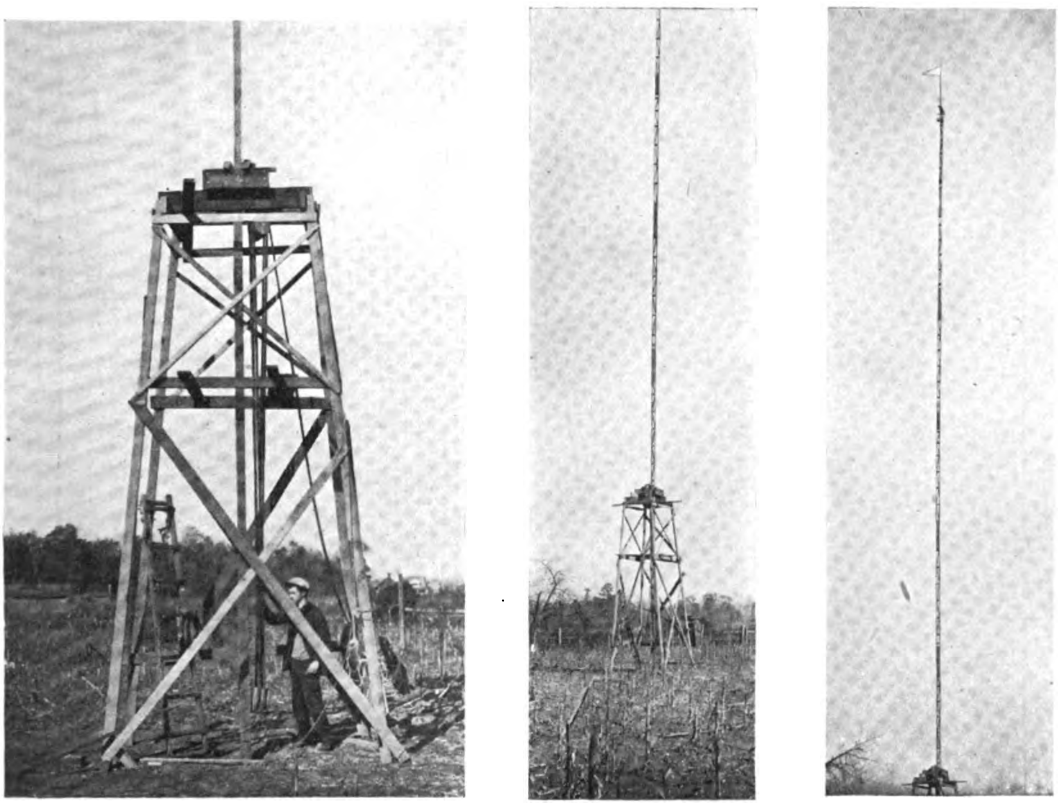
AUBREY WHITNEY, *Alabama.*

HONORARY MENTION

An Efficient Earth Connection and How to Make It

The average amateur earth connection is inefficient, but this is not surprising when we consider the time taken by the average experimenter to effect an earth connection. I have often wondered why such experimenters do not take plenty of time and secure a more perfect earth connection. Certain amateurs simply drive a pipe 5 or 6 feet in the earth and expect to work to a great distance. A ground connection of these dimensions is exceedingly inadequate for any amateur station and effort should be made to construct one of greater current carrying capacity and earth surface contact.

The amateur is accustomed to attach the earth connections to the gas or water pipes in the house, but nine times out of ten, the connection to the pipe is not soldered properly and also the pipe possesses many high resistance joints before it reaches the street water mains, thus causing a considerable loss in current. Again, the pipes often run a short distance through the building where they are connected to a large pipe through a rubber gasket. This would almost prevent the passage of current coming in direct contact with the earth and would introduce a certain amount of resistance in the circuit which would be detrimental to its efficiency. Also, the average steam or water pipe connection runs a considerable distance before making actual contact with the earth and therefore considerable current is lost en-route.



Figures 1, 2 and 3, Honorary Mention Article, Aubrey Whitney

A gas pipe should never be used for this connection as there are rubber

(Continued on page 450)

N. A. W. A. National Chief of Relay Communications

William H. Kirwan (9XE), N. A. W. A. national chief of relay communications, was born in Baltimore, Md., February 5th, 1881. He was graduated in steam and electrical engineering from the Baltimore Polytechnic Institute, class of '97, and two enlistments in the United States Navy as electrician gave him additional training. Six years' study of law at Baltimore Law School and Baltimore University fitted him for the bar, but he took up engineering instead and became assistant erecting engineer at the Panama Canal for the machinery installed on all "emergency dams." He has long been a student of wireless. Mr. Kirwan is now employed as superintendent of construction for the Otis Elevator Company of New York in the states of Iowa and Illinois.

A Coast-to-Coast Relay

Comprehensive Plans for Interchanging Messages Between the Mayor of New York and the Chief Executives of Other Cities Under the Auspices of the National Amateur Wireless Association

By 9XE

National Chief of Relay Communications
NATIONAL AMATEUR WIRELESS ASSOCIATION

A WIRELESS race will start from New York City on the night of Saturday, February 24th, after the NAA report. A message will be sent from the mayor of New York to the mayor of Los Angeles and all West coast cities possible. The stations handling this MSG westward will be special stations which will receive and QSL the MSG in regular order if possible. If the operator of a station farther down the list gets the MSG ahead ot time he should wait until he has been called by the station preceding him before sending. This relay will be conducted under the auspices of the National Amateur Wireless Association, but will be open to all.

A return MSG will be ready in Los Angeles and Seattle. Only amateur stations will be used on the route East, the plan being to deliver the return MSG from the West coast to the mayor of New York. Both special stations and amateurs will be working against time. The time of sending the MSG East or West will determine which class of stations will be declared the winner.

All of the best special and amateur stations in the United States are entered in this relay. As many amateurs have complained that all of the preceding relays have been easy, only the names of the sending stations in this event are made known, neither the exact time nor the wave-lengths being revealed. This plan will serve to insure quiet and will also provide opportunity for practical work in locating the points on tuners where the sigs from the various sending stations are QSA. The sending stations, however, will receive printed instructions by mail before the relay, giving the wave-length, power, etc.

The MSG will start from station 2ZK, New Rochelle, N. Y. George C. Cannon, the owner of this station, has consented to arrange the details of the event in the East, as well as start the relay. The time will be about half past ten o'clock at night. The following stations will be called, each in turn calling the next station on the list. If the next station has already received the MSG ahead of time, the operator should indicate this fact by calling CK—QSL and then call the next station on the list.

Station 2ZK calls 8YI, but if QRM is bad, station 3ZS will QSL 2ZK and then call 8YZ, who will in turn call 8YO. This will eliminate 8YI. Both 3ZS and 8YZ should be very careful not to QRM 8YI, but give time for checking. 8YO calls 8YL, who in turn calls 9ZS and 9ZN. 9ZS and 9ZN will listen for each other's CK and if 9ZS gets the MSG he will call 9XV and 8XA, giving the MSG to both of them at the same time.

If 9ZS does not get the MSG, 9ZN will give it direct to 9XN and 8XA will repeat the MSG only once after 9ZN, so that there will be no doubt that 9XN and 9XV have received it. 9XN will give the MSG to 9ZF and if there is any QRM 9XV wil lgive it to 5ZC. The latter will in turn give it to 9ZF who will in turn give it to the West coast, landing the MSG direct at 6EA.

It is planned to have 8XA give the

MSG only once if possible, as it is likely he will be heard on both coasts. 9XV and 9XN should have no trouble in getting the MSG direct from 8YI if he sends, but in case he does not it will be better to follow the schedule. Here is the schedule simply explained: 2ZK, 8YI, 8YO, 8XA, 9XN, 9ZF to the coast; or, in the event that 9ZS receives the MSG from 8YL, 2ZK, 8YI, 8YO, 8YL, 9ZS, 9XV, 5ZC, 9ZF. In either event 8XA will repeat the MSG after 92F has it. Haig and Smith, in Denver, will have no small task on their hands and 8XA will probably be heard in the Northwest by 7DJ and 7YS who are anxious to get the MSG. They are practically cut off at present because of the fact that Campbell, in Lewiston, Mont., and Heacock at La Grande, Ore., are out of commission.

The stations in the Southern States should not send during the relay, being requested to wait until 9ZF has the MSG before manipulating their keys B. Martin, of Mobile; W. Horner, of Cleveland, Tenn., and W. Anthony, of Shreveport, La., together with the Rev. Philippe, of St. Charles' College, have been requested to check all special stations and, if possible, make reports showing the relative strength of sigs of all special stations heard, using the weakest signals as a standard.

Seefred Brothers, 6EA, Los Angeles, have agreed to co-operate with the writer in handling the details on the West coast and the return MSG will be arranged for ahead of time and returned to 9ZF as soon as they have received the westward MSG.

The sending stations for the eastward MSG will be as follows: 6EA, 6DM, 9ZF or 9AMT, 5DV, 9ABD, 9GY, 8AEZ. 2AGJ, 1IZ, 1ZM. The route may be slightly changed from 6EA to Denver.

On the return SG after 1IZ has given QSL, station 8NH (Mr. and Mrs. C. Candler), will be asked to send the MSG two or three times on QST for the benefit of the amateurs on the East coast who will listen for this station and also the westward MSG after 9ZF has received it.

9ZN will be asked to test the efficiency of his Mississippi River route to the Gulf by getting the MSG in every city south of Chicago on February 25th, starting at ten o'clock in the morning.

A number of wireless policemen or monitors of the air have been appointed and they will report those who send without authorization during the relay. Amateurs should have the MSG delivered to the mayors receipted for. The time that they, as well as the mayors receive the MSG should also be indicated on the MSG. Reports on what was received should be sent to 9XE, Davenport, Ia., not more than forty-eight hours after the night of February 24th. If the letters are delayed it will be impossible to publish the names of the writers.

Prizes will be awarded for quick reception, long distance reception and delivery of both messages. A partial list of the prizes follows:

First prize, 1 k. w. transformer, Thordarson Company, Chicago; second prize, 1 749 tuner, F. B. Chambers Company, Philadelphia; third prize, 1 Arlington tuner, W. B. Duck Company, Toledo; fourth prize, 1 pair 3,000 ohm phones, Mesco, Chicago; fifth prize, 1 wave meter ($8.00), Electro Importing Company, New York.

Henry W. Blagen, of Hoquiam, Wash., has arranged to send a message from the mayor of Seattle to the mayor of New York. The amateur picking up this message and starting it East will receive a prize. Prizes will be given to amateurs only.

9XE of Davenport, is having a handsome silver cup properly engraved to present to the operator of the best all-around station excelling in sending and receiving records in the relays this year. Opportunity will be given every year for others to contest for possession of the cup.

The names of the assistants in the relay are as follows:

G. C. Cannon, 2ZK, New Rochelle, N. Y.; Professor Blatterman, 9XV, St. Louis, Mo.; Professor Taylor, 9XN, Grand Forks, North Dakota; E. F. Doig, 9ZF, Denver, Colo.; W. H. Smith, Our Old Friend Mac, 6SH, Stockton, Cal.; Seefred Brothers, 6EA, Los Angeles, Cal.; G. F. Johnson, 9ZS, Illinois Watch Company, Springfield, Ill.

The following stations have been requested to act as wireless policemen and report all QRM, which will be published: V. C. McIlvaine, 4CT, Tampa, Fla.; F. F. Merriam, 4CL, College Park, Ga.; W. S. Rothrock, 4DL, Winston Salem, N. C.; W. T. Gravely, 3RO, Danville, Va.; C. R. Lamdin, 3ME, Baltimore, Md.; F. B. Chambers, 3XC, Philadelphia, Pa.; C. D. Tuska, 1ZT, Hartford, Conn.; Sergeant Pearce, 2ZA, New York Police Department, New York; Cornell University, 8XV, W. C. Ballard, New York; South Ohio Radio Association, Cincinnati, Ohio; H. C. Colburn, K1Y, Victor, Colo.; Professor A. H. Ford, 9YA, Iowa City, Ia.; R. W. Weitz, 9SK, Des Moines, Ia.; H. H. Shotwell, 9EF, Chicago, Ill.; Harmon Deal, 9NN, Cape Girardeau, Mo.; J. M. Clayton, 5BV, Little Rock, Ark.; D. R. Simmons, 5AX, Shreveport, La.; O. R. Terry, 9IIQ, Stoughton, Wis.; H. W. Blagen, 7DJ, Hoquiam, Wash.; R. Higgy, 6DM, Phœnix, Ariz.; W. S. Ezell, 9YE, Wichita, Kas.

In Complimentary Vein

What there is in THE WIRELESS AGE you may be assured you can rely upon. It is in a class by itself.—H. M. C., *Maine.*

I am very much pleased with your magazine and find many useful hints that help to add to the efficiency and looks of a station.—M. E. N., *North Dakota.*

Please renew my subscription. Please send the Year Book and "How to Pass U. S. Government Wireless License Examinations" *at once,* as I NEED them.—R. B., *Ohio.*

One of the best, if not the best magazine dealing with radio, that is published.—L. E. B., *Montana.*

SPEAKING OF THE N. A. W. A.

Those MONTHLY SERVICE BULLETINS are great.

L. MASON, *Minnesota.*

I received my equipment and now wonder why I had not joined the N. A. W. A. before.

JOHN J. SULLIVAN, *Rhode Island.*

I am very proud to belong to the Association. . JOSEPH O'CONNOR, *Minnesota*

I am delighted with my equipment.

N. R. BENOIT, *Washington.*

The MONTHLY SERVICE BULLETIN is excellent.

PAUL J. RASMUSSEN, *Wisconsin.*

The pennant, books and pin are worth more than the price I paid for them.

PAUL G. SINGLETON, *Indiana.*

WILSON FLASHES MESSAGE TO SAN DIEGO

President Wilson, on January 26 sent the first wireless message from Arlington to the new naval wireless station at San Diego, which forges another link in the chain of radio stations connecting American possessions by wireless with Washington. Greetings were flashed by the President to the new station, and an answering message was almost immediately transmitted from San Diego.

The new San Diego station will, according to published plans, permit of direct radio communication between the Atlantic and Pacific coasts, and will serve as a relay station for transmission of messages from Washington to the wireless stations at Pearl Harbor, in Hawaii, and at Cavite, in the Philippines, which are now in course of construction. The San Diego station will be able to communicate directly with wireless stations on the Panama Canal and in Alaska.

A Song of Wireless

Tah-daah-dah-dah, the king am I, the monarch of today;
O'er earth and air and sea and sky, I hold unquestioned sway
My Mercury-shaming couriers spring up from every clime,
Turn night to day, and laugh away the threats of Father Time.
From Eiffel's lofty reaches,
To Poldhu's lonely beaches,
From Sayville down to Arlington, across to Frisco town,
Honolulu, Yokohama
From proud old Fujiyama
To Hong Kong and Vienna, men do homage to my crown.

Tah-daah-dah-dah, the superposed gray bulldogs of the sea;
Loose triple-gun damnation at a word of code from me.
My crackling spark gaps guide aloft the swooping aeroplane,
And far below, with decks awash, the deadly submarine,
They solve the ether's mystery
They write the page of history.
And when, a thousand miles at sea, comes sudden grim distress,
Trim liners melt their funnels,
Lazy trampers drown their gunnels,
As they speed "Four bells," in answer to my ringing S. O. S.

Tah-daah-dah-dah, I tell the world of sorrow and of mirth,
With Wall Street stock quotations flanked by news of death and birth,
My messages are broadcast—seek not a chosen few,
But fall alike upon the ears of Christian, Pagan, Jew.
I span the racing oceans,
Safe from their wild emotions,
And I flout the booming breaker as he rages far below;
I join the hands of nations,
In firm, newborn relations;
I unify the universe; I'm king—King Radio.

—V. C. Jewel in Leslie's.

An Idyl of KPH

By Edward Walden

HE was being broken in for the third trick at KPH. Everything was new and interesting and he listened with close attention to the instructions of the regular operator. With delightful anticipation he looked forward to the time when he would be alone and in charge.

The hours wore away. Press was finished, the trans-Pacific boats had cleared and as he sat listening in with the other operator his mind had an opportunity to dwell on the other side of the picture.

A howling southeaster was blowing, shaking the building and straining the cables which held it on the hillside. He began to think that perhaps he would not fancy being alone in that isolated place in the dead of night. When he thought of that long black box in the little back room he concluded that this was well named the "graveyard watch." Why had they put the transformer in a case so suggestive of our last and final habitation? He could not get it out of his mind.

Suddenly he was startled to find that he was alone. Only one pair of phones was connected in and that pair was on his own head. Evidently he was the operator in charge. The wind had subsided and everything was still. The door to the little back room was open and the thought of that long black box came to his mind. He heard the cracking of wood and knew instinctively that a figure was emerging from the transformer case. A shuffling sound, a footstep and an aged man stood in the doorway. Reassured by his harmless appearance, the young operator asked him what business brought him to the station. The visitor pointed to the phones and said::

"With those instruments, you hear the signals which your ears cannot discern, but I have a pair of glasses which will enable your eyes to see the sparks as they fly through space."

He took a pair of dark colored spectacles from his pocket and handing them to the young man said:

"Come outside and put them on."

Stepping out into the clear starlit night the operator adjusted the glasses and instantly the sky was filled with balls and streaks of fire. As he looked more closely he observed that they moved in trains in different directions. There was a brilliant series coming over Twin Peaks from the north, both balls and bars looked to be a foot in diameter and followed one another at irregular intervals. He soon realized that the balls were dots and the bars dashes and found that he could read them.

He spelled out:

"Don't x JJC msgs. can cpy direct. KET"

Turning to the East, the plain covered by Berkeley and Oakland was a series of small spouting craters. He read a few of them, but they all seemed the same:

"How is my spark. Where are you located plse."

Coming over the Berkeley hills was a scintillating continuous streak of pulsating fire which he could make nothing of. The old man noticed his perplexity and handing him another pair of glasses said:

"Try these. The alternations are too rapid for the pair you have on." The young man changed the glasses and saw the continuous streak as balls and bars connected by a hazy arc. He read:

"We lsn fer u at 6 am—WGG"

He changed the glasses again and looking South was confused at the numerous trains of flying sparks. He tried to read them and this is what he got:

"Arrivals Nera at-50 lbs cabin coffee ten cases milk-clear nw 1 48—we know you are brainless or you would not interfere with a commercial station—terribly lonely without you—two gunners mates second class ten ordinary—903 miles south—hatch no 5 764 bags coffee-ten pound boy—flag fgyq, drtw, fynt, brqx,"—

He gave it up and turned seaward. A number of the fiery trains from the West were traveling slowly; evidently their force was spent. He read one, "RAS de JOC," just before it dropped into the sea.

Looking up at the aerial above his head he found it curious to watch the balls and bars strike the wire and run down the leads like billiard markers. Four balls followed by two balls now struck the aerial but instead of following the leads down, they clung for a moment then dropped on his head. He felt himself clutched violently by the arm and the voice of the regular operator said with a growl:

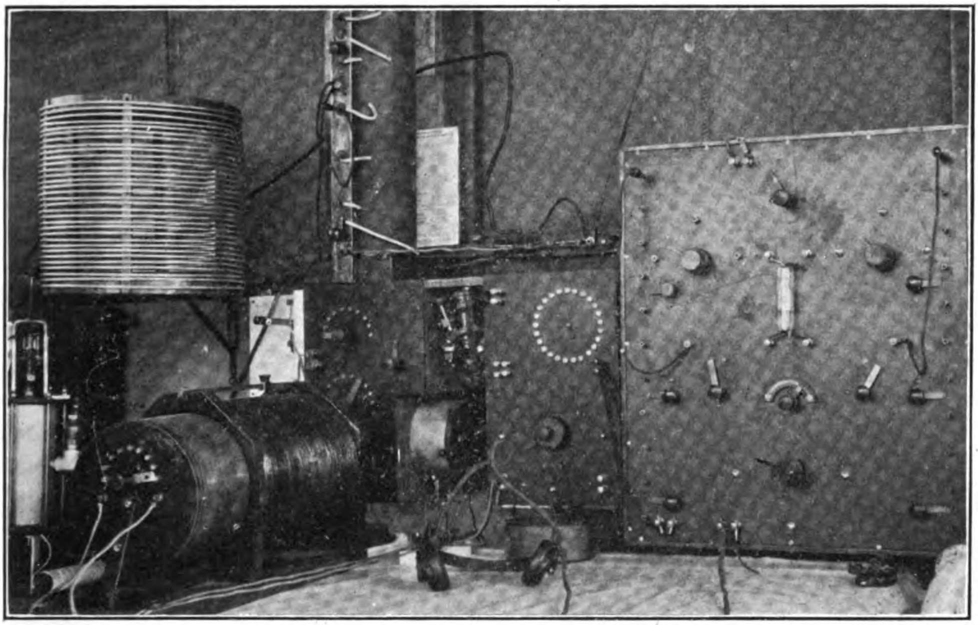
"The first thing to learn on this watch is to stay awake."

ANOTHER LETTER TO MR. MARCONI

Sir: I am intrested in the makeing of a wireless device for the long distance reading of books and papers by the use of sound. It is the use of the echo you start wuth a voilin. The sound of the voilin will throw the sound of the letters to the voilinest or in any direction that you wiish to. That is take letter A. The letter s sound can to form avocal sound of the letter and can be made to its so that crry thrugh awall. The volin can be made to form the sound of the letters and the sound of the voilin will cary the raeding sound of them as long as them as long of the voilin will cary. I have found that a common standard size of print will throw so a common standard size of print will throw sound to the distance of ten miles to a locomotive whistle where I could here it at this distance. I have this faclty pretty well worker in I worked with the use of a hanner so I could read a book with book closed at the distanceof a hundreds of yards. How to get this device worked and made with the use of machenery. It is a good thing for the long distance spyinging on the enemy. One could discover them at the distance of at least fivety miles and all that they knew. In an airoplane it would be more easy. This thing will work speciaily good a dark nught when there is stormy weather. I have studied this thing with the following tipes of sound, steam whistel, locomotive running, heavy machenry, automobile, street car ponograph, and in fact all types of sooound, it might possabe to make sonding and receiving appuratus for the use of electrisity, the use of heavy gun fire sound could be made use of preety easy. I can spy up all sorts of people on both sides of a road for hall with a common motorcycle makeing a recier with sound for thes porpous. This can all be made to work a return. The sound is sent by the echo from tyhe surface or edge of thes letters of the alfibet. First learn to throw the spoken sound of the letters o of the alfibet. First learn to throw the spoken sound of the letter a sound reflect. The idea is use the echo for this. With a fiddle you can go through any book with a fiddle and it will you wall want find out about this method of discovery. It is possed with the edge of a pace of cards to discover all that is in the pack of cards. It is pssable to get any sort of a sound or ecow return one experiment that I tried was the efect of an automobile sound thrown to a twig the automobilest able to get a complet return from the book to the automobeilest and haveing no sight of the book.

Another way is to wacth to spy with. A wacth will go thruh any kind of a book. A man could go throuh your premisis and get ahold of every thing that you had on them and you never find it out. In this way forign spy trains himself to find out every thing that is around him. This sound is a good thing as it tells you the principil of the thing.

With the Amateurs



Louis Falconi's station at Fort Stanton, New Mexico

On this page is shown a photograph of the receiving apparatus and experimental undamped arc transmitter of Louis Falconi at Fort Stanton, New Mexico. The receiving apparatus is the regular type of Armstrong circuit and has given good results despite the unfavorable conditions of the surrounding country which is extremely mountainous. German stations can be heard during the daytime and NAA has been read forty feet from the phones with no other apparatus except that shown in the photograph. The undamped transmitter is designed for experiments in wireless telephony and radiates about forty watts.

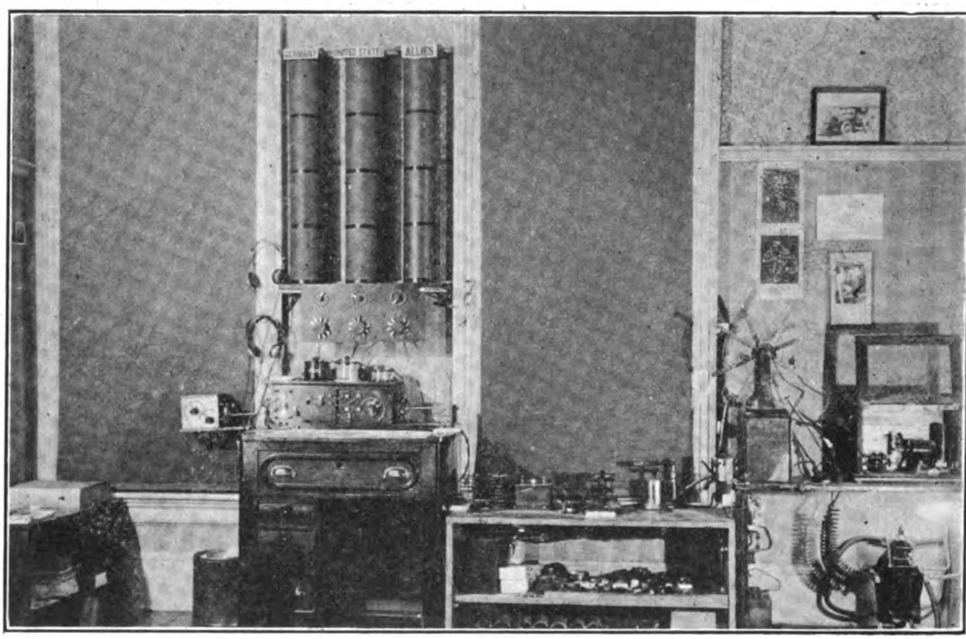
The recently-elected president, vice-president, secretary and treasurer of the Fort Wayne (Ind.) Radio Association re respectively Messrs. Carter, Paruin, De Witt W. May and Hall. Correspondence and exchange of ideas with other clubs will be welcomed. The address of Secretary May is 3021 Hoagland Avenue, Fort Wayne.

Frank A. Caswell of 21 DeKalb Street, Dayton, Ohio, is ambitious to have the Efficiency Radio Club of Dayton continue its activities. He would also like to get in touch with those interested in the formation of a signal corps.

Kenneth Husson, a wireless amateur, accidentally shot and killed himself with a pistol on January 23 at his home in Hollis Court Boulevard, Borough of Queens, New York City. He was sixteen years old.

Members of the Albany (N. Y.) Radio Club recently listened to an address by Ensign Philip F. Hambsch on the plan of the Navy Department to enroll amateur wireless operators as a reserve corps for use in war.

Ernest Ruhlman, secretary of the Peninsula Radio Club, delivered an address to the members of that organization at a meeting held recently in the Bayonne (N. J.) Y. M. C. A., Meetings of the Club will be held every Monday evening.



Kent brothers' station at De Witt, Iowa

The Clarke County Radio Association has been organized in Vancouver, Wash. It has three divisions of membership: full members who are able to receive messages in the continental code at the rate of five words a minute; honorary members able to receive twelve words a minute, and students. The officers of the Association are:

President, J. O. Dawson; secretary and treasurer, John Hertz; chief operator, Louis R. Devine.

The twenty-eighth meeting of the Radio Club of Marlboro, Mass., was held recently. After a general discussion of radio telegraphy a few laws were passed, one, that meetings should begin at half past seven o'clock in the evening instead of at eight, and another that in the future general discussion of radio telegraphy should not exceed one hour.

Amateurs on Cape Cod have formed the Cape Cod Wireless Club, its headquarters at present being located at the home of William Chapman at Dennis Port, Mass. The Club is desirous of getting in communication with other amateur organizations. Letters should be addressed to William Chapman at 14 Follen Street, Boston, Mass.

The Terre Haute (Ind.) Radio Club is a new organization of wireless amateurs.

A movement is on foot to organize a wireless club among the amateurs of New York City living in the vicinity of East Eighteenth Street. J. Schanz, Jr., of 230 East Eighteenth Street is one of those interested in the proposed organization.

The Lowell (Mass.) Radio Club was organized on January 6 at a meeting held at the home of Everett Taylor, 156 Winthrop Avenue. The following officers were elected:

President, Everett E. Taylor; vice-president, Wilder A. Fernald; secretary, William H. Carney; treasurer, Caleb F. Rogers. Charles H. McMasters, David H. Hanson, Warren R. Entwistle, Elmer A. Scott and Franklin S. Coppen were elected associate directors. Correspondence with other clubs is invited. It should be addressed to the Lowell Radio Club, Lowell, Mass.

Ames, Ia., has a radio club. The officers are:

President, Hollis K. Sels; vice-president, Professor C. A. Wright; secretary and treasurer, Ralph Blakeslee.

At a regular monthly meeting of the Puget Sound Wireless Association held in the Y. M. C. A. at Seattle, the following officers were elected:

President, Vincent I. Kraft; vice-president, O. S. Van Olinda; treasurer, Charles E. Williams; secretary, Ernest F. Goodner. The "Measurement of Capacities" was the title of a paper presented by Philip D. Naugle.

The New Haven (Conn.) Radio Association has elected the following officers:

President, W. F. C. Hertz; vice-president, R. Merwin; secretary, R. H. Campbell; treasurer, A. P. Seeley. The Club meets every Tuesday evening in its home in the Y. M. C. A. building. Communications should be addressed to the secretary at 365 Edgewood Avenue, New Haven.

Several interesting talks interspersed with musical selections, made up an enjoyable program at a banquet held by the Louisville (Ky.) Radio Club at the Tyler Hotel.

Thirty members of the Club, which was formed less than a year ago, attended the banquet and voted to make it an annual event hereafter.

The principal address was made by Professor Warwick M. Anderson, of the University of Louisville, whose subject was "Wireless Observations Made on the Civilian Naval Cruise Last Summer."

READY TO TEST HAMMOND TORPEDO

John Hays Hammond, Jr., has announced that he will turn over to the Government his wireless controlled torpedo whenever the Government shall desire it.

Last August a board of officers, consisting of Major General Leonard Wood, of the army; Captain John A. Hoogewerff and Commander David W. Todd, of the navy; Lieutenant Colonel George O. Squier, signal corps; Lientenant Joseph V. Ogan, of the navy, and Captain Fulton Q. C. Gardner, coast artillery corps, was appointed for the purpose of witnessing and reporting upon certain demonstrations and tests of the torpedo.

The first meeting of the board was held recently when it was decided to advise Mr. Hammond that the board was ready to observe what he had to demonstrate. The aviation authorities of the army have been co-operating with Mr. Hammond in obtaining a suitable and properly equipped airplane for use in connection with the demonstrations.

HIGH-POWER STATION ASKED FOR PORTO RICO

Secretary Daniels has asked Congress for an appropriation for a high-power wireless station in Porto Rico. Mr. Daniels said the island is of "extreme strategic importance in connection with fleet operations, owing to its location, and with a protected high-power wireless station, communication would be insured with the fleet, with Europe and South America to a greater degree than by any other means."

Faults of Amateurs and Suggestions for Improvements

By W. A. PARKS

JUST as the ambitious amateur is constantly striving to improve his apparatus in order that he may obtain better results, so should he strive to acquire more skill in operating. By this I do not mean simply the ability to send and receive rapidly, and with proper formation of the characters of the code; that is important, but it is by no means all-consequential.

A few words regarding the consideration that amateurs should accord one another deserve a place here, it seems to me. If two operators exchanging their nightly "How are you?" and "How is my spark?" are interrupted by someone who really has something to say, they should stand by until he has finished instead of harboring resentment.

Much interference is frequently due to the waste of time in sending long calls for some amateur perhaps two blocks distant from the station transmitting. One call is sufficient in such cases. Added to this waste of time is the ridiculous practice of making 5 —— - —— - ——'s, 10 r r r's and 15 k's during each part of the message. Display of this fault is unmistakable proof that an unskilled operator is at the key.

Many amateurs are also accustomed to holding down their keys for minutes at a time and neglecting to listen in to find out if anyone is qrw. There are few of us, indeed, who cannot find time to tune our sets either in the morning or afternoon, when we will cause no qrm with other amateurs.

Too much speed is worse than draggy sending. Never send more than twenty or twenty-five words a minute unless you have confidence in your ability, and that of the receiving operator to handle messages at that speed.

This article would not be complete unless I directed attention to the practice of calling a station as soon as it is heard, although the operator at the station in question has just called someone else. This practice is impolite to say the least. Another example of what not to do along the same lines is the habit of calling without first listening in to find out if anyone is working.

When abbreviations are employed the qr's qs's should be used in all cases. There are other abbreviations in general use among amateurs. Many of these are from the Phillips Code. Some follow:

abt, bi, clr, cud, cul, ga, gb, gg, gm, gn, gv, hr, hw, min, msg, nw, pwr, r, rt, sed, ses, sigs, spk, tks, tmw, tnx, tt, u, ur, wd-s, wr, wt.

It should be understood that the writer makes no claim to being an infallible authority on the subject discussed in this article. He has, however, been an amateur for several years and has had opportunity to observe considerable transmitting and receiving. It is on this experience that he bases his statements and suggestions.

MEDAL FOR PROFESSOR PUPIN

At the fourth annual convention and dinner of the National Institute of Social Science held in New York City, a medal was awarded to Professor Michael I. Pupin for his work in wireless telegraphy and the long distance telephone system.

The War's Wireless Record

NO sooner did the crisis between this country and Germany occur, than the United States Government at once took possession of the Sayville wireless plant at Sayville, L. I., which is controlled by German interests. On orders telephoned from Washington on February 4th, Lieutenant D. S. Lindsay, U.S.N., commanding the detachment of marines and bluejackets in charge of the station, discharged from employment twelve Germans who have been at work there since the Navy Department assumed control of the station.

On the night of the same day four wireless operators went on duty at police headquarters—probably to remain there indefinitely. With its wireless apparatus, the Police Department will keep in constant touch with naval and army stations.

Rear Admiral William S. Benson, Chief of the Bureau of Operations in Washington, the next day sent by cable and wireless to all American naval commanders a specific set of instructions covering the actions they are to take in difficult situations. The exigencies specified and the action to be taken in each case were contained in confidential code messages.

Wireless messages sent out on February 7th, by the Standard Oil Company of New Jersey, recalled such of its vessels as would have to pass through the "barred zone" established by Germany in order to reach their destinations. As a result the tankships Communipaw and Pioneer put back to the port of New York. The company has a fleet of about forty ships, twelve of which are in the Atlantic service, and others are expected to return to their ports in obedience to the wireless orders.

The presence of German raiders in the North Atlantic caused considerable anxiety to the skippers of trans-Atlantic liners and freighters. Passengers arriving on the French liner Espagne, on January 4th, from Bordeaux, told of seeing a ship corresponding to the raider's description in the Bay of Biscay, while incoming travellers on the Tuscania, of the Anchor Line, told of making a wide detour south to avoid regular shipping lanes.

Ten days later Captain Bullen brought the British steamer Herschel into Boston from Cardiff, Wales, having safely traversed the German submarine zone off the Irish coast. Warnings of the presence of submarines in the trans-Atlantic steamer ' lane reached Captain Bullen at Cardiff, and he fitted up a dummy wooden cannon, fashioned from a spar and equipped with smoke bombs and detonating caps. Upon receiving additional radio warnings after sailing, Captain Bullen ordered the after deck cleared for action, and the "gun" was mounted and manned, to convey the impression that the crew was engaged in target practice, and thus frighten off U-boats.

About a week afterward fast cruisers of the Allies in the Atlantic threw out an immense net for a German raider, then believed to be the Moewe or a sister ship, which sank or captured a score of allied and neutral merchantmen between December 12th and January 10 in the Atlantic. Reports from Norfolk said that wireless messages picked up from ships indicated that the commerce destroyer, after her exploits in southern waters, was headed north, obviously to operate in the more frequented trans-Atlantic shipping lanes. She was then thought to be about 1,500 miles south of Cape Henry, according to the wireless talk of British captains on the Atlantic.

Some Recommendations for Improved Amateur Legislation

By 9XE

National Chief of Relay Communications

NATIONAL AMATEUR WIRELESS ASSOCIATION

AFTER a thorough study of the bill to regulate wireless communication, which was approved by Congress August 13, 1912, I have set down on paper the suggestions and ideas regarding legislation for amateurs contained in this article. The remedy for improving conditions, I believe, lies in the utilization of my arguments to present the subject in its true light with the object of obtaining sufficient support to introduce into the legislature of each state a bill to control its amateur stations.

It is provided in the Constitution of the United States that Congress shall have power to regulate commerce with foreign nations and among the several states, and with the Indian tribes. Relaying for pleasure or glory is certainly not commerce in any sense of the word. Why should any restrictions be placed on the operation of an amateur station with the exception of a license, wave-length and QRM penalty? An inspection of an amateur station is surely not up to the United States Government, it is a state right and the only condition of obtaining a license from the Government should be that the operator is an American, and that no wave-length greater than 200 meters be used. The discussion about decrement is useless, so far as amateur stations are concerned. The grading of licenses by the Government is usurpation of the state right and nothing should be needed from the Government other than a permit to operate an amateur station.

I concede the right of Congress to license and tax, if necessary, but I cannot escape the conclusion that a mistake has been made in regulating the use of amateur stations. An amateur wireless station is looked upon as a means of education, or amusement, as the case may be and even if its signals are heard in another state, no regulation by Congress is needed.

I suggest that a Government License should, in no circumstances, be granted until the conditions of the state are first met. Few, if any, amateur stations are inspected by the state electrical inspectors. Why? Because the states have not been educated up to the fact that their jurisdiction covers the inspection and proper operation of that station. The Government issues a license to saloons, but does not attempt to control them, because this power belongs to the state. Congress admits it has no authority over a wireless message between points in the same state. I contend that it should have no authority over any amateur wireless message sent to any state.

The amateur should strive for a proper state regulation as to hours of transmission for clubs engaged in more serious work, a division of time for spark coil operators without licenses and a special time for sending for individuals who are not engaged in any particular work, but are merely amusing themselves. They should aim also for a curtailment of the privileges extended to amateurs who send sporting news and crop conditions without exercise of good judgment.

The practical way to better conditions is to have one bill prepared and present a copy of it to all the legislatures of the various states. By appointing one captain of the QRM League in each state of the Union, who will appoint three lieutenants, each of whom will appoint five helpers the movement has been started. These helpers will gather the opinions from their neighborhood, forward them to their respective lieutenants, who, in turn, will condense these opinions and forward them to their captain, he, in turn will either O. K. or change them and forward them to the zone manager for that territory. There will be as many zone managers as there are radio inspection divisions.

By this means it will be possible to get the best opinions from the leading amateurs of the country, condense them and arrive at a working basis for the framing of a bill to be presented to the legislatures of the various states. Many of the states are already organized. Another thing, we want to have your opinion concerning, is about State Inspection of Amateur Stations.

The Q. R. M. League would also like to obtain the opinion of amateurs regarding state inspection of amateur stations. It would be best to have all stations wired properly and with due regard to life and property. The electrical world would never have made the progress it has if there had not been some regulation about wiring. Send your comments to the helper of the Q. R. M. League in your district, whose name will be published shortly in this magazine.

In the relays that have been conducted under the supervision of the writer, the governors and mayors of the various states were first made figures in the events. Then the nominated president was brought into relay and it was demonstrated to President Wilson what could be done in the way of getting signatures to a M. S. G. The amateurs should use the same amount of energy in seeking improved legislation.

New Aeroplane Receiving Set

Dr. R. O. Shelton, of San Diego, Cal., sends in an interesting description of a receiving set constructed by him, with various devices of his own, which he has been using in the wireless aeroplane experiments that are being conducted by him and Captain Culver. His letter is in part as follows:

"In your November issue of THE WIRELESS AGE, under the heading of 'New record for aeroplane transmission' you have reported some of the experiments which Capt. Culver and myself have been conducting for some time. The last flight was made last week, and I was able to read him in the machine at a distance of 140 miles, when an oil lead on the machine was broken, forcing them to return to Martin field at Los Angeles for repairs.

"It might be of interest to you to know the aeroplane was equipped with a ¼-k.w. army field set, 60 ft. aerial on the upper plane and a 300-ft. trailing counterpoise. The aerial circuit had to further be loaded, besides the oscillation transformer to get a little over 200 meter wave. A much longer aerial is required to get the wave with no ground.

"The receiving set was constructed by myself and consists of aerial 120 ft. long, 75 ft. high, lead-in and ground 130 ft. with series condenser; small receiving transformer; amplifying phones; two step audion. The hook-up in the audions is of my own device, and gives better results than the best Armstrong. It is simple, easily tuned, requires only a grid loading coil, and, contrary to the Armstrong hook-up, works as good on the 200-meter wave as on higher ones. It tunes arc or spark with no change in the circuit other than tuning. I am perfecting the hook-up and when finished will give it out to the amateurs in general. I am able with the above set to read the German stations. Other stations in proportion. Common occurrence to hear 6-SH at Stockton, Cal., and talk with 6-AJC at Long Beach—90 miles distant—who uses a small coil and a 6-60 storage battery for power. I have heard over 100 stations north of here from 90 to over 500 miles. And all with the QRM of NPL which is less than 5 miles distant."

New York Signal Corps in the Field

What Company A, the Wireless Section, Achieved on the Texas Border

Captain Robert W. Maloney's Account of the Experiences of His Command

Photo. by C. H. Johnson

New York's crack wireless company on the march

THE First Battalion, Signal Corps, of New York, during its recent stay on the Texas border over a period of more than five months with the New York Division, won a splendid record for itself. In the words of Major William H. Hallahan, the battalion's commander, the men of his outfit were the most fit of any of the National Guard commands that went to the border. "Every man made good," said the Major. "We were ready to go ahead with our work the minute we reached McAllen, and the manner in which we handled the communications for the regular army as well as for the various State divisions won praise from the army officers. We ran telephone lines to the most distant outposts, and made our wirelesss outfits, good ordinarily for thirty-mile radius, communicate with Fort Sam Houston, 240 miles distant."

Public comment was made on the fact that the Signal Corps was the first organization to return from the border without voicing complaints of having been held there too long and without circulating stories of having experienced unnecessary hardships. The men returned in the best of physical condition and almost to a man agreed that their experience on the border had been both pleasant and profitable.

As a matter of fact, the men had no time to become discontented. During the five months they were in Texas, they erected more than 500 miles of telephone and telegraph wires, besides establishing several radio stations. They patrolled along a line of practically seventy-five miles, and did it as efficiently as a regular army organization could possibly have done it.

The radio company of the battalion it is understood, carried off most of the honors of the occasion. The crack wireless section of the Signal Corps is Company A, of which Captain Robert W. Maloney is in command. Captain Maloney has given an entertaining account of the experiences that beset the wireless men of the Signal Corps on their arrival at the Texas border, the difficulties with their equipment, the improvements they instituted and how achievement triumphed over the handicaps of unfavorable weather and obsolete wireless outfits. The ⅛-k.w. set with which the Signal Corps of the National Guard was provided was found unsuitable for the work that was to be done, it having insufficient power to work for the distances that had to be covered, but as rapidly as possible the men of the Signal Corps were provided with the far superior 1915 pack set in use by the regular Army.

"The Army," said Captain Maloney, "has its regular system of 5 and 10-k.w. stations running across the country, at Fort Sam Houston and various other Army posts. These are permanent stations and not stations that can be taken around in military operations. The regular Army troops are provided with the 1915 ¼-k.w. inclosed gear type generator and the new 1915 pack set, loaded on pack mules. They are equipped with 45-foot masts, a hollow spar mast, jointed like a fishing pole. In addition the regular Army has a 1-k.w. wagon set and a 2-k.w. auto tractor set.

"The National Guard's wireless equipment was to a large extent obsolete when we went to the border. It had no wagon or tractor sets and our company and others were equipped with old style ⅛-k.w. 500 cycle 1912 sets, with exposed gears. This was in general the equipment. We got down to the border in July and found ourselves in the midst of a stormy and rainy season. Our experiences showed that the ⅛-k.w. set was practically worthless, so far as possessing sufficient power to work for any distance or overcome any slight static. The receiving set was not very serviceable. But as rapidly as the Government could get them out, we were provided with the 1915 sets and by the time of our return, we were equipped with four of the 1915 pack sets. This is really a most remarkable set. The generator is entirely inclosed in an aluminum case and the gears run in oil. This is a great advantage as it prevents the alkali dust from running into the gears, as happened with the old 1912 set. With the latter we were lucky to obtain 1¼ amperes, while with the new set, with the same amount of muscular exertion, we could run it up to 2⅓ or 3 amperes. The receiving set was also far superior to that of the 1912 outfit. It has an oscillation transformer with a triple folding helix and the tuning coils are much larger and get a far greater range. It is also equipped with the new Baldwin 'phones and a silicon detector.

Photo. by C. H. Johnson.

Field wireless station in operation, with power for transmission of messages being supplied by hand generator

"We found down there that the ordinary radio mast, 45 feet in height, was too short to enable us to get good results. In order to send any great distances, we were obliged to increase the height to about 70 feet, using extra sections of mast. The antenna consisted of four loosely braided bronze wire strands, each consisting of three wires. These were subdivided for the purpose of creating an umbrella type of aerial into twelve single strands. We also doubled the counterpoise by using two counterpoises hooked together. As a result of these changes we found that the receiving qualities of the set were wonderfully increased as well as the sending power.

"With this little ¼-k.w. set the New York Signal Corps from September until the end of December handled all of the Government business between San Antonio and McAllen, Texas, which came through for the Sixth Division (New York). In other words, this little ¼-k.w. working with a 10-k.w. set at Fort

Sam Houston, handled all the business over a distance of nearly 300 miles. Not only was official business handled, but time signals were all taken from Washington, the regular press reports received from Key West and the daily press bulletins published. The World Series was reported and on Election night, receiving the returns by radio from Fort Sam Houston, we were able to beat the commercial wire telegraph by several hours. In ordinary quick field work we had no trouble at all, making communications over distances of forty to fifty miles.

"What the Army is trying to get is a light weight set, highly mobile, which can be assembled and set up rapidly, and of a sufficient power to cover reasonable distances without danger of interruption or interference either by light static conditions or by other light sets.

"It might be well to remark," added Captain Maloney, "that merely because a man is an operator, does not make him a Signal Corps man. He must understands horses and mules, and has to know how to pack an A P A R A J O. He must understand visual signalling and should know lineman work. During our presence at the border we built three complete camp telephone systems with about 30,000 feet of twisted wire each and rebuilt about 100 miles of telegraph lines, besides erecting buildings to put our central stations, etc., in."

One of the detachments of the battalion had an amusing experience, during which it displayed its resourcefulness by sending messages over a barbed wire fence. The detachment was stationed near Hidalgo, and was furnishing information to an infantry regiment which was operating several miles up the Rio Grande. A patrol of the opposing force discovered the lines and cut them, and then stationed a guard to see that they were not repaired. When the men of the detachment found out what had occurred, they connected up with one of the wires of a barbed wire fence, and the detachment on the other side did the same thing. In this fashion they managed to get their messages through with very little interruption.

Photo. by C. H. Johnson.

Portable equipment being transported in field, showing method of carrying mast sections and apparatus

EXAMINATIONS FOR RADIO OPERATORS

It is announced by L. R. Krumm, Chief Radio Inspector for the Radio Service of the Department of Commerce, that the examination of applicants for radio operators' licenses will be discontinued at the Brooklyn Navy Yard and Fort Wood, Bedloe's Island, until further notice.

Beginning February 12th, examinations for operators will be held in the office of the Chief Radio Inspector, No. 603 Custom House, New York City, every day at 10:00 A. M., to 2:00 P. M., except Saturdays, Sundays, and holidays.

All necessary forms will be furnished and filled out at the time of the examination. The papers will be marked and licenses issued as soon after the examination as possible.

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

B. R., Casey, Iowa, inquires:

Ques.—(1) I purchased a 10-inch Marconi induction coil of the type used aboard ship. What size spark should be obtained with a condenser capacity of .0125 microfarad?

Ans.—(1) This value of capacity is excessive for these coils. A condenser of .004 or .005 microfarad is of the correct value and should give a spark discharge of about ¾ of an inch in length.

Ques.—(2) What is the approximate capacity of each section of a Murdock moulded condenser?

Ans.—(2) Each section has a capacity of about .0017 microfarad. Three of these connected in parallel would do for the 10-inch Marconi coil, but if you want a series parallel connection you will require twelve sections. Six sections should be connected in parallel in each bank and the two banks finally connected in series.

It should not be necessary to publish a diagram in The Wireless Age for the connections of this apparatus, as previous issues have contained many diagrams applicable to your equipment. The book "How to Conduct a Radio Club" also contains a number of diagrams and advice for the beginning amateur.

* * *

R. J. F., Southampton, N. Y.:

If the steel mast you propose to erect is to be supported by guys, you can insulate it at the base by building up a wooden platform which in turn rests on a set of glass insulators. While glass will not stand a hard blow, it has considerable pressing strain and will serve your purposes. The base of the mast may be housed in to protect it from dampness and consequent leakage. We advise you to purchase a copy of the book "How to Conduct a Radio Club" and find out for yourself how to tune a wireless telegraph station.

By referring to the curves in the November, 1916, issue of The Wireless Age you can easily determine whether or not the wave-length of your antenna is within the Government requirements; otherwise you will require a wavemeter by which the wave-lengths radiated from your station can be definitely measured.

Your 500-foot aerial has an approximate wave-length of 800 meters.

* * *

J. B., New Orleans, La.:

Your should construct your filament rheostat of No. 20 or No. 22 German silver wire. Purchase enough to give a maximum resistance of about 20 ohms.

We do not understand what is referred to when you speak of the rheostat for the grid circuit.

* * *

G. C. W., Lexington, Conn.:

An exposed telephone wire gives fair results as a wireless telegraph aerial, depending to a large extent upon the local conditions and the general location of your station. The antenna posts of the receiving set should be connected through a variable condenser to one side of the telephone line. Care should be taken to select that side of the line which is not already grounded through a 2 microfarad condenser. Good results should then be obtained, particularly from stations near by. Whether or not you will be able to hear stations on the Atlantic coast is problematical.

* * *

J. C. P., Chambersburg, Pa.:

You and other inquirers requiring a complete set of instructions for the construction of a closed core transformer should purchase a copy of the book entitled "Wireless Telegraph Construction for Amateurs," by Alfred P. Morgan. This can be purchased from the Book Department of this magazine. We have no information at hand concerning the windings of the Packard ½ k.w. transformer.

* * *

A. A. K., Passadumkeag, Me.:

It is impossible for us to solve your problem without being on the ground, but we advise you to thoroughly test all circuits of your receiving apparatus for an open circuit. The parallel telegraph and telephone wires without doubt shield your station and absorb a certain amount of energy in the passing waves, but the fact that you once heard stations and now do not indicates that something must have happened to your apparatus.

A. B. L., Helena, Mont.:
Figure 19b on page 861 of the September, 1916, issue of The Wireless Age gives a detailed connection of the vacuum valve amplifier where one storage battery is used to light two filaments. The potentiometer control for the local batteries, B2, of the vacuum valve is shown in Figure 18 on page 860. This is nothing more than a 3,000 ohm potentiometer shunted around the high potential battery. It allows a very close regulation of the local voltage in the usual manner. We have no preference in the matter; in fact we should be perfectly satisfied to vary the voltage of this battery by means of a multipoint switch.

* * *

R. O. P., Scottville, Mich.:
The receiving tuner you have described is responsive to wave-lengths inclusive of 3,500 meters and you will therefore not be able to receive signals from undamped wave stations which usually operate at waves in excess of 6,000 meters. Practically any receiving tuner that will adjust to waves up to 6,000 meters will be useful in connection with the tikker detector.

* * *

V. C. D., Issoquah, Wash.:
No. 32 single silk covered wire or single cotton covered wire will do for the secondary winding of the transformer in question. This wire should be soaked in hot paraffine before being wound on the secondary pies.

H. W. X., Chicago, Ill., inquires:
Ques.—(1) How far should one be enabled to copy signals from the Arlington station with a first-class receiving tuner of inductively coupled type connected to a single vacuum valve detector?

Ans.—(1) No difficulty should be experienced in taking down these signals during the night schedule at a distance of 2,500 miles throughout the favorable months of the year.

* * *

E. R. H., Middletown, Conn., inquires:
Ques.—(1) Referring to the wavemeters described in the book "How to Conduct a Radio Club," is it possible to substitute a cardboard tube for the hard rubber tube upon which the coil of inductance is wound?

Ans.—(1) The cardboard tube may be substituted with a slight change in wave-length.

Ques.—(2) Are the plates for the high voltage storage battery referred to in the First Prize article in the October, 1916, issue of The Wireless Age made of plain lead or are they coated with that material?

Ans.—(2) They are made of plain lead.

Ques.—(3) How can bakelite or hard rubber be polished?

Ans.—(3) By an ordinary buffing wheel.

* * *

O. A., Conava, Ala.:
Ordinarily, a one- or two-inch spark coil will easily permit communication with another station eight miles distant.

(*Continued on page 442*)

J. F. M., Marlboro, N. J.:
Practically all the data you require will be found in the curves published in the September, 1916, issue of THE WIRELESS AGE, pages 108 and 109. Careful observation of these wave-length curves by all amateurs is recommended.

* * *

P. E. N., Fort Smith, Ark.:
The aerial you have described is suitable for transmission at a wave-length of 200 meters.

Stranded iron cable is not considered a good conductor for the earth connection of a wireless telegraph set; copper cable is by all means preferred. Of course a great number of strands of galvanized iron wire would probably have sufficient conductivity, but the copper cable would give the best results in any case.

The dimensions for a rotary gap can vary considerably and still effect the desired purpose. A good design is to make a disc 8 inches or 10 inches in diameter and mount thereon eight or ten electrodes, equally spaced about the circumference. This disc should rotate at speeds varying between 2,400 and 3,000 revolutions per minute.

* * *

J. F. N., Norfolk, Va., inquires:
Ques.—(1) At present I use an aerial 600 feet in length made of two wires separated 6 feet. Would it be practical to cut off one end of the flat top with insulators for use on wave-lengths around 200 meters, the lead-ins being taken from either side of the insulators? The small aerial is to be used for receiving and transmitting purposes in connection with a 1 k.w. set, but I planned to use either the long or the small areial or both connected together for the reception of longer wave-lengths.

Ans.—(1) The connection you propose is practical and will not interfere with the efficiency of the apparatus to a marked extent. Care should be taken to separate the lead-ins of the two antennae and not to have them lie in a close parallel position, otherwise the small aerial when transmitting may set the large aerial into oscillation and cause it to radiate a wave of another length.

Ques.—(2) Frequently I come across an expression which seems to limit the capacity of the condenser in a closed circuit .02 microfarad. Is this value of capacity a fixed quantity, or is it the usual capacity employed in connection with the 200 meter wave?

Ans.—(2) The wave-length to be radiated definitely limits the size of the condenser in the closed oscillation circuit and the maximum permissible capacity for the closed circuit of a 200 meter set is .01 microfarad as has been mentioned several times in the columns of this department. Two k.w. transmitters of the 60 cycle type frequently use values of .02 microfarad, but when a transmitting set is designed to operate on the three standard wave-lengths of 300, 450 and 600 meters, the capacity should not exceed .012 microfarad. To illustrate, the 2 k.w. standard panel sets of the Marconi Company use a capacity of .012 microfarad for the 450 and 600 meter wave, but a value of .006 microfarad for the 300 meter wave. Since it is necessary to have some inductance in the primary winding of the oscillation transformer to transfer energy to the secondary, you will readily understand that the capacity of the condenser must be limited in order not to exceed the desired wave-length.

Ques.—(3) As I understand it the low pitched note of the ordinary spark discharger is due to the fact that the condenser is excited from a 60 cycle alternating current, but it would seem that the usual amateur rotary gap interrupts the closed oscillatory circuit at least 300 times per second. Now it might be possible to construct a gap running in an air-tight housing at such speed as to give interruptions at the rate of 10,000 or 20,000 per second. Would this be efficient for use in connection with a limited 200 meter wave? Would a gap of this kind increase or diminish the demand for condenser capacity in the closed circuit?

* * *

Ans.—(3) The gap proposed is not practicable. The ordinary telephone receiver is most sensitive to vibrations corresponding to a frequency of about 500 cycle alternating current and you probably are aware that vibrations above 20,000 per second are practically inaudible to the human ear. Furthermore, you could not interrupt the closed oscillatory circuit 20,000 times per second and have useful energy at each interruption because, the frequency of the current supply being no more than 50 cycles per second, many interruptions of the spark gap would be obtained when the condenser voltage was at zero.

* * *

V. S., Urbana, Ill.:
We have had no experience with the oscillating vacuum valve circuit where the antenna is connected to the plate instead of to the primary winding of the usual receiver and consequently we can give you no advice.

Practically equal results will be obtained with all kinds of receiving telephones listed in the first part of your query.

We know of no better undamped oscillation circuit than that described in the second edition of the book called "How to Conduct a Radio Club." If the apparatus listed therein is duplicated good results will be obtained up to distances of 4,000 miles.

* * *

R. J. C., Fort Wayne, Ind., inquires:
Ques.—(1) Please give an approximate formula for determining the capacity of a condenser to be used in connection with a rotary spark gap, when the secondary voltage of the transformer, the frequency of the current supply and the power in watts are known. In the particular problem I desire to have solved, the transformer has an input of ¾ k.w. with a secondary voltage of 16,000 volts operated on a 60 cycle alternating current. The speed of the motor is approximately 3,000 r. p. m.

Ans.—(1) You failed to give us the number of spark discharge electrodes on the rotary

disc, but assuming that you have a disc 8 inches in diameter fitted with 6 spark electrodes, at a speed of 3,000 revolutions per minute you would obtain 300 sparks per second which would be approximately the equivalent of 150 cycles with a synchronous spark set. We may use the following approximate formula:

$$C = \frac{W}{V^2 N}$$

where C = the capacity of the condenser in microfarads

V = secondary voltage of the transformer in (kilovolts)

N = the cycle frequency

W = watts consumption at secondary.

Then in your particular problem:

$$C = \frac{750}{(16)^2 \times 150} = .02 \text{ microfarad}$$

approximately.

This formula requires considerable modifications under various operating conditions, but is sufficiently accurate for preliminary determination.

* * *

P. E. G., Mt. Sterling, Ill.:

Your query regarding the wave-length of an aerial is fuly answered in the curves published in the November, 1916, issue of The Wireless Age. In view of the fact that these curves have been presented in a recent issue, we do not consider it necessary to make extended computation of the wave-length of aerials for our readers.

An oscillation transformer must by all means be provided for a 1 k.w. transmitting set.

The wave-lengths of the various government and commercial stations are listed in the government call list which can be obtained from the Government Printing Office, Washington, D. C.

* * *

E. W. M., Ridgewood, inquires:

Ques.—(1) Please publish the overall dimensions for a ¼ k.w. open core transformer.

Ans.—(1) The primary core for this transformer may be 15 inches in length, 2 inches in diameter, made up of a bundle of fine, soft, iron wire. The core should be covered with two or three layers of thin Empire cloth followed by two layers of No. 14 double cotton covered B. & S. magnet wire.

The completed primary winding should be then inserted in a hard rubber or micanite tube with walls about ⅛ of an inch thick. The secondary winding is split into about eight sections, each of which are approximately 1 inch and ⅛ inch in thickness and 6 inches outside diameter. The sections of the secondary are wound up with No. 30 B. & S. single silk covered wire. Just previous to the winding, this wire should be soaked in hot paraffine, that is to say, during the winding process, the wire should pass through a pan of melted paraffine wax.

Ques.—(2) Approximately how many amperes will this transformer draw?

Ans.—(2) From 3½ to 5 amperes.

Ques.—(3) Will a risistance or a reactance coil be required in connection with it when connected to a 110 volt 60 cycle alternating current circuit?

Ans.—(3) It can be connected directly to the power main.

Ques.—(4) Can cardboard tubes be employed in place of the hard rubber tubes for the wavemeter described in the March, 1916, edition of The Wireless Age?

Ans.—(4) Yes.

Ques.—(5) How can the wave-length of a loose coupler be measured with a wavemeter?

Ans.—(5) The complete process is told in detail in the book "How to Conduct a Radio Club." The better method for measuring the wave-length of the secondary winding is to connect all apparatus in the regular manner and then place the inductance coil of a wavemeter in inductive relation to the secondary turns. This wavemeter, excited by a high pitched buzzer, acts as a feeble transmitter of electromagnetic wave and when the wavemeter is in resonance with the receiving tuner, the maximum response is obtained in the head telephone. More detailed information is given in the book mentioned.

* * *

C. B., Edinburg, Ill.:

All information you request concerning the construction of a 10,000 meter inductively coupled receiving tuner and the wave-length of a given size loose coupler, is contained in the book "How to Conduct a Radio Club." As the information asked for is given in detail in the book, you will probably find it more satisfactory to purchase a copy of this volume than to obtain brief instructions in this department.

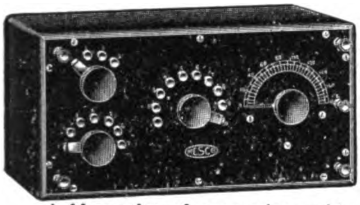
* * *

D. G. S., Wyoming, Ohio:

We do not make a practice of publishing the operating schedules of United States Naval stations. These stations are in operation at various hours throughout the day, and we are not informed concerning the actual hours of operation.

Regarding the construction of a carborundum detector: The essentials of this device have been published in previous issues of The Wireless Age, and by referring to these you should have no difficulty in building a satisfactory detector. Please understand that the construction of this detector is simplicity itself. It is only necessary to make some sort of a spring clip holder that will allow a slight pressure to be maintained on the crystal. Better results are obtained by mounting the crystal in a brass cup with Woods metal. In fact crystals mounted in this manner have, in many cases, proven more sensitive than when simply held between two metallic contact points.

A full list of licensed amateur stations appears in the latest edition of the Government



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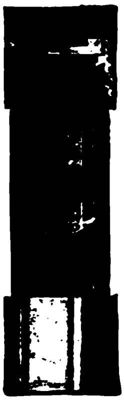

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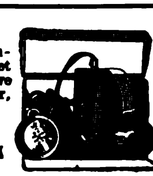

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* * *

D. & C., Campello, Mass.:

You should have no difficulty in calculating the wave-length of the aerials described in your communication, if you will refer to the set of curves shown in the November, 1916, issue of this magazine.

Reference to the so-called "static loop" is not understood. The two aerials you have mentioned will not interfere with each other to any marked extent, particularly in receiving, although one may set up very heavy potentials in the other when transmitting.

* * *

J. W., Lagrange, Indiana, inquires:

Ques.—(1) I recently purchased a ½ k.w. Packard transformer to operate from 110 volt, 60 cycle alternating current, but the current supply in our town is 110 volt, 133 cycles. I have been told that with this increased frequency, I can expect a greater output than that specified. Please advise if there would be any difference in the amount of power absorbed by the primary on these two frequencies. What would be the capacity required with or without a rotary spark gap?

Ans.—(1) The primary winding of your transformer will take less current at the frequency of 133 cycles than with 60 cycles. Consequently, to get the full power rating of this transformer, you must either take some of the turns off the primary winding or have a transformer specially constructed for this frequency.

Assuming that you intend to work this equipment at the wave of 200 meters length, the capacity of the condenser in the closed circuit cannot exceed .01 microfarad.

Ques.—(2) Would a cable made of nine No. 22 B. & S. wires for the secondary and 16 No. 24 B. & S. wires for the primary be satisfactory for an oscillation transformer?

Ans.—(2) The proposed windings would take care of the current, but we see no reason for going to the trouble and expense of winding a cable in this manner. Why not use No. 4 stranded rubber covered wire for the primary and No. 4 or No. 6 for the secondary winding?

Ques.—(3) How can an amateur be advised beforehand concerning wireless telephone tests, wireless relay contests, etc.?

Ans.—(3) The best way to get in touch with forthcoming tests is to become a member of the National Amateur Wireless Association.

* * *

E. T. R., Brooklyn, N. Y., inquires:

Ques.—(1) I have the secondary winding for an inductively coupled receiving tuner that is 5⅛ inches in length and 4⅜ inches in diameter, wound with No. 26 black enamelled wire, tapped every half inch. Please inform me of the dimensions for a primary winding of the correct proportion.

Ans.—(1) The primary winding for this transformer may be 4¾ inches in diameter by 6 inches in length, wound with No. 24 S. S. B. Wire.

* * *

J. G., Newark, N. J.:

Lacking more specific details concerning the proposed wiring of your receiving tuner, it is difficult to state the wave-length to which it will be adjustable when complete. The winding you mention, however, will require no more than ½ pound of No. 30 wire. No. 24 wire is preferred for the primary winding of the receiving transformer, or the aerial tuning inductance.

Data as to the wave-length of your aerial were published in the November, 1916, issue of this magazine.

* * *

A. D., Utica, N. Y.:

The wave-length of your 200 foot aerial is approximately 300 meters, but since it is placed very close to the earth you may be disappointed in the results obtained when receiving. We cannot calculate the possible effect of the oscillation transformer on the wave-length of an antenna circuit unless we know thoroughly the inductance and capacity of the antenna system and the dimensions of the primary and secondary winding.

* * *

F. H. H., Princeton, Ill.:

The telephone receiver used on wire telephone systems will receive wireless telegraph messages, but generally it is not as sensitive as receivers constructed specifically for wireless telegraph work. Good receiving telephones can be purchased for $5 per pair.

* * *

F. A. C., New Haven, Conn.:

For information concerning the details in wiring the diagram of a wireless telephone system, why not communicate with the manufacturers direct. If you are unable to obtain this information, it is quite likely that we will find ourselves in the same position. You are referred regarding the wave-length of your aerial to the curves in the November, 1916, issue of The Wireless Age.

* * *

H. C. R., Columbus, Ohio:

If you will refer to the description of the beat receiver described in the book "How to Conduct a Radio Club" you will have an apparatus feasible for the reception of undamped oscillation.

The diagram of connections attached to your query, is appropriate for the reception of damped or undamped oscillation at short wave-lengths. Perhaps you will obtain better results by reversing the connections to the coil, L-4. In fact it is quite important that the energy from the local telephone circuit should flow through this coil in a definite direction. The lower terminal of your secondary circuit is preferably connected to the negative side of the vacuum valve filament, rather than to the positive side.

A. H., Amherst, Ohio, inquires:

Ques.—(1) I have a secondary winding of a transformer which consists of 30,000 turns of No. 32 double cotton covered wire wound on pies of 1/4 inch thickness, 6 inches outside diameter, 2 1/2 inches inside diameter, each pie containing 3,000 turns. Please give the dimensions for an appropriate primary winding.

Ans.—(1) The primary tube should be about 8 inches in length, 2 1/2 inches outside diameter and 2 inches inside diameter. It should be wound with two layers of No. 12 double cotton covered wire.

Ans.—(3) A satisfactory diagram for the connection of the vacuum valve detector wherein the filaments of two valves are brought to incandescense by one battery, appears in Figure 19c, page 861 of the September, 1916, issue of this magazine.

Complete data for the windings of a small loose coupler for waves up to 400 meters appear in the last chapter of the book "How to Conduct a Radio Club." The dimensions are particularly suitable for the reception of short wave-lengths.

* * *

The Tionesta Radio Club inquires:

Ques.—(1) We have a loose coupler especially constructed for the reception of signals from N. A. A., also a crystaloi detector, 1,000 ohms Red-Head receiver, fixed condenser, all connected to an aerial 100 feet in length, 25 feet in height, consisting of four wires. We get very loud signals from Arlington, with one-third the possible values of inductance in use, but do not seem to receive other stations using 1/4 k.w. set which are but eighteen miles distant.

Ans.—(1) It may be that the 1/4 k.w. transmitting set operates at the wave-length of 200 meters and your tuner is not constructed for sufficiently small values of inductance to permit adjustment to the shorter range of wave-length. You should take out a tap on the primary and secondary windings in order that small values of inductance may be obtained.

Ques.—(2) Please tell me the best length of an aerial and the dimensions of a receiving tuner for all around amateur work.

Ans.—(2) An aerial of the "T" type about 120 feet in length with an average height of 40 to 50 feet is best for all around work. A receiving tuner adjustable to wave-lengths between 200 and 3,000 meters will do for the average reception of signals. Of course, for the reception of undamped oscillations, a vacuum valve circuit of some type adjustable to waves between 6,000 and 10,000 meters should be provided.

A tuner responsive to waves between 200 and 3,000 meters should have dead end switches to cut off the unused turns of the primary and secondary windings when adjusted to the shorter wave-length. For maximum efficiencies it is advisable to construct a small receiving tuner for 200 meter reception only. A tuner of this type is described in connection with the portable set mentioned in the last chapter of the book "How to Conduct a Radio Club." Receiving sets of this range are on sale by the Marconi Wireless Telegraph Company of America.

* * *

S. W., West Philadelphia, Pa.:

A complete set of diagrams of connections for transmitting and receiving apparatus appears in the book "How to Conduct a Radio Club" on sale by the Book Department of the Wireless Press, Inc.

A crystal detector can be protected from the local transmitter by completely disconnecting it from the receiving circuit during the period of transmission. A double pole single throw knife switch should be connected to the binding posts of the detector. Each time the transmitting key is closed, this switch should be opened.

Galena and cerusite are the favorite sensitive crystals among amateurs.

* * *

W. C. T., San Francisco, Cal.:

The condenser in the closed circuit of a radio transmitter increases the voltage provided a resonance transformer is employed, but whether or not the voltage is increased in other sets by this connection depends upon the overall design of the set. Unless designed for conditions of resonance or near to resonance, the presence of the condenser across the secondary winding may lower the secondary voltage.

The reading of an aerial ammeter on a radio set has been thoroughly explained in a previous issue of The Wireless Age. The meter in the antenna circuit, because of its low mechanical period as compared to the frequency of the oscillation, shows an accumulative reading of the energy flowing in two or three groups of oscillations, which may appear equal to the current input to the primary winding of the high potential transformer, but actually is not.

Merely connecting to earth the rotary spark gap of the standard 2 k.w. 500 cycle set has no effect upon the efficiency of the apparatus except to cause a slight loss of energy which may be due to the capacity effect between the closed circuit and the earth. Losses from this source are almost negligible.

* * *

S. S., Danport, Conn.:

Dimensions for a 1/2 k.w. open core transformer follow: The core for the primary may be about 16 inches in length and about 2 inches in diameter, covered with Empire cloth and wound with two layers of No. 14 double cotton covered B. & S. magnet wire. The winding should be covered by a hard rubber tube or by ten or twelve layers of Empire cloth. The secondary winding may be made of ten to twelve sections of No. 30 B. & S. single covered silk wire. These sections will have an outside diameter of 6 inches and an inside diameter of about 2 1/2 inches. Each will be about 1 1/4 inches in thickness.

There is essentially no difference in the effi-

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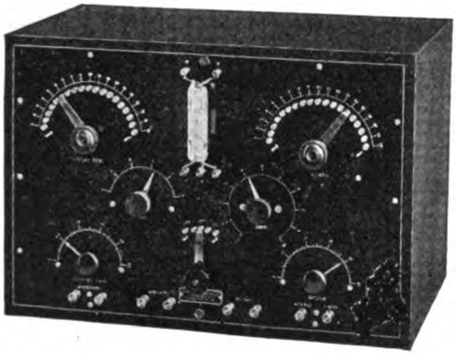

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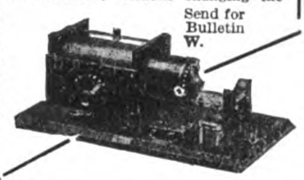

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* * *

A. E. G., Washington, D. C.:

We have no authentic information concerning the phenomenon apparently discovered by army engineers on the Mexican border, namely, the difference between daylight and night transmission in that region. The real facts of the case were probably inadvertently misrepresented in newspaper reports. The correct explanation is probably as follows: Owing to the severe atmospheric electricity experienced in semi-tropical regions, particularly during the night hours, it may have been necessary to transmit all radio reports in the early hours of morning. Generally static discharges are at a minimum during this period. It is a well known fact that a considerable amount of energy is absorbed from electric waves when they are required to pass over sandy wastes.

* * *

N. G. S., South Hill, Va., inquires:

Ques.—(1) I am about to erect an aerial for a 1 k.w. transmitting set, and would like advice as to the proper type and length of such aerial. It is planned to use it for reception and transmission amateur wave-lengths from commercial stations.

Ans.—(1) Presuming that you will transmit at the wave-length of 200 meters and that you can erect an aerial of almost any type, we advise that you construct one of the "T" type, with a flat top portion consisting of four wires placed about 2½ feet apart. The horizontal portion may be 180 feet in length, but it should not be more than 40 feet in height. The lead-in wires are, of course, attached to the center.

The aerial wires can be purchased direct from any electrical supply houses, but silicon bronze is preferred by commercial operating companies.

Complete data for the wave-length of various types of aerials appear on page 109 of the November, 1916, issue of THE WIRELESS AGE.

* * *

H. O. S., Bird Island, Minn.:

The diagram of connections for the receiving apparatus is correct, but that for the transmitting apparatus is incomplete. There is an open circuit in the closed oscillation circuit. Previous issues of THE WIRELESS AGE, and the book "How to Conduct a Radio Club" have contained a number of diagrams applicable to your transmitting set. You are advised to purchase this book or to examine back numbers of THE WIRELESS AGE.

We cannot tell the possible effect of a loading coil upon the wave-length of an aerial system without knowing the inductance and capacity of the antenna with which this is to be employed.

* * *

M. B. W., Lima, Ohio:

The efficiency of the Marconi ½ k.w. 500-cycle transmitting set may be accounted for by good design throughout, and the elimination of energy losses. Your question is not thoroughly understood except in part, and the sketches you have made are not practical. The most efficient quenching is obtained when the closed oscillation circuit of the given transmitter oscillates just long enough to build up the current in the antenna circuit to its maximum value. The oscillations in the closed circuit should then cease and the aerial left to vibrate at its own natural frequency.

Best response is obtained in the telephone receiver when the sparks at the transmitter occur at rates of from 700 to 1,000 per second.

The spark frequency of 300 per second would not permit the oscillations in the antenna circuit to overlap one another unless very long wave-lengths were employed. A very much higher spark frequency is ordinarily emproved to secure the overlapping of wave trains.

* * *

L. M. S., Salem, Wis.:

You may be able to overcome your difficulties with the telephone company by running a triple braid conductor from the telephone pole to the house, using two wires for the regular telephone connection. The third wire is earthed at both ends. In one instance where a similar difficulty has been experienced the trouble has been completely eliminated by this connection.

* * *

S. S. M., Winnipeg, Canada:

In Figure 4, page 187, of the December, 1916, issue of THE WIRELESS AGE, the two loading coils shown are mounted separate from the two coils marked "tuner." The latter coils have a lightning contact, while the loading coils have a multi-point switch. With this knowledge you should have no difficulty in constructing this apparatus after the description given by our contributor.

FROM AND FOR THOSE WHO HELP THEMSELVES

(*Continued from page 421.*)

joints in the pipe and a spark jumping from one point in the joint to another may cause an explosion. The best method of all is to make direct connection from the transmitting apparatus to the street side of the water mains in accordance with the Underwriters' requirements. Surface grounds work well, but amateurs located in large cities cannot employ one of this kind. If a surface ground can be used, it will prove efficient, but care should be taken that the wires composing it are laid directly underneath the antenna and also the conductor should be placed at least 6 or 8 inches below the surface of the earth.

MEREDITH B. LOWE, *Alabama.*

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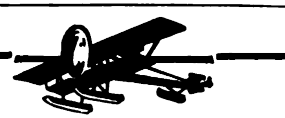

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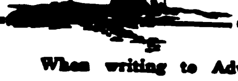

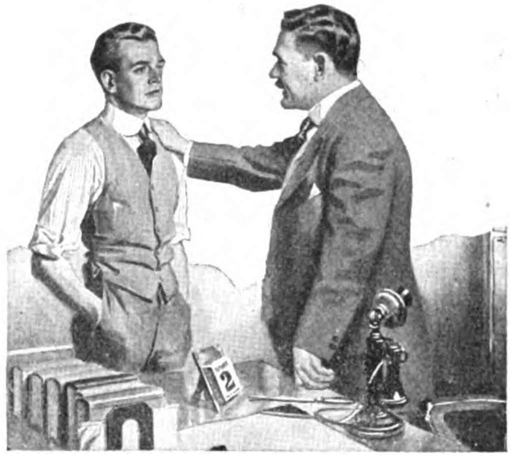

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THE WIRELESS AGE

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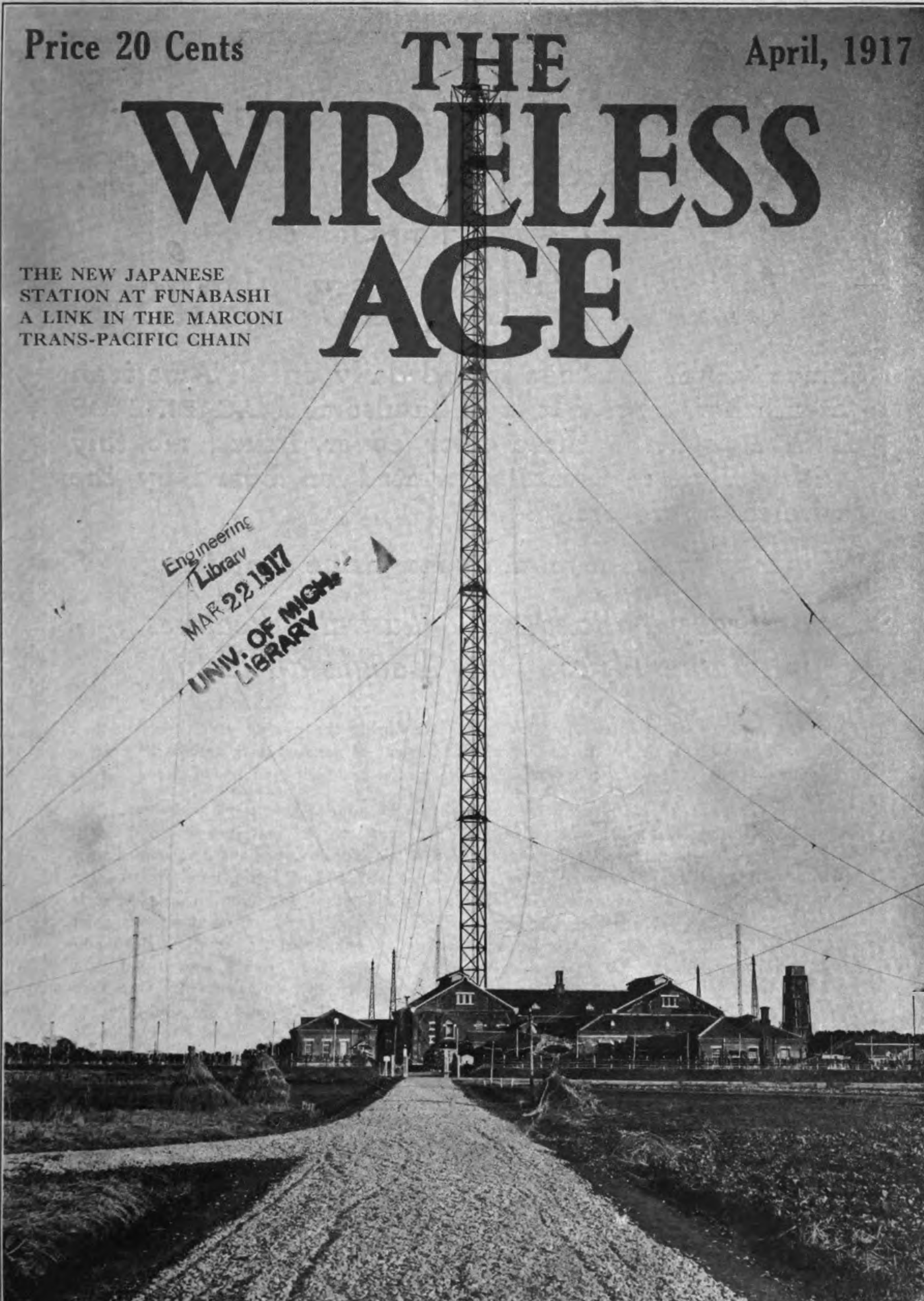


THE WIRELESS AGE

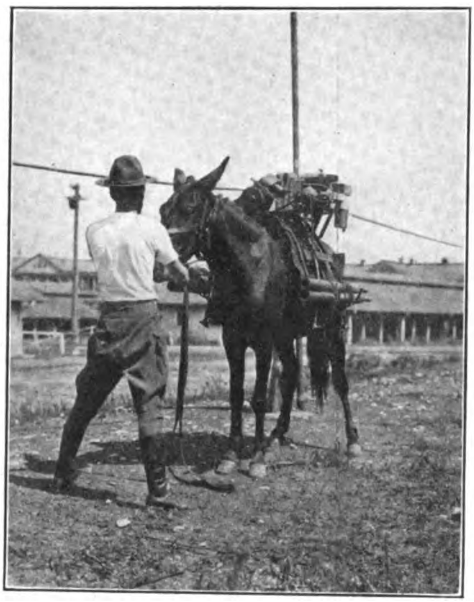
APRIL, 1917

On the Texas Border With a Pack Set

A Story of Actual Observation by a National Guard Signal Corps Member and a Description of the Apparatus

What it means to undergo experience on the Texas border with wireless equipment has been interestingly told for the readers of THE WIRELESS AGE *by George T. Droste, master signal electrician of Company A, First Battalion Signal Corps, National Guard, New York. A comprehensive analysis by him of the pack sets in use on the border follows the story of his actual observations.*

IN my earliest experience during July, when we did nothing but listen in for whatever went through the air and without any definite policies, using different operators, experienced and inexperienced, in the art of radio propagation, nothing of any glory was accomplished. By sending out different sections on detached service to Mission, Pharr and surrounding districts from McAllen, and conducting a main business of about three to four messages a day, consisting of reporting "present" in the morning and "good night" in the evening, we finally were put on details that carried on a more substantial business. My detail, in charge of Sergeant Upson, at Sterling Ranch, and acting as the relay point between Young's Ranch and McAllen, was a month of anxious and heartbreaking work, trying to make a 1/8-k.w. pack set do the work of a 1-k.w. headquarters' station, reporting arrivals and leaving of regiments; O. M. supply reports and personal messages, to say nothing of company orders.



The generator and frame of the apparatus on a pack mule

Our distances between stations being about eighteen to twenty-five miles, was a larger stretch when the poor detectors and the enormous amount of man power expended is considered. However, we triumphed by covering the work, if not by radio completely, then partly by radio and buzzer—that being our duty to get the work through. So by using private telephone lines as buzzer wires without any special orders, we succeeded in establishing records for the 1/8-k.w. sets under continuous service conditions that were never known to the New York Signal Corps before, being heard continuously by regular Army stations at Hidalgo, Fort Ringgold and Brownsville—distances of about twenty-eight, forty and sixty-eight miles, respectively.

My final detail was to conduct the station (NYA) at McAllen. This started a new era for pack set work, as we were called upon to work with the main army stations which were established for some years and carrying on a daily business that required experience to keep up with. To do this I was provided with an experimental engine and generator never before tried out with any continuous success.

Numerous heartbroken attempts to make various belts stand the strain of transmitting the energy from the engine to the generator, and preventing the engine from getting hot, took up our time, and we still carried on the entire official business for the Sixth Division, which passed between Fort Sam Houston at San Antonio, 250 miles away, and Brownsville, Tex., by intercepting it and acknowledging receipt of it. This demanded undenying attention and sacrifices from all the operators in the station as repetitions were not forthcoming. For us they came only once and we showed that we were able to cope with the situation and seldom lost a message. Our record consisted in not having lost a message by interception for a continuous stretch of a month with an average of ten to twenty-five messages a day, each consisting of fifty words or more.

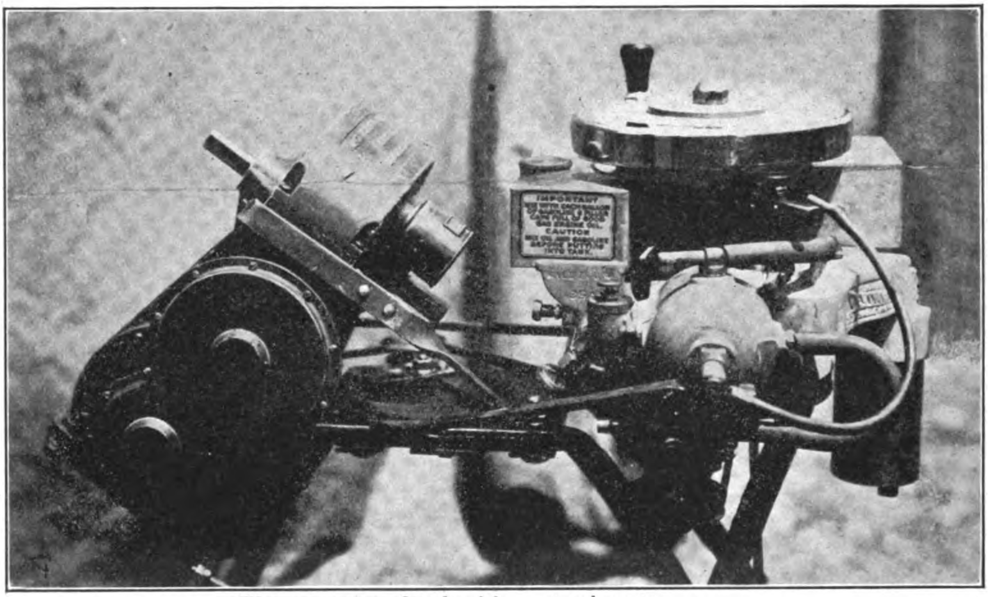
This service finally established us in the eyes of the regular army station at Fort Sam Houston and Brownsville, although militia stations were established at Fort Ringgold, Harlingen, Hidalgo, Lanogrande, Del Rio and other points on the border. They never were heard reliably for any length of time and the New York Division was always to be counted on for being alert.

On the night of December 11, 1916, we were forced to close the station, owing to the fact that we were about to be sent to our homes in the North and much to our regret had to sever our aerial connections with the men of the regular Army, principally WUJ and WUZ, with whom for two months we had been in continuous radio communication. We felt that we had gained their confidence because of being fully able to handle their work direct, notwithstanding the handicaps of experimental apparatus. This was confirmed by the friendly relations set up between the operator in my charge, namely, Corporal Schuster, and Private Leason and the regulars in charge of the station at Fort Sam Houston.

Summing up the entire experience, we feel that so far as radio work goes for the Signal Corps, we established ourselves in the eyes of the regular Army and that our successes will go down in the archives of their experiences of working with the militia.

Readers will be interested in an analysis of the radio pack sets in use on the border, as made by Electrician Droste, in which he says that for portability, the pack radio sets, consisting of wood masts, so arranged that one section can be placed on top of another and stiffened by metal ferrules, are used. The pack sets are provided with a four wire umbrella antenna, using insulated wire, the same being connected at the top and a lead-in brought down to the instruments. This insulated wire is more serviceable than the old bare three-strand plated phosphor bronze wire, as it does not kink so easily and the metal is protected from burring, the insulation also providing additional electro-static capacity.

The counterpoise or ground is also of four wires (insulated) and serves the purpose of distributing the electro-magnetic impulses over the covered area of earth when laid out. The chest or instrument contains a transformer for raising the low voltage to a higher potential, and consists of two windings, one heavy, called the primary, which excites the magnetic field, by conducting the alternating current and passing the same in a helical coil around a cluster of soft iron wires, causing them to be periodically magnetized, this rising and falling magnetic field being cut by finer windings of wire in sufficient quantity to increase the ratio of voltage about one to a hundred and called the secondary. The magnetic field above mentioned produces an induced current in the secondary windings which then charges a high potential condenser. The condenser is constructed of tin-foil sheets, separated by a dielectric of mica sheets and holds the electro-static charge until the potential reaches a breaking down point, at which


The generator fitted with a speedometer

time the current discharges through a gap.

The gap consists of flanged plates, separated by mica rings and a number of these gaps being placed in series and air-cooled, each air gap or sparking surface being about .001 of an inch. A well-designed gap is one which will be a perfect non-conductor while the condenser is charging and a perfect conductor is discharging, thereby producing a strongly quenched oscillation. The current is discharged through turns of inductance called an oscillation transformer, which is mounted on the inside of the cover of the chest. This transformer consists of three coils or pancakes, two of which having the outside turns connected to a common terminal forming the hinges, these two acting as a primary and secondary, the additional coil being used for extra loading inductance for increased wave-lengths. These coils can be coupled together and the resonant point found between the closed circuit which is formed by the condenser, gap, and primary of the oscillation transformer and the open antenna circuit, which consists of the secondary of the transformer, the antenna for aerial inductance, the hot wire ammeter for registering the output in mili-amperes and the ground or capacity. These coils are connected together by flexible wires with clips at the ends for placing in any desirable position, on the coils.

The antenna and ground are separated from the above sending circuits by a transfer switch for changing the same to the receiving circuits as the antenna and ground are used for transmitting electromagnetic oscillations and receiving them. The transformer is applied to a low voltage five hundred cycle A. C. current of 110 volts pressure, the medium being a generator consisting of two units. The A. C. generator having twelve poles for the 250-watt type and eighteen poles for the 125-watt type, the direct current exciter, the armature of which is mounted on the same shaft with the A. C. armature. The mechanical energy for turning this generator armature is either by hand, two to four men being required to turn handles, which by gearing to the armature shaft turns it to 5,000 R. P. M. for the 1/4 k. w. type and 3,333 R. P. M. for the 1/8 k. w. type, the men turning the handles about 33 R. P. M.

These generators are provided with suitable stands on which are mounted a two cycle marine Evinrude engine, which turns up to about 1,750 R. P. M. and is belted to the generator. Difficulty is experienced with this method of transmission of the energy due to slipping belts, and also the breaking of the same and the clip which makes the connection, all of which is due to the high speed, vibration and heat caused by the friction between the belt and the pulley. This belting must be round and not larger than 3/8 of an inch in diameter as it revolves over an idler sheave for taking up the slack and as the alignment of the pulleys is such that it changes the direction of the drive from horizontal to vertical, thereby causing the belt to come in contact on all sides.

The engine is supplied with gasoline by a small tank mounted on top, and a vaporizer with needle valve controls the inflow of the gasoline. A high tension magneto is mounted in the fly-wheel, the making and breaking of the current for igniting the gas being caused by a cam which actuates the contact spring, or vibrator. This vibrator is so mounted that it can be moved for advancing or retarding the spark, thereby being one of the means for controlling the speed of the motor.

The cylinder of the motor is water-cooled and a small pump circulates it through the water jacket. If a continuous supply of water is not available, a container will be required to hold an initial quantity of water, which must be re-circulated. This re-circulation of water is a serious drawback when the motor is required to do considerable work, as it quickly heats to a boiling point, causing the overheating of the engine, which prevents the same from running.

The primary current from generator to transformer is interrupted by a key which, when closed and opened according to the Morse characters, allows the current to flow into the transformer. On some sets this key is placed in the field circuit of the A. C. generator, interrupting the latter, on others it is placed in series with the current from the A. C. brushes, the latter being the better method, as it allows the A. C. field to be continually energized. Upon pressing the key, the armature winding revolves in an already strongly-built up magnetic field, thus producing an even and unchanging note, otherwise, when the key is in the field circuit and is pressed, the magnetic field has to build up, causing a varying note due to a low potential spark, which cannot charge the condenser to maximum capacity to break down the gap until the charging current has reached its maximum amplitude.

Connecting the generator to the chest is accomplished by flexible cords with plugs attached at the ends, which fit into receptive sockets.

The sending side is calibrated to a number of standard wave-lengths and by adjusting the clips on the oscillation transformer to points indicated by the calibration chart, and watching the needle on the hot wire ammeter, the resonant point can be detected when the ammeter shows its greatest deflection, making it known that the energy circulating in the primary windings of the oscillation transformer has been brought to a harmonic or in tune with the period of vibration of the secondary, antenna and ground.

The high frequency oscillations which are being forced into the antenna and ground discharge periodically into the ether and produce wave trains which apparently travel parallel with the earth's surface, and when they strike some other object which has the same or nearly the same fundamental oscillating period at the distant sender will induce currents therein of a frequency corresponding to the wave motion.

These impulses are then carried into a receiving tuner, which is also in the chest, and consists of electro-statically coupled inductances.

The incoming impulses are carried into the primary windings of the receiving transformer and produce an oscillating electro-magnetic field, oscillating at a frequency which can be altered by adding or removing inductance through multiple switches, thus causing the circuit to be brought in tune or resonance with the incoming wave train.

The oscillations then charge small fixed capacity condensers made of aluminum plates with an air dielectric and in turn discharge across a secondary inductance, which is thereby caused to oscillate. This circuit may be placed in or out of tune with the primary and thereby cause the induced electro-magnetic field to be made stronger or weaker, by a rotary switch arm, which places these inductances in series with the circuits and the wave-length accordingly.

The impulses having been transformed through induction and amplified, are then rectified by passing through detectors, which are of different types, as explained later. The detector serves the purpose of rectifying the current from an oscillatory current to a pulsating direct current. The properties of the crystal detector, such as galena, silicon, ferron, carborundum, etc., will retard positive or plus current in one direction and allow negative or minus current to pass from the opposite direction during the same alternation. The rectified current then enters the high resistance telephones and the impulses representing dots and dashes actuate the diaphragms by the energizing of the small magnets.

Another type of detector is the vacuum valve which emits electrons from a lighted filament and relays a local battery current which has large amplifying properties. This local current energizes the head 'phone magnets and thereby causes the diaphragms to vibrate accordingly.

The Evinrude engine, which is mounted on a pack frame, is not designed consistently to work with the generator, considerable energy being lost in the driving mechanism due to slipping belts, small diameter pulleys and idlers which should all be eliminated. The engine should be designed, together with the generator, as one unit. This plan will eliminate a considerable quantity of castings and metal, lightening the load and lessening the vibration, due to the fact that the load is top heavy and has inadequate foundation and possible loosening of parts. The driving medium from the engine to the generator can best be accomplished by housed gears running in oil, similar to the driving mechanism from an automobile engine to the pump and magneto shaft. The engine can be air-cooled to eliminate the trouble with the water cooling system previously referred to, the fan or blower being driven by a similar driving gear.

Rope, thicker and thinner leather, belting fibre packing, wire and steel spring were all tried for weeks with no success. In one case the speed would make the belt slip; in another, where the belt held to the pulleys, the strain was too great and either the clips or the belt itself broke, making the entire outfit useless for rapid service—the most essential item in a portable mobile outfit. If, in an emergency, it should be desired to crank the engine by hand, it and all its braces, including the bed plate, would have to be removed to allow the setting up of the generator on the stand for hand cranking purposes. This would take some time and, as pack space is limited, and the engine would have to be salvaged, the operation would involve the burdensome necessity of carrying the loose parts. The generator and engine should be so designed that they will be proof against damage during transportation.

At an inquest abroad into the death of the master of a merchant vessel, which was sunk with a loss of seventeen lives, the jury requested the coroner to suggest to the proper authorities the advisability of installing wireless on all ocean-going vessels.

The International Telegraphic Bureau has been notified by the Japanese Administration that Baron Kenjiro Den has been appointed Minister of Communications to succeed M. Katsuto Minoura, who has resigned.

Wireless communication has been established between Australia and Tulagi, near the coast of the Island Florida in the Solomon group, and Ocean Island, the Gilbert Islands.

Building Stations on Shipboard

Installations That Have Been Made in Record Time

WIRELESS telegraphy has succeeded in introducing revolutionary methods in establishing the means of long distance communication. This is aptly demonstrated in the speed and thoroughness with which vessels are outfitted with radio apparatus. In twenty-four hours it is possible for the Marconi Wireless Telegraph Company of America to establish a complete wireless apparatus on shipboard, and in emergencies such installations have been completed in eight hours. This is rapid work, especially when one takes into consideration that such an installation signifies the equipment of a complete telegraph office, ready for instant service. Contrasted with the time requisite for the equipment of a wire telegraph office, or that consumed in installing telephone service in a building, which requires at least a week, one is a position to appreciate the improvements represented by the wireless service over the older forms of communication.

The construction of wireless stations on vessels has been organized and simplified to an extent that it can be executed with remarkable speed and precision. The mode of procedure may be best illustrated by that carried out on the Spanish steamer, Joaquim Mumbru, on February 18th. The construction department of the Marconi Company, in the Edison Building, received notice that the Joaquim Mumbru would be at her dock at Yonkers on Saturday, noon, and that a wireless station was to be installed in a hurry, since the vessel was expected to leave for Europe on the following Monday.

The Spaniard, however, did not arrive at her dock until nine o'clock on Sunday morning. The apparatus was promptly assembled in the stock room, and loaded on a motor truck, which sped to Yonkers. On his arrival at the ship, the superintendent of construction gave to the men under him the necessary orders for the carpenter work needed in fitting up the wireless cabin and equipping the vessel with the gear needed in hoisting the aerial. The man in charge of the layout of the wireless equipment had the apparatus hoisted on board and the work on the aerial was immediately begun. The work as a rule begins with the construction of the aerial, unless the weather is rainy or stormy, when the aerial work is postponed in the hope for a clear-up.

The transmitting apparatus as a whole is a unit, and was quickly arranged, with the exception of the motor-generator, which had to be installed. The receiving apparatus was then put in place and all the necessary wiring for connecting the transmitting and receiving apparatus was then attended to. Connections were made for changing from receiving to transmitting and vice versa. Means were then adopted for insulating the aerial where it passed through the bulkhead on deck and the erected aerial was then connected.

Finally the construction engineer was in a position to state the time when he would complete the equipment, whereupon a Marconi inspector was sent to the ship to oversee the installation and make out the necessary license application required by the United States Radio Service. Meantime the superintendent of the operating division was notified, and an operator was assigned to the ship.

So the work, which was begun at nine o'clock on Sunday morning, was completed by one o'clock Monday afternoon, when the wireless station was ready for tuning.

In the instance of the Joaquim Mumbru, the wireless station was installed within a period of twenty-eight hours, but in three previous instances such stations were built on rush orders within twelve hours. In the case of the steamship Chalmette of the Southern

Pacific steamship lines a telephone message came to the Marconi construction department at four o'clock in the afternoon that the Chalmette was to sail at daylight, and wished a wireless station installed on board in short order. The apparatus was taken from the stock room and sent to the ship, which lay at her pier in Jersey City at the time. Work was continued at a rapid rate and by two o'clock in the morning the set was ready for tuning, thus establishing a record of ten hours for the building of a station on shipboard.

A still quicker installation was accomplished on the steamer Old Colony, of the Eastern Steamship Corporation. The Old Colony was to take the place of a sister ship that had met with an accident, and the company at nine o'clock in the morning decided to send out the steamer at five o'clock that afternoon. It was necessary to have a wireless station installed, and before the vessel sailed a 2-k.w. 240 cycle synchronous rotary gap set was installed and tuned, and the vessel sailed three minutes later. As the gangplank was raised the construction engineer and the inspector, who had just completed their work, barely had time to pass over to the dock.

Another record was made in equipping the steamer Bunker Hill of the same steamship line. This steamer got in at eight o'clock in the morning and sailed at six o'clock in the evening. Within those hours the Marconi construction department installed a complete ½-k.w. 500 cycle panel set and in addition installed a wireless telephone apparatus intended to be used for a demonstration to be given to a body of electrical engineers, of whom 400 were going on the steamer to attend the dedication exercises at the Massachusetts Institute of Technology, in Boston.

Achievements such as these show what may be accomplished by determination and organized effort when emergencies arise.

The Re-equipment of The Herald Station

In the presence of federal officers and officials of the Marconi Wireless Telegraph Company of America, the wireless station of the New York Herald, equipped with Marconi apparatus, was formally returned to commission on February 28 in its new quarters atop the United States Barge Office in New York City. After testing and tuning of the apparatus the key was pressed down and the first official spark of the station flashed out on a 600-meter wave-length, ringing into the ears of all operators at ship and shore stations with a radius of many hundred miles.

David Sarnoff, commercial manager of the Marconi company, sent out the first call, and the Marconi station at Sea Gate responded with the first message to the new WHB—a message of congratulation from a sister station.

Sea Gate's message, the initial despatch to be filed on the new station's receiving hook, was as follows:

"Congratulations on the opening of Marconi station at the New York Herald. (Signed) Weaver."

The Wanamaker Marconi station at Philadelphia was the second station to answer the call sent out by Mr. Sarnoff. It came in:

"Congratulations on opening of the new station. The successful working of same is already assured by the type of installation.

(Signed) D. J. Heilig."

A moment later the same station came back with the following:

"The spark is very good and sharp. Best note I ever heard. Get you fine."

The opening of the new station was witnessed by John Bottomley, vice-president, secretary and treasurer of the Marconi Wireless Telegraph Company of America; Captain Godfrey L. Carden, United States Coast Guard; Thomas Lawler, assistant custodian of the Barge Office, and others.

Dudley Field Malone, Collector of the Port, who is also custodian of the Barge Office, was to have been present, but he was hurriedly called to Washington. Mr. Lawler acted as his representative.

It had been intended to send, as the first official business of the new station, a message from Governor Whitman to President Wilson, but this program could not be followed because of the fact that by special orders the naval radio station at Arlington, which was to be the receiving station, has been detailed to watch for signals from naval stations only.

While the station was being opened a detachment of Coast Guardsmen, detailed by Captain Carden, mounted an honorary guard in front of it, in recognition of the close alliance between the station and the Coast Guard service for the protection of lives and property at sea.

After Mr. Sarnoff had sent out his first call and had received the response from Sea Gate and from Philadelphia, the station was turned over to the regular staff of operators.

The new station is situated on the roof of the Barge Office, commanding the entire bay, and its aerials, of which there are two, run from the Municipal Ferry Building, at the Battery, to the Barge Office Building. There are two aerials—one for commercial use on 600 metre wave-length, while the other, which is much larger, is used for the press bulletins, sent out twice daily, on a wave-length of 1,700 metres, where the powerful spark will not interfere with commercial business between vessels and ships at sea.

The transmitting apparatus consists of the latest type Marconi 5-k.w. set and a receiver of the latest design of the Marconi Company. The installation of the Marconi apparatus was under the supervision of John B. Elenschneider, construction engineer of the company.

The station is one of the three links in the chain of radio stations that send out into the ether nightly the wireless press service issued for the benefit of seafarers on the Atlantic and Pacific oceans. The other two stations are the Marconi high-power stations at South Wellfleet, Mass., and Hillcrest, San Francisco, which send out to the North Atlantic and the Pacific, respectively, WHB takes care of ship reports, sends out information to mariners, and in the press service, issued in the early morning and in the evening, gives the news of the day to vessels, particularly in the coastwise service and the West Indian and South American traffic.

Record Broken in Trans-Atlantic Test

Remarkable Results With the Aid of Marconi Timed Spark in Establishing Communication

Another record-breaking achievement in the wireless art has been accomplished by the Marconi system in establishing strong, direct and continuous communications over twelve-hour periods between the station of the Marconi Wireless Telegraph Company of America at Chatham, Mass., and that of the English Marconi Company at Carnarvon, Wales. The signals received at Chatham from Carnarvon where from three to eight times as strong as those obtained from any other European station. These tests were successfully carried out on January 29 and January 30.

The Marconi system has thus again shown itself to be a pioneer in radio communication, and its feat was made possible by the practical application of an entirely new system of continuous wave generation—none other than Marconi's timed spark, which has recently been developed into a useful form. The station at Carnarvon was equipped with the new Marconi transmitting apparatus, and its sending power is regarded as nothing short of marvelous. The station at Chatham also accomplished wonders, in the opinion of the wireless engineers who supervised the test, owing to the fact that it was but temporarily outfitted for the test, having been equipped on a couple of days' notice.

The distinctive accomplishment of this test lies in the power and continuity of transmission and in the large number of words accurately received on the American continent in the specified time, from a European station. The test began at seven o'clock in the morning of January 29th, and continued until seven o'clock of that evening. The second trial was made at seven o'clock the following morning. Thus two twelve-hour periods were covered, embracing the various influential phases of the day and night.

The messages transmitted consisted of press matter, the total number of words copied in the combined twenty-four hour period amounting to 15,000. The speed varied from twenty to thirty-five words a minute.

During the first six hours of the Monday morning test, every letter was received plainly and not a skip of any kind occurred to mar the initial communication between the British and American stations. During the period of the second day's test a total of about 9,000 words were received.

It was the opinion of the engineers that the initial test of the new Marconi system was carried to a highly successful conclusion. It was also taken into consideration that the conditions that prevailed were unusually disadvantageous for the winter time. The results obtained, however, are regarded in authoritative quarters as having established a new wireless record, both in the continuity of words received and the number obtained within the specified period.

MEXICO REPORTED IN WIRELESS TOUCH WITH BERLIN

Information has reached the United States Government, says a Washington correspondent, that through the perfection of a powerful wireless telegraph plant in Mexico City direct communication between the Mexican capital and Germany has been established.

Officials realize that, if confirmed, this news is of great importance. Sea raiders and submarines might be directed and full information concerning the leaving of ships from American ports furnished.

ARMY RADIO COMPANY PLANNED FOR CANAL ZONE

The organization of a radio company as a unit in the regular army for duty in the Panama Canal zone and other foreign service is planned at Fort Leavenworth. Captain J. O. Mauborgne, is to organize the company and will have command of it when it goes on foreign service. Aside from a few soldiers with experience in drill an effort will be made to get recruits, who have taken up radio work.

HARVARD IN PREPAREDNESS MOVEMENT

A new phase of army and navy preparation was introduced at Harvard University recently when fifty students gathered to learn of the work performed by the radio corps during war time. Lieutenant Blakeslee, U. S. N., of the Charlestown navy yard, and Captain H. G. Galler, United States radio inspector for New England, addressed the men.

In connection with the reserve officers' training corps the Harvard men with a knowledge of wireless telegraphy are to take a special course of training to prepare them for service. The work will be carried on under the direction of the Harvard Wireless Club, which has headquarters in the Harvard Union. Classes will be held three times a week for the radio students. A score of students have enrolled in the wireless corps.

A wireless telegraph station has been established at Alamos, an important mining camp in Southern Sonora, and regular communication is now going on between that place and Chapultepec, Guadalajara, Salina Cruz, Merida, Vera Cruz, Matamoros and other points.

Professor Michael I. Pupin, inventor of electric tuning and a world renowned authority on communication

Shall Parents Raise the Infant Wireless or Place It In a Government Institution?

The Opposition to Proposed Legislation made by the President of the Institute of Radio Engineers

PROFESSOR M. I. PUPIN of Columbia University in no uncertain terms expressed his decided objections to the proposed bill to regulate radio communication at the recent hearing before a Committee of the House of Representatives. His cogent reasoning and emphatic statements and illustrations, comprise so effective an indictment of the proposed measure that his entire testimony, as given to the Committee, is now placed before the readers of THE WIRELESS AGE.

"I am not a parent of the wireless art," said Professor Pupin, "but I am a very close blood relation to it, because I am the inventor of electric tuning, the only means they have today of preventing interference between different stations receiving signals or transmitting signals at the same time."

There are not many whose words carry more weight than those of Professor Pupin, when the subject of wireless is under discussion, and in the imminency of legislation affecting the science, his views and counsel deserve attentive consideration. Professor Pupin's qualifications as an authority may be gauged from his activities and affiliations. He is professor of electromechanics of Columbia University; director of the Phoenix Research Laboratory in Physics of the same university; president of the Institute of Radio Engineers; president of the New York Academy of Sciences; president of the National Academy of Sciences; member of the National Advisory Committee for Aeronautics, and member of the National Research Council, organized at the request of President Wilson.

Professor Pupin invented the art of electric tuning and sold the patents to the Marconi Wireless Company of America in 1902. He is also the inventor of the electrolytic detector, and was the first to suggest the advisability of rectifying the received electrical oscillations. He suggested this before the American Physical Society in November, 1899, and showed the apparatus, namely the electrolytic rectifier, by means of which the rectifying of received electric oscillations can be and was effected. This rectifier was used for a long time as one of the methods of receiving wireless messages. It has been superseded by better apparatus, but the rectification of received electrical oscillations is one of the fundamental elements in the modern or recent developments of wireless telegraphy, and the idea was that of Professor Pupin.

The foregoing record, however, is sufficient to emphasize the fact that the opinions of Professor Pupin represent expert testimony.

Professor Pupin informed the members of the Committee that he had never been interested financially in any of the companies manufacturing wireless apparatus. He appeared before the Committee, he said, for the purpose of demonstrating, if possible, that the bill under consideration would be most detrimental to the development of the young wireless art, since it would inevitably lead to Government ownership. He likened the art to a very promising, healthy baby, which had a great future before it.

"A great future," repeated Professor Pupin, "provided this healthy, robust and most promising baby receives the proper training and the proper bringing up. And the question in my mind is simply this: Who is to be responsible for the training of this wonderful baby? Its parents or a Government institution?

"It has been represented by the heads of our Government departments, namely the Secretary of War, the Secretary of the Navy, the Secretary of Commerce, Commander Todd and by other Government officials interested in the national defense, that it is advisable and necessary that the Government should control, in fact, that the Government should own, wireless telegraphy, I am interested in the national defense as much as anybody, and for that reason was appointed as a member of the National Advisory Committee on Aeronautics, which is a Government institution. I am convinced that if we are to use any art and particularly the wireless art for the national defense, the best thing for us to do is to develop that art. If interferences exist, as has been pointed out in the several depositions here before you, on account of the present imperfection of the wireless art, then these interferences should be eliminated not by legislation but by perfection of the art.

"If you will be indulgent with me, I will illustrate that by describing as briefly as I can the experiences that the world had in the development of other arts which are very closely related to the wireless. Take the ordinary telegraphy and telephony by wires. What was the experience in their early history? Exactly the same as we have in the wireless art. From 1845 to 1860 the men interested in the development of telegraphy, electromagnetic telegraphy, invented by Joseph Henry and commercially developed by Morse, spent most of their time in quarreling among themselves on the subject of how to get around the inductive disturbances. They had inductive disturbances just as much as we have to-day in wireless telegraphy, and they were of two different kinds: Inductive disturbances produced in a wire by the operation of other wires and inductive disturbances produced by God. Inductive disturbances produced by God have not been discussed in the depositions so far, but under certain conditions they are a great deal more serious than inductive disturbances in wireless telegraphy produced by man. And although it is possible—I do not say it is advisable, but it is possible—to get around the inductive disturbances produced by man through legislation, you cannot get around inductive disturbances created by God by means of legislation, because God says, 'My acts can be eliminated in the operations of man not by brute force (and that is what legislation in many cases is) but by intelligence.'

"What are these interferences produced by the acts of God? We did not realize them until electro-telegraphy was invented. And we never realized them to such an extent as we do to-day, since the wireless telegraphy was invented. Wireless telegraphy is communication between two points on the surface of the earth, or between a point on the surface of the earth and a point in the air, as in the case of the aeroplane, by means of electric oscillations. You create an electric oscillation at the sending station; that electric oscillation goes to the receiving apparatus and creates there an electric oscillation which affects a receiving instrument.

"We know to-day that these electrical oscillations are produced in the atmosphere by God for purposes that are known to Him. We can explain how they are produced, but we do not know yet what is the real intention of the Creator in producing them. They are called statics, and statics are the blackest enemy of the wireless stockholder. Statics have prevented the wireless stockholder from reaping any benefit from his work. The wireless art is not quite yet, excepting in some of its features, a commercial art; in other words, it does not return dividends, principally because the statics prevent it —these disturbances, these electric waves that go up and affect, in fact, every receiving instrument.

"In April, 1914, when our bluejackets had landed in Vera Cruz, and it looked as if we were going to have a war with Mexico, I was here in Washington attending a meeting of the National Academy of Sciences. I happened to meet Dr. Austin, who is the director of the Wireless Research Laboratory of the Navy, and he told me that they could not force a message through between Arlington, or even Key West, and Vera Cruz; it was impossible. Why? Not because the Mexicans had a wireless apparatus which interfered with ours and not because anybody else had it, but because the static was going on in the Gulf of Mexico and prevented our messages from reaching Vera Cruz. Interference in wireless telegraphy due to static, due to the acts of God, is so serious that sometimes a wireless station cannot receive a message for forty-eight hours or even twice forty-eight hours. For days in succession they cannot receive a thing. Not on account of interference of other stations but on account of the static, on account of the electric waves, the electric oscillations, which God sends from an infinite number of stations located anywhere in the atmosphere between the North and South Poles. These are the acts of God, and I do not see that these interferences have even been touched upon in all of these depositions. And these are the most serious interferences that we have, and you cannot get rid of those by any act of the legislature. The only way to get rid of them is by the perfection in wireless, by the proper training and bringing up and education of this healthy, robust baby, the wireless art.

"But the heads of the Government bureaus propose that this baby should be put into a Government institution, should be taken away from the loving arms of its parents and relations (and I am one of them). Now, it seems to me that would be almost a crime. We would suffer, the United States would suffer—the people of the United States; the Army and Navy would suffer, because they would not have an efficient art with which to defend themselves in time of war.

"When it comes to getting rid of the acts of interference produced by legislation, we can do that to a certain extent, provided we are legislating against the acts of our own citizens. But what legislation is going to prevent the enemy from interfering with us in time of war? It is told by the English wireless operators who took part in the battle off Falkland Islands that the Germans, as soon as the battle started, went up and down the scale of their wireless sparks for the purpose of making it impossible for the English ships belonging to that squadron to communicate with each other. Now, I would like to know how any act of legislation, how any act of Government ownership, can prevent that. Of course, mind you, I am proceeding from the hypothesis that Government ownership is inefficient in the development of a new art."

At this point the Chairman of the Committee inquired whether it would help the situation any if citizens or wireless stations in our country were to intensify that condition of interference?

"If I had my own way," replied Professor Pupin, "I would produce as many interferences as I possibly could, for the purposes of development of the art so that no ingenuity of man could interfere with a wireless operator when he receives. And that is possible. Things are being done to-day by well-organized industrial research laboratories which will undoubtedly lead to wonderful results so far as preventing interferences produced by the acts of man are concerned. Things are within the reach of those who are studying the situation which will transform the whole aspect of the wireless art. Now, these things, I say, are being done because the Government does not own the wireless. And if the Government owned the wireless they would not be done. Why? I will tell you the reason why. I have the greatest respect for the Army and Navy. I have a great many friends among the officers of the Army and Navy. And I would not for the world do anything which would hurt their feelings. But we are here to be frank and open and aboveboard, and we must say what we think is right, what we think is best for the wireless art and for the people of the United States.

"How does the inventor feel with regard to the Army, and particularly the Navy—I mean the wireless inventor? I will describe it briefly for the purpose of explaining what I mean when I say that if the Government owned the wireless, the men who are interested in the development of wireless probably would drop out—drop their interest in the development of the wireless. I may be wrong, but that is really my opinion. I refer now to a man who made a very beautiful invention. In 1910 Dr. Austin, director of the Wireless Research Bureau of the Army and Navy, and whose station is on the grounds of the Bureau of Standards, published a paper in which he compared the efficiency of various types of receivers. Among the receivers he examined was a new receiver, the so-called audion, invented by Mr. de Forest, the very audion receiver which is used to-day almost universally. Dr. Austin found that this audion receiver was one and a half times as good as the best receiver they had prior to that time—one and a half times, mind you. At that time a young inventor, to whom I refer, was a student in Columbia University, a sophomore. That was in 1910. In 1912, when this student graduated, he got a patent—or I do not know whether he got a patent that year, but he had the invention anyhow, a very simple thing, which consisted of taking the audion tube and by a simple transposition of the circuits, making it 5,000 times as sensitive as the one which Dr. Austin examined. This young student, by a simple transposition of circuits, made the same audion 5,000 times as sensitive. With what result? With the result that everybody is using it to-day and all the operating companies pay the young man a modest royalty. Not a very large royalty, because the operating companies are not making money—not much anyhow. They cannot afford to pay more than a very modest royalty. But it enables this young man to support his mother and two sisters. The United States Navy uses this invention more than anybody else. According to the information which an officer of the Navy gave to myself, they have been using it since January, 1914. And they had it at this time—and this was a year ago—in something like forty stations. They have not paid a cent to the young man, and they do not intend to. They all tell him, You can go to the Court of Claims."

The Chairman inquired whether anyone were contesting the right to the invention.

"The right has not been contested," replied Professor Pupin, "and it is proved that it is not contested, because the wireless operating companies pay this young man a royalty, which is the best proof that an invention is valid; you cannot have a better proof. The wireless operating companies know more about the art than anybody else. And if they did not have to pay the royalty, they would not pay it; but they are paying it. But the Government has never paid a cent, and probably never will until the Court of Claims decides in favor of this young man. Now he is poor and cannot go to the Court of Claims. It costs money, and he cannot afford it. His lawyer tells him, 'You had better not go to the Court of Claims; you will spend a lot of money; you will spend everything you have, and God knows when you will get any return from it.' And the result is that the young man has no other claim for his rights.

"I am sorry to be compelled to testify to that effect, but that has been the policy of the United States Navy. And I am afraid that if the United States Navy takes control over the wireless art that will be the policy still, unless the laws are very much amended. In other words, if this bill passes through, you will have to pass perhaps five, six, perhaps ten other bills for the purpose of protecting the inventor and protecting the art.

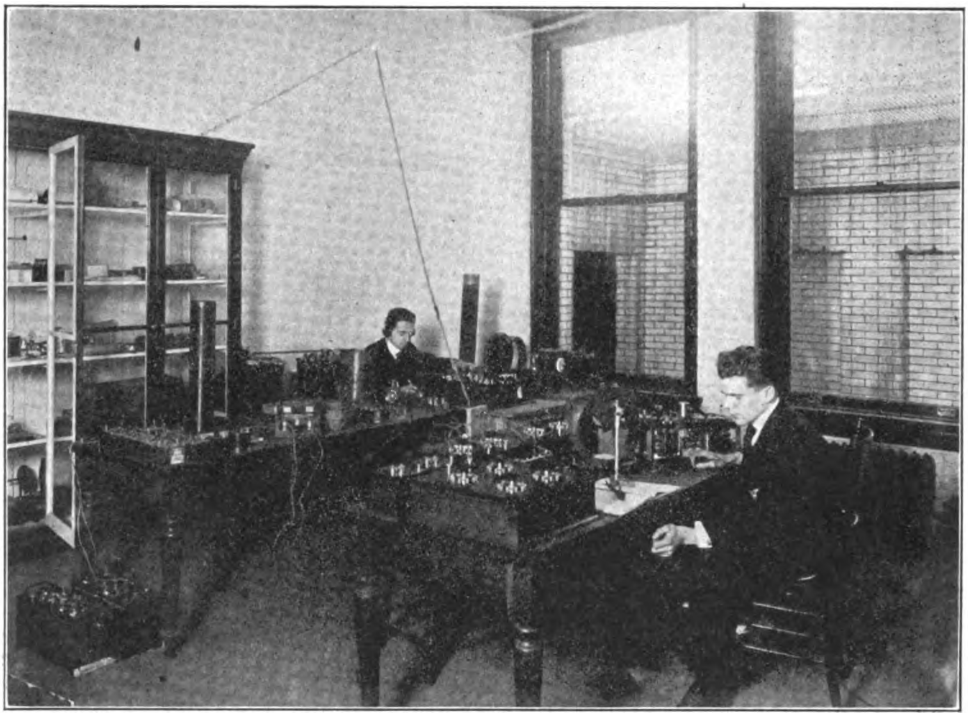
"But brushing that aside with the argument that these things can be fixed up in such a way that the inventor will be protected and that he will be very anxious to work for the Government, offer to the Government his inventions and help in the development of wireless, I still maintain that the Government is not and never will be in a position to develop a new art. That must be left to private enterprise and private initiative. Why? Well, it is a question of psychology, and there is no use arguing about that. It is a fact well understood everywhere that a new art is not developed and cannot be developed by the Government. Even the German Government has not taken possession of the wireless art and will not take possession of the wireless art for some time to come. Why? Because the German Government understands that this is a young art, and should not be intrusted to the Government for its development—for its bringing up. It leaves it to private enterprise. Moreover, the German Government very wisely subsidizes private enterprise. It pays so much a year to develop the wireless art. And I should say that if the United States Government is anxious to prepare this art for the national defense, the wisest thing for the Government would be to subsidize private enterprise to develop the art for the national defense as much as possible and as soon as possible. That would cost a great deal less and give very much better results than Government ownership.

"To go back again to the history of telegraphy, electromagnetic telegraphy and telephony: I said a little while ago that their experience was the same as the experience of wireless operators today. They had interferences from men and interferences from God. The inductive effects of one line upon another line were felt then. And if the United States Government at that time had decided to take the new art of electromagnetic telegraphy into Government ownership, because there were interferences between wires, they would have done probably this: No telegraph wire, should be near another telegraph wire—nearer than, say, a mile or 2 miles. That would have been their way of overcoming interferences, because that is the way they propose in this bill, that the wireless stations should not be placed except here and there, and the Government is to decide that. The heads of the departments are to decide that. The wireless engineers and the wireless experts and the men capable of building up the wireless art have nothing to say about it.

"Now, if that policy had been pursued in 1845 and 1846, up to 1860, we would have been compelled to place the telegraph wires at a distance, say, of a mile apart or perhaps ten miles. And you can easily imagine what would have become of interferences then, as far as the acts of man are concerned, and what would have become of interferences then as far as the acts of God are concerned, because the statics in electromagnetic telegraphy would have been just as bad, no matter how far apart the wires are from each other. But that was not done, thank God! The inventive genius of the American mind and American enterprise went on and solved this problem in a most satisfactory way by the Wheatstone automatic system. The Wheatstone automatic system enabled the wires to be placed right alongside of each other, if you please, within eighteen inches. So that you can have any number of wires on a one-pole line to-day. That means a tremendous saving in expense of installation of telegraph lines.

"It was found in the early history of telephony, from 1876 on, that we had cross talk between telephone wires; you would be talking on one wire and another man talking on another wire, and you could hear each other's conversation; and if ten wires were near by you would hear ten persons at once talking to each other, owing to the inductive interferences.

"It has been testified in this case by Government officials that wireless telegraphy is different from other methods of electric signaling, because they use the same medium, the air, the ether, whereas



Professor Pupin's laboratory in Columbia University, New York

in telegraphy and telephony each man has his own circuit. Well, a school boy, a sophomore at Columbia University, knows that that statement is absolutely incorrect. There is nothing in it. They do not use the same medium in wireless telegraphy any more, nor any less than they do in ordinary telegraphy and ordinary telephony. It is very true that in ordinary telegraphy and ordinary telephony you have one wire so that as far as the motion of electricity is concerned you have only one path. But the electric force is not the only force used in signaling; there is magnetic force. In fact, it is the magnetic force that enables us to set our detecting apparatus into motion and not electric force. It is magnetic force with which they operate. Now, as I said, every schoolboy knows about that. But, as far as magnetic force is concerned, we use the same medium in ordinary telephony and ordinary telegraphy as we use in wireless. They all use the atmosphere; they all use the infinite medium. The same medium serves the telephone, the telegraph, and the wireless. They all use the same medium for the ordinary transmission of the magnetic force. And there is no distinction between the two methods at all. And for that reason, as far as interference by the acts of man and the acts of God are concerned, both had the same difficulties, both had to go through the same history of development—the electromagnetic telegraph and the electromagnetic telephone.

"In the electromagnetic telephone, we had interference between wires. We had cross talk, so that you could hear any number of people at once interfering with other people. To-day we use a cable with a sheathing, say, of four inches in diameter, and we place inside of that sheathing 600 definite circuits, and we can have 600 different people talking at the same time through these circuits without any cross talk; without any interference at all, whereas if the Government had owned that art from 1876 to 1895, or 1900, we would have had to separate those wires and the art would have never reached that point where it can have in a small space 600 different circuits; it would have been impossible."

When asked why he was so positive that Government ownership would have precluded the further development of telephony, Professor Pupin replied that, had the legislature passed a law that telephone wires should not be placed so close together as to cause interference, there would have been no incentive to the inventor for seeking to overcome the limitations of telephony.

"But the Government," interposed the Chairman, "is the most generous purchaser and pays the largest price."

"To whom?" demanded Professor Pupin.

"To the inventor," was the reply.

"When?" retorted the wireless authority. "A lieutenant in the Navy told me to my face that the Government never paid any inventor more than $7,000 for an invention. I received from the American Telephone & Telegraph Co.—well, I won't say; but certainly not $7,000, but probably seven hundred times that. The invention is worth to the company hundred, perhaps a thousand, times as much as they paid me. Certainly a hundred times. And it is worth to the people of the United States a hundred times as much as it is worth to the company. It is the people of the United States who profit by it. We can telephone to-day from any point in the United States to any other point in the United States. You can be on a ranch in Texas or Arizona and telephone to the Waldorf Astoria at any time—at any time of the day or night. You can call up anybody in the United States. Why, you can not only talk to one man, but you can talk to an audience of a thousand hearers in the Waldorf-Astoria. I was one of an audience of 2,500 people in the Symphony Hall, of Boston, last June, when the voice in San Francisco was heard by every one of the 2,500 hearers. I candidly and openly confess that if the telephone had been in Government ownership, we should never have reached that point; never. Why haven't they reached that point in France or England?"

"Who was the inventor of the process by which this was possible?" asked the Chairman of the Committee.

"I was the inventor," was the reply.

"Of the process by which you can magnify the voice?"

"No," corrected Professor Pupin, "by which you can preserve the character of the speech. When you preserve the character of the speech that has been transmitted any distance, say from San Francisco to New York—if you preserve it so that it is not distorted—then you may easily magnify it to any amount you please.

"Now, if the Government means to take possession of the wireless art and establish industrial research laboratories and go into this art of manufacture—because that is the only way that you can develop an art—to manufacture yourself and not have somebody else manufacture it for you—then well and good. Then perhaps this bill would have some meaning. But this bill as it stands, with the other conditions—with the other laws existing and the other historical conditions of Government work existing—this bill means nothing else than a blow to wireless telegraphy."

The Chairman, interposing, called the attention of the speaker to the fact that the bill under discussion did not provide for Government ownership, although there was an amendment suggested to that effect.

Professor Pupin admitted that the bill itself did not provide for Government ownership, but he reasoned that it inevitably led to that eventuality, since Mr. Baker, the Secretary of War, the Secretary of the Navy and Commander Todd all had favored Government ownership in their testimony before the Committee.

"Mr. Chairman," he continued, "I can not read anything else in this provision, sections 5 and 6, than that it does mean Government ownership. And section 20 and other sections which refer to regulation by the Government, if the Government is going to impose arbitrary rules upon wireless operators, upon private enterprise operating wireless stations, why that control will kill the art, even without ownership. If we are to control the transmission and reception of wireless signals I believe the Government should do it, but I believe the Government should do it in conjunction with well-known recognized electrical authorities —wireless authorities. Let them together devise a method of preventing interference. The patriotism of this country is not all centered in the Army and Navy and the administration. There is some patriotism in the rest of us who are not in the Government service, and we will do our best to prevent interference with the operations of the Army and the Navy —do our best. And we will do it for the same motives that the Government has, namely, pure and simple patriotism. But don't let the Government, independent of anybody else, prescribe rules of operations so as to avoid interference. This thing can be done and would be done and should be done."

The members of the Committee requested the speaker to outline his views as to the nature of the regulation which, in his opinion, should be adopted.

"I suggest," replied Professor Pupin, "the same thing the Government has done in the case of aeronautics. The Government has appointed a committee of twelve, the so-called National Advisory Committee for Aeronautics. It is a committee, I believe, of twelve. I am a member of it. There are four Army and Navy men, two from the Army and two from the Navy; four from the Government bureaus, and four from the universities—Johns Hopkins University, the Columbia University, the Leland Stanford University, and the Northwestern University. I represent Columbia University. Now, with twelve men—four civilians, four Government officials, and four Army and Navy officers—we are getting along beautifully, and we are fixing up the aeronautic arrangements for the Army and Navy in a most friendly and successful way. We have done a lot of work. We are doing the work, and everbody is just as loyal to it as the Army and Navy men are, and I am sure in a short while we will have accomplished great things. And the Government has perfect confidence in it. Let us have the same thing for wireless; let us have four Army and Navy men, four Government officials, and four university men. And I think it would be all right to have some men representing operating companies. Let us have a committee, and let that committee meet once a month, as the other committee meets, through arrangements made by its executive board, and go over the field carefully and advise the Government what should be done. A committee of that kind would do wonders—wonders. And whatever they decided to do, it would be a decision not of the Army and the Navy alone, of the Government officials alone, but the Army and the Navy and the Government officials, together with the universities and the operating companies. Certainly advice of that kind would be acceptable to everybody, and I think it can be done and should be done, and we will have magnificent results. I could almost guarantee them, if my guaranty was worth anything.

"That is the way to do it, in my opinion, and not by legislation," added the speaker.

"Wouldn't you need legislation," suggested Mr. Hardy, of the Committee, "to enforce the rules of the committee as against outside parties?"

"Yes," agreed Professor Pupin, "but such legislation would be recommended by this national committee for the wireless. Legislation, to be sure, but not of the kind that would hurt the art."

"Do you think," persisted Mr. Hardy, "that such a committee could possibly devise a conclusion, a harmonious set of rules, that would not meet with as much opposition as this bill? I was wondering whether you couldn't agree on something on which there would be a unanimity of opinion."

"You will never get a unanimity of opinion among the people of the United States," retorted Professor Pupin. "It is quite impossible; you can not do it, and it has never been done yet. You can not have a unanimous opinion. But among the members of a well-trained, intelligent, patriotic committee—I will say like the National Advisory Committee on Aeronautics, we have had some unanimous decisions. They were good. They were for the good of the aeronautic art of the United States. The President thinks well of them, the Government thinks well of them, and the Army and Navy think well of them, and the House of Representatives thinks well of them, because they have given us appropriations. That is the best proof of what they think.

"I know we had a meeting at the Smithsonian last May between the members of this committee and the manufacturers. The question arose of how to get a first class, large-power motor for the Army and the Navy for flying machines —for aeroplanes. You know at that time we had the Mexican trouble, or we were looking ahead and seeing that probably we were going to have trouble there. And we had no aeroplanes that could fly very high in that rarefied atmosphere of Mexico, because we did not have high-power motors. And the Navy men, like Captain Bristow, told us that he had tried his very best to get a good motor over 100 horsepower, if possible 200 horsepower, with no success. Now, he said, what shall we do? It was suggested that we should have a meeting between the executive board of this National Advisory Committee for Aeronautics and the representatives of the manufacturers. They came and we had a meeting at the Smithsonian under the presiding chairman, Mr. Walcott, the Secretary of the Smithsonian. Well, you may say that if there ever was a meeting of men where there were conflicting interests it was at that meeting; because we had something like fourteen or fifteen manufacturers, one advocating one type of motor, the other man advocating another type of motor, and so forth. And yet when the thing was presented to them in the right light—that we should, for patriotic reasons, brush aside all of our personal likes or dislikes and personal interests, you know you never saw such a meeting. Unanimous; perfect unanimity of opinion. I never attended a meeting in my life where everybody was trying to do his very best as in that meeting. And we did succeed in getting some of the manufacturers, notably Mr. Algers, of the Packard Company, who is a rich man and who does not care whether he spends $200,000 or not in the development of a motor—he told me personally 'I will spend $200,000 to develop a motor satisfactory to the Army and Navy, and I do not care whether I get a cent of that back or not.' Such was the result of that meeting.

"I only mention this to illustrate what was the motive, the moving spirit of that meeting," concluded Professor Pupin. "It was patriotism. And so it is in wireless telegraphy. When it comes to regulating the wireless art for the purpose of avoiding interference with the operations of the Army and Navy we will have one motive in every member of that committee, the motive of patriotism, which will sweep everything else aside. And we will have decisions that will actually help the Government. I am just as sure of that as I can be. They will help the Army and the Navy. We want to help the Army and the Navy. We do not want to interfere with them. Every scientific man to-day wants to have the best Army and the best Navy in the world, and he will do everything he can to help the Army and the Navy."

It is needless to add that these patriotic assurances had their effect upon the members of the Committee of the House, especially as coming from a man whose achievements in scientific pursuits have given him a reputation that is world-wide.

Cross-Continent Relay Successful

The Transcontinental Relay conducted by the National Chief of Relay Communications, National Amateur Wireless Association, and announced in our March issue was a complete success. The westbound message from Mayor Mitchell, of New York, crossed the continent in an hour and a half, starting from (2ZK) G. C. Cannon, of New Rochelle, and being delivered to the mayor of Los Angeles by Seefred Brothers (6EA). The greeting of Mayor Woodman, of the latter city, reached New York by the same route in an hour and three quarters. Full particulars will be published in the May issue of The Wireless Age.

THE SHARE MARKET

New York, March 5.

Bid and asked quotations in Marconi shares today:

American, 2⅜—2¾; Canadian, 1¾—2¼; English, common, 11—15; English, preferred, 10—14.

Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE IV

AN arc system of radio telephony distinguished by simplicity rather than by efficiency or perfect reliability in practice has been developed by the Telefunken Company, though it has been superseded by their radio frequency alternator-frequency changer methods to be described later.

The arcs used by the Telefunken Company were burned either six in series on 220 volts direct current, twelve in series on 440 volts, or twenty-four in series on 880 volts. They burned practically in the open air. The lower carbon electrode rested in a depression in the base of a large, hollow, copper cylinder filled with water, which cylinder formed the other electrode. The water naturally served for cooling, and the carbon dioxid formed by the slow combustion of the carbon remained partially in the depression mentioned, and prevented the further and free access of air to the arc. No magnetic field was used with the arcs in question, and the efficiency was low. With an energy consumption of 6 kilowatts for 24 arcs in series, only about 10 per cent. of the available energy was converted into the radio frequency form. However, the carbon electrodes which were 3.5 cm. (1.4 inches) in diameter burned nearly 200 hours for each half inch of length.

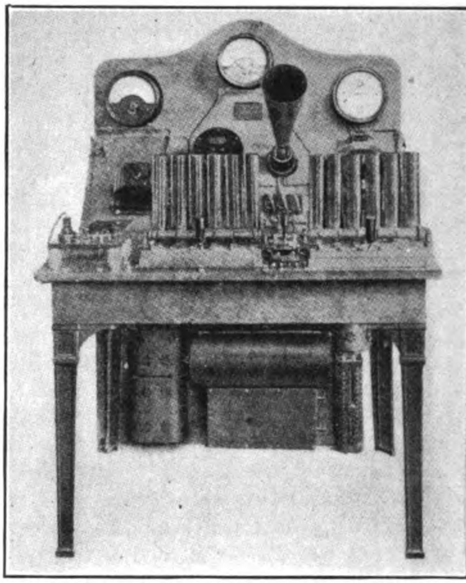


Figure 26—Telefunken Company series arc radiophone transmitter

The arcs were arranged as illustrated in Figure 26. It will be seen that all six could be struck at once by the right-hand handle, and that the length of each arc could be adjusted individually by a separate adjustment screw (not shown in the illustration). The actual wiring of the set is shown in Figure 27, and presents some valuable features. To begin with, there is a switch, *X*, which not only transfers the antenna connection from the transmitter to the receiver, but short-circuits the receiver while transmission is going on, by the use of auxiliary contacts, not shown. The switch, *Y*, connects together the points, *Q* and *S*, while sending is going on and the arc is oscillating. While receiving is going on, the oscillations are stopped by opening the connection between *Q* and *S*. At the same time, the resistance, *R*, becomes operative in holding down the direct arc current. During transmission the alternating current generated by the arc passes through the condenser, *C*, while only the direct current passes through *R*. In this ingenious way, the arc current is prevented from rising markedly when the oscillations cease, which is otherwise the case. The microphone is seen to be connected across the antenna tuning inductance, which also serves for coupling. Consequently, the microphone has the triple purpose of diminishing the coupling, shortening the radiated wave-length, and diminishing the antenna current by dissipating a portion of the available energy.

On November 15, 1907, using the apparatus just described, radiophone speech was transmitted from Berlin to Rheinsberg, a distance of about 45 miles (75 km.), the mast heights being 85 feet (26 m.), and the input power 440 volts and 5 amperes.

In 1908, a system of radio telephony developed by Lieutenant and M. Jeance V. Colins of the French Navy was first thoroughly tried out.* There were used three arcs in series supplied with 600 volts, the three being regulated

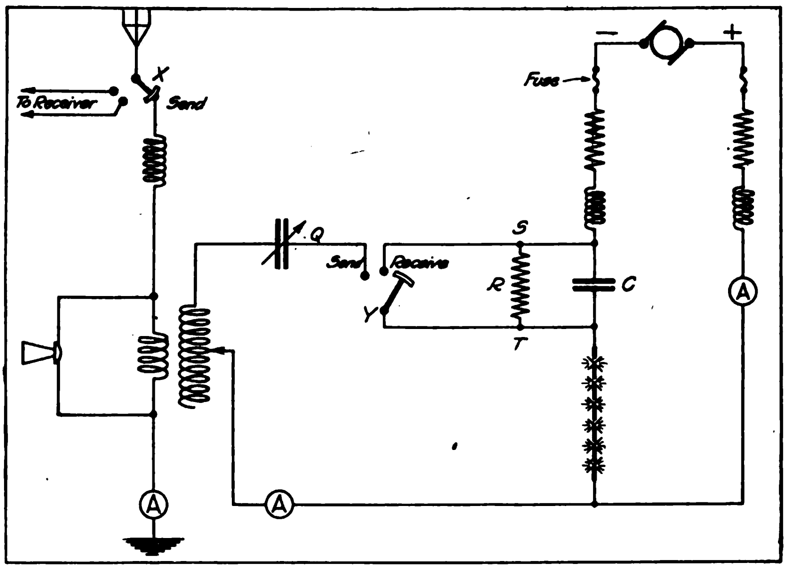


Figure 27—Telefunken series arc radio transmitter

simultaneously (and in later models automatically). An oscillatory circuit is shunted around the arc, and coupled to an intermediate circuit, to which the antenna is coupled in turn. The positive electrodes are heavy copper cylinders with cooling (usually by an interior stream of kerosene), and the negative electrodes are carbon rods of extremely small diameter (1 or 2 mm., i. e., 0.04 to 0.08 inch), the arcs taking place in an atmosphere of some hydrocarbon such as illuminating gas, acetylene, gasoline, alcohol, heavy oils, etc.

Under these conditions, the positive electrodes are not attacked at all, and the negative (carbon) electrodoes merely increase slowly and regularly in length because of the deposition thereon of a fine layer of carbon from the hydrocarbon atmosphere. Consequently, the arc does not tend to wander about the electrodes as is usual.

In order to ensure purity of the radiated wave and freedom from over-

* For much of the information here given, the Author is indebted to the "Bulletin de la Societé Internationale des Electriciens," for July, 1909.

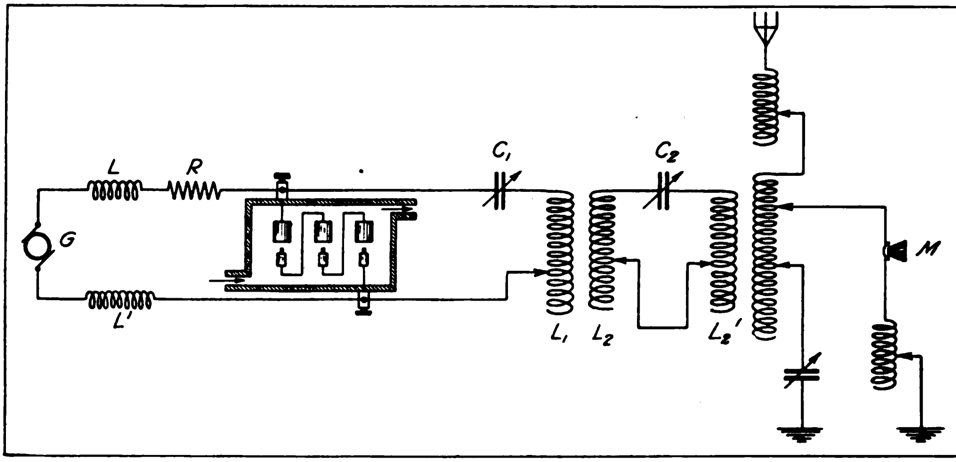


Figure 28—Colin and Jeance radiophone transmitter

tones (which are apt to prove troublesome, particularly for arcs in powerful magnetic fields, or arcs from which excessive energy is being drawn), the arc oscillating circuit is coupled to the antenna by means of an intermediate tuned circuit which, in turn, is inductively coupled to the antenna.

The microphone transmitters are of special design and contain no combustible material, the grain carbon being placed in cavities cut into sheets of marble or slate. The vibrating diaphragm is held at a suitable distance from the carbon support by a metal washer.

The actual circuit employed during some tests in 1914 is shown in Figure 28. Here *G* is a 650 volt direct current generator, which furnished in the tests in question 4.2 amperes (that is, 2.73 k.w). This current passed through the choke coils *L* and *L'*, and the large regulating resistance, *R*, to the arcs which are shown schematically in cross section. The relative size of the electrodes and the method of admitting the hydrocarbon gas atmosphere are indicated. The potential difference across the arcs in this case was 350 volts, and consequently the energy consumption in the arc was 1.47 k.w., leaving 1.26 k.w. to be absorbed in the circuit of the generator, *G* and probably mainly in the resistance *R*. The intermediate circuit, $L_2C_2L_2'$, was very slightly damped, the capacity, C_2, being large. It will be noted that the microphone, *M*, is shunted across a portion of the antenna coupling and tuning inductance, being itself in series with an inductance. It will thus have the triple function of altering the coupling to the intermediate circuit, altering the radiated wavelength, and absorbing intermittently a portion of the available radio frequency energy. The main antenna current was 3.2 amperes at a wave-length of 985 meters, and the current through the microphones was 0.5 ampere. Nine microphones in series were employed, and two sets were provided for alternate use to avoid overheating.

The arc carbons in these tests were 1.5 mm. (0.06 inch) in diameter, and the arc took place in at atmosphere of acetylene (from calcium carbide and water) mixed readily in proper proportions with hydrogen (from calcium hydride and water). Under these conditions, the arcs were not burnt away; in fact, the carbons increased slightly in length with operation. Independent arc length regulation was provided for each arc, but was not found necessary.

Flat spirals of copper strip were employed in the various circuits, and either air variable condensers or glass fixed condensers. An auxiliary tone circuit shunted around the arc was provided (not shown in the figure), whereby musical note telegraphy could be easily accomplished. Since the total terminal arc voltage dropped from 350 to about 150 when not transmitting, an auxiliary resistance was provided in the supply circuit which was automatically shunted into circuit whenever reception was begun.

With the equipment shown, communication was maintained between Paris and Mettray, a distance of 200 kilometers (125 miles).

In Figures 29 a, b, c, and d are shown the various assembled portions of a modern complete set of this type, as manufactured by the Compagnie Générale de Radiotélégraphie. The panel of Figure 29a supports the motor and generator switches, measuring instruments, and control rheostats. The three arcs and their enclosing chamber together with the arrangement for their gas supply are illustrated in the upper part of Figure 29b. An automatic regulator for the arcs is mounted directly in front of them. In the lower portion of the table are mounted the supply circuit choke coils and resistances. The means for tuning the primary, intermediate, and secondary (or antenna) circuits are provided in the cabinet shown in Figure 29c. The hot wire ammeter at the top is in the intermediate circuit. The two couplings between the pairs of circuits are controlled by the projecting handles. Figure 29d illustrates the operator's table. The measuring instruments are the antenna ammeter, the microphone, shunt circuit ammeter, and a voltmeter across the arcs. The resistance to the right is in the microphone circuit. The two microphone mouthpieces and reversed horns and the change-over switch

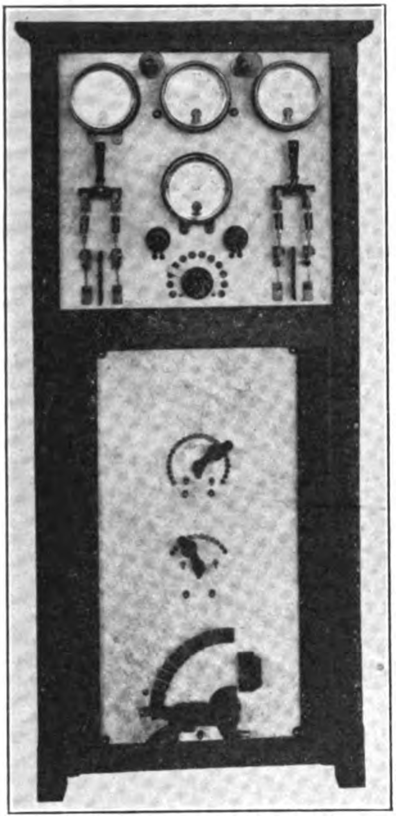


Figure 29a—Motor generator control panel of Compagnie Générale de Radiotélégraphie-Colin-Jeance radiophone transmitter

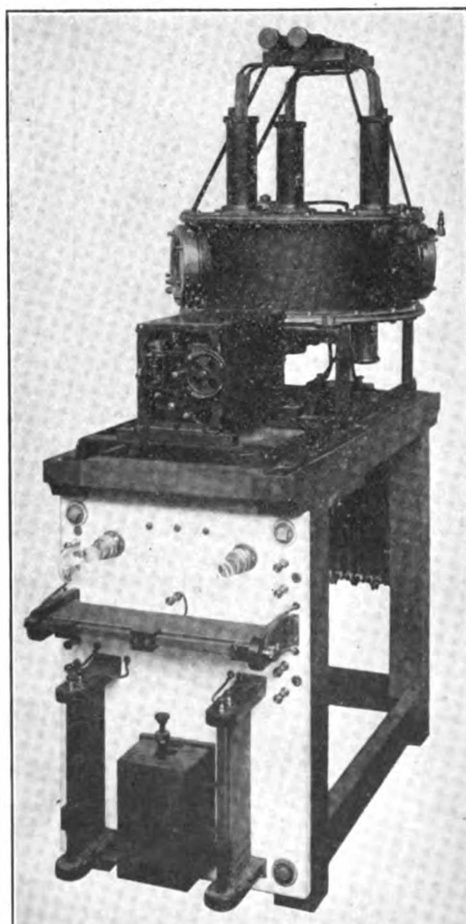


Figure 29b—Colin and Jeance series enclosed arcs, automatic regulator, and control apparatus

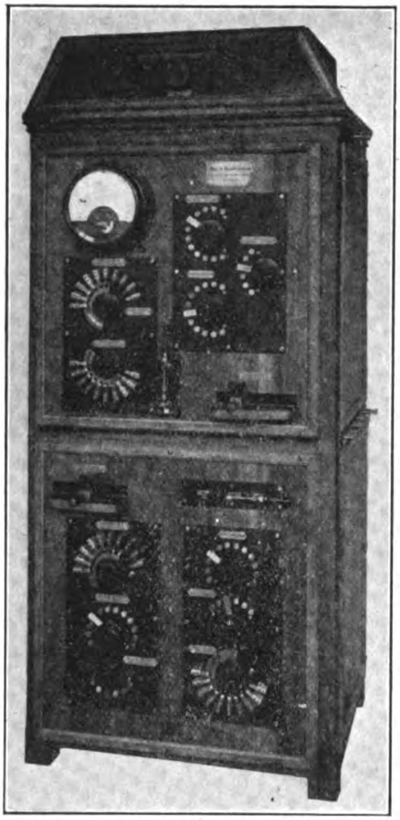
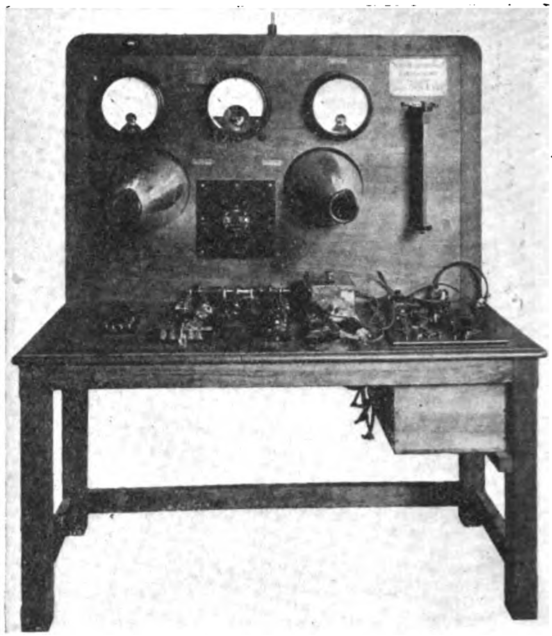


Figure 29c—Colin and Jeance primary, intermediate, and secondary control panel

Figure 29d—Colin and Jeance transmitting and receiving operator's table for radio telephony



between sets of microphones are also on the back panel. On the table top are the antenna switch, a change-over switch from telegraphy to telephony, the sending key, the enclosed detectors, and a complete receiving apparatus. This last is of normal type, having inductive coupling between the antenna and secondary circuits, a tuned secondary, and crystal detector.

(b) **RADIO-FREQUENT SPARKS.** It has occurred to a number of investigators that practically sustained radiation could be secured in an antenna by using spark transmitters, but having these transmitters so arranged that the extremely high frequency of the sparks (above the limits of audibility) would render the usual "spark tone" inaudible. If, then, the antenna energy were modulated by a microphone or otherwise, radio telephony would become possible. To specify in further detail, imagine a special form of spark gap and associated circuit so arranged that discharges occurred more or less regularly across the gap at an average frequency of, say, 50,000 sparks per second. If the circuit in which these sparks occurred were connected inductively to an antenna, there would be produced in the antenna practically sustained radiation, susceptible to suitable telephone modulation by a microphone transmitter or otherwise.

In Figure 30 is given a graphic delineation of the effects. It will be noticed that highly damped oscillations occur rather irregularly in the primary circuit, and that each of these short oscillation groups starts a decadent wave train which has still a large current amplitude when the succeeding spark takes place. Inasmuch as the sparks follow each other so frequently and since the antenna circuit damping is low, the effect at the distant receiver would be appreciably that of sustained radiation at the transmitter, and paricularly is this the case since the changes in antenna radiation occur above audio frequency. Most of the radio-frequent spark transmitters for radio telephony operate in the fashion indicated, but there is a second special case, which has certain interesting features. It is illustrated in Figure 31a, and occurs with the Chaffee "arc" (which is really a spark phenomenon). To begin with, in this case the spark gap has such excessively high intrinsic damping that the spark discharges in the primary circuit tend to be aperiodic. (The structure of the Chaffee arc will be described hereafter.)

The tendency toward aperiodicity just mentioned is enhanced by Chaffee in that he couples the secondary circuit very closely to the primary, thereby obtaining a "quenching" action through the secondary reaction on the primary. In addition, the direct current feed circuit of the arc and the coupling to the energy-absorbing secondary are so arranged that the spark frequency is an integral fraction (e. g., one-half, one-third, one-fourth, etc.) of the frequency of the oscillations in the secondary circuit. Thereby it occurs that the successive discharges come at just the right time to be in phase with the secondary (or antenna) oscillations, and not at random (with possible interference) as is the case for the conditions illustrated in Figure 30. In Figure 31b are shown oscillo-

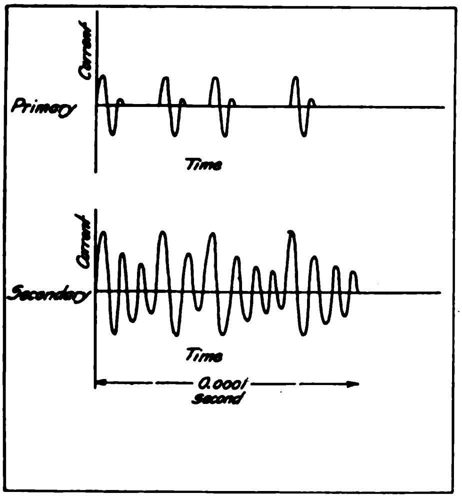


Figure 30—Irregular radio-frequent spark excitation of antenna

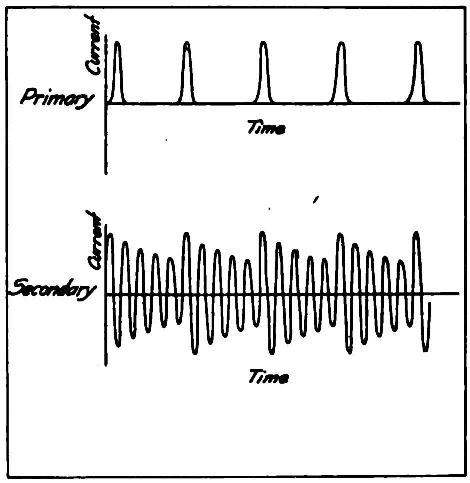


Figure 31a—Regular radio-frequent impulse excitation of antenna

grams of the actual phenomena.* Chaffee uses the term "inverse spark frequency" for the ratio between the radio frequency in the secondary circuit and the spark frequency in the primary circuit. The inverse spark frequency is a whole number for the Chaffee arc.

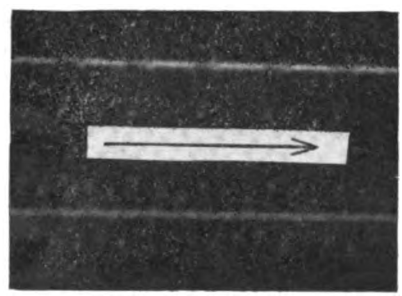


Figure 31b—Primary and secondary current with Chaffee gap (Inverse charge frequency = 3)

In general, spark methods of radio telephony are open to very serious objections. Unless the sparks not only follow with great regularity but also have nearly equal current amplitudes (neither of which conditions are easily fulfilled, particularly in steady operation), there will be produced in the receivers of the distant station an annoying hissing sound, which will interfere seriously with clear articulation in the speech. This accounts, naturally, for the frequently poor quality of spark radiophone transmitters.

Nevertheless, many investigations have been carried on in these directions,

* By courtesy of Mr. Bowden Washington.

and in some cases with marked success, and these will now be considered.

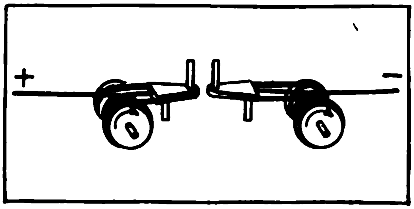


Figure 32—Ruhmer moving wire arc for radio telephony

In the fall of 1900, working with a special interrupter enabling him to obtain as many as 10,000 regular sparks per second, Fessenden succeeded in trans mitting speech over 1 mile (1.6 km.), but the quality was poor and there was much side tone. By 1903 better speech was obtained, though the extra noise was still present. It does not appear that Fessenden developed this method further, although he describes a special rotary gap (with 40 per cent. platinum-iridium studs) operated on 5,000 volts direct current and arranged to give 20,000 sparks per second by the successive charging and discharging of a condenser.

One of the earlier workers with radio-frequent spark systems was Ernst Ruhmer. Ruhmer used as his gap terminals two moving metallic wires which passed over water cooled prismatic surfaces at the sparking point. The apparatus is shown diagramatically in Figure 32, which shows clearly the reels on which the moving wire is wound and the water-cooled prismatic gap guides. The paramount advantages of Ruhmer's arrangement are that a fresh and clean surface is constantly presented for the arc, that excellent cooling (and consequently quenching) is obtained, and that the arc length should remain quite constant. Ruhmer's apparatus is shown complete in a hitherto unpublished photograph* in Figure 33. The arc mechanism is shown on the table near the extreme right. The reels from and to which the wire passes, the driving motor, and the two cup-shaped containers on the top of the apparatus just over the arc are visible. These cups surmount the gap bearings. At the right end of the table are the controlling rheostats and lampboard resistances which regulated the supply of high voltage direct current. On the table can be seen the microphone transmitter, antenna and closed circuit ammeters, coupling and inductance coils, and in the foreground a wave meter.

Figure 33—Ruhmer's radiophone transmitter

Another early system (1911) of radio telephony with what the inventor, Mr. William Dubilier, called a "quenched arc" (really a radio-frequent spark) transmitter, is indicated in outline in Figure 34. The arc is indicated at *A*, and is fed with moderately high tension direct current. Shunted around the arc is the oscillatory circuit, $C\ L_1$, which is opened automatically by a simple switch during reception. The oscillatory circuit, or primary, is coupled to the antenna

* Which photograph, together with a number of others shown herein, I owe to the courtesy of Mr. William Dubilier.

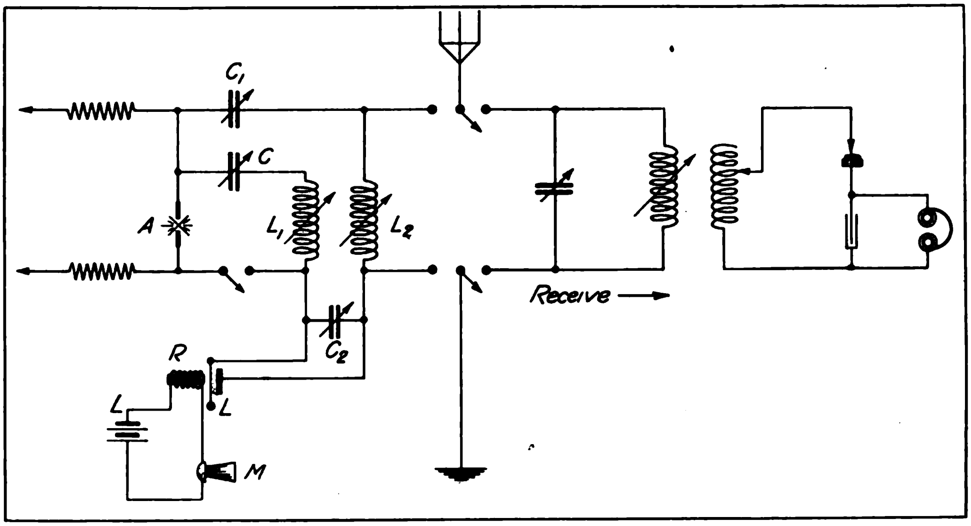


Figure 34—Dubilier radiophone transmitter and receiver

by means of the inductive coupling between L_1 and L_2, and also by means of a capacitive coupling through the condensers C_1 and C_2. Shunted across the condenser C_2 is the telephone relay *R* of special construction to be described hereafter. It is practically a heavy current microphone transmitter coupled to an ordinary receiver electromagnet, the electromagnet in question being energized from the master microphone *M*. Mr. Dubilier has pointed out that the terminals of an ordinary telephone line may be substituted for the local microphone connections at *L, L,* thus causing the incoming energy from the telephone line to control the heavy current telephone relay, *R,* and enabling direct

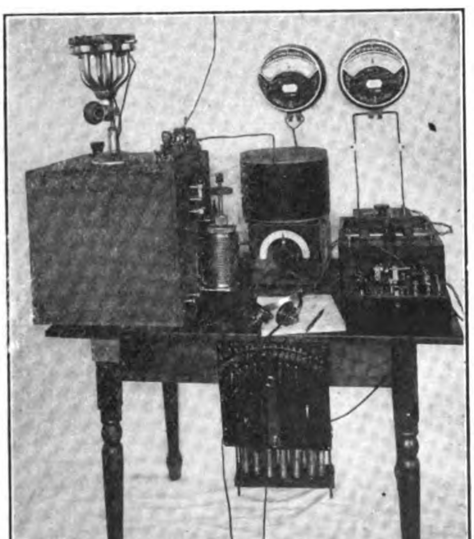


Figure 35—Dubilier radiophone transmitter and receiver

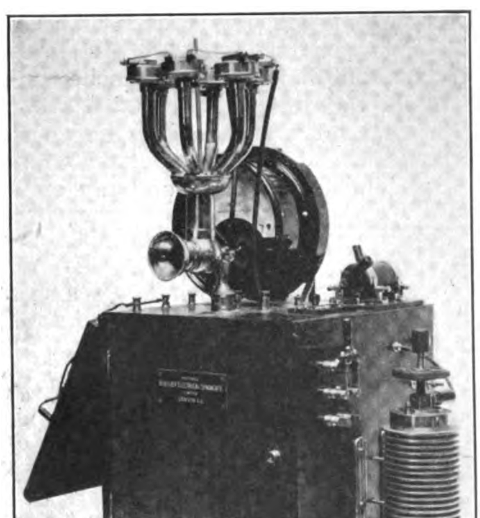


Figure 36—Complete Dubilier radiophone transmitter

communications from any usual land line telephone station to a ship at sea.

The receiving set is indicated at the right of Figure 34, and is an inductively-coupled, aperiodic secondary, crystal detector receiver of fairly conventional design.

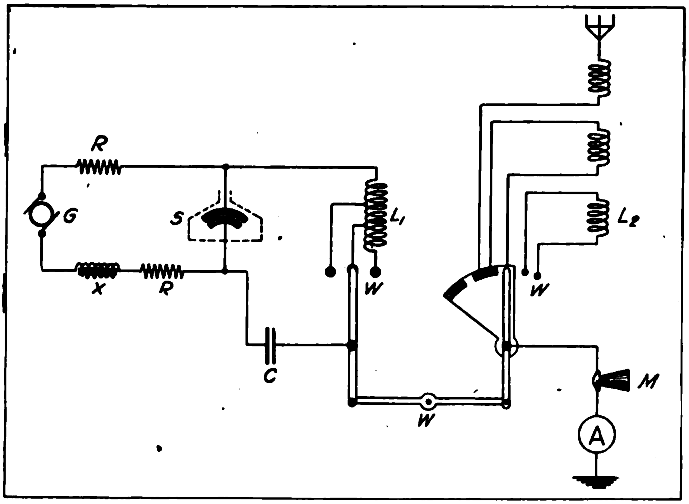


Figure 37—Lorenz radiophone transmitter

In Figure 35 is illustrated a complete radiophone station of this type. The box at the left of the table contains most of the transmitting equipment. On the right rear corner of the top of the box is the multiple contact commutator for changing from transmitting to receiving. This commutator perfoms all the necessary functions indicated by the switches in Figure 34. On the top of the box is a moderately heavy current, multiple microphone transmitter, consisting of a number of transmitters (7) in series. At the right of the box is mounted the special gap or discharger. It consists of one heavy, well cooled metal electrode and one small uncooled electrode. The antenna inductance and coupler is shown in the middle of the table and, at the right of the table, the receiving set.

A later and improved type of set is shown in Figure 36, which is the entire transmitter self-contained. The antenna commutating switch has been somewhat improved, and the antenna ammeter is mounted on the top of the apparatus box. The details of the gap, including the horizontal fins for air cooling, are clearly shown. This particular set has an input of about 3 k.w. and has enabled radio telephony 250 miles (400 km.) on one occasion. The containing box is only 14 inches on a side (35 cm.). The tilted side at the left of the box has mounted on it one of the spiral coils of the antenna coupling, so that merely changing the angle of inclination of the exterior tilted side varies the antenna-to-primary coupling.

The C. Lorenz Company of Berlin has developed through its engineer, Dr. H. Rein, a system known as the "multitone" system. Though primarily intended for low and medium power, variable tone, radio telegraph transmitters it has also been employed in radio telephony. The circuit diagram of the set is given in Figure 37. Here *G* is a moderately high voltage direct current generator, *R* and *X* are feed circuit resistances and choke coils *W* is a wave changing switch, which, after a preliminary and final adjustment of the taps on L_1 and L_2 enables choosing instantaneously any one of three wave-lengths. The microphone is placed in the antenna as indicated. Dr. Rein pointed out

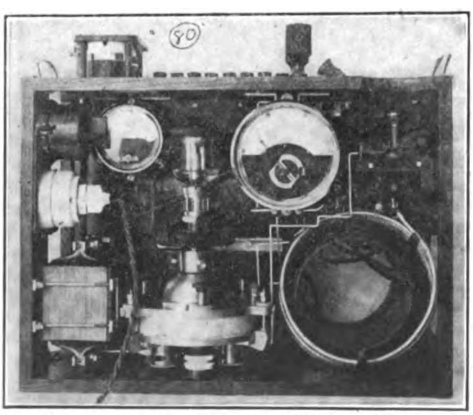


Figure 38—Lorenz aeroplane multitone transmitter

(as had also, and independently, Dr. Seibt) that the resistance of the microphone for best modulation should be equal to the total resistance of the remainder of the antenna circuit. This would imply that one-half the available energy would be consumed in the transmitter microphones, a rule that obviously limits the available modulated output of sets of this type.

A small aeroplane set of this type (intended for telegraphy, however), is shown in Figure 38. The gap, which is the most interesting portion of the set, is seen in the left corner. It consists of two nearly concentric spherical segments, one fitting within the other. The construction is given by Figure 39, which is the dis-assembled gap. The discharge takes place in an atmosphere of alcohol vapor, the alcohol being supplied by the top sight-feed cup. The gap was devised by Scheller. A complete ship station of this type is given in Figure 40, and a semi-high-power station in Figure 41. This last has gaps for high tension, low frequency alternating current, the gaps being assembled in groups of six in series. In radio telephony, Rein states that in general carbon grain microphones having resistances between 4 and 10 ohms were used. If necessary, these were coupled to the antenna through a suitable transformer or otherwise in such fashion that the equivalent resistance they interposed in the antenna circuit was equal to the remaining antenna resistance.

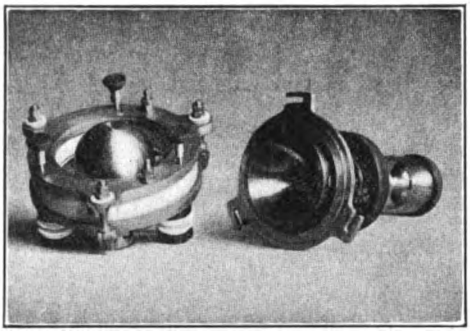


Figure 39—Interior of Scheller "multitone" gap

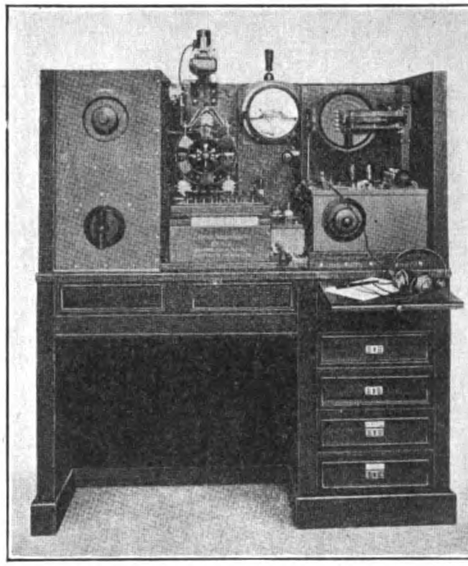


Figure 40—Lorenz "multitone" ship set

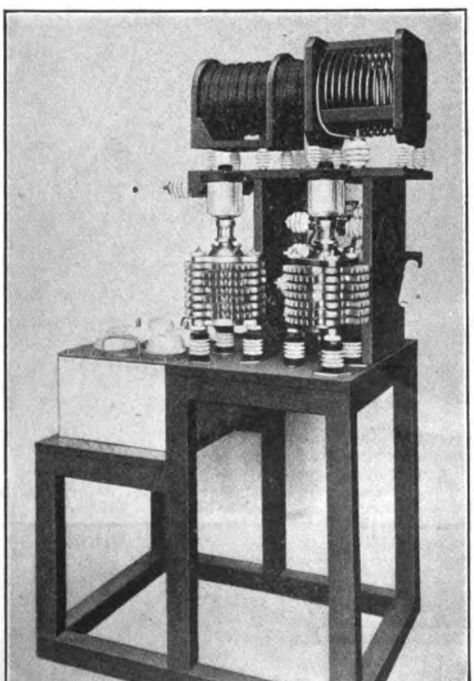
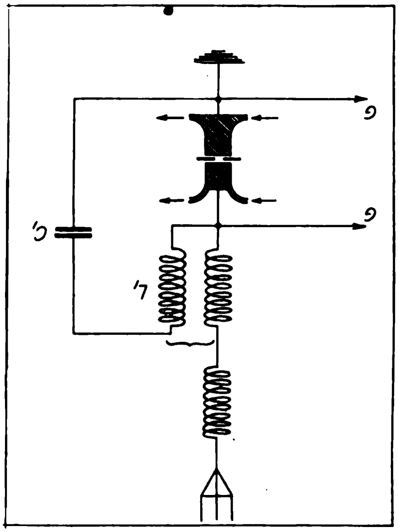
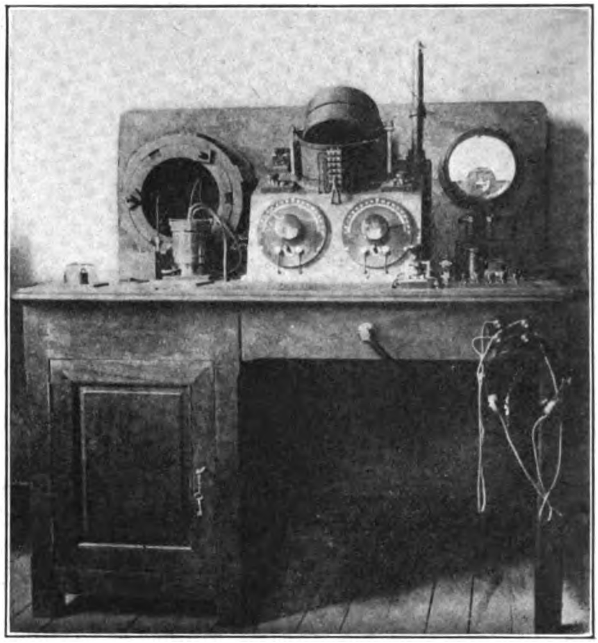


Figure 41—Lorenz "multitone" semi-high

Another system of radio telegraphy that has been adapted to radio telephony in quite a similar manner to the latest mentioned is that due to E. von Lepel. The circuit used is identical with that of Figure 37 in some cases, though in the recent 2 kw. sets the circuit used in Figure 42 is used. This is analogous in action to that shown in Figure 14 (but with L, R_1 and C_1 omitted), and operates in the manner there explained, at least to some extent. The spark gap shunt circuit $L_1 C_1$ is tuned to nearly the same frequency as the plain antenna circuit.

Figure 43—Lepel station at Harfleur
Figure 42—Lepel transmitter





The Lepel gap consists of a plane bronze negative electrode separated from a plane copper positive electrode by a thin sheet of "bond" paper, say 0.002 inch (0.05 mm.) thick. The center of the paper sheet is perforated, and when approximately 500 or 600 volts direct current is applied between the electrodes, the discharge bridges the gap. It then continues rambling outward and slowly burning up the paper sheet, in a spiral path starting at the center and ending at the edges. This action is probably due to the deflecting action of the electrostatic field between the plates on the discharge current.

The Lepel gap is usually shunted by an audio frequency oscillating or "tone" circuit, when used for telegraphy. When used for telephony, however, the gap is unshunted and a very rapid succession of discharges occur, each setting up its train of waves in the antenna, as indicated in Figure 30. In the receiver there is then heard a faint hissing sound. By inserting a microphone in the antenna, this hissing is drowned out by the speech, and telephony becomes possible. A Lepel radio telegraph set (at Harfleur, France), is shown in Figure 43. The spark gap, which is water-cooled, is seen just to the left of the large coupler. It can easily be dis-assembled for cleaning and replacement of the paper separator.

This is the fourth of a series of articles on "Radio Telephony," by Dr. Goldsmith, an eminent authority on the subject. In Article V, in the May issue, he continues the discussion of radio telephony by means of radio-frequent spark transmitters, considering a system developed by Dr. E. Leon Chaffee in conjunction with Professor George W. Pierce. A system developed by Lieutenant W. T. Ditcham is also described, as well as one devised by Messrs. Wichi Torikata, E. Yokoyama and M. Kitamura. The article, describes, in addition, with details of experiments, a recent radiophone method of the radio-frequent spark type, using the Moretti arc.

Theoretical Determination of Signalling Range

By Charles S. Ballantine

A QUANTITATIVE estimation of the range that a transmitter will cover under certain conditions is sometimes very valuable to the radio experimenter or engineer. This calculation, while sought for very extensively, is not, unfortunately, one of the easiest to make. In view of this fact, and also that the average radio man does not care to make long computations, the writer has come to the conclusion that an outline of a method to be used would be welcomed in radio circles. The following method possesses simplicity and accuracy or at least all the approximation that may be expected from our incomplete knowledge of the subject. The subject of transmission of electro-magnetic waves over the earth's surface is very broad and even at the present time scientific men are not agreed upon the various theories that have been proposed to explain the observed phenomena. The contents of this paper, therefore, will be limited to a general review of the features encountered in determining the signalling range of a given transmitter. A specific method of solving for this factor will be presented which should be valuable to the amateur field.

The mathematical theory of the radiation from a Hertz oscillator has been completely given in a number of standard works on the subject. It is unfortunate for the average engineer that most of this material has been presented in such a way as to be unintelligible to him. In most of these theories the use of the higher mathematics and quaternions is found which in some cases will not conclude in a form adaptable to rapid calculation. The theory of radiation from a Hertzian oscillator has received the treatment of Dr. Louis Cohen and in the Journal of the Franklin Institute, April, 1914, a very clear and concise analysis of the problem in elementary mathematics is given. Those interested in the mathematical aspect of the subject are referred to Cohen's paper. The problem has received the attention of other eminent mathematicians among whom might be mentioned Sommerfeld, Poincare, Nicholson, March and von Rybczynski. The treatment of Sommerfeld is perhaps the most interesting from a practical point of view.

The equation deduced by Sommerfeld expressing the relations between the received current, sending current, antennæ heights, distance and wave-length is given below:

$$I_r = 377 \frac{h_1 h_2 I_s}{\lambda d R} \cdot \epsilon^{-\frac{.0019d}{\sqrt{\lambda}}} \qquad (1)$$

In this equation the received current is represented by I_r, the sending current by I_s, the wave-length by λ, height of the receiving antenna and sending antenna by h_1 and h_2, respectively, and the effective resistance of the receiver by R. The heights in the foregoing equation represent the heights to the center of capacity. This is defined as the total height times the form factor, which is the ratio of the average value of the current at all heights to the maximum measured at a potential node. (See Standardization Report of the Institute of Radio Engineers, page 14.) It is customary in theoretical treatment of the problem to employ this unit of h because it gives a very definite idea of the length of the equivalent oscillator in the Hertzian system. Since the length of the equivalent oscillator is then 2h and the energy of the electric field at a distance from the radiator is proportional to this length, the occurrence of this term in the theoretically derived equation is explained.

It will be observed that there are two distinct parts to this equation. The first part

$$377 \frac{I_s h_1 h_2}{\lambda d R} \qquad (a)$$

is simply the theoretical expression for the energy in the field at distance, d. The exponential term

$$\epsilon^{-\frac{.0019d}{\sqrt[3]{\lambda}}} \qquad (b)$$

may be called the dispersion factor since it expresses the loss of energy in the emitted wave due to the tangential flow of the waves into the upper atmosphere. At night some of this energy is returned to the earth by reflection and refraction from the upper ionic layer and gives rise to some of the vagaries of transmission which have been so widely observed. For this reason it is only possible to regard a definite equation as expressing the facts during a stable period. Daylight working furnishes this state of affairs and the expressions that will be given hereafter must be understood as expressing *the average daylight working range.*

In addition to the factors contained in equation (2), in cases where the wave trains are damped and discontinuous, the denominator will be modified as shown below

$$I_r = \frac{377\, I_s h_1 h_2}{\lambda d r \sqrt{1 + \frac{\delta^1}{\delta_2}}} \epsilon^{\frac{-.0019d}{\sqrt[3]{\lambda}}} \qquad (2)$$

Here δ_2 and δ_1 are the decrements at the receiver and transmitter, respectively.*

In 1911 the problem of long distance transmission was taken up experimentally by Dr. L. W. Austin† and the data collected enabled the selection of an empirical formula to express the results of these experiments. The equation obtained by Austin, widely known as the Austin formula, is an extremely useful one. The original formula was given as

$$I_r = 4.25 \frac{I_s h_1 h_2}{\lambda d} \epsilon^{-\frac{.0015d}{\sqrt{\lambda}}} \qquad (3)$$

where the lengths are expressed in kilometers and the currents in amperes. It will be noticed that the factor expressing the absorption is somewhat different from that given by Sommerfeld. In reality the exponential term of this expression is more useful since it expresses the loss of energy under actual operating conditions, while the theoretical term was determined on the assumption that the ground was perfectly conducting. The discovery that the absorption varied inversely as the square foot of the wave-length was made by Dr. Louis Cohen, while assisting in the work started by Austin. The above equation fully expressed the results obtained during the original tests made in 1910, but later when the work was again taken up in connection with the acceptance tests of the Arlington station, it was found that a much closer agreement could be obtained by combining the first part of the theoretical formula with the empirical exponential term found under actual conditions.

The resulting expression, referred to as the "semi-empirical expression" by Austin, is given below

$$I_r = 377 \frac{I_s h_1 h_2}{\lambda d R \sqrt{1 + \frac{\delta_1}{\delta_2}}} \epsilon^{-\frac{.0015d}{\sqrt{\delta}}} \qquad (4)$$

This equation is by far the most accurate one that has been given, and fits quite closely the graphical data obtained under all conditions. Wave-lengths from 300 to 4100 meters have been tested, heights ranging from 40 to 600 feet and distances up to 2000 miles. In all cases the received energy obtained from the foregoing equation is in close agreement with that taken from the smoothed curve of observations.

As stated in the previous section the distance covered is that during the average day over water. While some data have been obtained for conditions during the day with land absorption, this

* L. W. Austin—Scientific Papers of the Bureau of Standards, No. 226, p. 73, 1914.

† L. W. Austin—Bulletin of the Bureau of Standards, Vol. 7, No. 3, p. 315, 1911, or Scientific Paper, No. 159. 1911.

is not yet complete enough to warrant its conversion into mathematical form. The experiments that have been made indicate a wide range of values in the absorption term over the various sections of the country. In view of these facts it is concluded that the best expression available at the present time is the semi-empirical equation of Austin. This will be used in the following section in the determination of the range of a given transmitter.

A glance at the equation (4) will reveal the fact that simple algebraic solution for the distance factor, d, is not possible since its variation is simultaneously linear and exponential. A very convenient method of solving a transcendental function of this sort is to rewrite the equation parametrically in terms of the arbitrary constant, p. The simultaneous couple obtained may then be solved graphically as usual. The intersection of the loci of the two functions will determine the value of d sought. We have then

$$\frac{212 I_s h_1 h_2}{I_r \lambda d} - \epsilon^{\frac{.0877d}{\sqrt{\lambda}}} = O \quad (5)$$

Now writing $\frac{212 h_1 h_2 I_s}{I_r \lambda d}$ as a function of a third, variable, p, then $\epsilon^{\frac{.0877d}{\sqrt{\lambda}}}$ will also be a function of p and we may write

$$\left\{ \begin{aligned} d\,\frac{I_r \lambda}{212 I_s h_1 h_2} &= p \\ \frac{1}{\epsilon^{\frac{.0877d}{\sqrt{\lambda}}}} &= p \end{aligned} \right. \quad (6)$$

where p is the parameter. The solution of the above equation is very readily accomplished graphically. We may first plot the values of each equation against the common abscissa, p, representing the parametric axis. The intersection of the two curves will evaluate d. Calculate the values of

$$\frac{1}{\epsilon^{\frac{.0877d}{\sqrt{\lambda}}}}$$

and tabulate them as shown in Table I.

TABLE I

d	200	300	400	500	600
40	.780	.729	.840	.855	.865
60	.690	.736	.769	.790	.808
100	.525	.601	.645	.675	.700
140	.419	.491	.540	.577	.605
180	.325	.402	.454	.493	.525

The wave-lengths are 200, 300, 400, 500 and 600 meters, these being assumed to be the most useful to the readers of this publication. The figures from the foregoing table are used to plot the curves shown in Figure 1. Now plotting the values of the ratio

$$\frac{I_r \lambda d}{I_s h_1 h_2 212}$$

on the same abscissa, the straight lines shown will be obtained. The values of d corresponding to the intersection of these systems are found as ordinates.

In using these curves to rapidly estimate the range of a transmitter the following procedure may be followed:

(a) calculate the value of the ratio

$$\frac{\lambda}{I_s h_1 h_2}$$

(b) locate this value on one of the straight lines in the figure.

(c) follow along this line until it intersects the curve for the wave-length used.

(d) from this intersection follow horizontally to the left hand side of the figure and locate the value of d sought.

Perhaps the foregoing explanation may be made clearer by means of a practical example. Assume the following values for the factors:

TRANSMITTER

Radiation current .... 4 amperes.
Antenna height .... 60 feet.
Wave-length ....300 meters

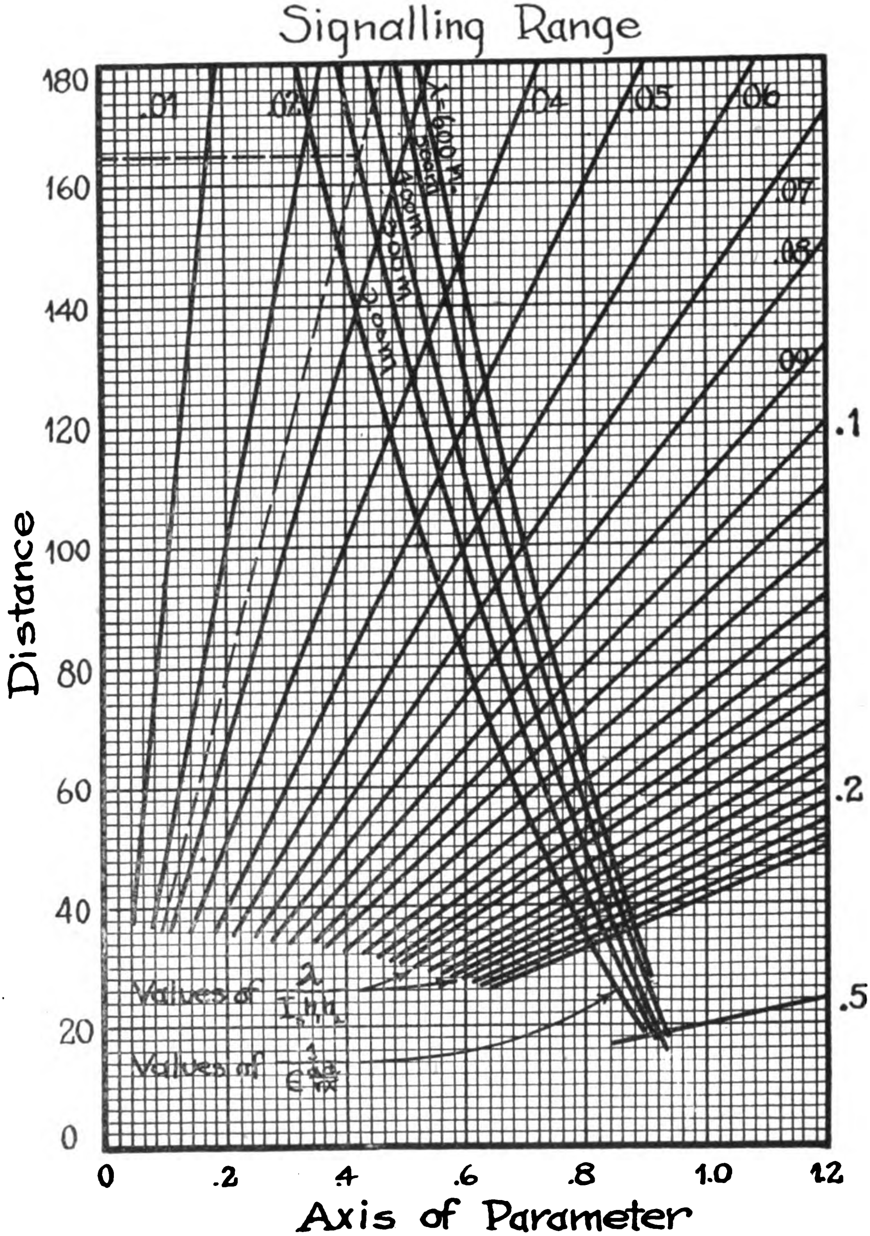
RECEIVER

Antenna height ..... 50 feet.
Received current ... 21.2 micro-amps.

Calculating the value of the ratio we have

$$\frac{\lambda}{I_s h_1 h_2} = \frac{300}{4 \times 60 \times 50} = .025$$

The position of this curve may be judged and is indicated by the dotted line in the



accompanying drawing. Now following along this line until it intersects the wave-length curve for 300 m. and turning to the left we find the value of d as 165 miles.

It might be mentioned that the curves given in the figure represent the current necessary at the receiving station for reliable communication through an effective receiving resistance of 25 ohms. This includes the actual resistance of the antenna system, the ground resistance and the resistance represented by the component of the decrement caused by the absorption of energy through coupling with the detector circuit. It is evident that the arbitrary figure will not afford great accuracy in the determination of signalling range since at small wave-lengths it will be too low and at the longer ones, too great. However, when working near the fundamental of the antenna, even though the resistance of the tuning inductance is not great, the radiation and absorption resistance is very large, which partially compensates for this extremity. The figure is representative of average conditions.

The figures given by Austin for a "good" signal and a barely audible signal are 40 and 10 micro-amperes through 25 ohms. These figures were obtained with the electrolytic and crystal detectors. With the heterodyne receiver of the National Electric Signaling Company, 7 micro-amperes will give an audible signal. At this point it will be evident that the personal equation of the operator will have a great influence upon the results that may be obtained with a given receiver. The working distance then will vary approximately within these limits with the ability of the operator, the amount of interference, etc. In the present case it is supposed that the crystal detector has given its place to the newer regenerative circuits with the electron relay, as curves obtained on this assumption are thought to be of more practical value than if the original conditions of Austin were supposed. The writer has found that readable signals may be obtained through moderate interference with 12 micro-amperes in the antenna and a good electron relay used on one of the Armstrong circuits. The foregoing figure is rather critical and it is believed that some latitude in this connection would be more representative of all-around working possibilities. The foregoing graph is therefore drawn to 21.2 micro-amperes, this figure being used for convenience.

In the solution for the working range, no account has been taken of any transitory phenomena such as drifting ionic fog or freaks of any kind and the results obtained represent the average daylight range with the average absorption. After sufficient time has elapsed after nightfall for the dissipation of the ionic fog, the exponential term may be neglected and the solution becomes very much simplified. The range then becomes

$$d = \frac{212 I_s h_1 h_2}{I_r \lambda} \qquad (7)$$

It might also be mentioned that in the case of land stations the heights represented in the equations given may not be as great effectively as it would seem. This is generally true of stations erected on a ground that is not a good conducting medium. For example, in the Arlington experiments, after the signals had been measured at short distances, at Washington Navy Yard and the Bureau of Standards, and the calculations were made, it was found that the results were twice as large as the actual measurements. This indicated that the effective height of Arlington was only half its height to the center of capacity. This has also been observed at numerous other land stations, and this fact may help to explain the great differences in the transmission conditions on the East and West coasts. Independent measurements of specific ground resistance do not substantiate this conclusion, but even in cases where the ground conditions are ohmically very different it is found that the effective height is not changed. The writer has made extensive investigations of earth resistance and its effect on signalling range and has found that the condition of the soil has very little effect upon the energy in the electric field. Observations made during wet weather only indicate a loss due to the standard carona loss increment as pointed out by Peek.* This, of course, results in an increase in the decrement of the emitted waves which will have the effect indicated by the occurrence of the decrement term in the denominator of equation (4) but the change occasioned in this way is not of sufficient magnitude to explain the great difference observed. As far as the writer knows no adequate explanation of this phenomena has been offered.

It is rather unfortunate that there are no theoretical or empirical methods for taking into consideration these various changes in the value of the factors and thus add to the degree of approximation of our formulæ, but the above method of determining the signalling range of two stations is very useful. The equa-

* F. W. Peek, Jr.—Journal of the Franklin Institute. December, 1913, page 680.

tions given also afford an estimate of the influence of the various factors on the results to be expected.

In this connection a few remarks on the subject of wave-length may be of interest. It has been concluded in certain exceptional cases where large distances have been covered on certain wave-lengths that there is an optimum wave-length for a given combination of factors. If this conclusion is an accurate one it would certainly be an advantage to be able to determine mathematically this optimum wave-length. An inspection of the equation will reveal the fact that at night when the exponential factor is dropped the functions being simply hyperbolic and linear will have no maxima or minima except at zero and infinity. Therefore we must look to the exponential for a condition whereby a singular point might be determined. Let us consider the problem analytically. Solve the equation for the term to be made maximum. This is obviously the ratio $\frac{I_r}{I_s}$

Solving then

$$\frac{I_r}{I_s} = \frac{212 h_1 h_2}{\lambda d} \cdot \epsilon^{\frac{.0877d}{\sqrt{\lambda}}} \qquad (8)$$

Now it is required to determine the critical wave-length to produce either a maxima or minima in the value of this ratio. This is very readily accomplished by differentiating (8) with respect to λ and after equating the coefficient to zero, solving the resulting expression for real roots. Replacing the numeric coefficient in the exponential by ∞ and denoting the ratio I_r/I_s by I, we have the result shown by the equations on the following page.

In other words the critical value of the variable corresponding to either a maximum or minimum in the Austin equation solved for I_r/I_s will occur at a wave-length equal to the square of the distance divided by the numeric 4 multiplied by the square of the absorption. In order to determine whether this critical value of λ corresponds to a maxima or minima, we may substitute the value

$$\frac{\alpha^2 d^2}{4}$$

in the second derivative. This causes a reversal of sign and determines the point as a maxima.

A very interesting conclusion may be drawn from this result, e. g., that the value of this optimum wave-length will vary greatly with the absorption. From daylight, when the absorption is maximum, until solar midnight when we may neglect this term, the absorption will vary and in order to keep abreast of this change and secure a maximum working range, it will be necessary to vary the wave-length in accordance with these changes. At sunset the optimum wave-length may be higher than the wave-length to which the transmitter is adjusted, but as the absorption approaches zero the exponential term will approach unity and the maxima will shift to zero, so that at some time during this period it may be possible to secure an extended range at the point where the absorption is reduced to correspondence with the wave-length to which the transmitter is adjusted. Large variations in the absorption from moment to moment are also noticeable, especially at this time of the day and this may account to some extent for the great variations in range that have been observed from time to time. As pointed out in a preceding paragraph, this may be caused by the reflection and refraction from the upper ionic strata and from physical reasoning would be expected to be rigidly connected with the length of the waves used in transmission.

At this point in the discussion of the subject we emerge into speculation, which the present writer will avoid until further experimental verification of this hypothesis is available. The writer has been engaged for some time in research work in connection with the subject of transmission and hopes to outline the results of this work in another paper. It is hoped that the few and necesasrily incomplete remarks made here, may be of some value to those interested in the subject. The derivation of the equation

$$\frac{d}{d\lambda}\left(\frac{212h_1h_2}{d\lambda\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}}\right) = \frac{-212h_1h_2\frac{d}{d\lambda}\left(\lambda d.\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\right)}{\lambda^2d^2\epsilon^{2\varphi d\lambda^{-\frac{1}{2}}}} \qquad (9)$$

But

$$\frac{d}{d\lambda}\left(\lambda d.\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\right) = \lambda d.\frac{d}{d\lambda}\left(\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\right) + \epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\frac{d}{d\lambda}(\lambda d) \qquad (10)$$

and

$$\frac{d}{d\lambda}\left(\lambda d\right) = d \qquad (11)$$

also

$$\frac{d}{d\lambda}\left(\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\right) = -\frac{\infty d\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}}{2\lambda 3/2} \qquad (12)$$

so that

$$\frac{d}{d\lambda}\left(\lambda d.\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}\right) = \propto \lambda d^2\epsilon^{\varphi d\lambda^{-\frac{1}{2}}} - 2\lambda 3/2d\epsilon^{\varphi d\lambda^{-\frac{1}{2}}} \qquad (13)$$

Hence

$$\frac{d}{d\lambda}\left(\frac{212h_1h_2}{d\lambda\epsilon\propto\varphi d\lambda^{-\frac{1}{2}}}\right) = \frac{h_1h_2 424\lambda 3d\epsilon^{\varphi d\lambda^{-\frac{1}{2}}} - 212h_1h_2\propto d\lambda\epsilon^{\varphi d\lambda^{-\frac{1}{2}}}}{\lambda^2d^2\epsilon^{2\varphi d\lambda^{-\frac{1}{2}}}} \qquad (14)$$

Simplifying

$$\frac{dI}{d\lambda} = \frac{424h_1h_2\lambda^{\frac{1}{2}}}{\lambda d} - \frac{212h_1h_2\propto d}{\lambda d} \qquad (15)$$

Equating to zero

$$\frac{424h_1h_2\lambda^{\frac{1}{2}}}{\lambda d} = \frac{212h_1h_2\infty d}{\lambda d} \qquad (16)$$

Solving for λ

$$\lambda^{\frac{1}{2}} = \frac{\propto d}{2} \qquad (17)$$

Finally

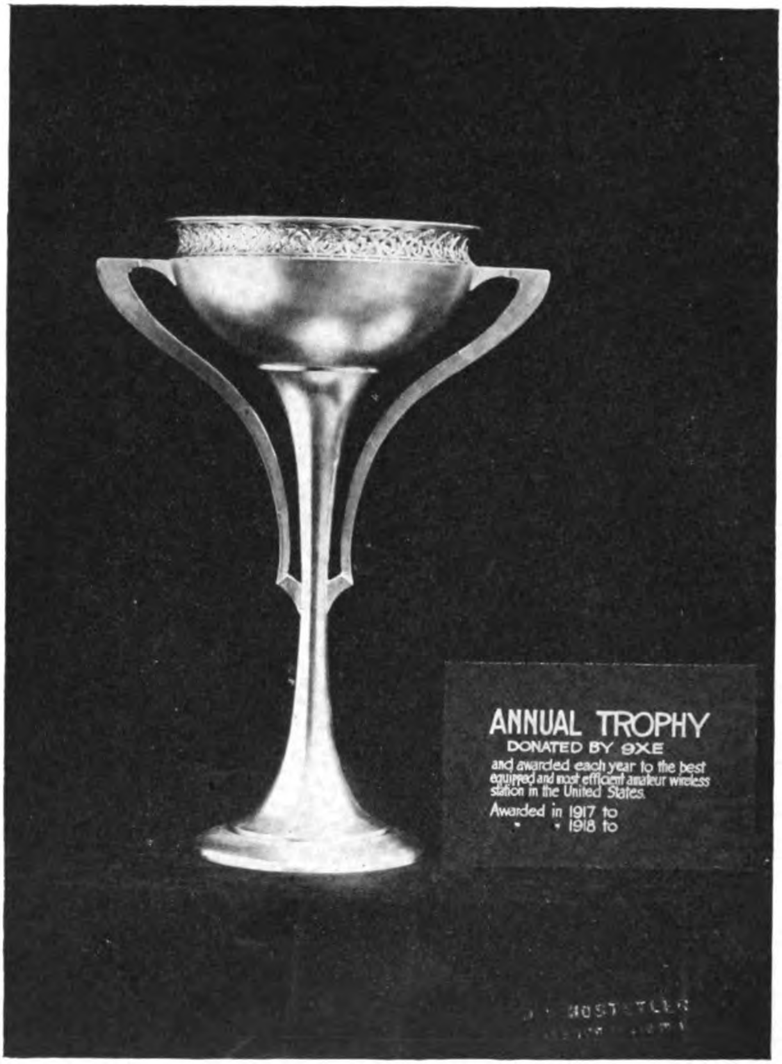
$$\lambda = \frac{\propto^2 d^2}{4} \qquad (18)$$

for the optimum wave-length has been given in detail as modern tendencies in mathematical work is to show each step in the evolution of the final result so that the conclusion may not necessarily have to be accepted on faith without knowing the limitations and assumptions involved in the work.

LITTLE REFUGEES AIDED

When the liner Nieuw Amsterdam was nearing New York recently with nearly 1,000 refugees from Russia, Poland and Belgium, it was discovered many of the children had no proper clothing. A wireless call was sent to the Red Cross headquarters in New York and officers of the society took complete outfits for 250 children down the harbor to meet the vessel.

Prize Donated by N.A.W.A. Relay Chief



The handsome silver trophy illustrated above is to be presented at the close of the working season to the best equipped and most efficient amateur station in the United States. It is the gift of 9XE, National Chief of Relay Communications, N. A. W. A., and stands 21 inches high. The selection for its presentation will be made by a committee appointed by various clubs throughout the country, perfection of equipment and lack of QRM being among the important points taken into consideration in the award. The winner will hold it one year, when the committee will consider the merits of all contenders. If the cup is awarded to an amateur station two years in succession, possession will be permanent.

Plan To Facilitate Amateur Relays

By W. E. Packman

WITH the object of learning the cause of the interference which seems so detrimental to amateur radio stations and the failure of the operators to conduct satisfactorily their relay chains, I recently investigated this much discussed question. The operation of various stations was carefully observed and information as to the results that were being obtained in different quarters was acquired. In addition a number of the best amateur radio receiving sets, complete receivers with vacuum valve detectors attached and several of the best types of loose couplers which seem to be more widely used by amateurs than others, were submitted to tests. The results of the investigation are contained in this article, together with a summation of some of the more important factors concerned with the subject of interference in radio telegraphy.

These are the three main causes of interference among radio stations:

1—Promiscuous sending.

2—Lack of knowledge of the principles of tuning.

3—Improperly designed instruments.

Any one of these factors alone is sufficient reason to cause undue interference when a large number of stations are operating within range of each other, but when all three of these conditions exist nothing but interference can be expected, and this, in certain localities, seems to materially retard amateur wireless operation at the present time. In discussing the causes of interference, the term interference is taken to mean interference from radio transmitters and not static or other interfering, uncontrolable, vagrant waves. It is further presumed that the operators are all capable of receiving telegraphic signals, which is, of course, not the case and may lead to interference. It is also presumed that all radio transmitting stations emit wave trains having a decrement of 0.2 as required by the regulations of the Department of Commerce.

"Promiscuous sending," although disposed of in the present article in a few words, is probably the principal cause of interference. It might better be known as interference due to lack of judgment on the part of amateur operators. It has been observed many times by station operators that when you are working with a distant station the signals of which are not loud at best, that the operator of some powerful station nearby will break in, calling a station in some remote part of the country which he has heard or believes he has heard. This is nothing more or less than lack of judgment on the part of the interfering station. It is assumed that he does not know you were receiving, otherwise he would be violating the law in sending, and if he did not know you were receiving he should have listened in long enough before transmitting to assure himself that he would not interfere with another station that was engaged in receipt of some message addressed to him.

It is not essential for an operator in a wireless station to call every distant amateur whom he may hear and in most cases it is more to his discredit to work with a station a thousand miles away than it is to his credit. It has long been known by persons versed in the art of radio telegraphy, in fact, ever since Marconi's voyage on the Philadelphia in February, 1902, that the distance a radio station can be heard is usually greater at night than during the day and that occasionally a station using very low power can be heard at extremely long distances. Such feats are now known in commercial circles as "freaks" and no longer excite wonder, interesting though they are. The distance at which a station may be heard under such conditions is no criterion as to the efficiency of the station.

The success of an amateur relay chain will be more certain if every amateur station is included in the chain or is under its control, and certain stations are designated to work with certain other stations and *not* to work with any other station. Can you imagine the existence of a successful commercial system if, for example, every operator on Atlantic coastwise vessels attempted to work WGO or any other ship or land station in the Great Lakes District, which he might pick up under freak conditions? For the information of some, whose experience does not date back to the beginning of commercial wireless in this country, it might be added that this was attempted at one time, when all commercial operators were amateurs in a new art, and it was learned that it would not succeed.

Rapid Receiving Apparatus

In the foregoing paragraphs interference caused by poor judgment on the part of sending operators has been discussed, and in what follows it is the purpose to cover the two other causes of interference by discussing some of the important points in the design of radio receiving apparatus and emphasizing certain features of the operation of such apparatus which make for interference or its prevention.

The term radio receiving apparatus, is meant to cover all apparatus required in the reception of radio signals, namely: the antenna, earth, primary and secondary tuning inductances, condensers, detectors, telephones, etc. In commercial receivers there are two objects to be attained, the first of which is to absorb the greatest amount of energy from the wave trains of the station which it is desired to receive and to transfer this energy to the telephone receivers with the least possible loss; the second is to prevent the apparatus from picking up and transferring undesired signals to the telephones. It appears that in the design of amateur receivers this latter feature of the receiving equipment has been eliminated, probably because of the fact that most amateurs are more interested in hearing as many stations as possible than in copying from any one. If, however, amateur relays are to become successful it will be necessary for amateur stations to have receivers which are capable of selective adjustment.

Commercial Field Practice

In commercial systems it is customary to have two possible circuit arrangements in the receiver, one of which is suitable for receiving signals varying over a long range of wave-lengths, and the other capable of being adjusted so that it will respond but very slightly or not at all to wave-lengths which differ from that to which the circuit is tuned. In the Marconi service the first of these circuits is called the "Stand Bi" circuit and any wave-length within the commercial range can be received. The second circuit is known as the "tuned" circuit and this is capable of very close adjustment to the exclusion of other frequencies than that desired.

In practice it is impossible to construct a receiver which is one hundred per cent. efficient, that is, one which will transfer a given number of microwatts of received oscillating energy in the aerial circuit to the telephones without loss; in any conversion system there will be some loss. As a matter of fact, in any radio receiver involving a rectifying detector, whether of the crystal type or a vacuum valve, the efficiency cannot exceed fifty per cent. It should be the object of the designer, however, to reach the limit of efficiency as nearly as possible.

It is likewise equally difficult to construct a receiver which is absolutely immune from interference, but if advantage is taken of the fundamental principles in designing the receiver and if the operator is well versed in these same principles, interference may be greatly reduced without resorting to other than simple standard circuits.

In all modern receiving systems there are at least two distinct circuits used. One is the open aerial circuit and serves to absorb the oscillating energy from the passing wave trains. The other is a closed circuit which receives energy from the open circuit and delivers it to the detector and telephone receivers. These two circuits are coupled together either electromagnetically, as with an oscillation transformer, or electrostatically as in the case of the Cohen tuner where the energy is transferred from the aerial circuit to the closed circuit through small condensers. The aerial circuit is adjusted by means of variable inductances or variable condensers, so that its period of electrical vibration is the same as the period of the oscillations in the wave train which it is desired to receive. The circuit is then said to be in tune or in resonance with the oscillations and the current that will flow in the circuit is limited only by the e.m.f. induced in the antenna by the passing wave train and the impedance of the circuit. If the tuner is wound with wire which has small resistance, the current and the resulting signal will be relatively strong, while if the resistance is large, the current and resulting signal will be weak. Again, in order that a maximum current be induced from the aerial circuit into the closed circuit, it is necessary that this circuit be tuned to or brought into resonance with the primary or open circuit and, furthermore, it too must be of low resistance. When this condition of resonance between the two circuits and between the circuits and the wave trains has been brought about and the coupling is not too close, the maximum response will be given in the telephone receivers.

Factors in Signal Strength

In summing up the factors or points of importance in the production of strong signals we have the following:

1. The two circuits must be capable of exact adjustment to the frequency of the desired wave train.
2. Both circuits must be of low ohmic resistance.
3. The coupling must not be too close.

A fourth cause for decreased signal strength lies in the so-called dead end effect wherein certain unused portions of the tuning coils may in themselves, or in conjunction with other parts of the circuit, have periods of free vibration which correspond to the frequency of the waves being received and will therefore absorb energy from the system.

Delivering Electrical Energy

It is not the purpose of this article to give a technical exposition of the relations existing in the circuits of a radio system, nor to discuss at length the phenomena associated therewith, but merely to point out and discuss in the briefest way those factors which are mainly responsible for the existence of interference in radio receivers. Interference may be due either to a lack of sharpness of tuning in the circuits or to the other factors which will be discussed.

If electrical energy is delivered in any one of several ways to an oscillatory circuit such as is found in radio telegraph apparatus, that is a circuit containing inductance, capacity and resistance, electrical oscilltions of high frequency and gradually decreasing amplitude will be set up. These oscillations will persist until the energy has been expended in the generation of heat, or until it is transferred to another circuit or radiated, or dissipated as a result of a combination of all three effects. If the resistance is high, or if the energy is otherwise absorbed rapidly, so that the energy is expended in a few oscillations, the damping of the system is said to be high, while if the resistance is low or the energy is drawn out slowly so that there will be a large number of oscillations, the damping of the system is said to be low.

The term, damping, here means the logarithmic decrement of the damping, which is the Naperian Logarithm of the ratio of the amplitudes or any two successive oscillations, in the same direction. The logarithmic decrement, then, or simply the "damping," is a measure of the rate of decay of the oscillations in any circuit. If the logarithmic decrement is 0.2 or less, the damping is said to be low, while if it exceeds this amount it is said to be high, this figure having been taken as the dividing point since it is found in practice that sharp tuning at a receiving station is impossible if the logarithmic decrement of the transmitter is greater than 0.2. A transmitter then which emits waves having a decrement of 0.2 or less is said to be "sharply tuned," and if the decrement of a receiver is 0.2 or less, it is said to be a sharply tuned receiver.

Sharpness of Tuning

As defined by the Institute of Radio Engineers, sharpness of tuning is the measure of the rate of diminution of current in transmitters and receivers with detuning of the circuit which is varied. This may be explained as follows: If a receiver is tuned to a transmitter whose emitted waves are, say, 600 meters in length, a certain amount of current will be received, while if the receiver is detuned slightly, that is, adjusted to a wave-length which is a little greater or a little less than that of the incoming waves, a somewhat weaker current will be received. In fact, if a micro-ammeter is connected to the receiver, and the receiving circuits are adjusted to a series of wave-lengths and at each adjustment the received current is measured, a complete resonance curve of the system can be plotted. The steepness with which this curve rises as the receiver adjustment approaches the wave-length of the transmitter is a measure of the "sharpness of the tuning." It will be found from experiment and can be shown otherwise, that if the logarithmic decrement of either transmitter or receiver is high, the resonance curve will rise slowly forming a broad curve, that is, a relative large change in the receiver wave-length adjustment will result in comparatively small change in the received current. On the other hand, if the logarithmic decrement of both transmitter and receiver are low, the resonance curve will rise steeply and we have what is known as a "sharp curve," and if a very small change is made in the wave-length adjustment of the receiver, the received current will decrease very abruptly.

The significance of low damping in both transmitters and receivers is very clearly shown by an observance of such resonance curves. It must be borne in mind that the curves show not the damping of either transmitter or receives alone, but the sum of the dampings of both. No matter how sharply tuned the transmitter may be, the resonance curve will be broad if the receiver is highly damped and, conversely, no matter how selective is the receiver, the resonance curve will be broad if the incoming waves are highly damped. The practical effect of a highly damped transmitter, such as a plain aerial transmitter, is well known, but the effects of high damping in a receiver, though less fully recognized, are equally pronounced. If the damping in a receiver, due to resistance or other cause, is high, sharply tuned waves from transmitters of widely varying wave-length will be received almost equally well at any adjustment of the receiver. Assuming, therefore, as we did in the premise, that all transmitters in use at the present time are so arranged that they comply with the regulations as to logarithmic decrement, we will be able to accomplish selective receiving if the receivers used are of low decrement.

Damping In Receivers

The damping in receivers is due in part to the resistance of various portions of the circuit and in part to the coupling between the primary and secondary circuits. The resistance of both primary and secondary circuits should be kept as low as possible. The inductances should be wound with conductor having low resistance and the earth connection and aerial itself should be of low ohmic resistance. There will, of course, be damping in the aerial system due to re-radiation of the received energy. From the well-known formula for the damping of a single circuit,

$$\delta = \frac{\pi}{2} R \sqrt{\frac{C}{L}}$$

it is apparent that the inductance, L, to the capacity, C, should be as large as possible. A circuit, whether it be the antenna circuit or the secondary closed circuit, which has a large amount of inductance and small value of capacity for any given wave-length adjustment, will not respond readily to waves which differ even slightly from that to which the circuit is tuned. Such a circuit is referred to as a "stiff circuit" and should be used in all cases where interference is impending.

The Loosened Coupling

The damping in receivers due to coupling is less well understood, but is one of the most predominant causes of interference. The wave train in passing the aerial of a radio receiving station induces in the aerial system an oscillatory current which increases in amplitude until the wave train has completely passed the aerial, after which the current begins to decrease in amplitude. If the damping of this circuit alone were small the oscillations would persist for a considerable time, but, as a matter of fact, the energy is partly transferred to the secondary circuit through the coils of the loose coupler. If the coupling between these two circuits is close the energy in the aerial circuit is very rapidly drawn out of the aerial circuit, causing a high damping in this circuit. During this time the energy is building up in the secondary circuit which finally receives all the energy absorbed from the passing wave train except that which has already been lost in heat. Now, the aerial circuit being still closely coupled to the secondary, rapidly draws the energy out of that circuit into the aerial circuit, producing a high damping in the secondary circuit. This transference and re-transference of the energy from one circuit to the other continues for several cycles and the energy being rapidly damped out in both circuits, sharp tuning in either is impossible. If, however, the coupling is loosened as much as possible without appreciably weakening the signals, the energy will be transferred slowly from the aerial to the secondary and equally slowly will be returned to the aerial. Thus the oscillations will be only feebly damped in both circuits and sharp tuning will be possible in both.

Furthermore, when two circuits are coupled together, no matter how loosely, the system as a whole, if a receiver, responds to two wave-lengths, and if a transmitter, will radiate two wave-lengths. If the coupling is made sufficiently low, such as 3 per cent. to 5 per cent., the two waves will be so close together that they cannot easily be detected as two waves, but if the coupling is too close, that is of such value as 20 per cent. or greater, the two waves may be as much as several hundred meters apart. A transmitter coupled as closely as this, unless a quenched gap is used, will cause interference on either of these two wave-lengths and more or less interference on all wave-lengths between them or near them either above or below. In the case of a receiver the system will respond readily to any wave-length within these limits. Loosening the coupling of the transmitter to avoid double wave radiation is common practice, and in like manner if the receiver coupling is loosened, the two principal wave-lengths to which the system will respond will be brought closer together, so close in fact and without loss of signal strength, that the system will to all effects respond to but a single wave-length, that to which the system is tuned.

The Dead End Effects

Another cause of interference which exists to a considerable degree in nearly all amateur receivers lies in the so-called dead end effect. We hear much of late regarding dead end losses, but the losses are extremely small in effect as compared with what may be called dead end interference. It often happens that unusued portions of the primary and secondary inductances may in themselves or in conjunction with other portions of the circuit have a period of vibration which corresponds to some passing wave train. These coils will then be set in electrical vibration and the oscillations will be communicated to the detector and telephones and interference will result. In tables I and II are shown some figures taken on one type of amateur tuner. The test here disclosed the fact that there was no possible adjustment of the secondary with which one frequency only could be received.

Another cause of interference which was found to exist in many makes of amateur tuners tested by the writer was the fact that the shortest wave-length which they would respond to was in excess of 200 or even 300 or 400 meters. Any wave-lengths under these values which might be received would then be received as forced oscillations and the tuner would respond as easily to one wave-length as another.

Designing and Operating

In summing up the factors which should be observed in designing and operating a radio receiver, so as to be immune from interference, we may enumerate the following:

1. The resistance of both primary and secondary circuits should be as low as possible.
2. Both aerial and secondary circuits should be continuously variable so that an exact adjustment to the desired wave-length may be obtained.
3. A tuned secondary system should be used.
4. The coupling should be capable of very loose adjustment and should be worked as loose as possible with proper signal strength.
5. A maximum amount of inductance and minimum of capacity, for any wave-length should be used.

Some figures taken from a typical amateur tuner appear on the following page. Referring to Column 1 of Table I: Natural wave-length of secondary coil, measured by connecting detector unilaterally to end of winding and moving the switch lever across the secondary contact points. The switch lever was not connected with anything except the binding post. All readings of wave-lengths were well pronounced.

Column 2 of Table I: The detector and stopping condenser, in series, were connected across the secondary binding posts, forming a so-called untuned secondary circuit. Wave-lengths were measured with secondary switch on each point.

Column 3 of Table I: Direct current resistance in ohms measured between the secondary binding posts. The high frequency resistance would be considerably greater than the values given here.*

Secondary consisted of twelve sections or about forty turns, each wound on a cylindrical tube six inches long and about three and one-quarter inches in diameter. The winding space was five and one-half inches.

The primary was wound on a cylindrical tube slightly larger than the secondary so that the two tubes would telescope. In the primary there were 286 turns of No. 26 or 28 wire, arranged in the usual way with tens and units switches. There was also provided a small switch which, when open, cut off a portion of the primary coil.

Measuring Wave-Length

A loose coupling between the coils could not be obtained although the secondary was movable along the ordinary slide rods. The secondary could be moved out until it was just flush with the active end of the primary coil.

The secondary inductance was then shunted with a variable condenser and with this set at four different values of capacity, the wave-length was measured on different points of the secondary. It will be noticed from Table II that two wave-lengths at least could be received on any possible adjustment, one of which corresponded to the wave-lengths of the untuned secondary circuit as shown in Table I, and the other the resonant wave-length for the inductance in use in conjunction with the shunt capacity. It was found, furthermore, that the latter wave-length adjustment was very broad and after the contact switch had been moved past the fourth point no resonance point could be detected, the tuner responding to one wave-length as well

* Data on construction of the loose coupler known as "Navy Tuner."

as any other. The shunted variable condenser served only to reduce the loudness of the signals and was of no value in tuning.

Table I

Secondary Switch Point.	1 W. L.	2 W. L.	3 Ohms.
1	565	565	2.9
2	545	480	6.3
3	535	410	9.6
4	530	375	11.7
5	525	335	15.3
6	540	310	18.3
7	525	270	19.0
8	610	225	22.5
9	640	180	25.6
10	675	170	29.1
11	690	190	31.9
12	722	208	36.0

Table II

Secondary Switch Point	Shunt Capacity	Short Wave Length	Long Wave Length
1	0.00001 m.f.	310	575
	.00014	345	585
	.00025	405	600
	.00050	465	692
2	.00001	435	660
	.00014	455	760
	.00025	465	900
	.00050	470	1,183
3	.00001	415	805
	.00014	425	1,183
	.00025	425	1,265
	.00050	430	1,380
4	.00001	375	1,150
	.00014	380	1,270
	.00025	400	1,375
	.00050	405	1,850
8	.00001	225	No resonance point.
	.00014	205	
	.00025	220	
	.00050	220	

It is hoped that this article will be of value to amateurs and other operators in bringing out some of the important points in the design and manipulation of receiving apparatus that are related to the subject of interference.

* A long wave is always the loudest and the shortest wave the sharpest.

LONG DISTANCE WORK

I think the following will be of interest to readers of THE WIRELESS AGE. I find that long distance work is easy here in Wisconsin, especially in the evening. I have frequently copied 8AEZ and 8NH with the telephones ten feet away, by the use of a single vacuum valve detector, but the signals from these stations and all other stations at a distance fade considerably at times. Stations within my daylight range, such as 9IK, 9EV and 9EM of Chicago, come in equally well both day and night. I have often noticed that stations outside of the daylight range of my station come in much stronger after dark than stations located in the daylight range.

In regard to daylight transmission, I occasionally work 9IK, Chicago, a distance of about sixty miles, and another station located in Wauwatosa, Wis., a distance of about seventy miles, using a 3-inch spark coil set consuming twenty-four watts. I use an oil condenser having a capacity of .01 microfarad and usually employ a mechanical coupling of 6 inches between the primary and secondary circuits. My antenna is not designed for 200-meter work, as I have to use a series condenser to reduce my wave-length to 200 meters.

Station 9BF, of Racine, Wis., a distance of about thirty miles, reports that he can hear my signals about fifteen feet from the head telephones when using a single step vacuum valve amplifier.

My friend's station, 9MA, here in Wisconsin, has been heard at 8AEZ in Lima, O., a distance of approximately 250 miles, when using a 2-inch coil set consuming about fifteen watts.

In conclusion I might remark that this long distance working is certainly not freakish, unless you wish to consider everyday work freakish.

E. H. HARTNELL, *Wisconsin.*

Members of the John Paul Jones Post. United States Junior Naval Reserve, Sea Cliff, Long Island, are constructing a small portable set. They are ambitious to purchase a larger equipment, however, and in order to obtain the money to do so, several of the boys are engaged in selling newspapers.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

Removing Induction Troubles and Making an Aerial Changeover Switch

A number of amateurs in my vicinity have installed vacuum valve receiving outfits during the last year. Invariably they have found that the 110 lighting circuit strung about the operating room caused so much induction in the receiving phone that it was practically impossible to receive signals.

In each case which I investigated the owner had the transmitter installed on the same table with the receiving apparatus and also had various lengths of antenna and ground leads strung about the operating room. I suggested that he remove the transmitter from the operating table and mount it on a separate stand located as near as possible to the point where the antenna wire enters the room. I then suggested that he place his receiving apparatus at least six to eight feet from the transmitter, or to whatever distance conditions in the room would allow.

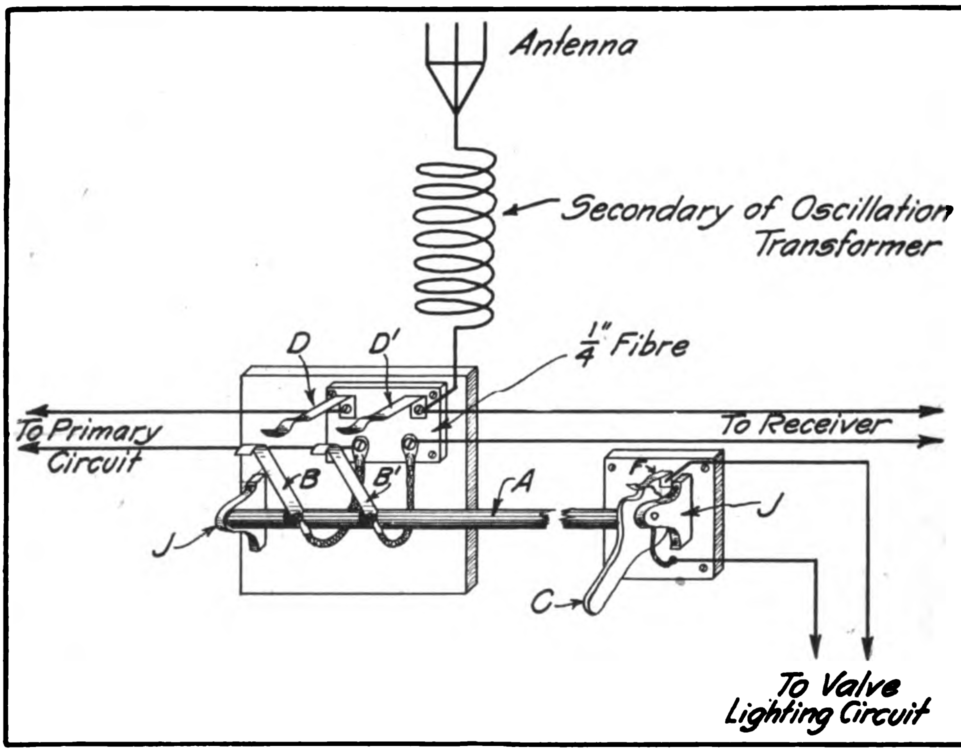


Figure 1, First Prize Article

After these changes were made, the induction troubles were completely eliminated, being helped by the antenna switch as shown in the details of Figures 1 and 2. As a further precaution, the light was installed immediately over the operating table and the circuit leading to the telegraph key was wired up with No. 3 flexible conduit or "B. X." as it is popularly termed by supply houses. The outside iron casing was then connected to earth.

Referring to the construction of the lightning switch in Figure 1: The shaft, A, is a piece of hard wood of suitable length to reach from the transmitter to a position near the operator's left hand at the receiving table. The shaft may be round or square and should be supported by a pin driven into each end. The bearing brackets, J, are made of No. ⅜-inch sheet fibre.

At the end connected to the transmitting apparatus are two contactor arms, B and B-1, made of 1/16-inch sheet brass bent over at their free ends so as to present a smooth round surface for the springs, D and D-1, which are made of 1/32-inch sheet brass.

One pair of contactors, B and D, closes the primary and rotary spark gap circuits and the other pair, B-1 and D-1, completes the ground circuit of the transmitter and simultaneously short-circuits the primary winding of the receiving tuner as shown in Figure 1.

The handle, C, is shown in detail in Figure 2. It is cut from a piece of ⅜-inch sheet fibre and may be about 6 inches in length from the center of the shaft to the end of the handle.

The depressions, G and H, are so located that when the spring, F, rests on G, the switch is held in position for receiving. But when F rests in depression H, the switch is in a transmitting position.

A square hole is cut in the handle at I and the wooden shaft is shaped to fit it snugly. A piece of brass, which is connected by a flexible cable, K, is inserted in G. This is used as a switch to control the lighting circuit of the vacuum valve.

E. E. Sly, *Pennsylvania.*

SECOND PRIZE, FIVE DOLLARS
Regenerative Vacuum Valve Panel Set for Short Wave-Lengths

The regenerative vacuum valve panel set herewith described is designed for the reception of short wave-lengths only, the upper limit of adjustment being about 600 meters. A front view of the panel is shown in Figure 1, a side view showing the position of the variable condensers and variometer in Figure 2, and a complete circuit diagram of connections in Figure 3.

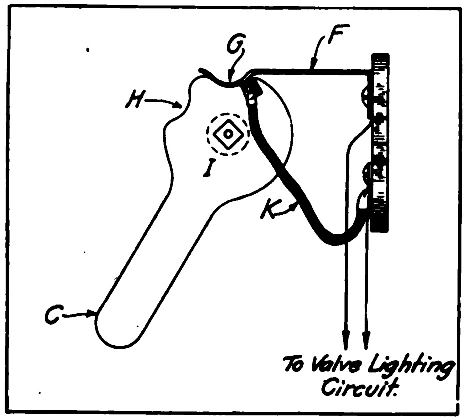


Figure 2, First Prize Article

The front of the cabinet should be made of some good insulating material, such as "Bakelite"; it may have the dimensions shown in Figures 1 and 2. It is recommended that the holes for the switch points be drilled first and the panel be polished with rotten stone and oil afterwards. The remainder of the case may be made of wood, properly stained and finished to suit the taste of the maker.

The variable condenser, C^1, shown in Figure 3 and also in Figure 2, should be of very small capacity, not more than .0005 microfarad. The variable condenser, C^3, should have maximum capacity of .001 microfarad. These condensers should be mounted on strips of wood at the back of the case and be connected with the knob and pointer on the front of the panel, as shown in the cross section of Figure 2.

The receiving transformer shown in the drawing should be made according to the dimensions given: The primary should be 3½ inches in diameter, 1¼ inches in length, wound with fifty turns of No. 26 S. S. C. wire, and the secondary winding 3 inches in diameter, 1¼ inches in length, wound with eighty turns

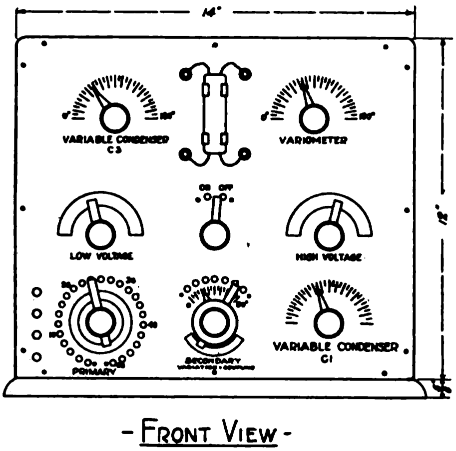


Figure 1, Second Prize Article

of No. 32 S. S. C. wire. It will be noted that the secondary is constructed to revolve within the primary on an axis which is controlled by a knob on the front of the panel.

The primary winding should be tapped every other turn and have leads extending therefrom to contact points on the primary switch. The turns of the secondary winding should be divided into six equal parts and leads connected therefrom to the taps of the secondary switch.

The completed secondary winding is mounted on an No. 8-32 threaded brass rod and locked into place by two nuts at each side as shown. The primary winding should be blocked up in a stationary position.

The variometer coupler should have tubes of the same dimensions as the loose coupler, but they should be wound with No. 32 S. S. C. wire. Care should be taken that the coils are wound in opposite directions or that the current circulates through them in opposite directions. The mounting of the variometer in the box and the connection to the knob and pointer may be similar to that employed at the loose coupler.

The grid condenser, C², should be made of two sheets of tinfoil, 2 inches in width by 4 inches in length, separated by a sheet of thin paraffine paper. The entire unit may be tightly rolled upon a short length of pencil. The grid condenser may be fastened in any convenient place within the case.

The low voltage rheostat may be either the carbon rod type or the ordinary battery resistance wire type. If it is the latter, it should be mounted on the inside of the case operated by a knob and pointer on the face of the panel. The variation of the secondary battery may be obtained by means of a high resistance carbon rheostat or by single cell variations through a multi-point switch. In the event that the latter method is used, the switch points therefore should be mounted on the panel, alternate points not being connected to prevent short-circuiting of adjacent cells, which would be the case if the switch blade rested on two adjoining contact points.

Proper binding posts for connection of the high and low voltage batteries, the aerial and earth connections, may be placed on the back or one end of the case, thus leaving the front free of all exposed wires except the phone cords. The four

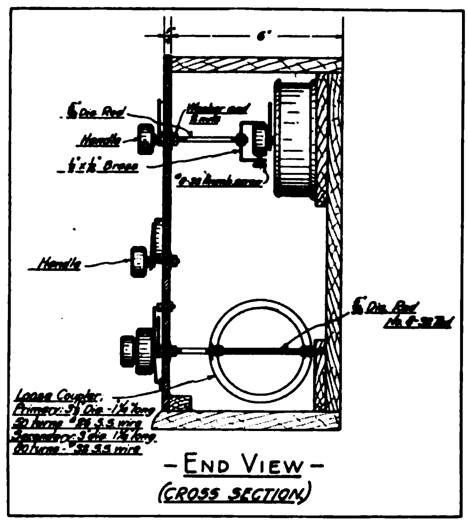


Figure 2, Second Prize Article

binding posts for the telephone connections are wired as shown in the diagram. These permit two pairs of receivers to be connected in series.

Either the round type of vacuum valve bulb or tubular type may be employed in connection with this cabinet, the type of course determining the method of mounting. The switch points, binding posts and knobs may be purchased at any supply house and are neater and as inexpensive as any that could be made.

The knife edge type of switch blade should be used wherever possible and may be made of spring German silver sheeting or phosphor bronze.

All interior wiring and connections should be made with rubber covered stranded "fixture' wire and the wiring diagram connection shown in Figure 3 should be closely duplicated. The back of the containing case should be made removable to permit examination of connections whenever necessary.

The writer has been using a set similar to the one described for the last few months and with an aerial but seventy feet in length, forty-five feet in height at one end and twenty feet in height at the other end, has heard amateur stations in twenty-five different states, including all amateur districts except the sixth and the seventh. This list includes 5 DU and 5 ZC of Dallas, Texas, at a distance of 1,100 miles, 5 AX of Shreveport, La., 1,000 miles and 5 BC of Little Rock, Arkansas, 800 miles, as well as numerous other stations at distances of 600 and 700 miles. All these stations are heard regularly and not only on "freak" nights as some readers might suppose. Certain stations within a distance of a few hundred miles have been read with the telephone on the table.

F. J. Scupholm, *Michigan.*

THIRD PRIZE, THREE DOLLARS
Instructions for Making a Serviceable Transmitting Cabinet

In the design of the cabinet (Figures 1 and 2) I have endeavored to bring forth a compact and neat transmitting set which will give a high degree of efficiency. In designing these sets the fact that the average amateur uses a pancake oscillation transformer should be taken into account and the cabinet must be constructed to mount this instrument to the best advantage. I believe that I have succeeded in doing this without lengthening the connecting leads of the closed oscillation circuit. Contrary to the usual arrangement of such apparatus, the oscillation transformer in my set is not jammed up against the other parts of the apparatus, but is placed on the side where it is readily accessible.

All the woodwork of this set is of mahogany which should be given the following treatment: First give the wood one coat of stain, and when this is dried, apply a coat of filler. Allow it to set over night and in the morning give it a coat of white shellac. When this coat is dry, rub it down with steel wood, being sure not to

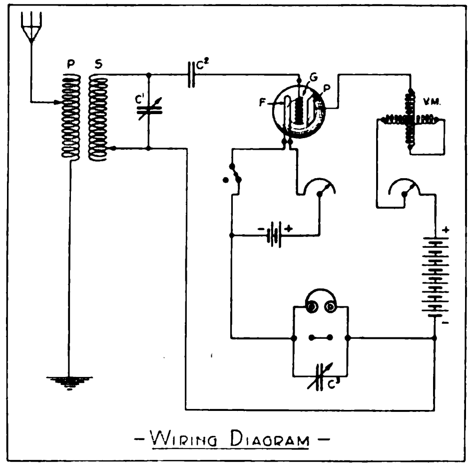


Figure 3, Second Prize Article

rub through the shellac as this would cause a scratch in the final finish. After the woodwork has been rubbed down, follow it by another coat of shellac and repeat this operation until the grain of the wood is completely filled up and no depressions can be seen. The wood should then be given a coating of very thin shellac and rubbed down with pumice stone and all. If a great number of coats of very thin shellac are applied instead of a few thick coats, a much finer finish will result.

The transformer should be mounted in the bottom of the cabinet with the condenser placed on a shelf immediately above it. This condenser should not have a capacity of over .01 microfarad as this is the limit permitted by the 200 meter-wave. A good value of capacity for 200 meters is .0086 microfarad and if the transformer has the correct secondary voltage, this is the value that should be employed. The rotary gap shown is some-

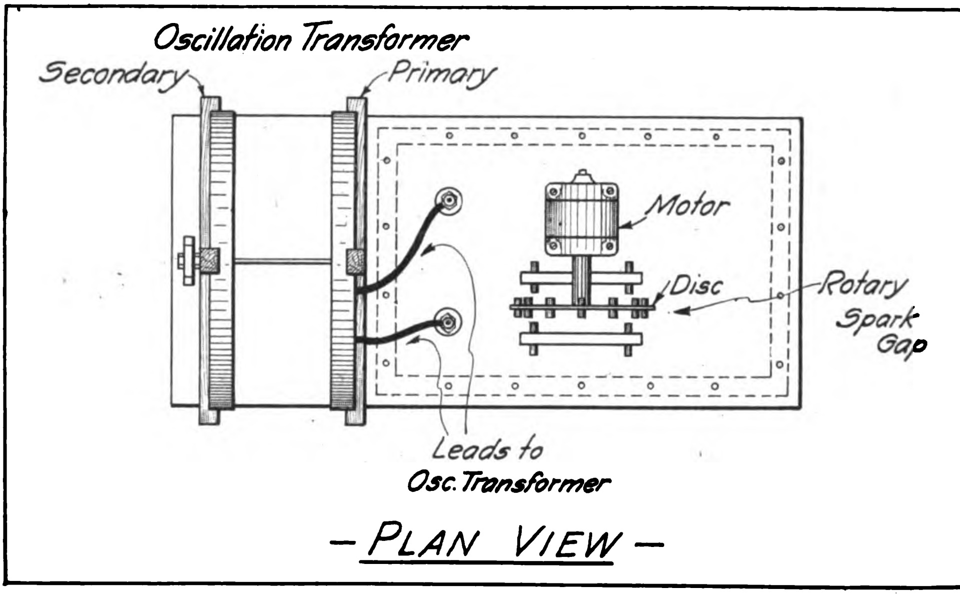


Figure 1, Third Prize Article

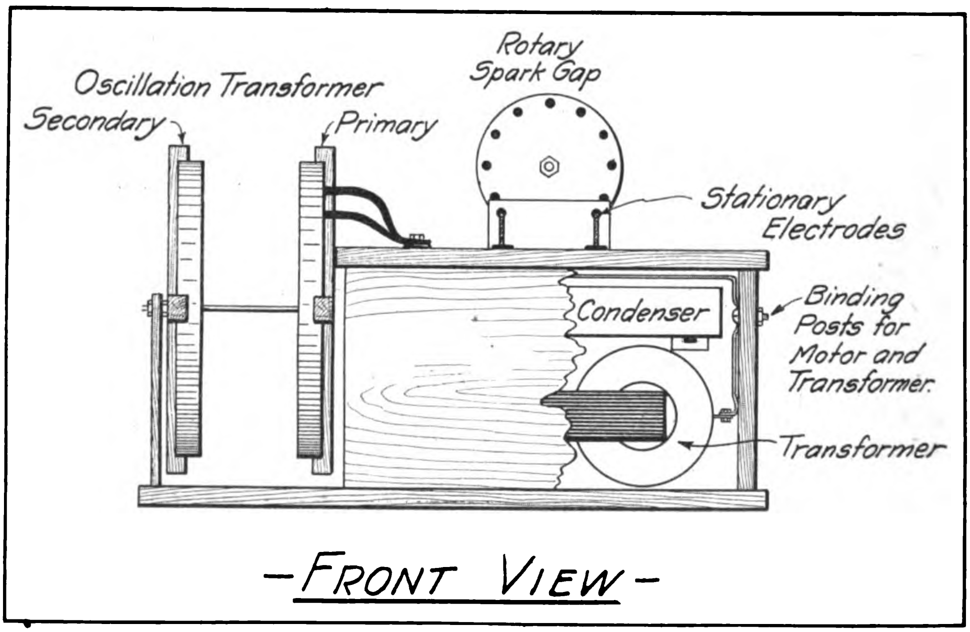


Figure 2, Third Prize Article

what different from the type used by the majority of amateurs, and for the benefit of those who would like to construct one of similar type I shall give the fundamental details.

The disc is of 1/8-inch Bakelite, 6 inches in diameter. It has twelve spark plugs which protrude on each side, their diameter being determined by the size of the transformer used. The stationary lugs, of which there are four, are supported by two pieces of 1/2-inch Bakelite, 2 inches in width and 4 3/4 inches in length. The lugs are connected so that the four sparking surfaces are in series. This will be clear from an inspection of Figure 1. The oscillation transformer is of the well known pancake type, and consequently, no description is required.

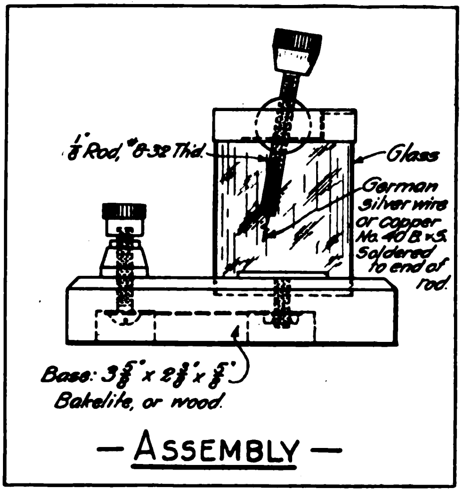


Figure 1, Fourth Prize Article

Although I have not employed this cabinet transmitting set during the winter months, I have been able to cover distances of 250 miles during the summer under very bad conditions of static at the receiving station. The power input during these tests was approximately 1 kw. Dimensions have not been given in my drawing as they must be changed according to the size and type of apparatus employed. The design was merely intended to show other workers how their transmitting cabinets may be assembled.

JAMES M. SOMMER, *Indianapolis.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Dust Proof Detector That Is Easy of Adjustment

I find the dust proof detector shown in Figs. 1 and 2 to be very easy of adjustment and quite sensitive. It will be noted from an inspection of Figure 1 that the elements of the detector are mounted on an insulating base of "Bakelite" or wood. The dimensions of the base are 3⅝ inches by 2⅜ inches by ⅝ inch in thickness. At a point 1⅜ inch from the end and 1 5/16 inch from the side of the base a hole is drilled by means of an expansion bit to a diameter of 1-9/16 of an inch. This hole should be approximately 5/16 inch deep.

Another hole ⅛-inch in diameter is drilled at the center of this in order to pass a ⅛-inch binding post screw.

One half inch from the other end of the base, and approximately ½-inch away from each side, two additional ⅛-inch holes are drilled to take the binding posts. In order that the base may be perfectly smooth, the holes for the binding post are counter bored underneath with a ½-inch bit, to a depth of ¼ inch.

When the detector has been constructed thus far, the small hole in the center of the large hole should be plugged up and filled with sealing wax or tar which may be taken from the top of old dry cells. While this is hot, a piece of glass tubing 1½ inches in diameter and 1¾ inches in length is placed in the hole and left until the wax cools.

When the wax is cold, a ⅛-inch hole must be drilled through the center to take the binding post screw. Next, a round piece of brass is cut from 1/16ths of an inch or 3/32nds of an inch stock to

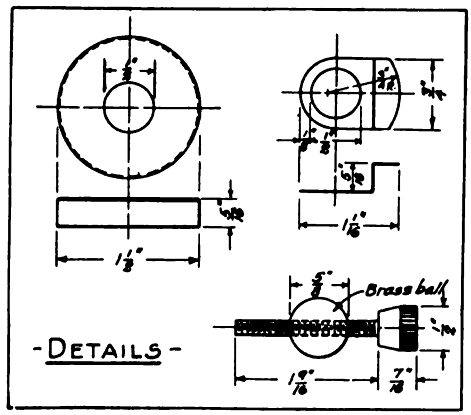


Figure 2, Fourth Prize Article

a diameter of 1 inch and a hole is drilled in the center and tapped with an 8/32-inch thread; or the piece of brass may be soldered at the end of a binding post screw. This, as shown in Figure 1, is placed inside the glass tube for the support of the mineral cup.

The complete dimensions for the cap to be placed on the top of the glass tube will be found in Figure 2.

A small wire for making connection with the cap and binding post can be run down the inside of the tube through the wax and base. Details of the adjusting rod for the detector are shown in the lower part of Figure 2.

Merle A. Cobb, *Wisconsin.*

HONORARY MENTION

A High Potential Transmitting Condenser of Goood Appearance

To amateurs who desire a high potential condenser with plates that can be easily removed without taking the entire unit apart, I suggest the design indicated in Figures 1, 2 and 3. If con structed as shown it will present an appearance on a par with the remaining apparatus in the complete set.

As shown in Figure 1, it consists mainly of a hard wood rack with slotted pieces, A, indicated in Figure 2. The slot is made of sufficient width to take the plate with an intervening distance between slots of ½ an inch. A small strip, D, is screwed to A to hold the plate in position at the base.

The plates are coated on both sides with tinfoil, as shown in Figure 4, and connections are made to them by the brass contact clip, B, indicated in Figure 3. These are in turn connected to the copper strip, C, with binding posts located at each end for connection to the transformer. To keep down the brush charge, the plates should be coated with a good grade of beeswax.

It is evident that the condenser is readily accessible and of more than passable appearance.

Robert Hall, *Minnesota.*

For anyone interested or enthusiastic over wireless—its fascination, construction or development, The Wireless Age, in my opinion stands out alone—a magazine that I will recommend as the best.—C. W. Patch, *Iowa.*

HONORARY MENTION

A Device for Preventing Flickering of House Lights

Amateurs who are troubled by the flickering of the house lights when sending at high power may be interested in the following device, which has proved successful.

The writer's transformer is of the open core type, operating on 220 volts, 60 cycle A. C., and is used in connection with a rotary spark gap. There are six different powers secured by means of a rheostat in series with the primary. The input varies from 50 to 830 watts, and the flickering of the lights was noticeable on all powers except the lowest, in spite of the fact that

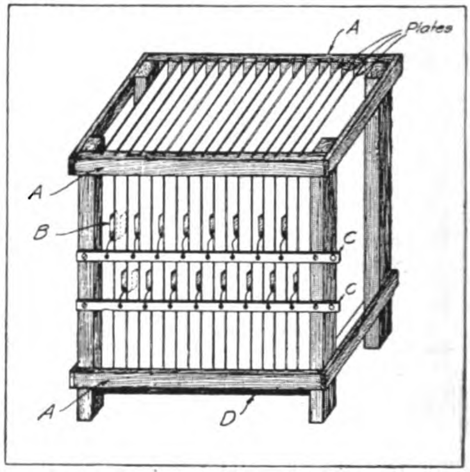


Figure 1, Honorary Mention Article, Robert Hall

the house lights are on the 110-volt circuit, while the transformer has a 220-volt connection direct from the main switchbox.

The principle employed was to make a rheostat of equal capacity to the primary of the transformer, placed in shunt with it in such a way that when sending, the key merely switched the current back and forth between the rheostat and the transformer. In this way a steady load was imposed upon the house mains during the time of sending, and the only noticeable effect upon the lights was a slight drop at the beginning, and a corresponding rise at the end of each message.

While this is simple in principle, a number of difficulties arose in practically carrying it out. An attempt to make an inductive rheostat composed of one or more choke coils failed on account of the large amount of heat developed. It could, of course, have been managed by using a very large wire, and making proper division for cooling.

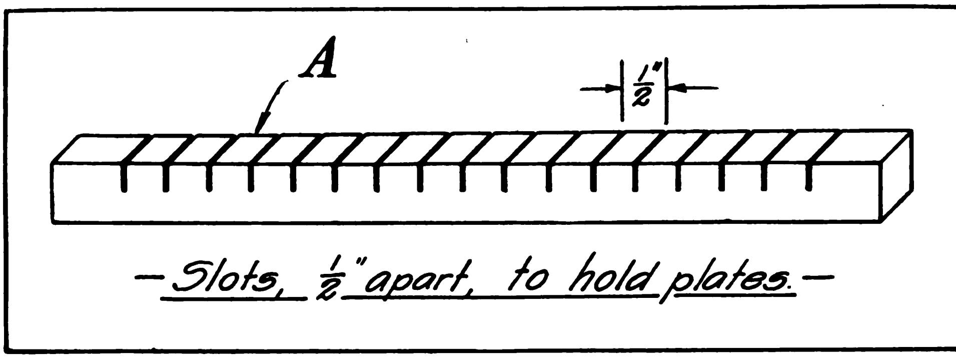


Figure 2, Honorary Mention Article, Robert Hall

The method finally adopted was to use a bank of incandescent lights. By selecting Tungsten lights of various sizes, eight independent units were made up, having the following capacities: One each of twenty, thirty, fifty, sixty and eighty watts; two of 120 and one of 400 watts. Wires were led from each of these units to separate switches on the operating table, and by use of one, two or more units, it was possible to balance any load imposed by the transformer, with an error of not more than ten watts. The heel of all these switches and one of the transformer leads was connected to one side of the A-C circuit. The other side of the circuit was connected with the armature lever of a sounder used as a relay.

The usual anvil on which the lever strikes was removed and a wooden frame, carrying upper and lower contact points, substituted. The lower point was connected to the transformer and the upper one to the return wire of the bank of lights forming the rheostat. The latter connection was interrupted by a circuit closer, so arranged in connection with the main aerial reversing switch that the rheostat lights would only be lit while sending.

Most houses are equipped with Tungsten lights. These lights respond very quickly to changes in load or voltage, and to prevent flickering the sounder lever must operate almost instantly in both directions. This is secured by placing the two contacts so close that the movement of the lever will be as small as possible, and by using a light lever, and sounder magnets of low inductance. A four ohm. sounder with an aluminum lever would be ideal for this purpose.

(*Continued on page 530.*)

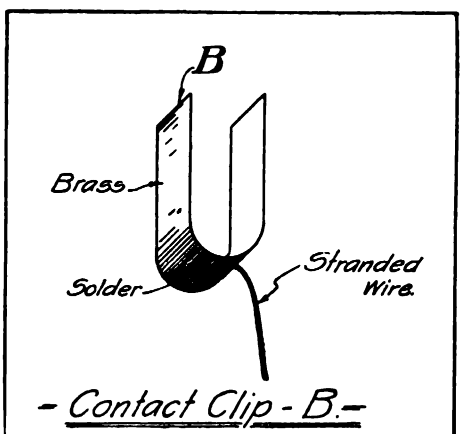


Figure 3, Honorary Mention Article, Robert Hall

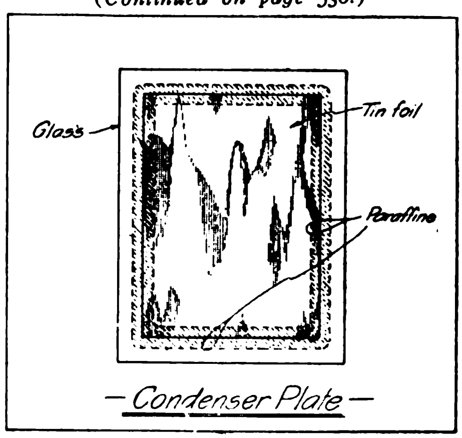


Figure 4, Honorary Mention Article, Robert Hall

General Advice for the Amateur Experimenter

By Elmer E. Bucher

CONTINUING the discussion of the problems of the amateur, pertinent advice will be given in regard to certain misconceptions held by some experimenters concerning the receiving station and associated apparatus.

We frequently receive an inquiry stating: "I have a 3,000-meter loading coil. What will be the wave-length of the aerial if I connect it to an aerial 120 feet in length?"

In this problem the electrical dimensions of the circuit in which the coil is to be employed are not known, nor are the dimensions of the tuning coil itself; in short, the information supplied concerning both the aerial and the coil is so incomplete that nothing can be calculated therefrom.

When a manufacturer offers to the amateur field a 2,000-meter or 5,000-meter loading inductance, the coil is only applicable to an antenna of stated capacity and inductance, and at all other values, the possible wave-length adjustment of the system will either be greater or less according to the dimensions of the aerial. To illustrate: Assume that an amateur aerial had capacity of .0005 microfarad (ignoring the inductance) and a loading coil of given dimensions raised the possible wave-length adjustment to 1,000 meters; if the same coil be connected to an aerial of double the capacity or .001 microfarad, the wave-length will be increased by $\sqrt{2}$ or to approximately, 1,450 meters. If the coil be connected to an aerial of .00025 microfarad capacity, the wave-length will be decreased by $\frac{1}{\sqrt{2}}$ or to approximately 710 meters. Thus we see that the affect of the coil depends upon the capacity of the aerial with which it is to be employed and unless something is known of the capacity of the aerial, the possible wave-length adjustment of the system cannot be foretold.

To be more explicit, in order to compute the affect of the loading coil on the total wave-length of an antenna system, we must not only know the capacity of the aerial but its total inductance as well. We must also add to this value the inductance of the primary winding of the receiving transformer, and with all these values before us, the frequency of the system can be readily obtained. We have shown the article of this series in the February issue how the inductance of the coil may be calculated by a simple formula, and on page 107 of the November, 1910, issue of THE WIRELESS AGE the inductance and capacity of four-wire T and inverted L aerials of various lengths are fully given. In determining the capacity of his aerial system, the amateur should select that value corresponding to an aerial nearest to the dimensions of his aerial.

When the individual values of inductance are obtained, the total wave-length is computed by adding the values of inductance together and multiplying the result by the capacity of the aerial. If the square root of this product is taken and the result multiplied by 59.6, the wave-length of the complete circuit is obtained.

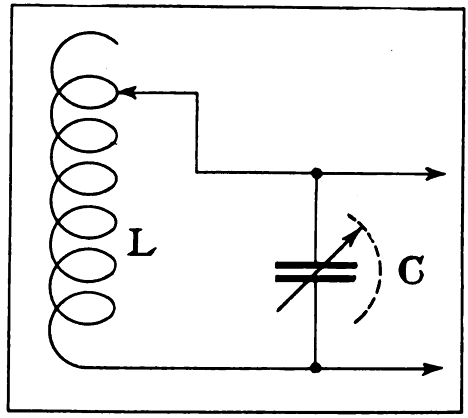
This may be written: Wave-length (of an aerial circuit) $= 59.6 \sqrt{\text{inductance}_{\text{cms}} \times \text{capacity}_{\text{mfds.}}}$ (1)

The amateur experimenter frequently requests us to compute the wave-length of receiving tuner, giving merely the dimensions of the primary and secondary windings together with the size of the wire. In a case of this kind we can do no more than conjecture the possible wave-length adjustment because we have no knowledge of the constants of the antenna circuit nor the capacity of the condenser to be connected in shunt to the secondary windings.

If the condenser is not to be connected across the secondary, we must assume a certain value of distributed capacity between turns. The value can be calculated, but the computation is somewhat difficult. In order to simplify the problem, we may assume a value of .0001 microfarad which is, of course, rather high for the average amateur coil. By calculating the inductance of the secondary winding from knowledge of its turns, diameter, length, etc., we can use the foregoing formula (1) for wave-length and thereby ascertain the maximum possible adjustment. If a variable condenser is employed, knowledge of its capacity enables us to determine the wave-length adjustment at any particular value of capacity.

In working out the possible wave-length adjustment of many amateur tuners we frequently find a set where the antenna circuit can be quite readily adjusted to waves of 6,000 meters length, but the maximum adjustment in the detector circuit is not more than 2,000 meters. On the other hand we have come across examples where the reverse condition obtains, and of course, in either case resonance cannot be secured throughout the range of wave-lengths. This means, in the first example cited, that when the primary and secondary windings are tuned to 2,000 meters, there will be a number of unused turns in the primary winding which are useless. It should now be self evident that in order to correctly estimate the wave-length of an amateur's tuner, we must know fully the inductance and capacity of his aerial and whether or not a condenser is connected across the secondary winding. Unless these data are given we can only conjecture the range of adjustment.

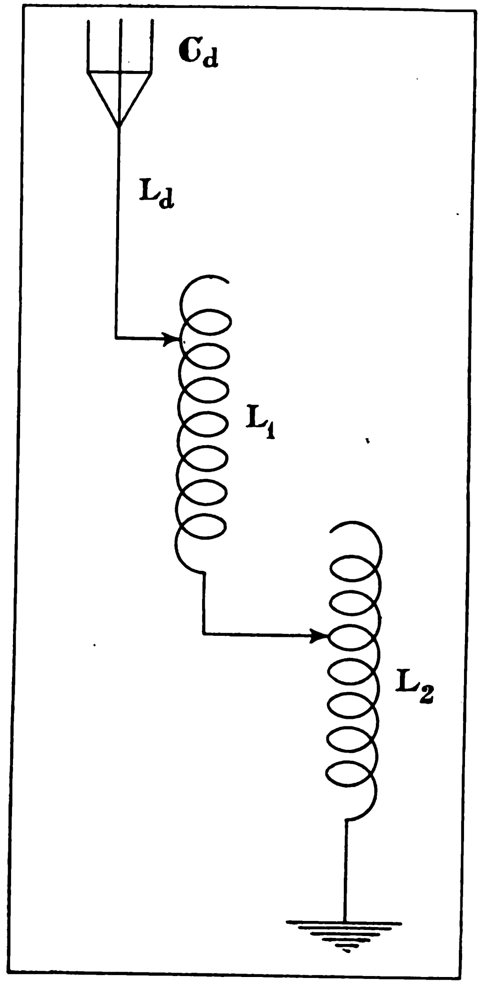
Many experimenters do not seem to understand the term wave-length as applied to the receiving apparatus. Some believe that in some incomprehensible manner the waves sent out by the transmitter pass through the apparatus and on to the earth, and that tuning consists in making mysterious adjustments in the circuits to pick up these waves. This is more or less true, but it is not directly the wave motion which passes through the tuner. The function of the receiving aerial is to extract a certain amount of the energy from the passing wave motion and to build up the oscillations induced thereby to amplitude by the phenomenon of resonance. The fact is, that in tuning a receiving aerial to a distant transmitting station, we adjust it so that if set into excitation it would radiate a wave of the same length as a distant transmitting station, although it would not necessarily have the same decrement. When the antenna is receiving a half wave of the transmitter must have set up a complete alternation of current in the receiving aerial before the next half wave acts upon it, otherwise the current set up in the receiving aerial by the first half will be opposed by that of the second half. Analogous to this is the case of the ordinary swing. If we wish to keep it in oscillation,



Secondary Circuit of Receiving Tuner.—The wave-length adjustment of this circuit = 59.6 × $\sqrt{L \times C}$, if L is expressed in centimeters and C in microfarads. It is not advisable to design a tuner so that the values of C exceed .0003 microfarad in the case of the vacuum valve detector and .0005 microfarad in the case of the crystal detectors we must be careful to push the swing exactly at the point where the energy of the movement in one direction has spent itself and another oscillation in the opposite direction is about to take place. If we apply a "push" at this particular moment the oscillation of the swing will not be interfered with, but, in fact, the applied force will tend to maintain the to and fro movement.

In designing receiving apparatus, the amateur should keep in mind:

1. That there is no need for constructing a spark tuner for waves in excess of 3,000 meters.
2. Practically all stations within range of United States amateurs employing wave-lengths in excess of 3,000 meters are fitted with undamped oscillation transmitters which require a special type of receiver.
3. The undamped receiver need not exceed the wave-length adjustment of 12,000 meters.
4. That for the reception of undamped waves either a tikker or a "beat" receiver is required.
5. That the most effective beat receiver is the vacuum valve oscillator employed in connection with special circuits which have appeared in previous issues of The Wireless Age.



Primary Circuit of a Receiving Tuner.—The wave-length to which this circuit will respond $= 59.6 \times \sqrt{(Ld + L_1 + L_2) \times Cd}$, *where Ld is the distributed inductance of the antenna in centimeters,* L_1 *the inductance of the loading coil, and* L_2 *the inductance of the primary winding. This formula is only strictly true when the aerial is loaded with very large values of inductance at the base. As shown in the October, 1916, issue of* The Wireless Age, *if small values of inductance are employed, a certain correction factor must be introduced, data for which appears in Figure 8, page 34, of that issue*

The amateur frequently inquires regarding the smallest possible dimensions for the coupler of the "beat" receiver. Experiment shows that a coupler which has sufficient values of self inductance to respond to the wave-length of 3,000 meters gives very good results, although a coupler of less mutual inductance will do. Also, it should be remembered that the dimensions given by the writer in previous issues for various types of beat receivers, need not necessarily be duplicated to the fraction of an inch, both in respect to the diameter and length of the windings. Should the experimenter use smaller tubes for the primary and secondary loading coils or for the coupler, he need only employ larger values of capacity in shunt to the secondary winding or in shunt to the primary winding. Care should be taken in the secondary winding, however, in the case of the vacuum valve not to exceed capacity of .0003 microfarad.

Many experimenters do not seem to

realize the labor involved in calculating the exact position for the dead end switch of a receiving tuner. It may also be remarked that a considerable number ask for these data without knowing the function of a dead end switch. A complete explanation appears in the book, "How to Conduct a Radio Club," and the subject has also been taken up several times in the Queries Answered department of The Wireless Age.

The experimenter will readily see that in order to give data for the position of the "breaks" in the primary winding, the inductance and capacity of the antenna must be definitely known and what would be the correct position for the switch in connection with one aerial would be entirely out of place for another aerial. On the other hand, the position of the dead end switch for the secondary winding can be quite readily determined when the capacity of the condenser in shunt is definitely known.

In the case of the 3,000-meter tuner, the first break in the primary and secondary windings should be located so that waves between 200 and 700 meters can be adjusted to. The next group of turns should permit adjustment to waves from 700 to 1,100 meters and the last group, waves from 1,100 to 3,000 meters. This will cover all the standard wave-lengths in use by spark stations, including the wave-length of the Arlington station when sending out the time signals.

In locating the position for the dead end switch in the secondary winding, the experimenter should decide definitely upon the value of capacity in shunt and if, for instance, this is to be .0002 microfarad, then the required inductance can be determined approximately by $L = \frac{700^2}{3552 \times .0002}$. After the required inductance has been obtained the dimensions for the winding can be calculated as shown on page 81 of the second revised edition of "How to Conduct a Radio Club."

(To be continued)

Receiving Without an Aerial

The man who spoke jokingly of a wireless message being received on an aerial composed of a tack sticking in the wall and a wire running from it to the receiving instruments, with a flower pot filled with earth for a ground, did not realize that he was predicting a near possibility. The idea of a flower pot for a ground, of course, is absurd; the tack aerial is not so contrary to the dictates of good judgment.

I have designed and built a receiving instrument with which, by using only one vacuum valve, I am able to read stations from a distance of 600 miles and more, without any aerial whatsoever; in fact, there is nothing connected to the aerial binding post, nor is there an aerial within a mile of my residence. All I use is a ground wire which is connected to a small piece of iron sticking in the earth.—T. M. Daly, *Tennessee.*

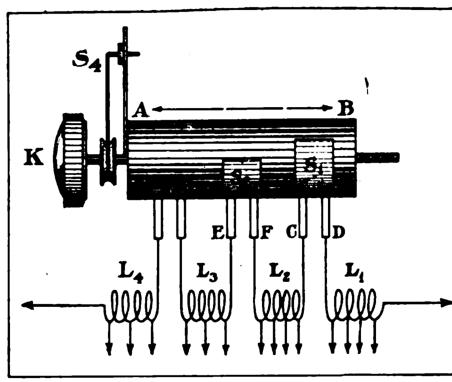


Diagram Showing the Use of a Dead-end Switch on the Receiving Set.—The taps of the single blade switch, S-4, are connected to the successive inductance groups, L-4, L-3, L-2 and L-1. When switch S-4 is turned counter clockwise and has progressed so far that all turns of L-1 are in use, segment S-1 makes contact with brushes C and D, connecting group L-2 in the circuit. In the same way, when all the turns of L-2 are in the circuit, brushes E, F make contact with segment S-2, thereby cutting in group L-3, and so on until all the turns of the winding are included

The members of the Sacramento, Cal., Radio Club

With The Amateurs

The Radio Club, of Marlboro, Mass., was notified at a recent meeting that it had been admitted to membership in the National Amateur Wireless Association. Robert Marshall was elected delegate to the national convention. Walter Weeks read a paper on "Charging of Storage Batteries."

The Fifth District Radio Club, at its annual meeting at the radio room in the Y. M. C. A. building, in New Orleans, La., re-elected Robert B. Godbolt president and Karl Freubing, secretary-treasurer.

Plans were discussed by members for the erection of a wireless station. Mr. Godbolt is taking active interest in the move to make the organization's library one of the best collections of wireless and electrical books in the South.

The Sacramento Radio Club, organized in Sacramento, Cal., a little more than a year ago, has now reached a membership of eighty. Meetings are held every Friday evening at eight o'clock. Social meetings are held every other Friday. The members of the Club recently held a banquet in their new quarters.

Plans are under way to install a 1-K.W. vacuum valve amplifier. With the aid of a mimeograph, bulletins, call lists, etc., are printed from time to time.

The dues at present are 25 cents a month. The initiation fee is 25 cents. All communications should be addressed to Ellis J. Griffin, secretary, 2216 Thirty-second street, Sacramento.

The Twin City Radio Club was formed at a meeting of wireless telegraph operators at the Lewiston (Me.) High School recently.

Officers elected were: Honorary president, Frederick Pierce; president, E. P. McShane; vice-president, A. Pasquale; secretary-treasurer, R. Anthony.

The following committees were named:

Library Committee: L. Hilton and C. Gagnon.

Electrical Board: A. Pasquale and L. Hunter.

Advisory Board: Messrs. Pierce, McShane, Pasquale, Anthony, Mansfield and Maliar.

Initiation Committee: A. Pasquale and L. Hunter.

More than sixty Colorado Springs, Colo., High School boys have enrolled for the wireless telegraphy class which has been formed at the school. A wireless outfit has been installed.

At a recent meeting of the Albany (N. Y.) Wireless Club, a resolution was passed offering the services of the members of the organization to the Government in case of war. The Club has eight commercial operators among its members. Copies of the resolution have been sent to Secretary of War Baker and Governor Whitman. The Club is installing a wireless station on the Central Y. M. C. A.

The wireless station of the Philadelphia Turngmeinde was closed recently by officials of the radio section of the organization. This action was taken to do away with any suspicion that the association's equipment was not being used in the best interests of the United States.

The alumni of St. Ignatius College, Cleveland, O., gave a smoker in the college gymnasium recently and presented to the college a wireless telegraph outfit.

A radio club has been organized at the Jackson (Mich.) High School under the name of the J. H. S. Radio Club.. The following officers were elected:

President, Lewis Holland; vice-president, Harold Knowles; secretary, Barry Frost; treasurer, Leon Watts. The Club has formed a class in wireless. Communications should be addressed to the secretary at 816 West Main street, Jackson, Mich.

The Plattsburgh (N. Y.) Wireless Club has been organized with the following officers:

President, C. W. Spaulding; vice-president; W. J. Vincent; secretary and treasurer, Norman P. Mason.

Meetings of the Club take place on the first and third Fridays of each month, due notice being published in newspapers. A course of lectures and experiments has been planned and the organization announces that it will welcome visitors who may be interested in wireless. The Club would like to hear from other wireless organizations on meeting nights.

The Radio Club, of Antigo (Wis.) has been formed. Its officers are as follows:

President, Paul Kavanagh; vice-president, Morgan Knott; secretary, Frank Manthey; treasurer, Herbert C. Fischer.

The Club has a home in the First National Bank Building.

Amateurs of Kansas City, Kans., have formed the Kaw Valley Radio Association. The officers follow:

President, Ralp Rehm; vice-president, Parker Wiggin; secretary, Harlow Eppert; treasurer, Joe Harlan. All communications should be sent to the secretary at 841 State Avenue, Kansas City, Kans.

The following message was sent by wireless on January 26, by the Rochester (N. Y.) Chamber of Commerce to the Chamber of Commerce, of Scranton, Pa.:

"To the Scranton Chamber of Commerce: The Rochester Chamber of Commerce sends greetings to the Scranton chamber and extends its best wishes for the ensuing year:

"Harper Sibley, president of Rochester chamber."

From his key in the parish house of St. Paul's Episcopal Church, the meeting place of the St. Paul Amateur Radio Association, Curtis Swanton started the message on its way. The members of the Association who arranged the feat were present to witness the sending.

Howard Alexander received the message at his station, SRL, No. 34 Asbury street, Rochester, and relayed it to the station at 435 Park Avenue, 8UC, owned by Willis Brockett and Abe Frankel. Cyril Staud, secretary of the Rochester Wireless Club received the message at his station, SOZ, in Rutgers street and sent it out of the city.

Laurens Taylor, of Geneva, was the first out-of-the-city operator to whom the message was sent. His call is 8AJE. Taylor sent the message in turn to Ithaca, where it was received by Perkins Coville, at station 8XU, and Robert Brown, at Cornell University. Dr. H. E. Fitch then received it at his station in Elmira and relayed it to L. Bush, secretary of the Binghamton Progressive Radio Association.

Bush sent the message direct to Roy C. Ehrhardt, 820 Monroe Avenue, Scranton, who delivered it to the Scranton Chamber of Commerce. Ehrhardt immediately replied through the same stations.

A book containing much useful information has been issued to the members of the Southern Tier Radio Association (of New York State). Included in the contents are a list of the stations of the members of the Association and the call letters; the power output of the sending stations and hours of listening in. The book also contains information about how the Arlington station transmits weather reports in code form.

More than 200 amateur wireless operators in the New Jersey counties immediately adjacent to Philadelphia are at the command of the Federal Government in the event of war. These stations are under the supervision of the South Jersey Radio Association, of which C. Waldo Batchelor, of Collingswood, is president. The Association was formed by a group of boys and young men last June. At that time there were only sixteen members all in Camden County. The Association has grown until it takes in all of Camden, Gloucester, Burlington, Ocean, Cumberland and Cape May counties and part of Salem County. The membership is more than 200.

Most of the operators are from sixteen to twenty years of age. They are carrying on a continuous round of lectures and research work to increase their proficiency.

Robert B. Godbold, was re-elected president of the Fifth District Radio Club at a meeting of the organization held in the class room of the Y. M. C. A. Radio School, 815 St. Charles Street, New Orleans, La., recently.

Mr. Godbold has done much for the promotion of experimental wireless work in the South and is now taking active interest in the Club's modern radio station. Plans for the wireless equipment of the Club's station was formulated at a meeting of the organization.

Karl Fruebing was installed in the office of secretary-treasurer. Members of the club are now working to make the organization's library one of the best collnctions of wireless and electrical books south of the Mason and Dixon line.

The Baltimore (Md.) Radio Association, which is composed of amateur wireless experimenters, has offered its services to the Government in case of need. The members of the Association met at their headquarters, 22 St. Paul Street, recently and passed a resolution which called upon Charles E. King, secretary of the Association, to offer their services to the Government. Mr. King sent the following telegram to President Wilson and Secretary of the Navy Daniels: "The Baltimore Radio Association, representing fifty amateur radio operators, offers its unqualified services to the Government in its hour of need."

Secretary King pointed out that the services of the operators in Baltimore could be put to excellent advantage during war, as many of the wireless stations in that city are high-powered.

The Boy of Promise Who Became a Knight of the Key

A Narrative with a Moral

By Robert Kennedy

ONCE upon a time. In a Small Town. And not so awful long ago. Was born a Boy of Much Promise. As a babe he could tell Soap from Candy at a glance. At two he could stick pins with deadly precision. In the Cat, his Father's Leg or Brother's Balloon. At five he was the terror of his family. He Inspired Disrespect. A dish-cloth in the soup. Molasses on the dog. Tacks on the chairs. Verily, he had much to his credit as a Budding Genius.

At ten Electricity gripped him. In its Power. Then, indeed, did the neighbors wax indignant. The Talented Youth Boy indulged his fancy. Shocking their pets, Animal and Human. Electrifying Gate Latches. Yeah, even did his Sister admit him clever. One day her Curling Iron. Developed a Kick like a mule. Thence on he was Fresh.

Thus toiled this Marvelous Youth. Borne down and Ridiculed on all sides. He Hit Back at them. Verily, he struggled thru their laughter. His woodshed laboratory became a Wondrous Place. All the powers of the Black Art had be chained. He knew when the Bell Rang. When the Gate Opened. He heard the soft, sweet nothings uttered in the parlor between Seven and Eleven—twice a week. Yeah, and all these he accomplished against Heavy Odds.

Verily, his wireless station was a Marvel. A Barbed wire aerial prevented the Escape of Messages. His lightning switch, a gigantic Gate Hinge. His transformer. Hand made. Had an efficiency of 23.7%, or so he Calculated.

Yeah, and well did the town know when he Sent. The Lights Winked in the whole community when he adjusted for a 2 K.W. to send one and one-half miles.

Then honor of honors. He met a Girl. He grew Sentimental about her. Wrote poetry. Tossed his long hair, while reading it to her on bended knee. Verily, he was Degenerating. Finally, the minx cast him aside for a Johnny with a Roll. Would he Despair? NO. He would rise to fame as a poet. And make her eyes Pop Out with envy and jealousy when he brought his Wife to town.

Sad, indeed! Long hair indicates not the Master Pen. Failure stared him in the face. Was he beaten? He must make her Look Up to him. But How? Ah, a thought! (Chain It! *Stage whisper.*) He would be a Hero. A Knight of the Key. Have his Photo in every paper in the country. Eureka! And Excelsior! He Had It.

Later he entereth the Radio School. His Trials were many. His code was Dilapidated and Threadbare. The Mystery Boxes (tuners) puzzled him not a little. Yet, true to his ideals, he Succeeded.

All honor to him. He is now Second Operator on the s.s. Snail. Flagship of the Peruvian Navy.

MORAL: When in doubt, be an Operator.

A Convenient Method of Calculating Inductance of Coils

By Hugh A. Brown, Instructor of Engineering, University of Arkansas

THE busy experimenter and radio Engineer must view with dismay some of the intricate precision formulas for calculating the inductance of air cored coils. It is the purpose of this article first to give a method, which is not only short, but also will give results accurate within 3.5 or 4 per cent., and second, to show how to obtain a coil having the maximum inductance within the minimum length of wire.

Figure 1 shows longitudinal sections of various coil shapes, the constant for each shape being calculated from the universal formula derived by Professor Morgan Brooks, which is accurate within 3 per cent. for any shape of coil, long or short, thick or thin, wide or narrow, assuming that the spacing between the wires is small, i. e., spacing for D. C. C. wires, or even thin rubber for the larger sizes. Professor Brooks points out that it is almost impossible to duplicate a coil already constructed and have it check within less than 3 per cent. in inductance. The method of this article is as follows: To find the inductance of a coil of given proportions, it is only necessary to select the diagram in Figures 1, 2 or 3, whose proportions are nearest that of the coil in question, and using the constant K given with the diagram, substitute in the formula,

$$L = \frac{K d^2 N^2}{10^8 l} \text{ henries or } \frac{K d^2 N^2}{10^5 l} \text{ milli-henries}$$

where d is the radius of the coil in inches, N is the number of turns and l is the axial length of the coil in inches. Take as an example the following coil: axial length l is 2 inches, inside diameter d is 6.8 inches and it contains 2,000 turns of a certain size wire. This coil corresponds in proportions to the first diagram in Figure 1, for which K = .97. Substituting in the formula,

$$L = \frac{.97 \times (6.8)^2 \times (2000)^2}{10^8 \times 2} = .896 \text{ henries}$$

It makes no difference whether the

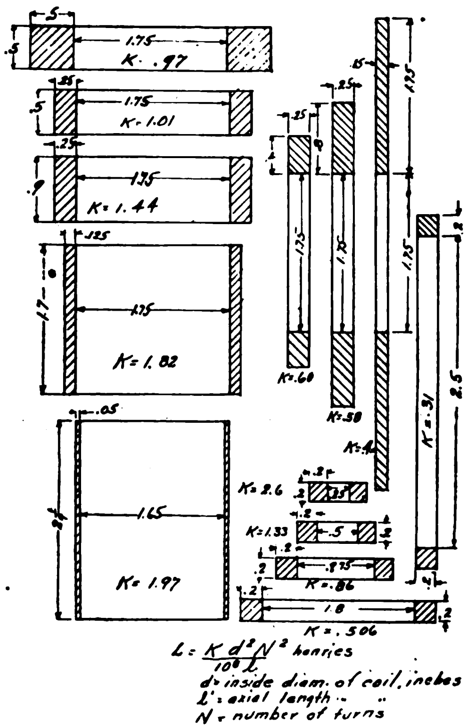


Figure 1

coil to be calculated is much larger or much smaller than that shown in the figure; as long as the proportions are the same the constant can be used. Figure 2 shows coils of the average variometer, loose coupler and theoretical long solenoid, and the constant for each. In the heterodyne receiving circuits large variable inductances are required for the long wave-lengths, and there is a certain shape of coil which will give the maximum inductance with the minimum length of wire, as can be seen by examining the figures. Professor Brooks has deduced the maximum shape to be that of Figure 3. Take a coil having the dimensions of that in Figure 3, which are

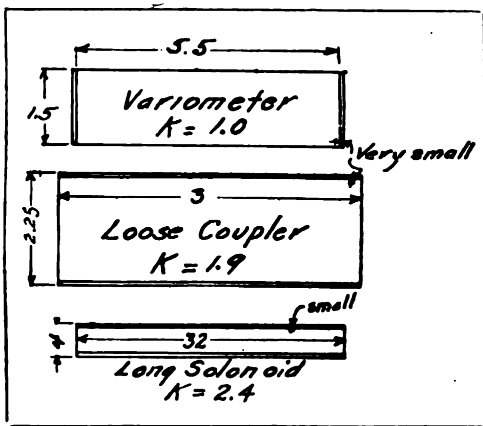


Fig. 2

in inches. If this size and shape coil were wound with No. 24 D. C. C. wire, it would have an inductance of from 65 to 135 milli-henries, depending on how closely and evenly it were wound. Taking an average value of 1,000 turns per square inch gives 1 x 1.2 x 1,000 = 1,200 turns and using the formula and

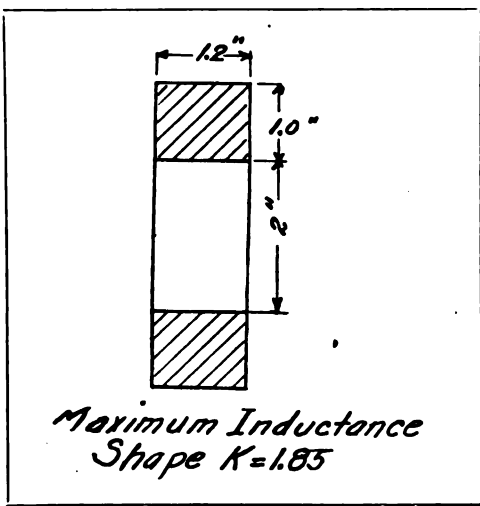


Fig. 3

K as given for this shape, L = 89 milli-henries. The inductance varies with the number of layers, counting from the inside outward as shown in Figure 4; and if it is desired to use a twelve-point switch, so as to vary the inductance in twelve equal steps, the first tap (connecting to the first switch point), should be made after 30 per cent. of the total number of layers are put on. This corresponds to 1/12 or 8 1/3 per cent. of the total inductance as read from the curve.

In winding this coil it is well to leave a radial slit ⅛ inch wide in one of the sides of the spool or form to facilitate counting the number of layers and making the tap connections. After winding

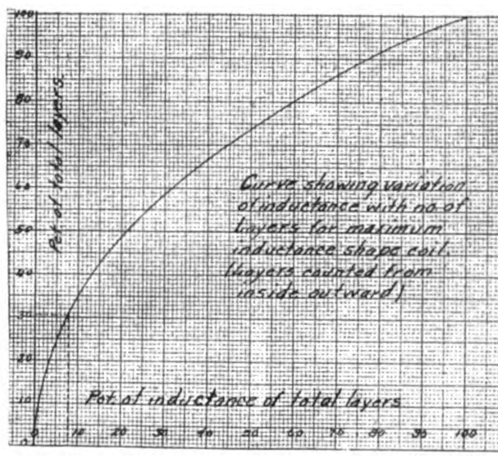


Fig. 4

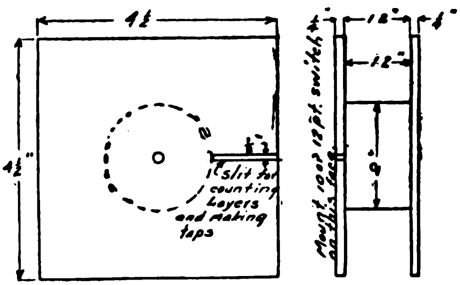
on wire to give about ¼ inch thickness, one can easily estimate the total number of turns he will have by counting the number of layers and turns per layer. The location of the remaining eleven taps can be found in the same way as for the first. This is an excellent loading coil to put in series with the antenna, as the total resistance will be only twenty-five or thirty ohms. The author has found that for the best results, pieces of 1/32" cardboard should be used to divide the coil into four parts. Each part will be ¼ of an inch thick, and the outside diameter of the coil will be 4¼' inches. This will not change the calculated results very much. If silk covered wire is used, more turns can be gotten on this size and the inductance will be considerably larger. Thus, we have a 12,000 to 17,000 meter loading coil that is only 1.2 inches long, and 4 inches in diameter.

For the inductance coils in the grid and plate circuits of the heterodyne receiver, much smaller wire may be used with little reduction in efficiency. Taking No. 30 D. S. C. wire and a coil of the proportions of Figure 3 whose diameter is 1.16 inches, outside diameter 2.32 inches and axial length .7 inch, the total inductance will be 115 milli-henries with 800 feet of wire or ¼ pound. The location of the taps may also be found from Figure 4.

In order to show how economical this shape of coil is: If 1,500 turns (about 1,200 feet) of No. 22 D. C. C. wire can be wound on the coil of Figure 3, the inductance will be 133 milli-henries, and if this same length of wire be wound in the form of the long solenoid of Figure 2, the inductance will be only 16 milli-henries.

Another loading coil that is easier to wind than the above is of the shape shown in Figure 1, for which K = is 1.82. If the inside diameter is 3.75 inches, the axial length is 3.64 inches, and wound with ten layers of No. 24 D. S. C. wire, the inductance will be 140 milli-henries. A tap is made after each layer is completed, making ten taps. One layer of cardboard should be wrapped around the coil after five layers have been wound on to divide the coil into two parts. The next shape in Figure 1, for which K is 1.97, is a good one to use if the wire is small, and the inside diameter should be about four inches.

Although the constants do not hold for coils of large spacing between wires, such as in the spiral or helices in the radio transmitter, the comparative merits of the helix (coil for K = 1.82), and flat spiral (coil for K = .42, but smaller inside diameter), can be worked out. The author made some calculations and found that for the same length and size of wire, the inductance of the spiral is about 10 per cent. lower than for the helical form, the outside diameter of the spiral is twice that of the helix, and the axial length of the helix is about 10 times that of the spiral. Therefore, for stations of small capacity and short wave-length, the "pancake" oscillation transformer is probably the better, while for the station of long wave-length the helical form is better. The coil sheaves and constants for the cylindrical or helix types ought to aid the radio engineer in calculating the large loading coils used in the transmitters of the arc stations, as the voltages are not high and the wire



Wood spool for 12000 meter loading coil #24 DCC wire

Fig. 5

may be covered and closely wound.

Mutual inductance is a maximum when two flat coils placed together form the shape of Figure 3, or, if the coils are concentric, when both together form a short thick tube whose thickness is one-half its length. These are the most effective shapes for the primary and secondary of a transformer.

For those who may be interested in Professor Brooks' universal formula, it is as follows

$$L = \frac{.366 \times \left(\frac{\text{ft.}}{1{,}000}\right)^2 \times F' \times F''}{b + c + R}$$

$$F' = \frac{10b + 12c + 2R}{10b + 10c + 1.4R}$$

$$F'' = .5 \log_{10} \left(100 + \frac{14R}{2b + 3c}\right)$$

L is inductance in henries, ft. is number of feet of wire in the coil, b is axial length of the coil in inches, c is the radial thickness of the coil in inches, and R is the outside radius of the coil in inches.

The radio station at the State University of Iowa will send QST on Tuesday, Thursday and Saturday nights at ten minutes after eight o'clock (Central time). On Tuesdays and Thursdays the message will consist of a short radio lesson, while on Saturday it will be composed of university news.

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

E. O. S., Dorchester, Mass., inquires:

Ques.—(1) What changes in the size of the coils described on page 92 of the book, "How to Conduct a Radio Club," would have to be made in order that this receiving set may have a range of 25,000 meters?

Ans.—(1) If the inductance of these circuits is increased by four, the possible wave-length adjustment will be increased by $\sqrt{4}$ or 2, that is to say, the receiving coils would respond to wave-lengths of 20,000 meters if the coils are made four times their present dimensions. Please keep in mind, however, that after you have constructed a receiver of this range of adjustment, it would be of no use whatsoever as there are no stations in the world with which we are familiar that operate at wave-length near the value of 25,000 meters.

Ques.—(2) If the coils of the beat receiver referred to in the book, "How to Conduct a Radio Club," were fitted with dead end switches, would it be possible to receive 4,000 meter waves?

Ans.—(2) If the loading coils of the primary and secondary circuits were cut out, the tuner would easily respond to 4,000 meters.

Ques.—(3) How should taps be taken off these coils?

Ans.—(3) The more taps, the finer the adjustment; consequently, it is up to the builder to decide how many taps he would like to have.

* * *

J. G., Invercargill, New Zealand:

The diagram of connections attached to your query is a type of regenerative vacuum valve circuit. Although recommended for its simplicity, the circuit will not give the results of the more complicated Armstrong type of circuit. An explanation of the Armstrong Regenerative circuits appear in the September, 1915, issue of the proceedings of the Institute of Radio Engineers.

* * *

B. M. J., St. Raymond:

A complete description of the Goldschmitt tone wheel appears in the December, 1916, isue of the MONTHLY SERVICE BULLETIN of the National Amateur Wireless Association. The tikker is a circuit interrupter which takes the place in the ordinary receiving circuit of the crystal detector. The tikker may be some form of commutator interrupter which will interrupt the receiving circuit at rates varying from 300 to 600 times per second. A popular form of tikker is the so-called slipping contact detector which consists of a polished wheel with a groove in which rests a light contact wire. This wheel is rotated approximately 1,800 revolutions per minute and will give a hissing note in the telephone when receiving from undamped wave stations.

* * *

A. B. R., Kansas City, Mo., inquires:

Ques.—(1) What is meant by a regenerative vacuum valve detector circuit?

Ans.—(1) A regenerative receiver is one where either the current of radio frequency or audio frequency of the local telephone circuit is repeated back to the grid circuit and again amplified. It has been shown by Armstrong and others that the vacuum valve detector will repeat the oscillations of radio frequency into the local telephone circuit under suitable conditions. These oscillations, in turn, may be coupled back to the grid circuit and reinforced, by the well known relaying action of the valve.

* * *

V. C. M. C. I., Tampa, Fla., inquires:

Ques.—(1) How can I make the transformer described on page 220 of the December, 1916, issue of THE WIRELESS AGE give a secondary voltage of 5,000 volts for use with a rotary quenched gap?

Ans.—(1) Use six secondary sections of the size mentioned instead of ten.

Ques.—(2) Please publish a diagram of connections for a tuner and receiving set, using an anchor spark gap instead of an aerial change-over switch.

Ans.—(2) A diagram of connections is not necessary. The anchor gap should be exceedingly short and should be connected in series with the earth lead of the transmitter. Two leads should be extended from either side of the gap to the terminals of a primary winding of a receiving transformer. The circuit to the primary winding may be broken by a small two-blade switch, or, if the gap is kept very short, the primary need not be disconnected.

Ques.—(3) Where can I secure a diagram of a regenerative circuit for waves up to 600 meters, giving the size of the coils, the wire, etc.?

Ans.—(3) This diagram appeared in the December, 1916, issue of the Monthly Service Bulletin of the National Amateur Wireless Association.

A complete course in radio engineering is given at the College of the City of New York. Further particulars can be obtained from Dr. Alfred N. Goldsmith, Ph. D. director in charge, or from the dean of the College, Carleton D. Brownson.

* * *

L. L., Bay City, Mich., inquires:

Ques.—(1) How far apart should the wires be placed on an aerial which has a mean height of 70 feet and a flat top length of 60 feet? The lead-in is to be taken from the center of the flat top.

Ans.—(1) No advantage is derived from spacing the wires more than 2½ or 3 feet.

Ques.—(2) Approximately, what would be the wave-length of this aerial if the lead-in were 80 feet in length?

Ans.—(2) Approximately 125 meters.

Ques.—(3) Please give the dimensions for the loading coils of an 18,000-meter tuner used in connection with a coupler which ordinarily tunes to wave-lengths of 600 meters.

Ans.—(3) Generally speaking, a 600-meter coupler has insufficient values of mutual inductance for efficiency with the longer waves. Before you begin the construction of a coupler of this type, you should take into consideration that there are no stations that operate at wave-lengths of 18,000 meters. A tuner having a range above 12,000 meters is useless.

The receiving set described in the second revised edition of "How to Conduct a Radio Club" will be adjustable to 10,000 meters and if the length of all coils is doubled, the tuner will respond to about 15,000 meters.

* * *

C. A. S., Salem, Mass.:

It is not advisable to wind the loading coil in the antenna system with No. 28 wire. No. 24 wire is preferrable. Regarding the long distance receiving apparatus for response to waves of 6,000 meters upwards; you should construct apparatus like that described in the second revised edition of "How to Conduct a Radio Club." The tuning coil you mention, which is 11 inches in length, 2½ inches in diameter, wound with No. 24 wire, will respond to waves up to 2,000 meters. You should have no difficulty in hearing WCC with this apparatus.

* * *

C. C. H., Pennsylvania:

The third revised edition of the book, "How to Conduct a Radio Club," which is now on the press, will contain a number of circuit diagrams suitable for your long distance receiving set. The second revised edition of this publication contains a diagram for a "beat" receiver which you would do well to duplicate.

C. L. W., Colima, Mich.:

If your apparatus will respond to the time signals of Arlington during the daylight hours, you should have no difficulty in receiving them at night. Perhaps you have listened in at the wrong time. The night signals are sent out at ten o'clock at night. Eastern Standard Time. The apparatus you describe is well designed and cannot be improved upon.

* * *

H. O. H., Detroit, Mich:

You are quite right in believing that the capacity of the condenser in the closed oscillation circuit of a transmitter must vary somewhat with the speed of the rotary gap. No definite rule, however, can be laid down for the design of the rotary disc as it will depend a great deal upon the operating characteristic of the transformer. When a condenser is charged by a 60 cycle alternating current, there is generally no advantage in constructing a rotary spark gap to give more than 300 or 400 sparks a second. By special design, these gaps and transformers can be constructed to give 1,000 sparks a second, but this does not apply to the usual amateur outfit. It makes no difference whether the disc is run at a high speed with a few number of points or at low speed with a great number of points. In either case the interruptions per second will be the same. Furthermore, the spacing of the electrodes on the disc is immaterial provided they are not so close as to permit the spark to discharge to two electrodes at one time.

With the average amateur set, the correct value of condenser capacity and the speed of the disc are best found by experiment. In any event, a capacity of less than .01 microfarad must be employed. The adjustment for maximum should be gone about in the following manner: The open and closed oscillation circuits should be carefully tuned with a wavemeter or hot wire ammeter and the speed of the rotary disc adjusted until the maximum value of antenna current is obtained, taking care that the pitch of the spark note is not sacrificed thereby. Experiment reveals that the average amateur non-synchronous rotary spark gap will give better signals at the distant receiving station when revolved at such speed as to give 200 to 240 breaks a second.

Regarding the sounds issuing from your aerial: These are undoubtedly brush discharge and are due, of course, to excessive voltages. The remedy is to employ a looser coupling at the oscillation transformer.

* * *

A. W., Sylvan Grove, Kas., inquires:

Ques.—(1) Would a lightning rod or telephone or electric light wires interfere with the reception of wireless waves on an indoor aerial?

Ans.—(1) These conductors would absorb part of the energy from the passing wave, but they will not wholly prevent the reception of signals. In fact in certain cases a certain amount of energy picked up by the telephone or nearby wires may be re-radiated into your receiving aerial, resulting in increased strength of signals.

* * *

H. N. M., Covington, Tenn., inquires:

Ques.—(1) In what edition of the book, "How to Conduct a Radio Club," does the formula for the calculation of inductance mentioned in a recent article in THE WIRELESS AGE, appear?

Ans.—(1) In the second revised edition, also in the third edition which is now on the press.

Ques.—(2) I have heard that a wireless telephone set can be made from an ordinary ½ K. W. transmitting set. How is this accomplished?

Ans.—(2) The spark gap is connected directly to the secondary winding of the transformer and the terminals of the gap connected in series with the antenna. A microphone transmitter is connected in series with the earth lead. When the spark discharges across the gap, owing to the small capacity of the antenna, an arc will result, that is to say, the antenna will discharge at an extremely high spark frequency, at a rate sufficient to permit the modulations of the human voice to be transmitted. The amplitude of the oscillations in the antenna circuit is varied by speaking into the microphone and corresponding variation of the received current takes place at the receiver.

* * *

G. C. H., Fort Stockton, Tex., inquires:

Ques.—(1) Referring to your reply to the query of R. A. Danville, Pa., appearing on page 366 of the February, 1917, issue of THE THE WIRELESS AGE: Is there any method of eliminating this sort of interference at the receiving station such as by the connection of a fixed condenser in series with the power wires to the ground? Is shunting the "leak" in the power circuit the only way to get rid of this interference?

Ans.—(1) The only method that we know of is to stop the leak in the power circuit.

* * *

W. M., Springdale, Ark.:

There is no better way to determine the range of your receiving apparatus than by learning the Continental Telegraph Code and listening to stations which are in operation. After you have obtained the call letters of the station, refer to the Government Call List and then measure the distance off on a map and you will have the range of your apparatus.

* * *

A. S. R., Wisconsin:

We know of no method by which you can eliminate the interference caused by the sparking of the trolley wires. The fluctuation of the current in the trolley wires either acts upon your aerial, by ordinary induction or the spark at the trolley wheel sets up a highly damped wave which will set your receiving aerial into excitation regardless of the wave-length to which it is adjusted.

In the second revised edition of the book, "How to Conduct a Radio Club," a balancing out aerial which may assist in eliminating this interference is described. In some cases this apparatus has proven satisfactory while in other cases it has been only partly effective.

* * *

F. A. T., Fort Stanton, New Mexico, inquires:

Ques.—(1) Will you be kind enough to state the probable wave-length of an aerial, the flat top portion of which is 250 feet in length with an average height of 75 feet and the lead-in 90 feet in length.

Ans.—(1) The fundamental wave-length of this aerial is approximately 500 meters.

Ques.—(2) Could a series condenser be used for the reception of 200-meter waves, and if so what should be the capacity?

Ans.—(2) The aerial is by far too large for the reception of 200-meter signals even with a series condenser. The flat top portion should be reduced to a wave-length of approximately 100 to 110 feet for the reception of 200-meter signals.

* * *

H. V. H., Kansas City, Mo., inquires:

Ques.—(1) Please state the wave-length, inductance and capacity of a T aerial, 42 feet in length, with an average height of 52½ feet. It consists of four No. 14 copper wires, spaced 2 feet apart.

Ans.—(1) The natural wave-length of this aerial is about 112 meters, the capacity approximately .0002 microfarad, and the inductance about 15,000 centimeters.

Ques.—(2) Would you advise changing this to an inverted L aerial for transmitting?

Ans.—(2) The L aerial would require less inductance to radiate the wave of 200 meters and the resistance of the antenna circuit would thereby be reduced.

Ques.—(3) What is the possible wave-length adjustment of a receiving coupler the primary of which is 7½ inches in length, 5 inches in diameter, wound for 7 inches with No. 26 silk covered wire? The secondary winding is 7½ inches in length, 4½ inches in diameter, wound for 7 inches with No. 32 silk covered wire.

Ans.—(3) This tuner will respond to waves 4,000 meters in length provided the correct values of capacity are employed across the secondary winding.

Ques.—(4) Is this coupler large enough to receive signals from Nauen, Germany, if the proper loading coils are supplied, together with an audiotron detector?

Ans.—(4) This coupler is quite large enough for transferring the oscillations from the antenna to the closed circuit.

Ques.—(5) Kindly give dimensions for the necessary loading coils?

Ans.—(5) Correct dimensions for these loading coils appear in the second revised edition of the book, "How to Conduct a Radio Club."

N. R. B., Tacoma, Wash., inquires:

Ques.—(1) Please give me the dimensions of an inductively-coupled receiving tuner that will respond to 600 meters.

Ans.—(1) The secondary winding for this tuner should be 2½ inches in diameter, wound for 2 inches with 200 turns of No. 32 S. S. C. wire. The primary winding should be about 3 inches in diameter, 4 inches in length, wound with 220 turns of No. 26 S. S. C. wire. This coupler will respond to waves slightly in excess of 600 meters.

* * *

R. T., Poughkeepsie, N. Y.:

The book, "How to Conduct a Radio Club," contains innumerable circuit diagrams of the vacuum valve detector and full instructions for the connection of a variometer.

The variometer inductance is preferably connected in series with the antenna circuit, although one may be used in the secondary circuit if desired.

* * *

H. S. H., Orrville, Cal.:

Any of the vacuum tube bulbs obtainable in the amateur market, can be used as an amplifier. By connecting an iron core transformer around the fixed stopping condenser of your detector circuit and extending the terminals of the secondary winding to a second bulb, the signals received on a crystal detector can be amplified. A complete circuit of this type is given in the book, "How to Conduct a Radio Club."

* * *

M. B., Corpus Christi, Tex., inquires:

Ques.—(1) I have a T aerial, 65 feet in length, 70 feet in height, comprising four wires spaced about 2 feet apart. Please state the natural wave-length of this aerial.

Ans.—(1) The fundamental wave-length of this aerial is approximately 150 meters.

Ques.—(2) To what wave-length can this aerial be loaded for receiving purposes?

Ans.—(2) If a supersensitive vacuum valve receiver circuit is employed, this aerial could be loaded for wave-lengths up to 7,000 or 8,000 meters. In fact it would be possible to receive signals at the wave-length of 10,000 meters, but with not quite the strength of signal that could be obtained with a larger aerial.

Ques.—(3) What is the call of the Government wireless station at San Diego, California?

Ans.—(3) NPL.

* * *

S. W. P., Hagerstown, Md., inquires:

Ques.—(1) What is the natural wave-length of my aerial which is 132 feet in length consisting of 4 wires spaced two feet apart? It is 40 feet in height.

Ans.—(1) The natural wave-length of this is approximately 240 meters, and when the secondary winding of the oscillation transformer is connected in series, the emitted wave will be increased in length, depending upon the amount of inductance in use.

H. L., Brooklyn, N. Y., inquires:

Ques.—(1) I note that the table of natural wave-lengths of aerials given on page 26 of "How to Conduct a Radio Club" differs widely from the tables given by A. S. Blatterman on page 108 of the November number of The Wireless Age. Can you explain the difference?

Ans.—(1) The data in the table of "How to Conduct a Radio Club," were computed from the formula given by Dr. Cohen in February, 1913. Mathematical investigation revealed later that in oscillation circuits where the values of inductance and capacity were distributed rather than concentrated, as in the case of the closed circuit oscillator, a certain correction factor must be introduced into the usual equation for calculating the frequency of the oscillations in the closed circuit. The data given by Mr. Blatterman were calculated in accordance with Dr. Cohen's latest exposition of the facts. Hence the difference between the two tables.

In your question No. 2 you inquire concerning the natural wave-length of an aerial. It is evident from your first query that you possess a copy of the November, 1916, issue of The Wireless Age, and you should refer to the data given in that issue for determining the fundamental wave of an aerial from its dimensions. The Cape Cod station transmits at fifteen minutes after ten o'clock at night, Eastern Standard time.

Regarding your rotary spark gap: The best way to determine the correct speed of the disc is to set it into rotation and note the readings of the aerial ammeter. The disc should be run at a speed that will give the maximum flow of current in the antenna circuit, provided the pitch of the spark note is not sacrificed thereby. Generally the best results will be obtained if the disc is revolved to give about 200 or 250 sparks per second.

* * *

A. J. B., New Orleans, La.:

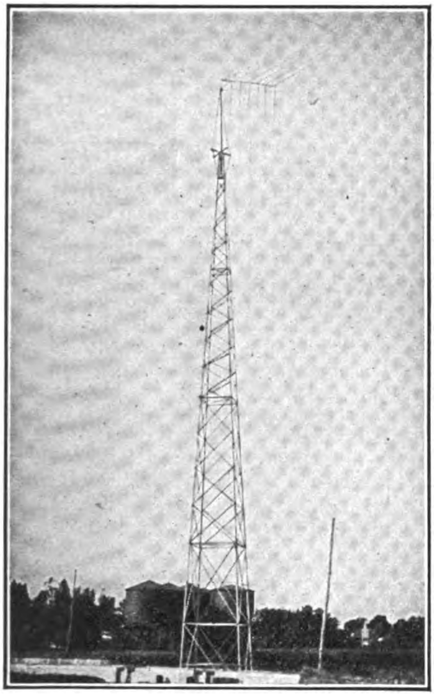
The November, 1916, issue of The Wireless Age gives full data for the calculation of a fundamental wave of an aerial from its dimensions. The second revised edition of the book, "How to Conduct a Radio Club," shows fully how the inductance of the secondary winding or the primary winding of a receiving tuner can be computed. The third revised edition of this volume, now on the press, gives more detailed information regarding the method of calculating the possible wave-length adjustment of a receiving set.

The tuner you describe will respond in the secondary winding to waves 4,500 meters in length.

* * *

H. H. L., London, England:

Unless you state specifically the particular type of Murdock tuner to which reference is made, we cannot compute the dimensions of the loading coils for obtaining a definite wave-length adjustment. We are not familiar with the windings of all makes of am-



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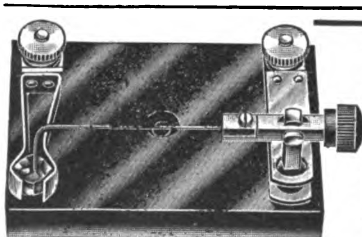

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ateur tuners. You could easily ascertain for yourself the exact dimensions of a loading coil if you would calculate the inductance from the formula given in the book, "How to Conduct a Radio Club." If you will count the number of turns in the secondary and primary windings of your receiving tuner and substitute the necessary dimensions in this simple formula, the inductance of the winding will be readily obtained. To compute the possible secondary wave-length adjustment, you must assume a certain value of capacity in shunt to the secondary winding. Similarly, you must know the capacity and inductance of your aerial to compute the possible wave-length adjustment in the primary circuit.

In the November, 1916, issue of THE WIRELESS AGE, the capacity of various sized aerials (inverted L and T types) is given, and by the use of these data you can easily calculate the size of the inductance required to obtain a definite range of wave-lengths by the following formula:

$$L = \frac{(\text{wave-length})^2}{3552 \times \text{capacity}}$$

Regarding the secondary condenser: One of .0004 microfarad, as you suggest, will do. Generally there is no advantage in using a capacity in excess of this across the secondary winding.

The use of multi-layers loading coils is not advised except in the case of long wave tuners. There is also no necessity for coupling between the aerial loading coil and the secondary loading coil provided the tuner has the proper amount of mutual inductance. If it does not possess the required value, then a certain amount of coupling between these two coils will be of advantage.

Any electrical supply house in Greater New York, such as the Manhattan Electrical Supply Company, or others, will be able to give you the cost of various insulating materials, like bakelite, asbestos wood, etc.

* * *

A. B. L., St. Louis, Mo., inquires:

Ques.—(1) Can you tell me of any publication which shows in detail how to assemble and construct a closed core transformer? I want a full set of drawings and detailed instructions.

Ans.—(1) "Wireless Telegraph Construction for Amateurs," by A. P. Morgan, and "Experimental Wireless Stations," by Philip Edelmann, tell of the construction of closed core transformers in detail.

An excellent article on amateur transformer design was published in the December, 1915, issue of THE WIRELESS AGE. This article was entitled "Designing Your Own Transformer" and was written by R. H. Chadwick.

* * *

N. L. D., Findlay, Ohio, inquires:

Ques.—(1) Will the inductively-coupled receiving tuner described in the Third Prize Article of the February, 1917, issue tune to waves of 3,000 meters? If not, will you kindly furnish dimensions of a tuner of this type, which will tune to this wave-length?

Ans.—(1) The tuner described will respond to 3,000 meters provided a small variable condenser is connected in shunt to the secondary winding. If you should place a reversing switch between the two coils comprising the primary and the two coils comprising the secondary, you could change the connections so that when the two coils in either winding are concentric, the inductance can either be zero or at a maximum value, depending upon which way the current circulates through each. To be more explicit, when the movable coil of the primary is directly over the stationary (primary) coil, and the current circulates in both coils in opposite directions, the inductance will be practically zero. However, if you reverse connections (while in this position) so that current circulates through both windings in the same direction, a large value of inductance will be obtained, which will not only be the result of the self-inductance of the two coils, but also of their mutual inductance.

Ques.—(2) Should as good results be obtained with this type of tuner as with the conventional type?

Ans.—(2) This type of tuner will not be quite as efficient on the shorter range of wave-lengths because when small values of inductance are employed, the current in both the primary and secondary winding is required to circulate through a number of turns of wire which are really of no use. Hence the damping of the oscillations will be increased and a slight decrease in efficiency result thereby.

Ques.—(3) Is it true that a variable shunt condenser is not necessary for close tuning of the secondary circuit?

Ans.—(3) A variable secondary condenser is not necessary with any type of tuner, but better results are obtained by the use of slight values of capacity across this winding. To say the least, this condenser permits a closeness of adjustment of the inductance of the secondary which the usual multi-point switch does not afford.

Ques.—(4) Where can I obtain a copy of "List of Radio Stations of the U. S."

Ans.—(4) The list is on sale by the Wireless Press, Inc., 42 Broad street, New York. The Goverinment Call Book can be obtained from the Government Printing Office, Washington, D. C.

* * *

S. T., Ottawa, Ill., inquires:

Ques.—(1) Will a quenched spark gap increase the pitch or the tone of the spark generated by a spark coil?

Ans.—(1) It may have an effect of smoothing out the tone, but it will not increase the pitch.

Ques.—(2) Approximately, how much will a quenched gap cost?

Ans.—(2) It depends entirely upon its construction. Generally they are found to be

rather expensive because the sparking surfaces must be milled to the thousandth of an inch in a milling machine.

If, as you state in your last question, the noise of the plain spark gap is objectionable, why not enclose it in a muffling box?

* * *

T. C. R., Vancouver, British Columbia, inquires:

Ques.—(1) How can one tell if the high-voltage condensers are broken down?

Ans.—((1) A breakdown of the condensers will be immediately manifested by no sparking at the spark gap. Generally the discharge of the broken plate is directly visible and in this manner it can be located.

* * *

J. C., Brooklyn, N. Y.:

Ans.—(1) We cannot undertake to calibrate a wave-meter for you and publish the results in this department. If you will refer to the second edition of the book, "How to Conduct a Radio Club," you will find a calibration for a small wave-meter made up of Mesco variable condenser and a coil of wire of fixed dimensions. A complete table of wave-lengths is supplied.

Ans.—(2) Your apparatus is properly connected and should give good results. The difficulty of arcing at the key is probably caused by too much current flowing through the primary winding of your induction coil. Some adjustment of the flow of current should be obtained by variation of the exposed surface of the fine wire electrode of the electrolytic interruptor.

If we should reply in detail to your third query, we should be required to publish a list of all wireless stations on the Atlantic and Gulf coasts. Full information concerning the call letters of these stations appears in the Government Call Book, a copy of which can be purchased from the Government Printing Office, Washington, D. C.

* * *

W. K. S., Jr., Clifton Forge, Va.:

Your 750-foot aerial has a fundamental wave-length of 1,150 meters. The receiving tuner you have described will permit adjustments in the secondary winding to waves of 4,000 meters. The wave-length of the antenna circuit with the primary winding connected in series will be approximately 4,500 meters.

* * *

W. H. Y., Sacramento, Cal., sends us a wiring diagram of a proposed break-in system. In this diagram two aerial wires lie parallel and are only separated by ten feet. One is connected to the transmitting apparatus and the other to the receiving apparatus. A small electromagnetic switch disconnects the receiving apparatus on the receiving aerial just previous to pressing the transmitting key. He desires our opinion of the working qualities of the arrangement.

The device is not practical because the receiving aerial will pick up a great amount of energy from the transmitting aerial. In fact, oscillations of such strength will be induced in the receiving apparatus that the oscillations will jump the gap at the magnetic switch.

In his second question he desires to know the dielectric constant of the glass used in ordinary photographic plates. The value can only be found out by actual test, but with this grade of glass it averages about 4.5.

The same inquirer seems to have difficulty with the three-element vacuum valve. He finds that the degree of vacuum apparently changes and that different values of voltage are required from time to time.

This difficulty is encountered in all types of valves in which there is a considerable amount of gas present and it can be compensated for by gradually increasing the voltage of the battery in the local telephone circuit.

* * *

O. R., Strand, London, England:

Ans.—(1) The regenerative vacuum detector circuits are without doubt the most sensitive of all types of receiving apparatus. You are, of course, aware that the vacuum valve can be used as a combined amplifier and beat receiver, all functions being performed by the single bulb.

Ans.—(2) It makes little difference whether the tuning of the antenna circuit is accomplished at the primary winding or at the aerial tuning inductance. All the inductance of the antenna circuit can be combined in the primary winding, but in many cases, it is more convenient to mount the aerial tuning inductance separate from the remainder of the apparatus.

Ans.—(3) A three-step amplifier can be readily employed to step-up the signals of a "beat" receiver. An audio frequency transformer must be placed in the local circuit of the valve which produces the best current.

* * *

W. B., Fort Dover, Ont.:

You and others are advised to purchase a copy of the book, "How to Conduct a Radio Club," and calculate for yourself the inductance of the windings of your receiving tuner. Knowing the capacity of the antenna with which it is to be employed and also the capacity of the secondary condenser, you will have no difficulty in calculating the possible wave-length adjustment of your apparatus. The inductance of the loading coils for the tuner you have suggested can also be easily reckoned in this manner. We would not advise you to construct receiving apparatus for wave-lengths in excess of 10,000 meters, as high-power stations do not normally operate at waves in excess of this value.

The 5¼-inch tubing you have on hand can be used quite as readily as the 6-inch tubing mentioned in the book, "How to Conduct a Radio Club." It makes little difference if the dimensions given in that volume are not exactly duplicated. For example, if the coils are slightly larger or slightly smaller than the dimensions given, the lack of inductance can be compensated for by a condenser in shunt to the primary winding and by the use

of slightly different capacities at the secondary

* * *

F. J. B., Chicago, Ill.:

A previous issue of The Wireless Age described fully the construction of a dead end switch. This switch merely disconnects some portion of the primary and secondary winding of a receiving transformer which is not in use at a particular wave-length adjustment. It is customary to divide the primary and secondary windings into groups convenient for operation on standard wave-lengths. For example, enough inductance should be included in the primary winding to permit a wave-length adjustment of 600 meters. At this point the winding should be interrupted and two leads extended out to a switch. Then all unused turns of the primary winding will be metallically disconnected from the used turns and the energy losses usually resulting therefrom be reduced to a minimum.

* * *

A. S., Albany, N. Y.:

A commercial operator is required when at sea to be six hours on duty and six hours off until the ship makes the next port. He is not required to be on duty in port, but he must keep in close touch with the officers of the ship and the local office of the wireless company. In the event of the ship docking in New York Harbor, the operator is required to report to the head office of the company daily.

* * *

L. R., Dayton, Ohio:

Complete plans for the construction of ½ k.w. closed core transformer appear in the book, "Wireless Telegraph Construction for Amateurs," by Alfred P. Morgan. The December, 1916, issue of The Wireless Age contained an article by R. Chadwick which gave very important information concerning the design of an amateur transformer.

* * *

A. T. B., Decatur, Ill.:

The porcelain base battery rheostat of the type used in the vacuum valve detector set can be purchased from almost any electrical supply house. The Manhattan Electrical Supply Company, New York City, will be able to furnish you with one of this type.

* * *

T. R., Newport, R. I.:

In the usual experiments, a two-wire receiving aerial will generally do as well as a four or six-wire aerial. It may be of advantage, in case the length of the flat top is limited, to use more than two wires, but in ordinary circumstances this number will do.

* * *

W. F. B., Sandwood, N. J., inquires:

Ques.—(1) What will be the spark frequency of my transmitting set which consists of a ½ K. W. 60-cycle alternating current transformer, high potential condenser and a rotary spark gap which has eight stationary electrodes and revolves 3,400 revolutions a minute.

Ans.—(1) The spark frequency will be approximately 488 sparks a second.

* * *

L. J., Des Moines, Iowa:

Therlo resistance wire can be purchased from the Manhattan Electrical Supply Company and also from G. H. Bunnell Company, New York City.

* * *

A. C., Paris, France:

Dead end switches are of great value to a receiving tuner which has large values of inductance but which sometimes is operated at short wave-lengths. In such cases the cutting off of the unused turns of the winding, gives increased strength of signals.

Complete circuit diagrams of vacuum valve amplifiers and detectors of all types appear in the third revised edition of the book, "How to Conduct a Radio Club," which is now on the press.

The receiving apparatus shown in the diagram of connections accompanying your query would not function satisfactorily on the shorter waves, such as 600 meters because the natural wave-length of the antenna-circuit will be close to 2,000 meters. An aerial of this length can not possibly be reduced to 600 meters by condensers. When the aerial tuning inductance (which you have marked as coil No. 1) is connected in series with the antenna circuit, it will respond to waves up to approximately 5,500 meters.

* * *

R. A. B., Buffalo, N. Y.:

It makes no difference whether the secondary pancakes of a transformer are wound in the same or opposite directions, provided they are properly connected so that the current flows in the same general direction throughout the entire set of windings.

The vibrator of an interruptor may be made of phosphor bronze or spring brass The contact points are, of course, made of platinum.

* * *

J. H., Jr., New York City:

Full information concerning amateur licensed certificates can be obtained from the chief radio inspector, Custom House, New York City.

* * *

V. V. V., Lodi, Cal.:

The 20,000-volt transformer mentioned in your query is recommended. A transformer with a 40,000-volt secondary places great strain on the condenser jars and on the insulation of the apparatus throughout.

A complete diagram for the amplification of signals by two-vacuum valve bulb, appears in the third revised edition of the book, "How to Conduct a Radio Club."

Two loose couplers can be quite readily connected in series both in the primary and secondary windings for the reception of longer waves provided the secondary windings do not oppose. The proper connection can

be readily obtained by trial; if signals are not obtained in one way, the secondary connections can be reversed.

* * *

W. R. M., Bangor, Me.:

We cannot publish in the columns of this magazine the complete operating schedules of various radio stations throughout the United States. The hours of service of most stations appear in the Government Call List, a copy of which can be purchased from the Government Printing Office, Washington, D. C.

The black line opposite the coil L-5, on page 218 of the December, 1916, issue of The Wireless Age means nothing. The variable contact, T, is fully explained in that issue.

Your aerial, 30 feet in height, 51 feet in length, has a fundamental wave-length of about 98 meters.

* * *

S. H. L., Greensboro, North Carolina, inquires:

Ques.—(1) Would a No. 16 tin wire make a good earth wire?

Ans.—(1) It might do for receiving earth wire, but it is not large enough for the transmitting earth connection. Several copper wires should be used in this case.

Ques.—(2) How many wires should a receiving aerial have?

Ans.—(2) Two wires will do in most cases.

Ques.—(3) Should the lead-in wire be the same kind as the aerial wire?

Ans.—(3) The lead-in should have the same number of wires as there are in the flat top.

Ques.—(4) What is the approximate wave-length of an aerial 100 feet in length, 50 feet in height comprising two wires spaced 2½ feet apart?

Ans.—(4) Approximately 175 meters.

Ques.—(5) I often hear the term "dead end" employed. Will you kindly explain it?

Ans.—(5) The dead end turns of a receiving tuner are those turns which are not actively connected in either the open or closed circuit at any particular wave-length adjustment.

* * *

A. J. H., Windsor Locks, Conn.:

In any event you cannot use a condenser the capacity of which exceeds .01 microfarad, for the 200-meter value, and since the Leyden jars constructed by the Marconi Company each have a capacity of .002 microfarad, you would require four (connected in parallel) for use with your transformer.

* * *

C. W. S., Modesto, Cal.:

From our calculations the natural wave-length of your upper aerial must be about 190 meters and when the secondary winding of the transmitting oscillation transformer is connected in series, the emitted wave will exceed 200 meters. We suggest that you remove the lower aerial entirely, but make no change in the upper aerial. In fact, according to our calculations, the upper aerial already requires a short wave condenser.

F. E. Van A., Gilmore City, Iowa:

The 22,000-volt alternating current power line, which is near to your aerial, will undoubtedly set up inductive noises during the reception of signals, and the only remedy we know for this is the balancing out aerial described in the second revised edition of "How to Conduct a Radio Club."

* * *

A. B. L., Chicago, Ill., inquires:

Ques.—(1) Please give me a formula for calculating the capacity of the rotary variable condenser.

Ans.—(1) The following formula applies:

$$C = \frac{2{,}248 \times \left(\frac{3{,}1416\ A^2\ N}{2}\right) \times K}{D \times 10^8}$$

Where N = the total number of air spaces between the moving and stationary plates.

D = the thickness of air space between a moving plate and a fixed plate.

A = the radius of the movable plates in inches.

In the case of the air condenser, the value for K is 1; for paraffine paper it is about 2 and for hard rubber approximately 5.

* * *

J. B. L., New York City, inquires:

Ques.—(1) Please give me a formula for determining the capacity of condensers for transformers of various power ratings.

Ans.—(1) The following formula is applicable:

$$C = \frac{D \times 10^{12}}{E^2 \times N}$$

Where C = the capacity of the condenser in microfarads

KW = the kilowatt rating of the transformer secondary

E = the secondary voltage (effective).

N = the frequency of the primary current in cycles per second.

This formula is based upon the assumption of synchronous discharges, or two sparks for each cycle of the charging current.

* * *

D. V. B., Charleston, South Carolina, inquires:

Ques.—(1) Approximately, what is the specific inductivity of ordinary or common grades of glass such as the amateur may procure from a photographic supply house?

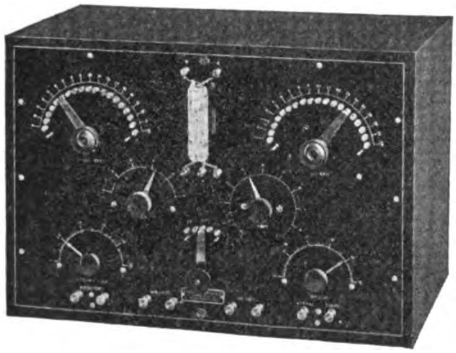
Ans.—(1) The inductivity of this grade of glass is rather low, generally no more than 4.5.

Ques.—(2) Is it of advantage to employ oil insulations in high voltage condensers?

Ans.—(2) Oil insulation is preferred, particularly when an extraordinary high potentials are employed.

Ques.—(3) How can I eliminate brush discharges?

GERMANY—ON AN 80 FOOT AERIAL



R-345 Undamped Panel Receiver.

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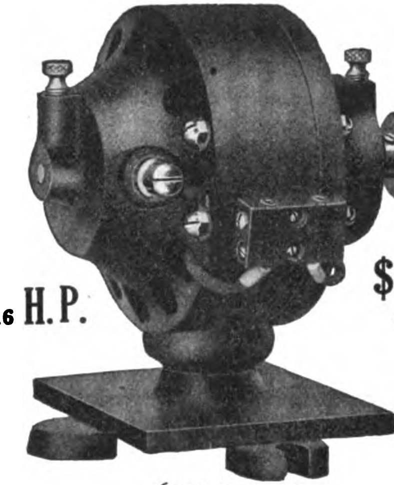

1/16 H.P. $5.00

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This Motor can be used for grinding, polishing, and as a general utility motor for the house. There is no better motor made for *Spark Gaps.* A powerful little motor, operating on A. C. or D. C. 100 to 130 volt.

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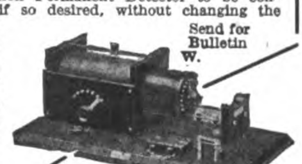

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The Marconi Trans-Atlantic Wireless Telegraph Stations of America, Canada, England, and Italy are equipped with

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American Transformer Co.
NEWARK, N. J.

Telephone Bryant 5477

Electrical Industries Mfg. Co.

328 West 41st St. New York

Ans.—(3) All corners of the tinfoil on the glass plate should be rounded off and the plates immersed in a god grade of Transil oil.

Ques.—(4) Which types of condensers secure preference in commercial work, the oil plate glass condenser, or the Leyden jar type?

Ans.—(4) The Leyden jar type is used in the majority of installations in the United States, principally because it is more convenient to install and handle and is not so difficult to repair in case of break down.

D. R. S., Chicago, Ill., writes:

* * *

A. B. K., Chicago, Ill., inquires:

Ques.—(1) Should the lower end of the ribs of an umbrella aerial be connected together?

Ans.—(1) They are usually so connected, but we have no data at hand to show that this is absolutely necessary.

Ques.—(1) Will you please explain the "Lepel" arc transmitter?

Ans.—(1) The Lepel arc transmitter uses a very short form of discharge gap which can be operated from either alternating or direct current. The arc gaps consist of two circular discs of copper with convex and concave surfaces having a thin sheet of paper between them. The discharge occurs between the discs through the paper. A small perforation is made near the center of the paper to afford a suitable starting place for the discharge. As this continues, the paper gradually burned away from the center outward. Since this burning takes place in an atmosphere practically devoid of oxygen, it requires several hours of use before the paper is completely burned up.

A groove is cut near the outside edge of the adjacent spaces of the copper plate to prevent the arc from getting to the outer edge of the disc and thereby being exposed to the air.

When this arc is connected to a condenser and oscillation transformer in the usual manner, a series of groups of oscillations are obtained, the frequency of which may be exceedingly high. The effect is much similar to that obtained from the singing spark system of Thomson. But in addition to the arc effect, a certain quenching is obtained which is highly desirable.

To make the oscillations of the antenna circuit audible, a tikker, or chopper, is required at the receiver.

The oscillations of the antenna circuit (at the transmitter) may be varied periodically by shunting the condenser with a large condenser and inductance, the circuit including a telegraph key. When the key is closed, energy is withdrawn from the closed circuit at a rate corresponding to an audio frequency and accordingly the oscillations in the aerial will be damped and can be heard at the receiver with ordinary detectors.

FROM AND FOR THOSE WHO HELP THEMSELVES

(*Continued from page 505.*)

The writer's sounder was a twenty ohm. one with a brass lever, and was too slow in its movements in its original condition. The inductance was cut in half by breaking the wire connecting the two magnet spools, and operating the two spools in parallel instead of in series. The mass of the lever, however, was too great for the spring to return it with sufficient quickness, so a wooden lever was substituted. For the electrical connection a thin brass strip was led along the top of the lever, over the end, and back for about an inch on the under side. This strip was securely fastened to the lever, and silver contacts were soldered on the top and bottom to correspond with similar ones on the fixed contacts. The sounder is, of course, operated by a key and battery circuit in the usual manner.

The adjustment of the relay can be readily tested, as follows: Disconnect the transformer lead, and connect the lower relay contact to the rheostat circuit as well as the upper. Close one or more of the switches controlling the lights in the rheostat, and operate the key. The lights will, of course, be lit, whether the sounder lever is up or down, but there will be more or less flickering as it passes from one position to the other. By properly adjusting the spring and using a suitable lever and magnet winding, this can be made almost, or even quite, imperceptible. When this condition is reached the house lights will not be materially affected in sending, if proper rheostat values are used to balance the transformer. These values can be readily determined by experiment if the power consumption of the transformer is not known. When once the proper light switches are closed, it will not be necessary to make any change until a different power is used, as the main switch will put out all the lights when it is moved from the sending position. If only the power is to be balanced, this will be the only switch required.

E. C. Reynolds, *District of Columbia.*

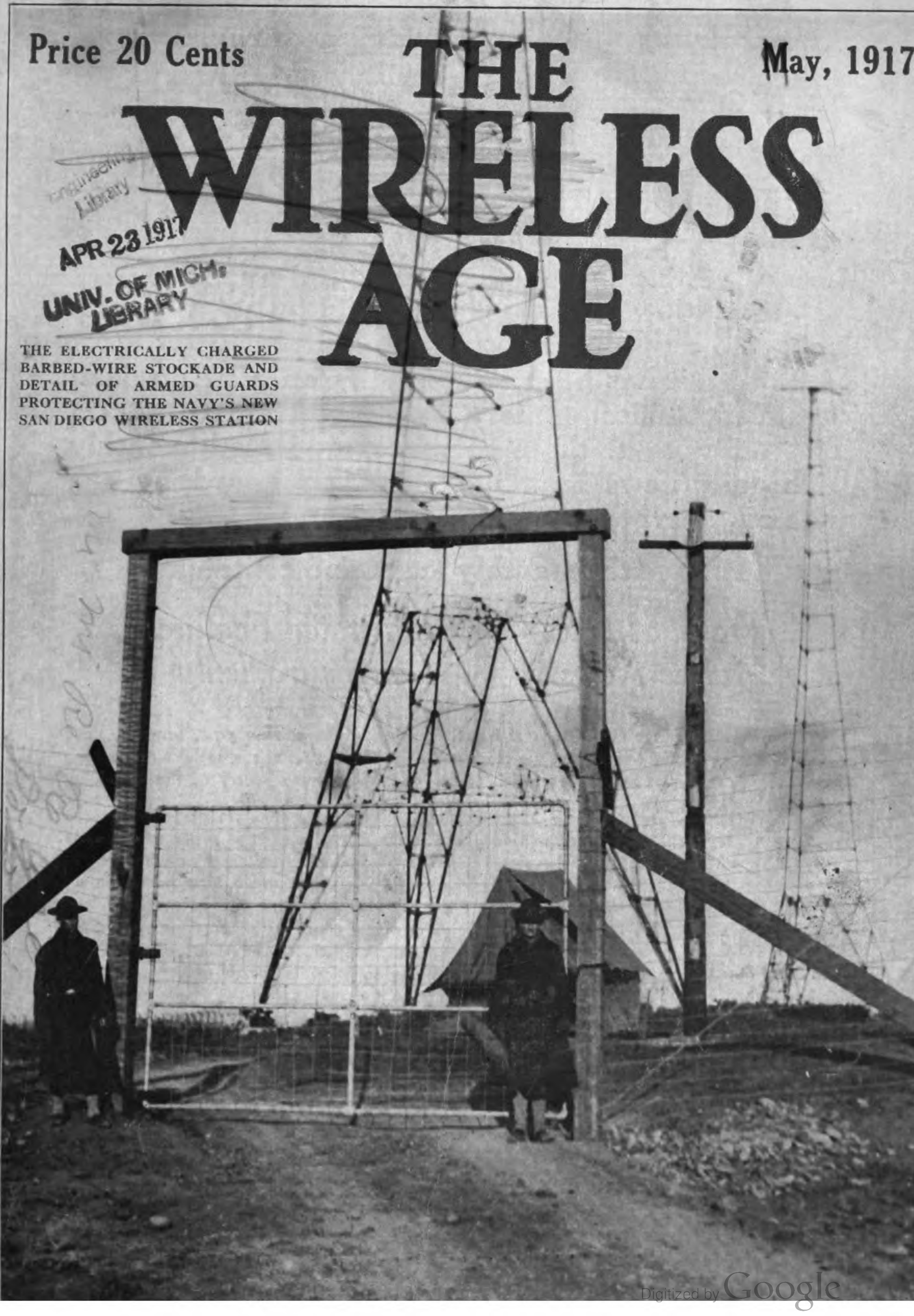
James A. Norris, secretary of the Radio Experimental Club of New Orleans, died on February 28.

Price 20 Cents

May, 1917

THE WIRELESS AGE

THE ELECTRICALLY CHARGED BARBED-WIRE STOCKADE AND DETAIL OF ARMED GUARDS PROTECTING THE NAVY'S NEW SAN DIEGO WIRELESS STATION



THE WIRELESS AGE

MAY, 1917

The Washington's Birthday Relay

Story of the Successful Interchange of Messages by Radio Between Mayors of the East and West,

By 9 XE

National Chief of Relay Communications

NATIONAL AMATEUR WIRELESS ASSOCIATION

SUCCESSFUL results marked the Washington's Birthday Relay, held under the auspices of the National Amateur Wireless Association, when a wireless message from Mayor Mitchel of New York to Mayor Woodman of Los Angeles, Cal., was transmitted and a relay by radio was flashed. Thousands of amateurs throughout the country copied the messages.

Special stations sent the westbound message from New York from 2 ZK at New Rochelle, using 8 YI, 9 ZM and 9 ZF to 6 EA (Los Angeles). When the time (an hour and a half) and the great QRM and repetition of messages because of misspelled words are taken into consideration, the achievement was not inconsiderable.

We had good wireless weather as far as the Rocky Mountains on the night of the relay. However, I had studied the weather conditions thoroughly and looked for trouble southwest and west. That I was not mistaken was shown by the fact that a small cyclone was sweeping over Texas, Arizona, New Mexico and California, and the tail end of a regular old-time QRM storm was disturbing the amateurs in the Far West. Notwithstanding, 6 EA received the message directly from 9 ZF. 6 DM, who volunteered to help 6 EA, put on full power and blew the fields of his gap motor. This left the work to be handled by 6 EA.

Seefred brothers delivered the message of Mayor Mitchel to Mayor Woodman and received the reply promptly. QRM and QRN were so bad by this time, however, that it was impossible to transmit the message through to 9 ZF. The amateurs who remained awake all night waiting for the return message will be particularly interested in learning that 6 EA remained in his station and transmitted the message through the following night, but the hour was so late that 9 ZF could not find any one awake. 9 XF arranged for all eastbound amateurs to be alert and the message came through, being delivered to Mayor Mitchel by George C. Cannon (2 ZK) early in the morning.

In responding, the total time consumed on each message was reckoned and the race between specials and the amateurs

> To the Mayors of Los Angeles, Cal., and Seattle, Wash.: On behalf of New York City, I send cordial greetings to Los Angeles and Seattle and best wishes for the success of the radio system.
> (Signed) John Purroy Mitchel,
> Mayor of New York.
>
> To the Mayor of New York City: On behalf of the City of Los Angeles I return your greetings and wish you continued prosperity. Congratulations to amateur radio on the successful message.
> (Signed) Fred I. Woodman,
> Mayor of Los Angeles.

The mayors' radio messages

was found to be a tie. The handicap of the low wave of the amateurs gave them a slight preference in the decision. However, my former contention that the amateurs are not yet prepared to handle transcontinental messages with as great a degree of certainty as the specials, unless they arrange for emergency stations in the long jumps in case of bad QRM, still holds.

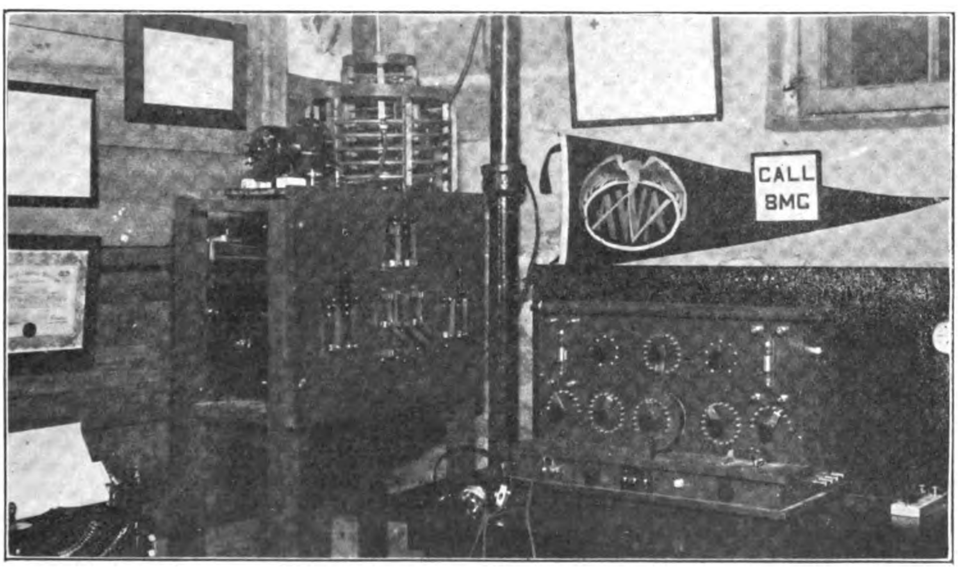
The station of E. B. Duvall and A. P. Smith at Baltimore, Md.—Winners of the First Prize

The following notice signed by 9 XE and distributed in advance of the relay, makes clear the conditions under which the event was held:

"Msg starts from 2 ZK—325 M.—10:30 P. M. 2-24-17 Eastern time. 2 ZK calls 8 YI on 325 M. 8 YI calls 9 XM on 440 M. 9 XM calls 9 ZF on 2200 M. 9ZF calls 6 EA on 425 M.

"In case of QRM or QRN, 2 ZK calls 3 ZS on 325 M. at 10:30 P. M. 3 ZS calls 8 YZ on 425 M. as soon as he gets MSG. 8 YZ calls 8 YO on 425 M. as soon as he gets MSG. 8 YO calls 8 YI on 400 M. as soon as he gets MSG. 8 YL calls 9 ZN on 425 M. as soon as he gets MSG. 9 ZN calls 9 XN on 425 M. as soon as he gets MSG. 9 XN calls 9 XF on 425 M. as soon as he gets MSG. 9 ZF calls 6 EA or 6 DM on 425 M. as soon as he gets MSG.

"In case of QRM or QRN at 9 ZF: 9 XN calls 9 XV on 425 M. 9 XV calls 5 ZC on 950 M. 5 ZC calls 9 ZF on 425 M. In any event 8 XA will repeat MSG on QST after 9 ZF has it O.K. and given QSL. Send once only, and this only for westbound MSG on 700 ing alert for the return MSG. No one but the sending amateurs east of 9 ZF



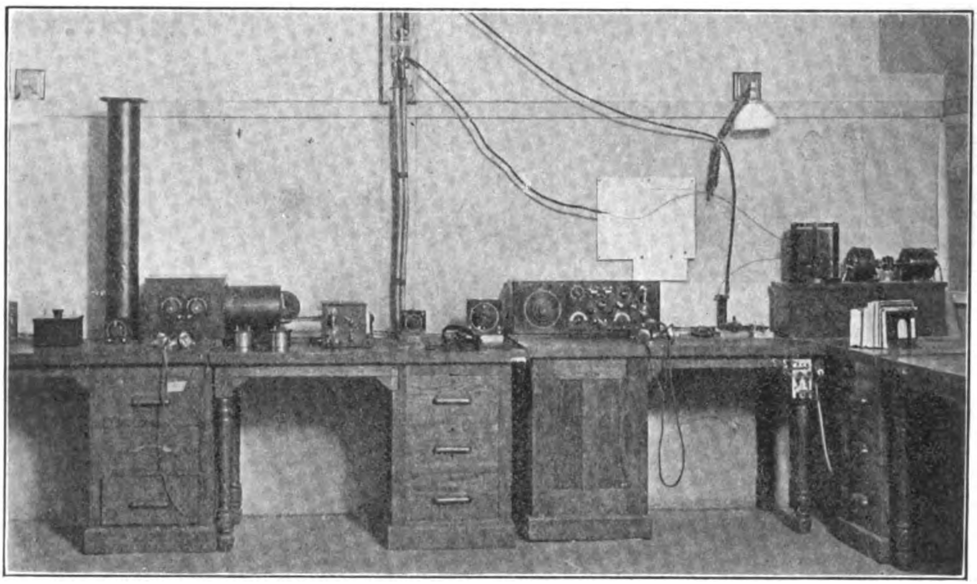
Kenneth Briggs' station at Rochester, N. Y.—Winner of the Third Prize meters. 9 XV will give MSG to 5 ZC after 8 XA sends it once only. 5 ZC will send MSG once only on QST for benefit of stations in New Orleans and Shreveport.

"As special stations are fighting against time, we prefer the first arrangement and that all others keep quiet and check strength of sigs.

"6 EA will have MSG ready from Mayor of Los Angeles and give it to either 6 DM or 9 ZF, according to QRN. 9 ZF gives MSG to 5 DU on 425 meters. 5 DU gives MSG to 9 ABD on 200 meters. 9 ABD gives MSG to 9 GY on 200 meters. 9 GY gives MSG to 8 AEZ on 200 meters. 8 AEZ gives MSG to 2 AGJ on 200 meters. 2 AGJ gives MSG to 1 IZ on 200 meters. 1 IZ gives MSG to 1 ZM on 200 meters. 1 ZM gives MSG to 2 ZK on 200 meters. 2 ZM gives return MSG to Mayor of New York. 8 NH repeats westbound MBG on 200 M. 3 times on QST after 9 ZF has it. 8 NH repeats eastbound MSG on 200 M 3 times on QST after St. James, 1 IZ has it.

"Interest everybody in helping the United States naval authorities get recruits for the Radio Reserve. Report all QRM."

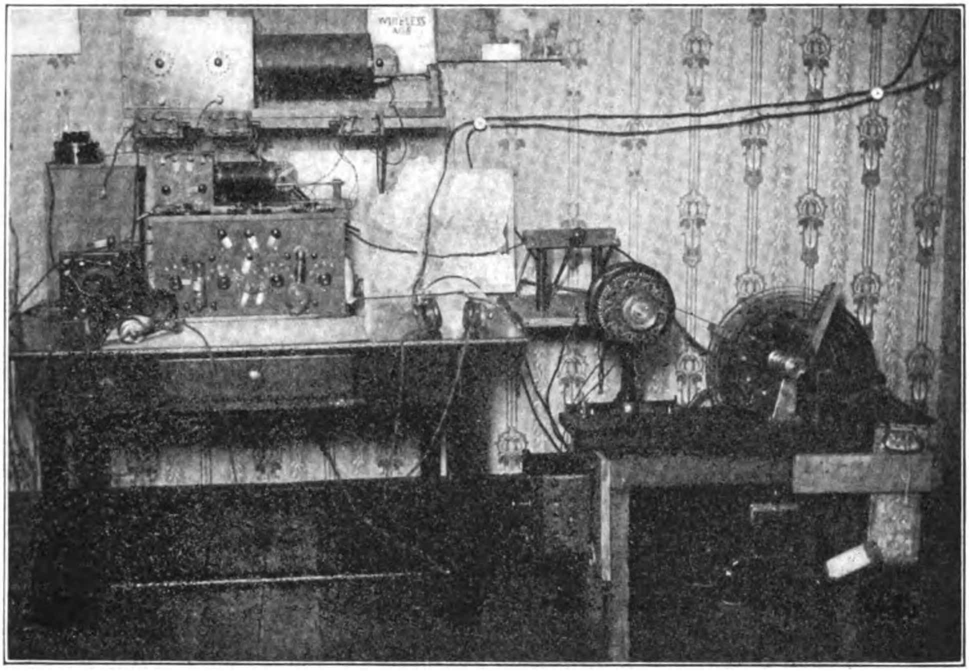
The reports made by those who took part in the Relay deserve mention, but lack of space prevents me from giving a detailed account of these compilations. Hoyt of Hayward, Cal. (6 SI), who is a prize winner, made one of the best reports that I have had the priviledge of reading. Stewart of St. Davids, Pa. (3 ZS), a member of the Radio Association of Pennsylvania, remained awake till almost six o'clock in the morning in order to make his report complete. Emerson of Dallas, Tex., formerly a member of the navy, wrote a report filled with interest and the log of the members of the San Francisco Radio Club was well worth reading.



Scott High School station, Toledo, O.— Winner of the Fourth Prize

The names of the prize winners follow:

First Prize—E. B. Duvall and A. P. Smith were awarded the donation of the Electro Importing Company, a "Nauen POZ" radio receiving set. Duvall and Smith operate jointly 3 AK, in Baltimore, Md. This prize was awarded for the quickest delivery of both messages, and particularly for be-



Mr. and Mrs. C. Candler's station, St. Mary's, O.—Winner of the Sixth Prize

knew when the eastbound MSG was coming through.

Second Prize—W. B. Pope (4 AA) of Athens, Ga., was awarded the professional wave meter, donated by the Electro Importing Company of New York. It was awarded for long distance reception, prompt, business-like delivery and for perfect indexing, timing and marking both east and westbound messages, received in approved commercial style.

Third Prize—Kenneth Briggs of Rochester, N. Y. (8 MG), whom you all remember as almost catching up with C. E. Hughes, the presidential candidate, with a copy of the relay message on October 27th, was awarded the 1 k.w. Thordarson transformer, donated by the Thordarson Transformer Company of Chicago. The QRM map showed marked interference, particularly on westbound messages.

Fourth Prize—Scott High School of Toledo, Ohio, was awarded the William B. Duck's Arlington tuner for long distance reception with moderate apparatus, diligent and persistent listening for the return message and a complete business-like report.

Fifth Prize—Leander L. Hoyt of Hayward, Cal. (6 SI), was awarded the Chambers No. 749 tuner, for the reception of arc and spark signals. This prize was awarded for long distance work and incessant effort to bring the amateurs in that neighborhood to a realization that California would be put on the Relay map.

Sixth Prize—Mr. and Mrs. C. Candler (8 NH) are located in St. Mary's, Ohio, but their sigs. do not stay at home. During the Presidential Relay this station received six hard earned credits, although its transformer was not working properly. If it had not been for this station amateurs south and west would not have received the westbound MSG. Some who did not know 8 NH was supposed to help on relay reported that station as QRM.

This station was awarded the donation of the Perfection Radio Laboratory of Clinton, Ia.—one short wave amplifying tuner. The writer used a tuner of this make during the last relay and could hear the sigs. of 4 CL and 2 PM very QSA.

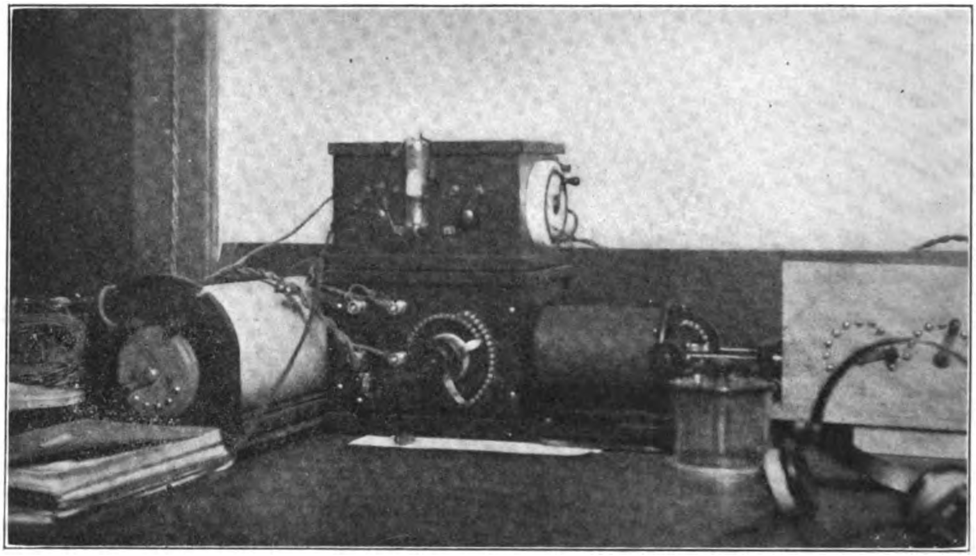
Seventh Prize—O. R. Terry of Stoughton, Wis., was awarded the prize of the Manhattan Electric Supply Company of Chicago. This is a pair of 3,000-ohm Mesco phones.

much for granted and not filing the time received on their reports. The names of the operators and the stations that made perfect scores will be found in the following list:

Arkansas—John M. Clayton, 5 BV, Little Rock.

Arizona.—R. A., 6 FD, Phoenix; L. E. Glenn, 6 IT, Alhambra; J. Giraud, 6 EO, Phoenix; R. Higgy, 6 DM, Phoenix.

Colorado.—E. F. Doig, 9 ZF, Denver; W. H. Smith, 9 ZF, Denver.



O. R. Terry's station at Stoughton, Wis.—Winner of the Seventh Prize

Eighth Prize—The Phoenix Radio Club of Phoenix, Ariz., was awarded the donation of Philip E. Edelman of St. Paul, Minn. This is his latest book, "Experimental Wireless Stations." The prize was awarded for long distance reception, co-operation in the relay and keeping quiet when necessary.

The prize winners may obtain the prizes by writing to the donors, giving their names and addresses and referring to this magazine.

In awarding the prizes the location of the station, QRM, neatness of the report, diligence in seeking the return MSG, judgment in making the reports and length of time spent by the operators as experimenters were taken into consideration. Many in the Relay failed because of misspelled words, taking too

California.—Seefred brothers, 6 EA, Los Angeles; L. Lynde, 6 UG, Long Beach; C. H. Hirst, Stanford University; F. Terman, 6 FT, Stanford University; L. L. Hoyt, 6 SI, Hayward.

Connecticut.—H. Haugh, HH, Derby.

The Dakotas.—M. Tuve, MT, Canton, S. D.; P. C. Green, PG, Aberdeen, S. D.; D. Cottam, DCL, La Moure, N. D.; E. Worthington, 9 APG, Aberdeen, S. D.; E. R. Isaak, 9 TZ, Eureka, S. D.; A. Shaw, AS, Parkston, S. D.

Florida.—J. C. Cooper, Jr., 4 EI, Jacksonville; C. M. West, U. S. N., St. Augustine.

Georgia.—D. L. Gaston, CWW, Commerce; A. F. Hood, CWW, Commerce; C. H. Williams, 4 CY, Covington; J. R. Shumate, 4 EC, Tomasville; W. B. Pope, 4 AA, Athens.

Indiana.—G. Decker, 9 QNO, Ligonier; L. B. Wilcox, 9 KH, Angola; L. Gehring, 9 AAS, Bluffton; P. K. Romey, 9 QR, Columbia City; J. E. Williams, JW, La Grange.

Illinois.—S. W. Pierson, 9 PY, Carrolton; R. H. G. Mathews, 9 ZN, Chicago; E. E. Boynton, 9 ARA, Sycamore; L. A. Kern, 9 GY, Matoon; H. Klaus, HK, Eureka; R. W. Beard, 9 GK, Pleasant Plains; E. H. Giddings, 9 MK, Lanark; H. A. Mackley, 9 AIM, Peoria.

Iowa.—W. E. Slauson, 9 AMI, Monticello; H. O. Ainsworth, 9 AMI, Monticello; S. U. of Iowa, 9 YA, Iowa City; Don Bailey, 9 RD, Clinton; Lester Fawcett, 9 AIF, Independence; C. Tumwall, CT, Ottumwa; W. Harper, WH, Ottumwa; H. M. Ennis, HME, Ottumwa; Kent brothers, 9 ARF, De Witt; The Old War Horse, 9 RD, Clinton.

Kansas.—W. S. Ezell, 9 YE, Wichita; Karl Keller, 9 ADE, Kinsley.

Louisiana.—P. E. Grenlaw, 5 BB, Franklinton.

Massachusetts.—R. T. St. James, 1 IZ, Great Barrington; P. C. Smith, Haverhill; E. B. George, 1 ANA, Framingham, B. H. Moran, 1 AAM, Natick.

Minnesota. — Peter Hansen, PH, Chisolm.

Michigan.—J. L. Munger, LM, Sturgis; W. Benson, 8 ANR, Battle Creek; Ed Holby, 9 OE, Marquette; Y. M. C. A., 8 QJ, Ann Arbor; M. B. Rann, 8 ADR, Lansing; W. Koivanen, WK, Chisolm; D. G. Carter, 8 WR, Grosse Point.

Missouri.—W. Corwin, 9 ABD, Jefferson City; Washington University, 9 XV, St. Louis; H. Longmire, Monroe City; B. Emerson, Monroe City.

Maryland.—C. E. King, 3 SV, Baltimore; E. B. Duvall, 3 AK, Baltimore; A. P. Smith, 3 AK, Baltimore; L. W. Passano, Marconi operator, M. & M. Co., Baltimore.

Montana.—A. C. Campbell, 7 ZC, Lewiston.

Nebraska.—Bradford Telepea (No call), Tekomah.

New York.—J. N. Simpson, 8 CM, Rochester; W. C. Ballard, 8 XU, Ithaca; Genesee Radio Station, 8 OZ, Rochester; Dr. H. E. Fitch, 8 ZE, Elmira; O. W. Saxton, 8 FY, Buffalo; A. C. Young, 8 ARB, Buffalo; H. Blower, 2 HB, Brooklyn; Kenneth Briggs, 8 MG, Rochester; J. Weiss, 2 FH, Port Washington; G. M. Benas, 8 CC, Utica; W. J. Vickery, 8 SE, Gloversville; J. K. Hewitt, 2 AGJ, Albany.

North Carolina.—W. S. Rothrock, 4 DI, Winston Salem; J. T. Moorehead, JM, Greensboro.

Ohio.—Fred Travis, Defiance; R. Hoffman, Defiance; D. Israel, 8 ANC, Cincinnati; G. D. Howsare, 8 ASC, Eaton; D. Schellenbach, 8 IF, Wyoming; R. A. Duerk, 8 AHI, Defiance; C. Linxweiler, 8 IJ, Dayton; (no name), 8 ATG, Tiffin; C. Candler, 8 NH, St. Mary's; L. Berman, 8 ML, Cincinnati; Scott High School, 8 ZL, Toledo; Merle Sager, 8 ASW, Tiffin; N. Thomas, 8 FX, Marietta; M. B. West, 8 AEZ, Lima; J. F. Eckel, 8 PL, Cincinnati; J. O. Hibbett, 1113, Ottawa; L. M. Clausing, 8 YL, Lima.

Oklahoma.—A. and M. Steddon, 5 AB, Oklahoma City.

Pennsylvania.—H. T. Mapes, 3 AUC, Carlisle; Chris M. Bowman, 3 PC, Lancaster; High School station, 8 JS, Bellefonte; L. and H. Alexander, 8 ALE, Grove City; R. R. Goodwin, Roulette; M. H. Mandelkern, 3 MR, Philadelphia; Peabody High School, 8 YZ, Pittsburgh; W. and R. Shoop, Vandergift; F. J. Anderson, QD, Reading; F. H. Brian, Smithport; C. H. Stewart, 3 ZS, St. David's; Nassau Brothers, 3 CT, Philadelphia; Karl E. Hassel, 8 YI, Pittsburgh; R. C. Clement, 8 AJT, Washington; St. Joseph's College, 3 XJ, Philadelphia.

Rhode Island.—C. E. Davis, Edgewood; M. V. Pollys, Jr., 1 EMG, Bristol; H. W. Thornley, 1 AI, Pawtucket.

Tennessee—S. H. Sheib, 5 CY, Nashville; C. B. Delahunt, 5 ZD, Memphis.

Texas—B. Emerson, 5 DU, Dallas; R. Corlett, 5 ZC, Dallas; J. L. Antry, 3 ED, Houston; C. W. Gilfillan, FM, Austin.

Virginia.—R. R. Chappell, 3 ST, Richmond; G. C. Robinson, 3 ST, Richmond; J. F. Wohlford, 3 WE, Roanoke; W. T. Gravely, 3 RO, Danville; J. E. Krone, 3 TY, Newport News; A. N. Johnson, 3 TY, Newport News.

West Virginia.—J. E. Law, Clarksburg; H. E. Burns, 8 AGH, Martinsburg.

Wisconsin.—H. J. Crawford, 9 WT, Wausau; C. Quinn, 9 ARD, Neehah; M. P. Hanson, 9 XH, Madison; E. H. Hartnell, 9 BV, Salem; A. Rufsvold, 9 ADI, Marinette; O. R. Terry, 9 HQ, Stoughton.

In conclusion, attention should be called to the fact that fifty miles, worked absolutely sure, with a considerable number of relay stations, is more reliable than a few stations with long jumps between, operating only when conditions permit.

As follows are descriptions of some of the stations, the owners of which were awarded prizes:

The station of Edward B. Duvall and Allan P. Smith, 3d, winners of the first prize, contains a vacuum valve cabinet, an auditron bulb, a bunnell 43-plate variable condenser, a cabinet receiving set with a small reconstructed and rewound Murdock receiving coupler, crystal detectors, a Blitzen variable condenser and loading coils which are inside the cabinet and are controlled by the change-over switches mounted on the front. Two of these switches also cut out unused parts of the small coupler which makes it efficient for short wave reception. A large reversing switch on the table throws the tuner either to the crystal detectors or the vacuum valve circuits. A large marble key of the Marconi and Murdock 2,000-Ohm receivers are employed.

The reception of signals is carried on through the secondary of the oscillation transformer. No large aerial change-over switch is used, a small rubber base pole changing switch being employed. The transmitter is contained in a large panel on the front of which are mounted switches for power control and a rheostat for rotary gap speed control. The transmitting set is made up of a ½ K.W. Clapp-Eastham Company transformer, a Hytone rotary quenched gap and motor, a Clapp-Eastham Glass plate condenser and an oscillation transformer, pancake style, insulated on hard rubber. All connections are of heavy brass ribbon, those in the closed circuit being extremely short. Marconi kick-back preventors are used in the primary circuit of the transformer. Clapp-Eastham hot wire ammeter is used. The ground is to water pipes, driven into the earth, and a heavy brass strip soldered to a roof. The main ground lead that connects to these grounds consists of six stranded phosphor bronze wires. The aerial is about 70 feet long, made up of two wires, suspended 30 feet above the grounded at both ends. The wires are standard-6 roof at both ends. The wires are standard-6 strand No. 18. Hard rubber insulators insulate each wire and are used wherever necessary.

The transformer input operating at full power is 340 watts and the aerial current is 2.5 amperes. The station has been heard over 300 miles, north, west and south, and has worked 2 AGJ Albany, N. Y.; 8 VX, Buffalo, N. Y.; 2 PM, New York City; 8 ALE, Grove City, Pa.; and others. The receiving range for amateur stations has not yet been determined. The owners are members of the National Amateur Wireless Association, the Institute of Radio Engineers and the Baltimore Radio Association.

The station of W. B. Pope at Athens, Ga., winner of the second prize, has an antenna of the "T" type, 70 feet in height at one end and 60 feet at the other. There are three wires of 7/22 hard drawn copper, 140 feet in length, spaced four feet apart. Other parts of the equipment include a special short wave inductively-coupled tuner, a single-valve Armstrong circuit, 2,000-ohm phones and two variometers, one in the grid circuit and one in the plate or wing circuit.

The station of Kenneth Briggs in Rochester, N. Y., winner of the third prize, has a transmitting set in the form of a panel. On the lower shelf is a Thordarson 1 K.W. transformer, and a plate glass, oil-immersed condenser. Above are the rotary gap and oscillation transformer. On the panel are the switches controlling the power for the transformer and gap motor, the antenna switch and a switch for the A. C.

On a table are the key and the receiving cabinet which is made of cherry. The cabinet contains a 3,000-meter coupler, and the primary and secondary loading coils, which will load the coupled up to 12,000 meters. There are two oscillations and a mineral detector with switches so that both damped and undamped waves can be received. The mineral detector can be used alone, one vacuum valve alone, and a vacuum valve with the amplifier. There is a variable condenser across the secondary, and in the cabinet are high voltage batteries for the vacuum valves. The phones are of the Brandes trans-Atlantic type.

The aerial, which is of the inverted "L" type, has four wires 55 feet in length. It is about fifty feet in height.

The entire set is home-made with the exception of the transformer, antenna switch, phones and detectors.

The transmitting outfit of the Scott High School station (8 ZL), at Toledo, Ohio, winners of the fourth prize, consists of two sets, one being a ½ K.W. Hytone outfit and the other a 2 K.W. rotary equipment. Three receiving sets are employed. One is for undamped waves with a range of from 600 to 15,000 meters. A vacuum valve set is employed for waves of from 600 to 1,500 meters. On 200-meter work a W. B. Duck specially-designed short wave regenerative receiver is used.

Two commercial first grade operators are in charge of the station, and Monday, Wednesday and Friday afternoons are devoted to message work with 8 NH. The operators in charge of 8 ZL request that all stations within a radius of 100 miles send a memoranda of the signals heard.

Leander L. Hoyt, winner of the fifth prize, whose station is located at Hayward, Cal., has a transmitting set consisting of a variable power step-up transformer. The power used for all work last year did not exceed ½ K.W. and the input variation permits power from ½ K.W. to 10 K.W. to be used if necessary. Power is supplied to the primary at 220 A. C. The oscillation transformer is of the conventional helix type. The condenser is of the rack type of flint glass and has a capacity of .008 microfarad. The rotary gap consists of a bakelite disc, 1 foot in diameter, run by an induction motor at 1,800 r.p.m. There are sixteen plugs mounted on a disc.

The receiving set is of the regular loose-coupled type. The Electron Relay is used. The loose-couplers employed are well adapted to vacuum valve circuits. Regenerative circuits have been employed recently, marked results having been obtained on low wave-lengths. The vacuum valve and regenerative circuit apparatus with the required number of variable condensers and the addition of a pair of Brandes phones complete the set.

Crystal detectors are used for ordinary and short range working. Good amateur sets within 1,000 miles and some beyond that distance are easily read at night. Many stations in the Ninth District have been copied. The sending aerial is of the "fan" type, being 60 feet in height and 70 feet in length. The receiving aerial is of the same height, and contains two wires. It is 250 feet in length.

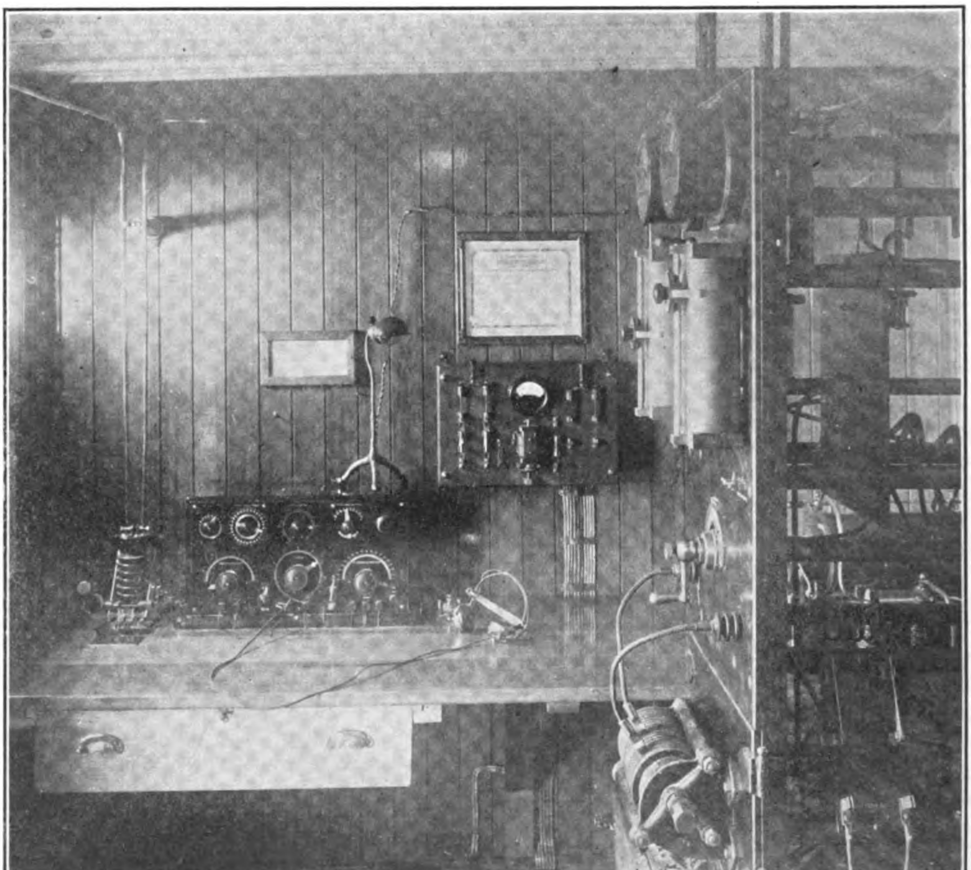
The transmitting set of Mr. and Mrs. Charles Candler, winners of the sixth prize, is composed of a 1 K. W. Thordarson transformer, an oil condenser having twelve 10 inch by 12 inch glass plates, coated on both sides with tinfoil, 7 inches by 9½ inches, a rotary gap composed of a 7-inch Micarta disc fitted with ten studs and driven by a belt to a motor at about 3,000 to 3,400 r.p.m., and a pancake type oscillation transformer.

The receiving set is made up of a cabinet in which are mounted both a vacuum valve and an audiotron, the latter being arranged to work on either the plain or oscillating circuit, two loose couplers, several variable condensers and two head-sets. Any wave all the way from 180 to 10,000 meters can be tuned in.

The aerial is of the T-type, 87 feet in length, 58 feet in height, having six wires, spaced 27 inches apart. The set is grounded to water, gas and waste pipes.

The transmitting set of O. R. Terry or Stoughton, Wis., winner of the seventh prize, consists of a 1 k.w. Thordarson transformer, a home-made oil-immersed condenser, a pancake type oscillation transformer and a rotary gap made up of a 5-inch disc, running at about 3,000 r.p.m. The disc contains six plugs.

The receiving set is made up of a pair of Brandes 2,800-ohm phones, one large and one small loose coupler, a variable condenser, one in series with the aerial and one shunted across the secondary, an audiotron bulb used with a regenerative hook-up and two large loading inductances for undamped wave stations.



The 2 k.w. Marconi radio panel set as installed on the steamship H. H. Rogers. ***An unusual*** *picture as it gives a detailed reproduction of the apparatus in the wireless cabin*

Radio the Highest Form of Engineering Expression

The Washington Section I. R. E., Dinner Records a Noteworthy Message of Patriotic and Scientific Inspiration to Workers in the Field of Wireleess Communication.

THE spirit of co-operation that finds science united for the protection of the nation as it goes to war, was eloquently foreshadowed at the dinner tendered on March 3rd to Brigadier General George O. Squier by the Washington Section of the Institute of Radio Engineers. An assemblage representative of the highest engineering skill in the art of wireless communication mentally and orally dedicated itself on this occasion to making available to the Government a system of radio unsurpassed, and even unequalled, throughout the civilized world.

Lieut. Commander S. C. Hooper, to whom is given a large proportion of the credit for the reorganization of the Navy's radio system and the installation of efficiency methods, began the addresses of the evening with an appreciation of the manner in which the workers in the wireless field had made ready industrially for preparedness of a high order. It was significant of the times, he said, that this newest of arts had a material representation in manufacturing circles and it was inspiring to know that the serious situation had effected a whole-souled mobilization of production effort for the mechanical equipment of the Navy. As to valuable personnel to be drawn from the field, he felt certain that quick response would be made to the call to the colors, with such anticipated acceleration in fact, that he hoped to make it understood that the nation's best interests would be served if the engineers would remain in their places as producers of equipment, allowing the less skilled workers who had not reached the plane of scientific standing to go to the front for the execution of the actual communication.

George H. Clark, expert radio aid for the Bureau of Steam Engineering of the Navy Department, echoed these sentiments in an after-dinner speech that carried an eloquent appreciation of the contributions to science of General Squier, the guest of honor, and Lee de Forest added a further testimonial on the cable inventions of the scientist soldier. Mr. Clark emphasized the fact that there now existed the closest co-operation between the Army and Navy Departments and through their co-ordinated effort the very highest type of equipment had been secured. That every engineer engaged in wireless work would offer his services to the nation unreservedly, was the prediction of Dr. Louis Cohen, of the Bureau of Standards, who followed the speakers with a review of the efforts of the engineers and their accomplishments. Recent inventions, he stated, were of the greatest importance and it was unquestioned that still greater refinements would follow fast in the crucible of wartime effort.

Further inspiration to effort was added by H. E. Knight, a patent attorney, who gave unstinted praise to the men who had set aside the isolation of the sea. A contribution of a more efficient type of apparatus so that ships and men at sea could be instantly controlled by the naval strategist, he characterized a more valuable gift than another ten million dollar battleship. The execution of these principles, the tearing aside of the curtain of ignorance, had been the aim and purpose of the Institute of Radio Engineers, added its secretary, David Sarnoff, commercial manager of the Marconi Company. Its rapid growth to the point where members who were none too friendly in the battle for commercial supremacy met on the common ground of enlightenment where scientific research was concerned, he believed justified most enthusiastic predictions for the acceleration of progress in the art itself. Mr. Sarnoff reiterated the praise due General Squier for his contributions to science, and noted that in the testimonial dinner tendered in recognition of his accession to the high office of Chief Signal Officer of the Army, the Institute was honoring one of its most active workers and heartiest well wishers.

An ovation marked the introduction of the guest of the evening, and General Squier responded immediately with a message of inspiration that pointed out a double incentive for every engineer present. The keynote of his address coincidentally lay in the toast carried on the menu, titled "To the Radio Engineer of Tomorrow."

Here is a toast that we want to drink to
 a fellow we'll never know—
The fellow who's going to take our place
 when it's time for us to go.
We wonder what kind of a chap he'll be
 and we wish we could take his hand,
Just to whisper, "We wish you well, old
 man," in a way that he'd understand.
We'd like to give him the cheering word
 that we've longed at times to hear;
We'd like to give him the warm handclasp
 when never a friend seems
 near.
We've gained our knowledge by sheer
 hard work, and we wish we could
 pass it on
To the fellow who'll come to take our
 place some day when we are gone.

It was the spirit phrased as "we've gained our knowledge by sheer hard work" which General Squier sought to emphasize. It was all hard work, he believed, so intensive that it gave little opportunity for the worker to realize that he was making scientific and industrial history. He noted that, almost without exception, the engineers of the art were young men, yet their research was conducted in a field which encompassed conduction and transfers of radiant energy, striking the very highest form of electrical engineering. He compared radio investigation with other forms of electrical engineering, pointing to the fact that the power and transmission engineers restricted themselves to the production or transfer of currents, whereas their finest productions were required to generate and control the high frequencies employed in wireless transmission. The radio engineer therefore was employing the most advanced expressions of other branches of power engineering; yet he could not remain satisfied with their perfection since it was his function to utilize them in a still higher form of development. In this lay the wireless man's great opportunity, he observed, and it was his belief that it was all too little appreciated among the workers in the art that their investigations represented the supreme expression of signal engineering. As an instance, he cited the control of currents through the employment of the vacuum valve, stating that in its study to define the theoretical action the engineer bordered on the highest form of physics. He advocated recognition of radio experts as signal engineers, a fuller designation of their field being thus expressed, since, in the pursuit of their research they first had to learn all that signal engineers know about power transmission, radio embracing all these forms and the additional form which was peculiar to their restricted field. In this necessity for wide knowledge lay the wonderful opportunities for the young man, he believed, and with the expansion of the art he looked for the attraction to the field of the best engineering brains of the country.

The General then commented on the new spirit which had swept the country during his absence abroad. The high type of patriotism evidenced everywhere had proved a revelation to him, he said. To his office in the War Department, for instance, had come the representatives of practically all the nation's greatest industries, offering to the Government their equipment and personnel without reservation. Men whom he had believed so engrossed in the magnitude of their commercial affairs that they could give only partial consideration to defense needs had placed at Government disposal everything they had, declaring their willingness and anxiety to serve the nation with all the facilities under their control. This spirit was inspiring, he declared, and promised well for the efficiency of the military establishment in war time.

With characteristic enthusiasm for scientific study, General Squier concluded his notable address with a suggestion to engineers. He called attention to the fact that the field was well acquainted with the result attained by signaling with oscillations above the point of audibility; he then noted that using the microphone he had transmitted signals by submarine cable below the point of audibility, and found this method efficient, not better than at high frequencies, but good. The suggestion was then in order, he thought, that American engineers try communication at a point in between, using the microphone. The result, he believed, would be interesting and would contribute valuable data to the field.

General Squier was the last speaker, and at the conclusion of his inspirational message the diners arose and recited in concert the vigorous expression of patriotism, "The Flag We Love," particular significance being attached to its delivery amid the distant rumble of a great nation preparing to go to war:

"Your flag and my flag, and how it flies today
In your land and my land and half a world away;
Rose red and blood red its stripes forever gleam,
Snow white and soul white, the good forefathers' dream;
Sky blue and true blue with stars that gleam aright;
The gloried guidon of the day, a shelter through the night.
"Your flag and my flag, and oh, how much it holds!
Your land and my land, secure within its folds;
Your heart and my heart beat quicker at its sight,
Sun kissed and wind tossed, the red and blue and white;
The one flag—the great flag for me and you,
Glorifies all else beside—the red and white and blue.

ANOTHER VIEWPOINT ON THE STATION IN MEXICO CITY

In El Pueblo, a government organ published in Mexico City, was published the following article on March 28:

"In the last few days the wireless station installed at Chapultepec, in this city, has been communicating directly with the North American city of Houston, in the State of Texas, and with some cities of South America, especially Panama.

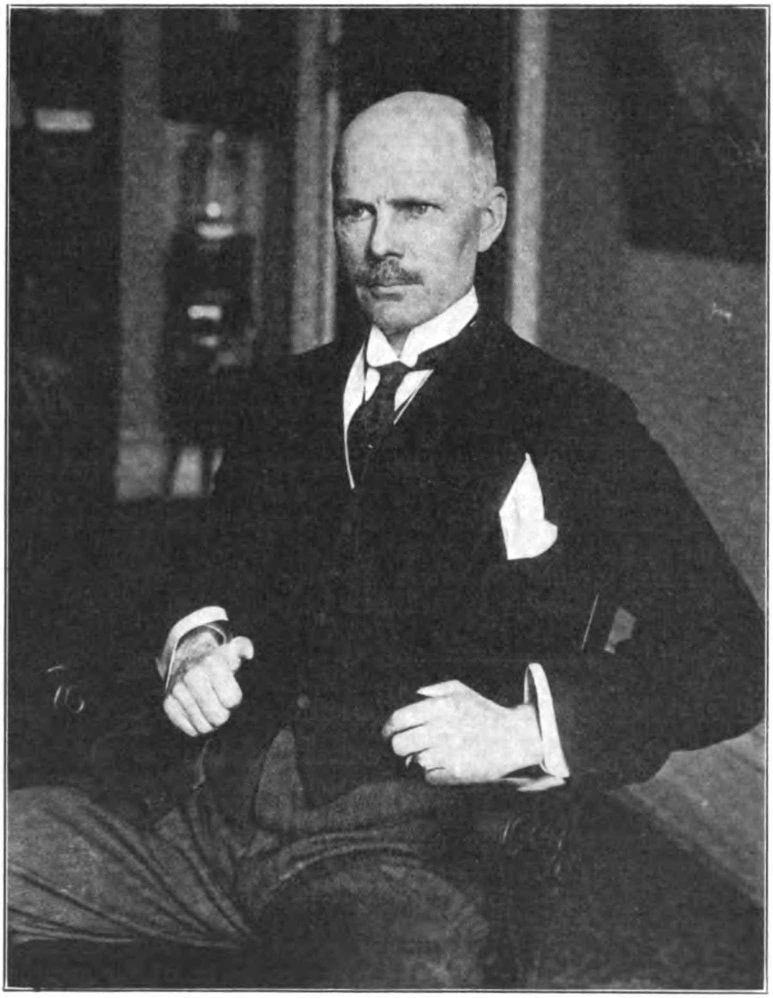
"This fact signifies that our wireless service is improving daily and that its field of action is extended more and more.

"In order that our readers may appreciate this progressive evolution of our wireless service, we will say that since the constitutional government controlled the greater part of the territory of the republic the service in question, with the ships arriving at our ports or to be found in national waters, is double what it was in former times."

This inspired "explanation" of why Mexico has suddenly added such a powerful station to its wireless service—to be prepared to report merchant ships after the war ends in Europe—was received with some amusement by foreigners who read it in Mexico City in the government organ. It was commented that the station might be of far greater value to German submarines in Gulf waters if possibly the Zimmerman note inviting Mexico to become an ally of Germany should prove to be something more than a mere "scrap of paper."

It is known that Mexico City has been holding wireless communication with San Salvador and also with Colombia, and it is also known that the German Minister in Havana has received mysterious wireless messages having to do with Mexican affairs.

General Squier, Scientist, Inventor and Soldier



Activities of the Newly Elected Advisory Board Vice-President of the National Amateur Wireless Association

MEMBERS of the National Amateur Wireless Association will be gratified to learn that Brigadier General George Owen Squier, Chief Signal Officer of the Army, has been elected one of the vice-presidents of the National Advisory Board of their organization. The National Amateur Wireless Association thus obtains all the benefits of the advice of an energetic officer of high scientific attainments.

Among the important researches made by General Squier are the electro-chemical effects due to magnetization; the polarizing photo-cronograph; the sine wave systems of telegraphy and ocean cabling; the absorption of electro-magnetic waves by living vegetable organisms, and multiplex telephony. He is the co-inventor with Professor A. C. Crehore of the polarizing photo-cronograph and of two systems of rapid telegraphy, both employing the alternating current. The polarizing photo-cronograph, which is based upon the principle of the electro-magnetic polarization of light and was devised for the measurement of the velocity of projectiles, formed the subject of several papers contributed to the Journal of United States Artillery, of which periodical General Squier was one of the founders. The earlier system of rapid telegraphy, described in a paper read in 1897 before the American Institute of Electrical Engineers, was based upon the employment of the alternating current and on the use of the polarizing photo-chronograph as the receiver. This system was experimentally operated over the lines of the British post office with satisfactory results. The later system, described in a paper read before the same body in 1900, was one for submarine telegraph service, and involved the use of sine wave e. m. f's. This sytsem also gave excellent results in experimental operation over a commercial submarine line. The transmitter used with this latter system was the subject of a paper read before the International Electrical Congress of Paris, 1900. General Squier and Professor Crehore also devised an alternating-current range and position finder.

WAR DEPARTMENT,
OFFICE OF THE CHIEF SIGNAL OFFICER,
WASHINGTON.

March 21, 1917.

My dear Mr. White:

Your letter of March 19, 1917, has been received and read with much interest.

I shall have pleasure in serving as an honorary vice-president of the National Amateur Wireless Association and desire to express to the Association, through you, my appreciation of the courtesy shown to me by my election to this office.

With kindest regards, I am,

Sincerely yours,

Mr. J. Andrew White,
Acting President,
National Amateur Wireless Association,
450 Fourth Avenue, New York, N. Y.

General Squier's letter accepting honorary vice-presidency of the N. A. W. A.

Among the more recent work of General Squier is a study of the absorption of electro-magnetic waves by living vegetable organisms, and an investigation of the use of trees in wireless telegraphy as antenna, which latter has resulted in some remarkable, practical developments.

His chief and most recent invention is popularly known as the "wired wireless." Its principal value lies in the fact that it enables the cable to transmit a number of messages at the same time. It is also possible to telephone a number of messages at the same time. It is even possible to telephone at the same time while the message is being telegraphed, without interference. What General Squier's invention has made possible—and this is his most important contribution to the wireless art—is that it puts a high frequency current into the line and controls it by the use of the vacuum valve, receiving it through the same instrumentality and controlling it to normal along the line. This arrangement permits him to have more than one alternator and more than one receiver.

This invention has another great advantage. It makes cable signals audible. They can be read faster and with less possibility of error than through sight reading, under which system cable messages have hitherto been received.

General Squier, who has been attached to the aviation section of the Signal Corps, was born in Michigan, March 21, 1865, and is a graduate of the U. S. M. A., class of 1887, when he was promoted in the Army to be second lieutenant, 3d Artillery. He was appointed a first lieutenant in the Signal Corps February 23, 1899. He took a course of instruction in electric engineering at Johns Hopkins University and holds the degree of Ph. D. from that institution. He has served as instructor in the department of electricity and mines at the Artillery School, Fort Monroe, Va., and was signal officer of the Department of the East. During the war with Spain he served as a captain and lieutenant colonel and signal officer of volunteers, and was chief signal officer of the 3d Army Corps. General Squier served in the Philippines, 1900-1902, through the entire rebellion. He was in charge of the captured Spanish ship Rita, which he refitted as cable ship (U. S. S. Burnside), and he designed and constructed the first ocean cable made in America and laid in two years, under the late General McArthur, all the cable system in the Philippines. He founded and was first assistant commandant of the Signal Corps School at Leavenworth. At the outbreak of the present war he was assigned as U. S. censor to New York City, and was later detailed as military attache to the American Embassy at London.

In 1910 Colonel Squier invented the "multiplex telegraphy system," the patent for which he took out in the name of the whole people, thus throwing aside a comfortable fortune. His ability as an expert in his line was early recognized abroad. He was made a fellow of the London Physical Society, and before this body, in 1915, he read a paper, describing a new method of cable system which since has been officially adopted by the British government. General Squier was chief signal officer of the maneuvers division on the Texas border in 1911, and also wrote the specifications for the first airplane bought by any government (the Wright machine), and was the first passenger ever carried in an airplane.

GENERAL DYER HEAD OF NEW YORK STATE HOME DEFENSE

It has been announced that the new head of the Home Defense Department of the Mobilization Research Bureau in New York state will be Brevet Major General, George Rathbone Dyer, commanding officer of the Junior American Guard, with which the National Amateur Wireless Association is affiliated. The selection was made by Adjutant General Stotesbury. General Dyer will have under his direction the organization, equipment and training of the Home Defense Corps, together with the recruiting for the regular army and navy and the National Guard. A dinner of the officers of the Junior American Guard took place in New York City on the evening of April 12th, when General Dyer outlined their duties now that the United States has declared war against Germany.

A powerful wireless outfit was discovered by men of the 71st New York Infantry near their headquarters in New York State on April 7th. Electricians dismantled the apparatus.

The information upon which Colonel Bates acted came to him early in the morning. At three o'clock in the afternoon a bugle blew assembly and a company swung off down the road toward the suspected farm. The wireless was owned by the occupants of the house, whose records are being looked up.

The War Spirit of the Signal Corps

A Dramatic Account of the Units in the Field Under Fire in Flanders.

SOMETHING of the sensations of signalmen of the British troops is given in a narrative by "Perikon" in The Wireless World. With the call to arms sounded, this article will interest all wireless men who contemplate taking the field in the service of their country.

* * *

The final inspection at the wireless depot is in full swing. Across the stretch of flat ground a small limbered wagon is careening, drawn by a four-horse team. Ahead and behind the swaying limber ride a posse of horsemen.

The glittering hubs and shining wheels are as clean as emery, "elbow grease" and "oil-preserving wood" can possibly make them. The horses have all the glossy satin coat which comes of decent treatment, feeding and grooming. The harness and saddlery glitter. Buckles, irons and bits gleam silver in the sun. The men themselves are spick and span, and sit their saddles well.

A number of whistle blasts, and the canter changes to a gallop. The cavalcade takes the prepared ditches and banks without slackening speed—the team horses straining into their breast collars and their traces taut. A second blast, and the troop halts abruptly. The team is swiftly unhooked, the "single mounts" are passed to the drivers and the horses move off in a bunch and "stand easy" some hundred yards off—snorting and blowing and generally having a breather.

The wagon is left with the station crew, who fall in smartly in the rear, and next second are busy "erecting station." Three minutes later the first mast is raised, stayed and secured. The second follows, and in a brief space there is a sudden road and a hiss as the motor starts, and Number One depresses the transmitting key.

"Station ready and working—six and a half minutes—not so bad," remarks a dapper officer of Engineers standing some hundred yards off—"Dismantle." The order is conveyed by whistle blast, and eight minutes later the pack trots past *en route* for stables and dinner—the dreaded ordeal over and with the conviction that they've done well and will surely soon be across the Channel.

* * *

Two weeks later sees the limber, then the trail, being swung aloft by a giant crane and swiftly lowered into the spacious hold of a "trooper." The horses are "'tween decks" with their saddlery on, but with loosened girths. The station crew are squatting on deck and doing their best to avoid the various white-hot steam pipes with which the decks of a tramp seem to abound, and in drawing their life-belts from the roomy chests on deck and elsewhere.

* * *

Ten months later the advance guard of the 160th Corps rattles through the deserted little village. First a troop of lancers, then four wicked-looking Q.-F.'s with ammunition limbers apiece, and a couple of baggage and forage wagons behind. Then a small limbered wagon with a small posse of horsemen ahead, and behind—the wireless wagon. If you looked closely you'd recognize it as the same one you'd noticed at the home depot undergoing its final inspection. But there's a drastic change in everything. The wagon is encrusted in dry mud and dust, and small pieces of turf are adhering to wheel and limber. The horses have lost much of their satin, and the metal fittings of the harness no longer shine silver, instead they are thick in rust. No glittering buckles, irons or bits now. Then men look thinner perhaps, and stubbly beards and unwashed appearance almost convince you that they can't really be the same men. You note a difference —a vague something in their way of looking at one, and you decide they're *not* the same men.

Behind them another troop of grimy cavalry clatter—horses in a lather, and horsemen blue-chinned and hollow-eyed. For three days they've pushed on, pressing and worrying the rearguard of the crack East Prussian Corps directly opposed to them. The great retirement has begun and the Germans so far have conducted it in a swift and businesslike manner. Another twenty kilometres perhaps, and they'll swing round and make a stand, for the black-eagled frontier posts begin just beyond that—*then* there's a possibility of firework displays on a large scale. Meanwhile the grey Uhlans of the rearguard can sometimes be picked out with the naked eye crossing fallow, or silhouetted for a fleeting instant on the sky line.

The leading troop of our advance and the four wicked-looking Q.F.'s suddenly swing through a gap in the roadside hedge and canter in the direction of a small plantation. The rest of the cavalcade follows and halts in the shade of a row of tall elms. A "fleeting opportunity" target has offered itself in the shape of a dense blue-grey smudge toiling like a big lizard into the heat haze some two miles ahead. An instant later the Q.F.'s are showering them with douches of whining metal. Smoke obscures the lizard, but when it clears nothing can be seen distinctly by the naked eye—perhaps it's better.

We turn round and see the pack crew hurrying to and fro at the double, "erecting station," much as they did on the depot ground more than ten months ago. Important "stuff" must be got through to Corps' Headquarters, and that within the next fifteen minutes, for the seeming impossible has happened. The enemy has been strongly reinforced—Heaven knows how or from which quarter—and is turning and slowly crawling back in his tracks. Squadron after squadron of apparently fresh cavalry can be picked out deploying in extended order from spinney and hedgerow, looking much like hurrying ants at the distance. It means our advance guard falling back perhaps ten kilometres, unless at least a cavalry division and the Corps' "heavies" can be rushed up in time to meet the oncoming wave and send it staggering back. Two troops of the finest cavalry and four Q.F.'s of small calibre can do some considerable damage, but it's suicide to attempt to stem an entire enemy division equipped with well over thirty light pieces maybe.

The enciphered message goes hissing out into space, and a yawning operator at Corps Headquarters (a tumbledown farm some four miles in the rear), takes down the message group by group, hands it to his superintendent, and signals the pack to go on with his "stuff."

Meanwhile the Q.F.'s have abruptly ceased firing, and their teams are trotting over to move them. The cavalry outposts have galloped in. A ranging shell bursts over the trees a decent hundred yards to the right, and occasionally spent bullets go whinny overhead. An orderly canters over to the wireless station, and next minute the masts are down and being packed, the aerial is running home on its drums, and the gear is being loaded.

Just as the orderly is gathering his reins to canter off, a giant billowy ball of saffron-hued smoke springs out of nothingness about ten feet off the ground, a deafening crash is heard—smoke and explosion occur at precisely the same instant. The orderly and horse appear to lift some three feet in the air and thud inert to earth. Three of the pack crew go down, ripped up in hideous strips. Two others attempt to get up and roll over with curious gurgles. They have crossed into calmer water. A horse shrieks and lies lashing at the lifeless carcass of his teammate. The wagon is splintered and the fore limber is wrecked. Only three of the pack crew are unscathed. Smart gunners these enemy horse artillerymen —not exactly blacks. Suddenly the Q.F.'s limber up and gallop towards the gap in the hedge.

"Come on, you people, get a horse and move yourselves, their patrols are three fields off," yells a Major of Artillery.

"No time to repair"—the rest is lost in the rumble of limbers and sog-sog of the hoofs. The pack crew hastily unstrap their axe and pickaxe and do a seemingly curious thing. They smash into the apparatus, and next second the shining fabric of ebony and nickel, of which they were so proud, lies in a tortured heap. A tin of petrol is ripped up and the pile drenched, a light applied, and a crimson tongue of flame shoots up, stationery, messages, etc., are thrown on top. Two minutes later three horsemen are tearing down the poplarlined pave in the wake of the fastly moving Q.F.'s and cavalry. Mauser bullets hum and whine about their ears and occasionally crack into the poplars with loud whiplike snaps.

One grimy rider turns to his comrade: "Anyway we got the message through, and the swine can't use our gear—get up, Billy boy"—as his weary horse stumbles and picks up his stride again.

Three kilometres farther on a loud close-at-hand rumbling assails their ears —our heavies about a kilometre off by the sound. Suddenly the Q.F.'s halt, unlimber, and send salvoes of shell shrieking into the strung-out advance guard of the enemy. Our cavalry reinforcements have arrived, too. To right and left they can be seen streaming and deploying. Eighteen-pounders, too, battery on battery are coming up at the trot through stiff plough, and unlimbering and beginning to spit and cough. Machine guns rattle, rifles and carbines crack, riderless horses tear insanely and aimlessly in all directions. The enemy's patrols wheel round, and in a few minutes they can again be picked out, their squadrons lighter, hurrying into the shimmering haze, much like scurrying ants.

The Q.F.'s gallop back on their tracks in a fog of choking dust, a squadron of lancers, more horse artillery, another dragoon and hussar squadron, and cantering hot in their wake with limber and trail swaying, and an eddy of dust astern, another pack wagon clatters. Everybody looks fresher and cleaner than the advance guard. They've all come up in response to THE message.

All Amateur Wireless Stations Being Dismantled

ACTING under instructions from the Navy Department at Washington, on April 8th, the military and police authorities throughout the country began dismantling all sets of wireless apparatus, with the exception of those used by the Government or under the direct supervision of United States officials.

Previously, on March 28th, Secretary of Commerce Redfield ordered, as a precautionary measure, that no further licenses were to be issued for the operation of amateur wireless stations until further notice. The order, as sent out by the Radio Service of the Department of Commerce, read as follows:

"The Commissioner of Navigation has instructed that no amateur station licenses be issued until further orders as a measure necessary for the public defense. Your application and forms for a station license have been received in this office, but no action will be taken thereon and they will be held in the files of this office for future consideration.

"Under the conditions it will be unlawful for you to do any transmitting with your station equipment, but the above regulation does not prevent your using your receiving apparatus until instructions to the contrary are issued."

Since the issuance of this order, however, came the declaration of war against Germany and the new instructions, ordering the dismantlement of all amateur apparatus.

Wireless Instruction for Military Preparedness

A Practical Course for Radio Operators

By Elmer E. Bucher

Instructing Engineer, Marconi Wireless Telegraph Company of America

With President Wilson's declaration of war with Germany, loyal Americans bend their energies to serving their country. The true American begins to think to what branch of the military (or naval) service he shall offer himself when the call comes.

Of course, the man whose trade or profession is such as is not required by any branch of the war service will enlist as a private. But to the man skilled in a particular profession useful in the army or navy an opportunity is now offered to enroll with the military forces in the particular field in which he is already qualified. Also, if there be any who by reason of physical disabilities or who for other causes are unable to take the field as privates, yet in whom the spirit of patriotism burns and the desire to serve seeks for expression, they, too, can qualify themselves for service in a skilled branch of the service.

Physicians, dentists, electrical engineers, civil engineers and other professionalists will all find their service in demand by the Government. And of equal importance with these professions will be that of radio operator.

Radio telegraphy is regarded as one of the most efficient and most rapid means of establishing communication in the field, and more and more reliance is being placed upon it by military authorities.

There is a clamorous demand for radio operators. Not only are they required for service at sea with the battle fleets and on land with the troops in the field, but there is an urgent demand for them on merchant ships, and coastal stations, as well. In probably no other branch of the Government service is there such a pressing need at this date for *skilled* workers.

One thing that may have tended in the past to keep many men (and women) from seriously taking up the study of wireless telegraphy is the lack of proper facilities for learning the profession. Radio schools are situated mostly in the larger cities. This means that the young man living far from the city has had to satisfy himself with whatever instruction could be gleaned from such radio textbooks as were at hand.

And yet here another obstacle presented itself. For up to the present time many of the writers on radio telegraphy have contented themselves with addressing an exclusive coterie already well versed in the art. Some authors have attepted only to write what amounted to a historical review of radio telegraphy, others have confined their efforts to disclosing the art as practised in Europe and still others have devoted their work to the mere theoretical principles of radio-frequency circuits. In fact such textbooks as have been written applicable for training the young man are so old as to be obsolete and of little aid in the study of present day wireless apparatus and manipulation.

Those of us actually engaged in practical radio telegraphy know well that an operator's course in wireless telegraphy includes vastly more than a theoretical discussion of radio-frequency phenomena. In fact, a commercial operator is not qualified to handle a radio equipment unless he has knowledge of dynamos, motors, motor generators, storage batteries, charging panels, antenna construction, installation of power circuits, installation of sets, etc. Beyond this he must have a theoretical knowledge of the principles of transmitting and receiving circuits in order that he may manipulate the apparatus with understanding.

From this it can be seen that a modern common-sense book on radio telegraphy addressed specially to those wanting a practical course in the art was urgently needed. In an effort to meet this need, the writer out of his practical experience as a lecturer and instructor to radio employees of the Marconi Company has brought out a book, which under the title, "Practical Wireless Telegraphy" will shortly be placed before the public.

In the meantime, however, the crisis so suddenly brought upon the country has moved him to compile a condensed version of this book and it will be published in serial form in the pages of the Wireless Age.

This condensed version will be the forerunner of a new method in the teaching of radio telegraphy. It will consist of a presentation of only the absolute essentials of the art and is intended for those who want to acquire the knowledge and ability to qualify in the least time as practical radio telegraphists. All theory and detail—however interesting and valuable—which has no pointed relation to the practical manipulation of a radio set will be omitted. This should not be taken to mean that the course will be incomplete and will skimp over things. Far from it. Every point that is at all necessary and desirable that the commercial wireless operator shall know will be covered. Every detail that concerns the actual adjustment of the apparatus will receive mention. All this will be in harmony with the purpose to train efficient wireless operators who will be prepared to serve at wireless stations conducting Government or commercial radio telegraphic traffic, when the call comes to them.

Reference at the student's leisure to the author's more complete book will give an insight into the theory of the art which the need of the moment does not require of the condensed version. Still it should be kept in mind that "Practical Wireless Telepraphy" is strictly an operator's textbook and devoted in a large measure to descriptions of practical commercial apparatus of all types and kinds in use by the Marconi Company.

In compiling the short version of this book, the author has held before him the requirement that upon the completion of this condensed course, the student shall be prepared to take up duty at a commercial or government wireless station. With this in mind, the course will include minute instruction in the equipment, care and maintenance of such a station.

Adjustments of apparatus necessary when traffic is being handled; the operation of the set under ordinary and extraordinary working conditions—these are the matters that will receive spcial emphasis, for it is in these things that the student will be interested and most in need to know.

As an invaluable aid in grasping the lessons to be published in The Wireless Age, drawings, pictures and sketches will accompany each installment of the course. Wiring diagrams, commencing with the most elementary circuits and gradually leading up to the more complicated circuits and illustrations of the various parts of the set will appear in each issue to help to a better understanding of the printed text.

The manner of presenting the text itself will be entirely different than that of previous instruction courses. The reading matter will be in short and crisp sentences, easily understood and remembered, and the text on each page will be devoted to the particular diagram on that page. In fact, it will be the first time that a course in radio telegraphy has been presented so briefly as to shorten the period of study necessary to secure a mastery of wireless telegraph operating.

Some of you may doubt your ability to complete successfully a course in radio telegraphy. To those let me say that if you have had a common school education, if you are of average intelligence and have an ambition to learn, and the persistence to stick out the course and not be side-tracked by shiftlessness, you can and will finish the course with profit to yourself and with pride in your abilities.

This serial course will be complete, starting at the very beginning with exact instructions as to the material needed for a start and working on, step by step, into the more detailed and interesting phases of wireless. Anyone (man or woman) who applies himself steadily to the study of the lessons presented each month in THE WIRELESS AGE, and faithfully practices as directed, will soon find himself engaged in a most attractive and profitable profession, and one which will bring honor to himself and benefit to his country.

PRELIMINARY PROCEDURE

MATTERS TO HAVE IMMEDIATE CONSIDERATION:

(1) All commercial radio operators must possess U. S. Government License certificates.

(2) Operators' Licenses are graded according to the ability of the one being examined.

(3) Examinations for licenses are taken at one of several examining posts (such as Custom Houses, Navy Yards, etc.).

FIRST REQUIREMENTS:

(1) The ability to send and receive signals in the International Telegraph Code. (The Continental Code.)

(2) Knowledge of the International Radio Telegraphic Convention Rules. (These are printed in "Traffic Rules and Regulations" issued by the Wireless Press, Inc.)

(3) Knowledge of the U. S. Radio Act of August 13, 1912. (This is printed in "Traffic Rules and Regulations" issued by the Wireless Press, Inc.)

(4) Information concerning the requirements of operators license examinations. (This can be obtained in Chapter 8 of "How to Pass U. S. Wireless License Examinations; also from the pamphlet "Radio Communication Law of the U. S.," a copy of which can be purchased from the Government Printing Office, Washington, D. C.)

GRADATION OF COMMERCIAL OPERATORS' LICENSES:

GRADE.	CODE SPEED REQUIRED.	SCOPE OF TECHNICAL EXAMINATION.
Commercial Extra 1st Grade	30 words per minute American Morse 25 words per minute International or Continental Code	Wider in scope than examination for original first grade certificate. (Passing mark 80%.)

Commercial 1st Grade	20 words per minute Continental Code (5 letters per word).	(a) Adjustment, operation and care of commercial apparatus. (b) Correction of faults. (c) Use and care of storage batteries and auxiliary apparatus.
Second Grade	12 words per minute Continental Code (5 letters per word).	Same as examination for first grade but less in scope.
Cargo Grade	Approximately 5 words per minute Continental Code. (Sufficient to enable "watcher" to interpret S O S signals and call letters.)	Must be able to explain adjustment of receiving apparatus and draw simple fundamental wiring diagram of transmitter and receiver.

GOVERNMENT CODE TEST (FOR LICENSE CERTIFICATE) WILL INCLUDE THE FOLLOWING:

(a) Call letters.
(b) Regular preambles.
(c) Conventional Signals.
(d) Abbreviations.

Reading matter will not be allowed. The test shall continue for five months at the rate of twenty (20) words per minute.

CREDITING OF GOVERNMENT LICENSE.

(75% constitutes passing mark for first grade certificate; 65% for second grade certificate.)

	Points Awarded.
A—Experience	20
B—Diagram of Transmitting and Receiving Apparatus	10
C—Knowledge of Transmitting Apparatus	20
D—Knowledge of Receiving Apparatus	20
E—Knowledge of the Operation and Care of Storage Batteries	10
F—Knowledge of Motors and Generators	10
G—Knowledge of the International Regulations Governing Radio Communications and the U. S. Radio Laws and Regulations	10

HOW TO OBTAIN CODE PRACTICE:

(1) Join the nearest telegraph school (practice Continental Code only).

(2) Purchase or construct a "buzzer practice outfit," consisting of buzzer, ½ microfarad condenser, 75 ohm head telephone and telegraphy key. Have a friend familiar with the code send character for practice.

TIME REQUIRED TO BECOME PROFICIENT IN THE CONTINENTAL CODE:

(a) 20 words—3½ to 6 months.
(b) 30 words—6 to 12 months.

BOOKS TO BE PURCHASED:

(1) Practical Wireless Telegraphy.

(2) Traffic Rules and Regulations.

(3 Practical Electricity (By C. Walton Swoope).

STUDENT OPERATORS' ENTRANCE QUALIFICATIONS ACCORDING TO THE MARCONI COMPANY:

(a) Age—17 years up.

(b) Education—applicant must be a graduate of a grammar school.

(c) Reference—two satisfactory letters of reference from parties of recognized standing.

QUES. What does a commercial radio operator's technical course include?

ANS. It includes study of,

(a) Principles of electricity and magnetism.

(b) The fundamental principle of the dynamo and motor.

(c) The operation and care of motor generators.

(d) The functioning of the induction coil and the alternating current transformer.

(e) The operation and care of storage batteries and charging panels.

(f) The production of radio-frequent currents by condenser discharges.

(g) The radiation of electric waves.

(h) The process of tuning. (Sender and Receiver.)

(i) Adjustment and functioning of receiving apparatus.

(j) Location of faults and troubles.

(k) Antenna or aerial construction.

QUES. What does a traffic course include?

ANS. It includes study of,

(a) Marconi traffic regulations.

(b) The International Radio Telegraph regulations.

(c) U. S. Naval regulations.

(d) The method of abstracting and accounting for tolls.

(e) Charging of tolls.

(To be Continued.)

Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE V

CONTINUING our discussion of radio telephony by means of radio-frequent spark transmitters, we consider next a system developed by Dr. E. Leon Chaffee in conjunction with Professor George W. Pierce. This system will be found to be unique in certain respects.

The wiring diagram of the transmitter is shown in its essentials in Figure 44, and presents no unusual features. The direct current generator supplies 500 volts (and from 0.3 to 0.8 ampere; i. e., from 150 to 400 watts) per gap. The resistance provided in the supply circuit is made in two parts, in series, one roughly variable in considerable steps and the other smoothly and continuously variable. This is desirable, since the operation of the gap, though steady, depends on a proper choice of the current, this current partly determining the inverse charge frequency. The phenomena of an inverse charge frequency (that is, a whole-number ratio between the secondary oscillation frequency and the primary impulse frequency) has been treated above, and is illustrated in Figure 31. It constitutes a distinctive feature of the Chaffee gap, and depends on the intrinsically great damping in the gap.

The primary condenser C need not be a high tension condenser with the usual low power sets, and generally has a value in the neighborhood of 0.009 microfarad. The coupling between L_1 and L_2 is close. Ordinarily, the microphone M is an ordinary Bell transmitter, though Chaffee has stated that this type of microphone deteriorates somewhat under radio frequency currents of one ampere or more.

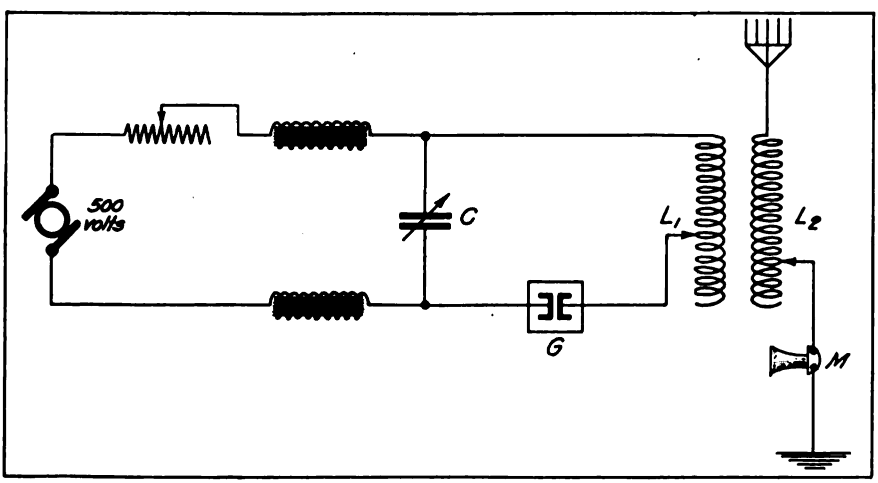


Figure 44—Chaffee radiophone transmitter

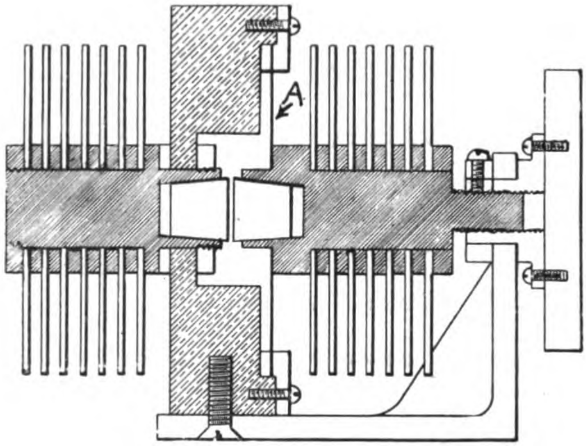


Figure 45—Cross section of Chaffee gap. Designed by Cutting and Washington

The cross section of a Chaffee gap, constructed by Messrs. Cutting and Washington (under patent license from Dr. Chaffee) is shown in Figure 45. The gap consists of plugs of aluminum and copper respectively, one or two square centimeters (or roughly two or four-tenths of a square inch) in area, larger dimensions being undesirable in the stationary forms of the gap. Originally the gap was run in an atmosphere of moist hydrogen; but hydrogen being difficult to obtain in ordinary practice, it was found by Cutting and Washington that alcohol vapor could be substituted provided it was distilled into the gap, by the gap heat, from a wick entering the bottom of the gap chamber. The form of gap shown is made air-tight by the use of the flexible phosphor bronze diaphragm *A*, which is held in place against a soft rubber gasket by a brass ring. Such a diaphragm permits the necessary movement required in adjustment of the gap electrode separation. The external appearance of the gap with its adjusting handle and cooling fins is given in Figure 46. For larger powers, a still later modification of the gap is used wherein the discharges pass between a rapidly rotating aluminum disc and a stationary copper plate, in hydrocarbon vapor. High efficiency (up to 60 or 70 per cent.) can be obtained with these last gaps.

The discharge begins when the switch is closed, provided the distance between the electrodes is not over 0.1 mm. (0.004 inch). It is a noiseless and fixed arc of a vivid violet or purple color. Occasionally it moves to a fresh point on the electrodes. The explanation of the extreme quenching action lies, according to Chaffee, in "the practically instantaneous re-establishment of the high initial gap resistance when the current becomes zero, due probably to the formation of an insulating oxid film on the aluminum; the high cathode drop of the anode metal; and the absorption of energy by the secondary, although rectification usually takes place without this aid. The best operating gap lengths are from 0.04 to 0.09 mm. (0.0016 to 0.0036 inch).

The primary discharge is a half loop of current, and, as correctly indicated in Figure 31, is not half a sine wave. Its duration does *not* depend on the primary supply current, which latter affects only the time between successive primary discharges. The time between successive primary discharges is also dependent on the primary capacity, since the charging phenomena connected therewith largely determine the successive break-downs of the gap. For an inverse charge frequency of 2 or

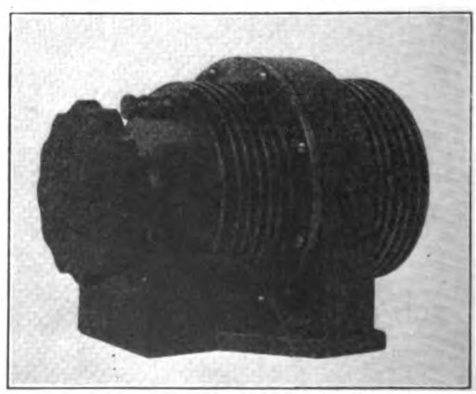


Figure 46—Chaffee gap. Designed by Cutting and Washington

3, the secondary oscillations differ only imperceptibly from truly sustained oscillation, as is evidenced by the interesting fact that when received on a normal beat receiver, a clear musical beat tone is obtained.

It is worthy of note that even with this absolutely aperiodic primary discharge, a definite relation between the primary period and the secondary period is required for maximum secondary response. This relation is, however, far from being one of even approximate equality being, in fact, a ratio of 1.71 for primary period divided by secondary period.

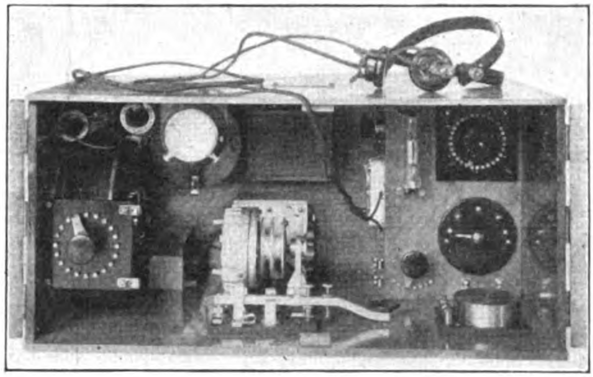


Figure 47—Aeroplane set with Chaffee gap. Designed by Cutting and Washington

The radio frequency output per gap is about 50 watts, and the efficiency is given as between 30 and 40 per cent. Two or three gaps may be operated in series on 500 volts, and four gaps on 1,000 volts. The actual voltage drop across the individual gap is about 150 volts.

The Chaffee apparatus as developed for commercial work by Cutting and Washington is illustrated in Figures 47, 48, and 49. The first of these is a 150-watt aeroplane set, with the special gap in the center. The primary condenser is behind the gap, and the primary-to-antenna coupler is mounted to the left. In the latter two figures, a somewhat larger set is depicted. Here two gaps in series are used, and a variometer type of coupling. Telegraphic communication was maintained with one of these sets 78 miles (125 km.) with 1.5 amperes in the antenna at 480 meters wave-length. It should be noted that, in marked contrast to almost all sustained wave generators, the Chaffee arc drops but slightly in output at very short wave-lengths.

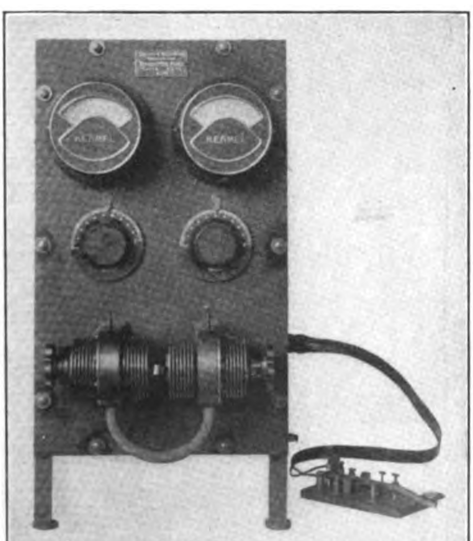


Figure 48—Front view, 0.25 k.w. Chaffee gap set. Designed by Cutting and Washington

It has been pointed out elsewhere by the Author that a marked tendency exists in radio development toward having all stations operate with sustained radiation. This tendency is much to be encouraged because of the remarkable possibilities in the direction of selectivitiy with beat reception at the short wave-lengths. While beat reception is not particularly suited to radiophone work, it is to be hoped that ship and small shore stations, and all amateur stations, will at least employ sustained wave generators. If this is done, the Chaffee arc would seem to be a suitable device, and has marked possibilities.

In the radiophone experiments described by Chaffee, great simplicity of apparatus was achieved. The regular tests were carried on over a distance of one mile (1.6 km.). A single gap was used with from 0.2 to 0.5 ampere

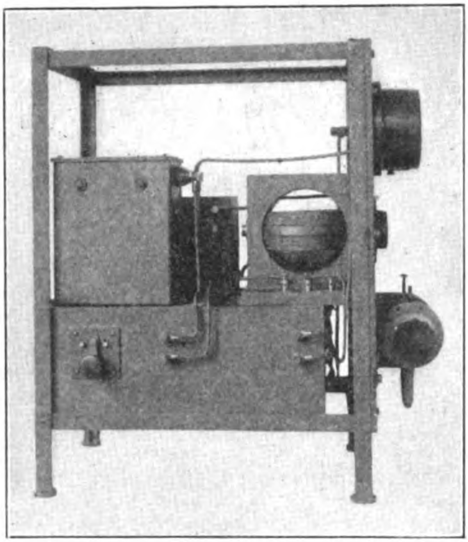


Figure 49—Side view, 0.25 k.w. Chaffee gap set. Designed by Cutting and Washington

through it. The voltages at all portions of the set in the station were comparatively low, say under 1,000 volts. It is stated that when the receiving station was properly tuned, only a slight hum or hiss, was heard in the receivers, which was tuned out, if desired, and in any case drowned by the voice. The articulation was very good, and communication was maintained for hours without losing a word or making any adjustments.

The speech was heard at a distance of 40 miles (64 km.), but it is believed that this distance is by no means the limit of the system, even when only one gap is used.

Mr. Washington has informed the Author that using two gaps and an antenna current of 2.7 amperes modulated by a water-cooled transmitter, music from a phonograph was clearly distinguishable on shipboard at a distance of 110 miles (180 km.).

Another system of somewhat similar characteristics was developed by Lieutenant W. T. Ditchman in 1912, and presents some features of interest. There was used a gap the cathode of which was aluminum, hard copper, or bronze, the anode copper or steel, each electrode about 1 cm. (0.4 inch) in diameter, and the discharge taking place in an atmosphere of carbon dioxid under pressure. Four such gaps were used in series, at a voltage of 1,000 and a current of 1.5 amperes. The capacity in the primary oscillating circuit was 0.012 microfarad. The multiple microphone transmitter employed is shown in Figure 50. It consists of four pairs of two microphones each, the microphones in the individual pair being simultaneously actuated by the voice and connected in series. A knob on the side of the holder (or, in some types of the apparatus, an automatic push-button arrangement) enables changing from one set of microphones to the next about every two minutes, thus preventing overheating. Antenna current up to 10 amperes have thus been handled without overheating of the microphones and consequent deterioration of articulation.

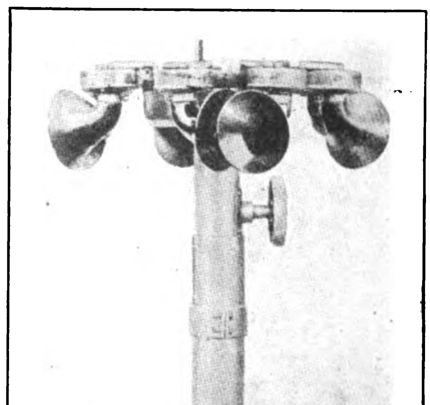


Figure 50—Ditcham multiple microphone transmitter

The description of the apparatus given by the inventor makes it clear that he was aware of the advantage of securing an integral inverse charge frequency, and attempted to secure this advantage in designing the apparatus.

The antenna fundamental was 460 meters, and its capacity 0.0007 micro-farad. It was normally used at 550 meters with an antenna current of 8 amperes. The antenna was lower than desirable, and probably had only small true radiation resistance. The normal distance of communication was from Letchworth to Northampton, a distance of 55 km. (34 miles). However, signals have been received 175 km. (110 miles) over land. In reception, a crystal detector (namely, Pickard's silicon-arsenic combination) was used.

It is interesting to note that the maximum radiation was attained in the system when the primary was tuned to 830 meters and the antenna to 550 meters, a ratio of 1.51 between them. his ratio is not far from 1.71, the value found by Chaffee for most efficient operation. Coupling to antenna as high as 40 per cent. is used.

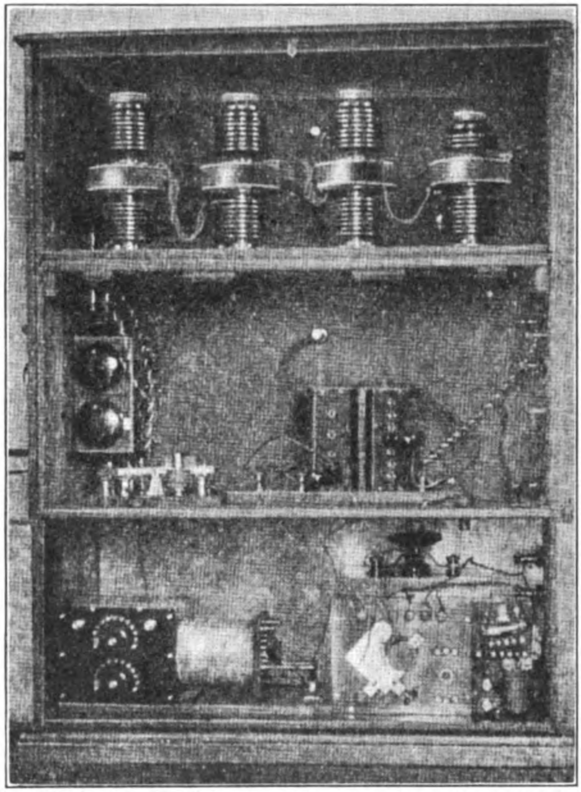


Figure 51—Ditcham radiophone transmitter and receiver

We are indebted to Lieutenant Ditcham for important previously unpublished data on the operation of these gaps. With hard copper or bronze electrodes in carbon dioxid under pressure, the gaps apparently had two functions: (a) cooling by expansion; (b) the formation of a hard crystalline film on the electrodes. This film permitted actual contact of the electrodes without "short-circuiting" or arcing. When the film was once formed, the gas could be shut off, and the spark would continue active for five or ten minutes before an arc started.

The entire transmitter is given by Figure 51. On the top shelf are mounted the four series gaps. On the shelf below are seen tuning inductances and a relay, while on the bottom shelf is mounted the receiver and a call-bell system. This last consisted of a Brown telephone relay fed from the crystal detector and, in its turn, supplying the current for a moving coil relay of no great sensitiveness. A long musical dash is sent for calling, the pitch being regulable by variation of the speed of the rotary make-and-break device ("chopper") which is inserted in the coupling between the closed and antenna circuits. A selective method of calling, permitting ringing any one of a number of stations within a given zone, was experimented with, but no details are available as to its success in operation.

A system of radio-frequent spark telephony has been devised by Messrs. Wichi Torikata, E. Yokoyama, and M. Kitamura. The spark or arc terminals in this system are composed of magnetite (oxid of iron) and brass. Other alternatives are aluminum, silicon, ferro-silicon, carborundum, or boron against minerals such as graphite, meteorite, iron or copper pyrites, bornite, molybdenite, marcasite, or others. Usually the electrodes are of small surface, this being regarded as essential by the inventors. The power supplied per gap is 500 volts and 0.2 ampere. A capacity of approximately 0.05 microfarad is used in the primary oscillating circuit. About 1 ampere is modu-

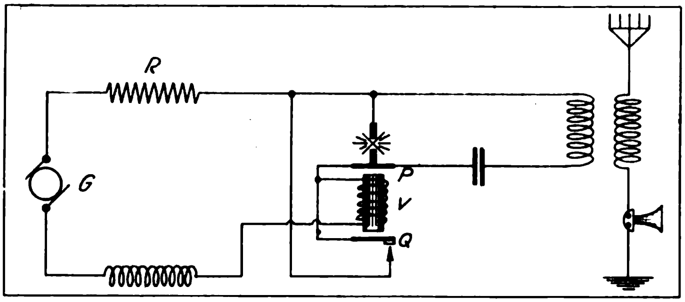


Figure 52—T. Y. K. radiophone transmitter

lated in the antenna by the microphone, and the every-day range is given as 10 to 15 miles (25 km.). Ordinary crystal detector reception is employed.

The wiring diagram of the apparatus is given in Figure 52. It will be seen that the starting device is of an unusual nature. It seems that a high-resistance film forms on the surface of the electrodes, as in Lieutenant Ditcham's system, and it is necessary in consequence to have some means of obtaining a momentary high voltage to break down this surface film, and start the discharge. This is accomplished by having a steady current flowing normally (before oscillations are desired) in the inductance *V* as indicated, this current being quickly broken at *Q* when it has once fairly started. The gap electrodes being in contact, the high inductive voltage breaks down the surface film, and the armature *P* draws the electrodes apart and serves as a sort of automatic arc length regulator thereafter.

Figure 53a illustrates the transmitter proper and receiver. A normal heavy-current microphone transmitter is used (mounted at the top in front of the equilibrator). The primary oscillating circuit, capacity control switch is directly below the microphone. The receiver is mounted in the lower case, together with the "sending-to-receiver" switch. The crystal detector is enclosed in a metal housing, the door of which appears at the lower left side of the receiving apparatus case. A usual test buzzer and normal tuning and coupling coil switches are provided. The equilibrator is shown in Figure 53b, with the alternative spark gaps (aluminum-brass or aluminum-magnetite), at the lower left corner. A small lamp with cover is mounted at the rear to indicate antenna current. The lamp resistance and choke coil box for the high voltage generator, supply circuit to the gap appears in Figure 53c. The 100 volt (and 2.7 ampere) to 500 volt (and 0.2 ampere) rotary converter is illustrated in Figure 53d.

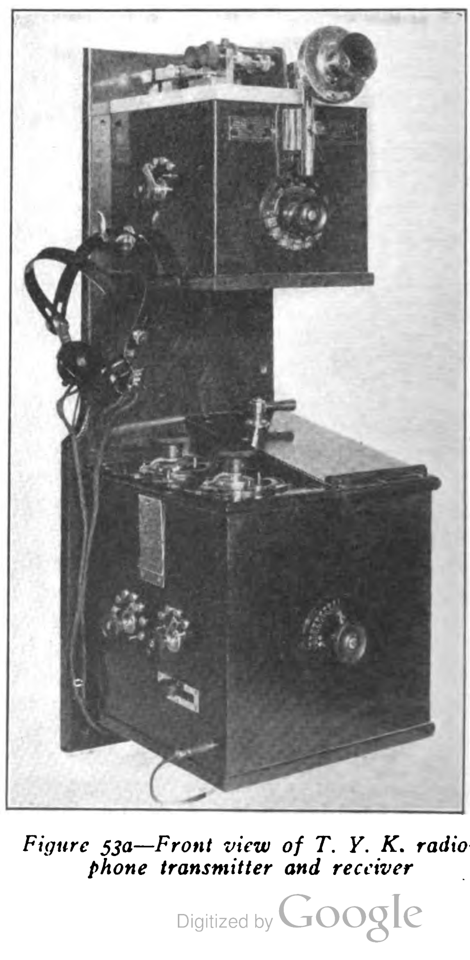


Figure 53a—Front view of T. Y. K. radiophone transmitter and receiver

In June, 1913, there were established eight land stations of this type in Japan and seven stations were installed on board ship. It is stated that commercial service was initiated at this early date.

A type of oscillator due to Mr. W. W. Hanscom operates with the gap surfaces immersed in alcohol. Their separation is automatically regulated by an electro-

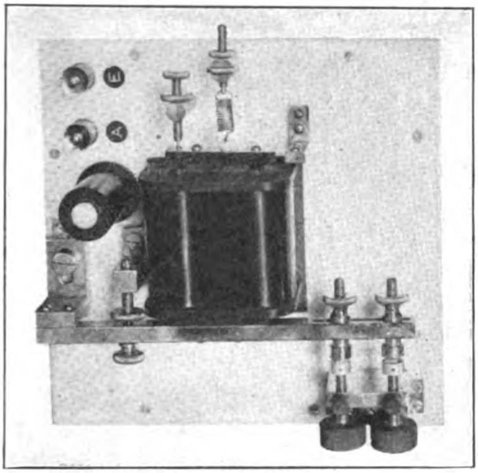


Figure 53b—Equilibrator and spark gaps of T. Y. K. radiophone transmitter

magnet plunger, a gravity adjustment by means of a sliding weight being provided for initial installation. The gap voltage is low (of the order of 100 volts). It is stated that steady automatic operation for hours has been secured. Only an occasional supply of alcohol and infrequent renewal of the gap surfaces are required.

In Figure 53c is shown such a set. The gap and regulator are mounted to the rear of the panel. The electromagnet winding is also used as a choke coil in the supply circuit. Direct current at voltages from 110 to 500 is supplied, and currents from 5 to 8 amperes pass through the gap. The system has been operated on wave-lengths between 300 and 2,700 meters. For modulation, a water-cooled microphone transmitter carrying 2.5 amperes is used.

With vacuum valve reception, distances of 100 miles (160 km.) are covered, but it is claimed that distances of 260 miles (400 km.) are occasionally bridged. On one occasion, the 800-mile (1,300-km.) span from San Francisco to Seattle was covered.

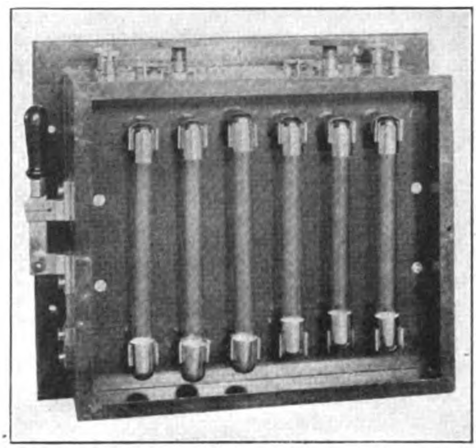


Figure 53c—Series resistance and choke coils for direct current supply circuit of T. Y. K. radiophone transmitter

Dr. Lee de Forest has done considerable work in connection with radio telephony. Originally he worked with a small arc of the Poulsen type, and communication over short ranges was obtained. More recently he has worked with several types of radio-frequent spark radiophone transmitters, and two of these types will be here described.

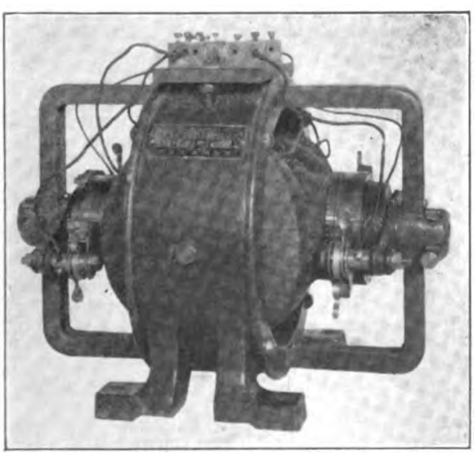


Figure 53d—100-to-500 volt direct current rotary converter of T. Y. K. radiophone transmitter

The first of these is a moderately high voltage, direct current system. The wiring diagram is given in Figure 54. As will be soon, a 1,000-volt, direct-current generator supplied a two-section quenching gap through a regulating resistance and choke coil. The ga pitself is made of parallel studs of tungsten in air, with minute but regulable separation. Shunted around the gap is an oscillating circuit which is directly coupled to the antenna. Two heavy current microphones (sometimes air cooled by a blower) are connected in series in the ground load of the antenna. A small set of this type is shown in Figure 55. It differs from that just described in that only one gap section is used and a single microphone in the antenna. The antenna ammeter is shown mounted on the upper left-hand portion of the apparatus box which contains the primary condenser, inductances, choke coils, and antenna switch. This sending-to-receiving transfer switch is controlled by the projecting knob on the upper right-hand portion of the apparatus box. The small 600-volt generator is shown separately. A 0.25-h.p. (200-watt) motor is recommended for driving the generator. The range is given as from 7 to 15 miles (10 to 25 km.). The set, as designed, operates at wave-length from 400 to 1,000 meters.

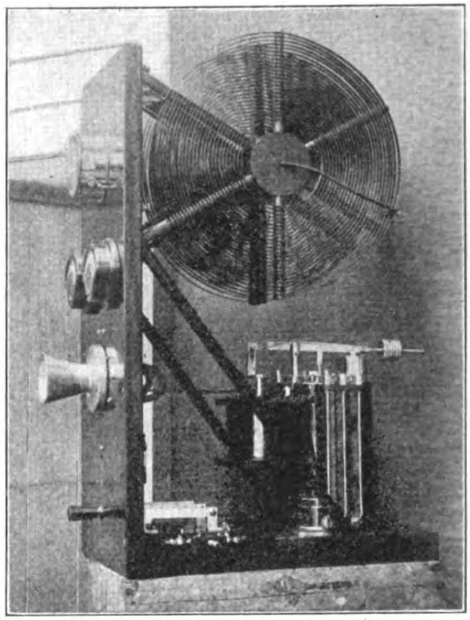


Figure 53e—One-half kilowatt Hanscom radiophone transmitter

A portable type of radiophone is shown, set up, in Figure 56. It will be seen that the double microphone transmitter is used in the set in question. The receiving set is seen at the left and toward the back of the instrument case. A somewhat larger set is illustrated in Figure 57, with an air-cooled, two-section gap. The antenna switch and direct coupling coil are mounted to the right of the panel. When used for radio telephony, an air-cooled, twin-microphone transmitter is mounted on the panel, usually under the supply circuit ammeter.

An alternating current system of spark radio telephony has been developed by de Forest. The circuit diagram is given in Figure 58. *G* is a 3,000-cycle alternator which supplies current to the primary of the transformer through the tuning condenser indicated, this latter having a value of approximately 8 microfarads. The transformer raises the terminal voltage from 100 to 5,000 volts. A number of gap sections similar to those previously described are used, and the primary is inductively coupled to the antenna. A double microphone is used in the ground lead as before. The audio frequency tuning to 3,000 cycles in the supply circuit is of interest. No data is available as to the extent to which the 3,000 cycle note can be eliminated and prevented from interfering with the speech in the arrangement under consideration. It is likely, however, that a square generator-wave form would be of assistance in this connection.

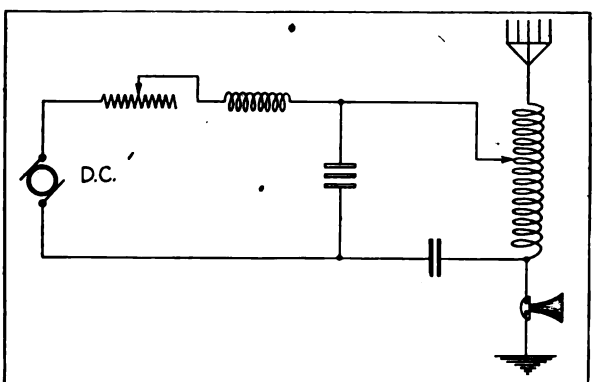


Figure 54—de Forest radiophone transmitter—D. C. type

When it is attempted to receive signals from the de Forest radiophone transmitters by ordinary beat reception, (no speech being transmitted) a

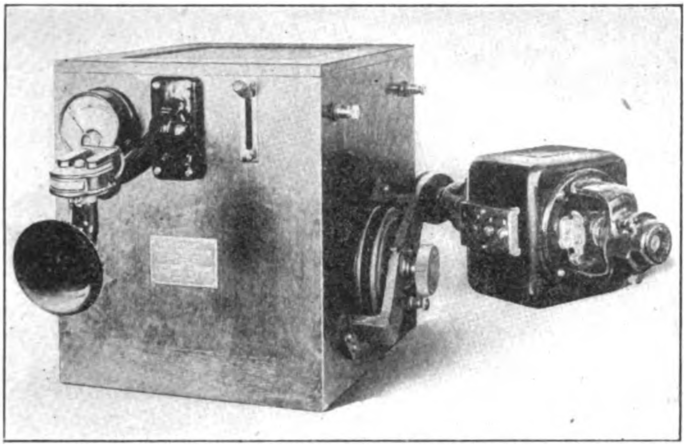


Figure 55—de Forest D. C. radiophone transmitter

very poor note almost without musical characteristics is obtained. This is accounted for by the absence of a definite inverse charge frequency and the consequent extremely frequent alterations in phase of the radiated energy.

A 1-k.w., direct-current equipment placed on a train of the Delaware Lackawanna and Western Railroad permitted communication from Scranton to a moving express train at full speed up to 53 miles (85 km.) De Forest Forest gives some interesting figures as to the average range of the sets. For the 2-k.w. set, using masts 100 feet (30 m.) high and at least 50 feet (15 m.) apart, the range over sea is up to 100 miles (160 km.) and over land up to 75 miles (120 km.) If 40-foot (13-m.) masts are used, these ranges are reduced to 0.3 or 0.4 of the values given. For the 5-k.w. sets, with similar 200-foot (60-m.) masts at least 100 feet (30 m.) apart, the sea range is up to 400 miles (640 km.) and the land range up to 300 miles (480 km.). This range is reduced to one-half the values given if the masts are reduced in height to 100 feet (30 km.). It is further stated that over heavily wooded and mountainous country, the ranges may be reduced 25 or even 50 per cent.

Excellent results have been obtained with a recent method of radio-frequent spark type using the Moretti "arc." The Moretti arc seems to be the most powerful generator of this sort yet discovered. It is a simple device, being shown in Figure 59. In the Figure, the arc is shown enclosed in an air-tight box of insulating material, but this enclosure is not essential. The arc may be used in the open air. Both electrodes are of massive copper, one with a plane surface, and the other *A* with a longitudinal perforation through which is pumped a steady stream of acidulated water. This jet impinges on the upper electrode (which is the negative one, usually); and the velocity of the stream of water can be suitably regulated by a

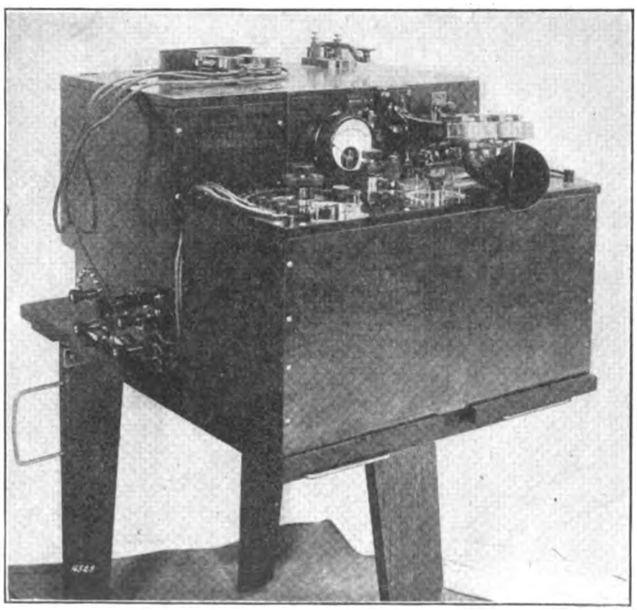


Figure 56—de Forest portable radiophone set

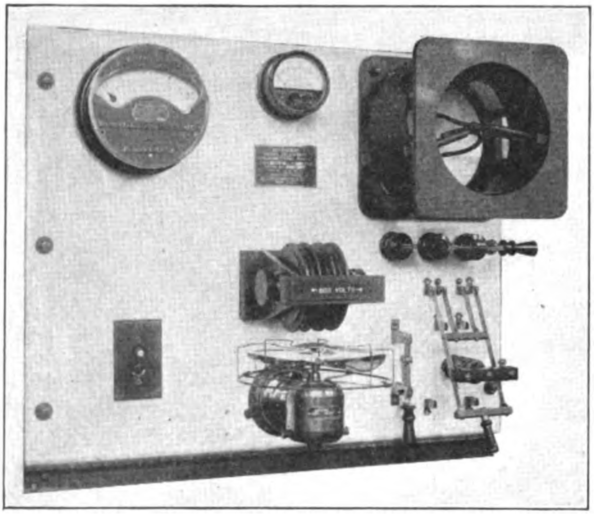


Figure 57—de Forest 2 k.w. radiophone panel transmitter

valve placed in the feed pipe. The theory of its action, as given by Professor Vanni, makes it a device somewhat analogous to the usual Wehnelt interrupter. He suggests that at the moment of formation of the arc, the water passes into the spheroidal state, vaporizing rapidly, and thus breaks the circuit very suddenly. At the same instant, the water is partly dissociated into hydrogen and oxygen; which, being an explosive mixture, quickly recombines, whereupon the entire cycle is repeated.

Whatever the action, the effect is to open the arc circuit at a radio frequency, which fact can be verified by an examination of the arc by a rotating mirror oscillograph. The spark frequency is thus found to be several hundred thousand per second. As in the Chaffee arc, the impulses are stated to be unidirectional, though whether an inverse spark frequency exists or whether syntony to wave form is evidenced is not indicated in the published descriptions.

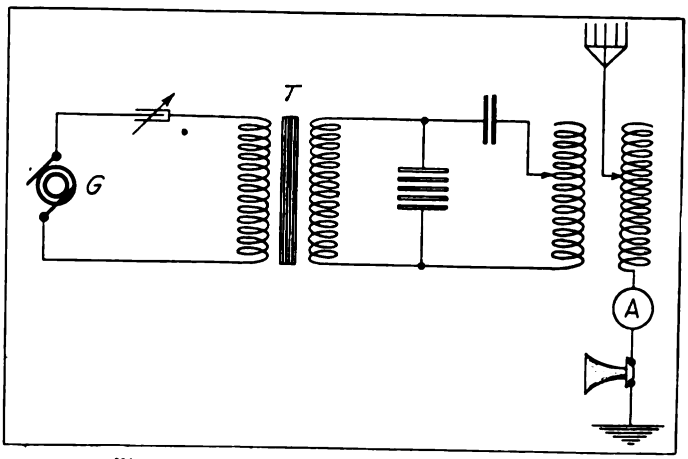


Figure 58—de Forest radiophone transmitter—A. C. type

This arc has been improved in construction by Mr. Bethenod in that a precision regulator of the arc length has been designed by him, and that a special direct generator has been used of high no-load e.m.f. and markedly lower load voltage. In this way, the series resistance in the supply circuit can be avoided and better efficiency attained.

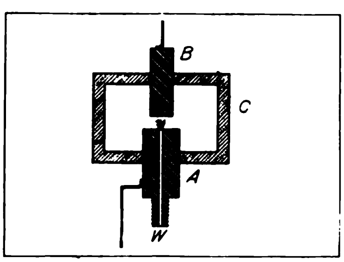


Figure 59—Diagrammatic representation of Moretti arc

As normally used, the arc is placed in series with resistance and inductance across the terminals of a 600-volt direct current generator. The energy supply in the following experiments carried on by Professor Vanni was 1 kilowatt. Across the arc is placed a usual oscillatory circuit, which is inductively coupled to the antenna. In the antenna was placed Vanni's special hydraulic microphone transmitter to be described hereafter. Unquestionably, the remarkable re-

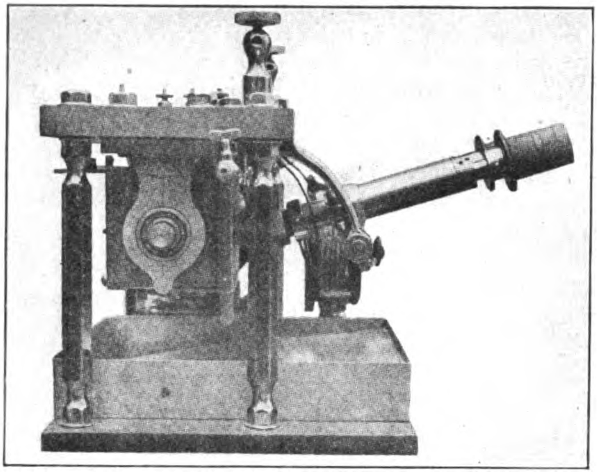


Figure 60a—Scheidt-Boon Moretti arc as used at Laeken station of Mr. Robert Goldschmidt

sults obtained are in large part to be ascribed to the development of this unusual form of telephone transmitter. The antenna current secured was 12 amperes.

In 1912, experiments were carried on by Vanni from the station at Cento Celle, several kilometers from Rome. The Island of Ponza, 120 km. (75 miles) away, was first reached, then Magdalena, 160 km. (100 miles) away; then Palermo, 420 km. (260 miles) away; then Vittoria, 600 km. (375 miles) away, and finally Tripoli, no less than 1,000 km. (625 miles) away. The results are noteworthy, and seem to be attainable without excessive uncertainty, as evidenced by the work done by Mr. Goldschmidt (of Laeken, near Brussels, in Belgium), and by the Merzi brothers in Italy.

The experiments carried on at Laeken early in 1914, before the unfortunate destruction of the station by its owners to prevent it from falling into the hands of an invading army, are of considerable interest.

As generator, a modified Moretti arc was used, fed with 600 volts. It is shown in Figure 60a*. One electrode was rotated rapidly. This was the positive electrode and consisted of a number of discs mounted on an axle. The negative electrode consisted of the surface of rods held in sleeves with screw adjustment so that the arc length was directly regulable. As stated previously, a water jet was injected into the arc. A special microphone heavy-current transmitter devised by the Marzi brothers was used, and this will be considered hereafter. Several Moretti arcs in series have been used by the Marzi brothers. With four arcs in series, running at 2,400 volts, radiophone transmission was effected between La Spezzia and Messina, the full length of Italy.

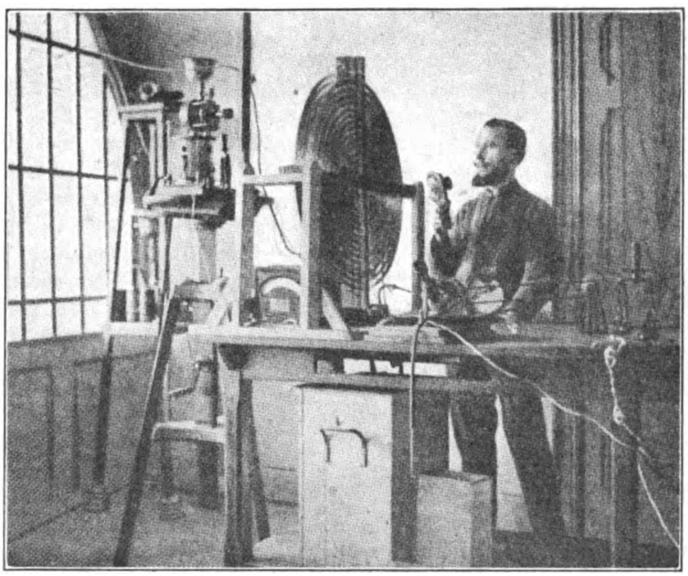


Figure 60b—Laeken (Brussels) station of Mr. Robert Goldschmidt, showing Moretti arc and Marzi microphone

* Figures 60a and 60b are reproduced by permission from the French journal "T. S. F.," based on material received from Mr. Scheidt-Boon of Brussels (1914).

The equipment used in the Laeken experiments is shown in Figure 60b. On the center of the table is mounted the Moretti arc, to the left of which are seen the coupling spirals. In the upper left-hand portion of the picture is shown the heavy-current transmitter, which is, in fact, controlled by the small transmitter held in the hand of the experimenter.

On March 13, 1914, using 3 amperes in the antenna, communication was established between the station at Laeken and the Eiffel Tower in Paris, a distance of 200 miles (320 km.) Tests were carried on regularly on wave-lengths of 300, 600, 800 and 1,100 meters. This arc shows the usual radio-frequent spark characteristic of satisfactory operation on short wave-lengths.

Reception was accomplished in various way, but it is interesting to note that the experimenters give the following as the order of merit of detectors in radiophone reception: sensitive crystals (such as galena), the audion, the Fleming valve, carborundum, and the electrolytic detector.

This is the fifth of a series of articles on "Radio Telephony," by Dr. Goldsmith, an eminent authority on the subject. In Article VI, in the June issue, he continues the discussion of radio telephony by taking up the subject of vacuum tube oscillators. He describes the experiments of Dr. Saul Dushman, and gives the latter's data in considering the current-carrying capacity of vacuum tube rectifiers. He treats of the development of the pliotron by William C. White, the studies of Dr. Langmuir, and Dr. A. Meissner's invention of a form of oscillating circuit of simple electrical nature.

Where Freak Conditions Prevail

Phenomena of Wireless and Expansion of the Art in Alaska

ALASKA occupies a distinct place in the mind of the wireless man who is familiar with that territory. He knows it as a land where radio conditions which do not prevail in any other part of the world are found. It is in this territory that the Marconi system has blazed the way of modern means of communication, bringing isolated points in the vast frozen wastes in touch with far distant places.

The unusual wireless conditions in Alaska may be due, it is said, to the geographical location of the territory and the continuous daylight during the summer. As an example of freaks, it may be instanced that at the Marconi station at Astoria, it has been observed that the atmosphere would be free from strays until about noon when they would appear, gradually increasing in intensity. The maximum would be reached at one o'clock in the afternoon and no change would be observed until four hours later. From that time until midnight conditions were the same as those prevailing at similar stations. The period of decrease in the evenings would vary occasionally, but the appearance of the strays at noon continued for several weeks.

The use of radio as a means of communication in Alaska seems peculiarly fitting to that territory, for the various topographical and geographical formations of the land place great difficulties in the way of the construction of telegraph lines and the laying of submarine cables. Along the coast volcanic disturbances are not of infrequent occurrence. These are not of a violent character, but they serve as a never-ending source of trouble to those in charge of the cables.

At Ketchikan, the first port of entry into Alaska; at Juneau, the capital city, and at Astoria, the Marconi Company has established semi-high-power stations. These stations will be among those of a chain that will some day extend along the Alaskan peninsula when the commercial development of the territory warrants the step. As an example of the speed and reliability of the service it may be mentioned that a mine owner in Juneau sent a marconigram from that city to Los Angeles, Cal., and received a reply forty minutes after the first message had been filed in Juneau. Besides the semi-high-power stations, a number of canneries and mining companies have had Marconi equipments installed, thereby establishing communication with the outside world.

Four towers of the self-supporting type for the antenna have been erected at Ketchikan. They face a strip of water—the Tongass Narrows—and are so located that they outline a rectangle, the dimensions of which are 300 by 600 feet. Three hundred feet in height, each of the towers is stepped with a wooden top mast, extending fourteen feet above the head of the steel portion. Eighty thousand volt, triple petticoat insulators carrying the antenna are mounted upon these masts. The antenna is made of two silicon bronze wires, each having seven strands of No. 18 wire. The tension of the latter can be fashioned to withstand the stress of the severest weather conditions. This antenna is employed both as a transmitting aerial for the marine service and as a receiving aerial for the 5 and 25 K.W. sets.

On triatics, between the towers, is suspended a twenty-wire antenna which leads to the reinforced steel concrete power house, 300 feet from the lower two towers, where it is connected to the 25-K.W. transmitter. The Ketchikan city power house is connected with the wireless station by a two-mile transmission line carrying 2,200 volts, single phase current, at a frequency of sixty cycles. About 300 feet distant from the power plant the line is brought into the building by means of an underground conduit. It is connected to the high tension switchboard and thence distributed to the various units, the transmitting apparatus and the lighting and heating transformers.

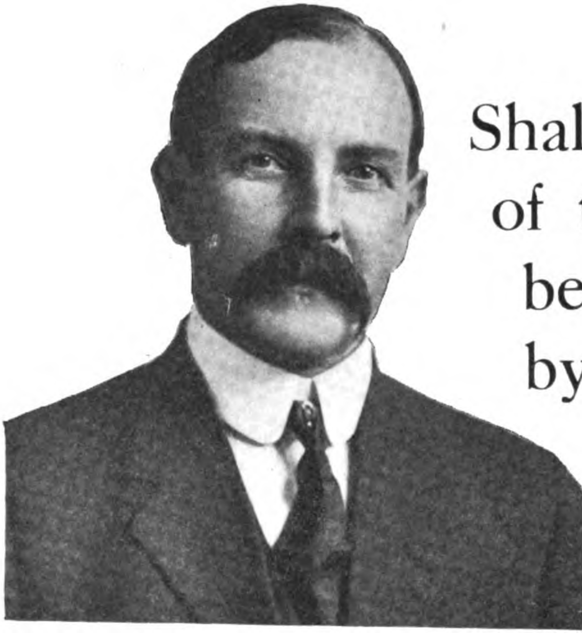
For furnishing seventy volt direct current for the operation of the solenoid keys and side disc motors, a synchronous rotary converter is used. By means of an extended shaft it drives a rotary discharger which controls the number and duration of the spark discharges. All the improvements for handling such currents are embodied in the disc discharger. The disc, which rotates at the rate of 1,79P revolutions a minute, is thirty inches in diameter. Equally spaced around the disc, close to its periphery, are inserted brass studs. The disc, in rotating, passes between two side discs set to give a clearance of 1/32 of an inch. Across this small air gap, that is, between the side discs and each of the revolving studs in turn the discharge takes place. Because of the fact that the discharger is rotated synchronously with the alternator which supplies energy to the condenser which is discharged, it is necessary to time the discharge to occur at, or near, the peak of the voltage wave in the alternator. The correct point on the voltage curve depends on several factors, arrangements being provided to permit adjustments of the interval between the time at which the revolving stud passes the side discs and the time when the machine voltage is at its highest. Thus maximum results are obtained.

The condensers consist of glass and zinc plates placed in earthenware containers filled with oil. A bank of thirty units is used in the circuit. Copper bus bars of ample dimensions lead from the condenser tank to the inductive coupler and to the disc discharger. The coils of this coupler are wound with a specially designed cable, and so arranged that each strand carries the same amount of energy, thus decreasing heat losses.

In the receiving office, which is seventy-five feet from the power house, are the operating key and the usual equipment, supplemented by two loose-coupled receivers (fitted for crystal and valve detectors), having ranges of from 100 to 4,000 meters, and from 100 to 7,000 meters, respectively.

The construction engineers found that the forests and the heavy rain fall, which in the vicinity of Ketchikan averages 168 inches yearly, added considerably to the difficulties of their work. However, the rain fall was advantageous as regards the ground system. The latter consists of 3,000 pounds of zinc plates buried in a circle around the power house, supplementing which are four foot strips running out on the beach to mean low tide level, thus insuring at all times good electrical ground.

The living quarters for the men detailed at the station are provided with the modern conveniences. A 12,000-gallon reservoir, located on high ground at the rear of the station, provides the water supply.



Arthur E. Kennelly, past president, I. R. E., vice-president National Amateur Wireless Association and professor of electrical engineering at Harvard University and Boston "Tech"

Shall the Interest of the Amateur be Suppressed by Injudicious Radio Legislation?

How Professor Arthur Edwin Kennelly Championed the Cause of the Young American Student of the Wireless Art Before the Committee of the House of Representatives

ONE of the most emphatic and convincing opponents of the proposed bill to regulate radio communication, on which hearings were lately held before a Committee of the House of Representatives, was Professor Arthur Edwin Kennelly, of Harvard University.

His practical career as a telegraph operator dating from his fourteenth year, the record of his remarkable life, showing how resolute effort and continued devotion to his chosen pursuits has led him to the front rank of the science of electrical engineering, will be read with vivid interest by every wireless amateur. And the amateurs will be still more interested in his views of the wireless art, since before the Congressional Committee he appeared as their especial champion. In fact, Professor Kennelly, who is a member of the National Advisory Board of Vice-Presidents of the National Amateur Wireless Association, informed the members of the House of Representatives that the proposed legislation was a blow to amateur invention and amateur application to radio study. "If you suppress the interest of the amateur," he said, "you will make a desolate world of it. I do not want to see that state of affairs in America, the land of freedom. The amateur needs to be protected just as the Navy needs to be protected and as the commercial stations need to be protected."

Professor Kennelly was born in Bombay, East India, a subject of Great Britain, and was educated in France, Italy and England. He was a telegraph operator at the age of fifteen, leaving school at the age of fourteen, to become an operator in cable telegraphy. He earned his living as an operator until about nineteen years of age, then being promoted to electrician on a cable ship. At twenty-one he was in charge of operations in laying and repairing submarine cables, which was his work for some seven years, during which time he was engaged in the laying and repairing of submarine cables all over the world between Great Britain and India. He also had charge of the laying of cables in this country, along the Mexican coast for the Mexican Government.

In 1886 Professor Kennelly came over to this country and became Thomas A. Edison's principal electrical assistant at his laboratory in Orange, N. J., and served for him and his companies about seven years. He left his employment to go into the business of consulting engineer with Professor Edwin J. Houston, of the Thomson-Houston Company, in Philadelphia. In 1902 he was appointed professor of electrical engineering at Harvard University and is now professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology.

"It has been part of my work at these institutions to teach the principles of radio telegraphy," said Professor Kennelly, "not as an operator, never having trained as a radio-telegraph operator, although I have a small set in my house and am accustomed to listen in to messages and eavesdrop generally in that way."

Of his radio record this well-known authority noted that he was the retiring president of the American Institute of Radio Engineers; had been past president for two years of the American Institute of Electrical Engineers, and also past president of the Illuminating Engineering Society; also a member of many scientific bodies. "As retiring president of the Institute of Radio Engineers," he added, "I am very much interested in this bill. I am not interested commercially in any way; I do not own any stock, and I hold no commercial interest in any radio telegraphic concern; but I am profoundly interested in this as a past president of the Radio Engineers, as a member of the teaching profession, and as an American citizen. For all these reasons I am deeply and earnestly concerned in this bill and the question of its passage."

This vice-president of the N. A. W. A. observed that he had gone to Washington to urge his contentions that this bill should not be passed for a variety of reasons. "In the first place," he said, "if there is one thing of which this country ought to be proud it is that this country has taken such a shining position in the world in regard to telephonic communication. I do not mean radio telephonic communication, because that is a very young art, although it is coming along; but I mean telephonic communication generally. It was this country that first established communication with France by telephone and with Honolulu by telephone, and there is no other country in the world that has any such telephonic record.

"And that has been accomplished because the telephonic art in America has been fostered and developed under free institutions and not under government control!

"In those countries of the world where there is government control of the telephone and telegraph you will find them in a relatively backward state. I went to France a few years ago in company with an American gentleman. We stopped at a hotel in Paris. He was very anxious to talk with somebody on the telephone. I tried to dissuade him from doing so. I said, 'Do not waste your time trying to talk over the telephone, because the telephones are very unsatisfactory here.' He said, 'But I must telephone.' He had been accustomed to using the telephone constantly in his office in New York. I said, 'Well, if you insist, come with me'; and we went to the telephone bureau, so called—a very miserable little concern, like a shoe-blacking box, in charge of a man who did not know much about it. He had a great deal of trouble in getting the central station at all. Finally, when he did get the central station, he abused them in unmeasured language, which would not have been tolerated in this country. The whole system is in a very backward state—largely because of Government ownership."

The chairman inquired at that point if the telephone system in London was controlled by the Government.

"Yes, sir," returned Professor Kennelly; "at the present time it is. It was not a few years ago, but it is now, and it has become in a worse condition since the Government has taken control than it was before it was Government owned.

"Everybody admits the telephonic communication in London is defective and was better under free administration than it has been since it was taken over by the Government; although when it was under free administration it was so hampered by the Government that it could not properly develop. That is common knowledge."

Chairman Alexander of the committee here observed that he knew, from personal experience, that the service is very poor. Whereupon Professor Kennelly added: "It is, sir. I take pleasure in endorsing your statement."

To indicate how the workers in the wireless field felt about the proposed legislation, the distinguished opponent mentioned the Institute resolutions printed in The Wireless Age at the time of their adoption. He explained that "there was entire unanimity among the members of the board," adding: "They felt very earnestly and very forcibly upon this question, because they were representatives of the science and art of radio communication; not because they were interested in any particular commercial enterprise."

The resolutions referred to stated that the board opposed "competition by any department of the Government, and particularly by any military or naval department, with existing organizations."

Professor Kennelly stated that the deep concern of the engineers was due to the fact that they have charge of the engineering future of the art.

"This was puerly a scientific art a few years ago," he explained. "It has now become an engineering art, an applied science, in which money is expended in a definite way, under the control of engineers, for producing the best efforts in the service of the public. As you know, there are certain corporate interests in this country that serve the public by investing their money in stations for the transmission of news whereby we, all of us, including all in this room, are benfited. And this bill, if passed, will undoubtedly have the effect of stifling and arresting that work and that development. It will inevitably have the effect of crippling those stations and putting them out of business. Now, I have no commercial interest in this; but there are, to my knowledge, many people, good citizens like ourselves, who have invested their savings in these stations and in this work, partly, no doubt, because they hope to get some financial return, but also partly because they think they are being patriotic to this country by supporting a young and promising art; and they think by taking part and sharing in that stock they are helping along the whole interests of the world, and particularly of America, in this wonderful art.

One-Man Power an Everlasting Disgrace to Country

"This bill should not allow one man, a Government officer, to lay his hands upon all that property and suppress it, and then, after having suppressed the property and making it become of no value, thus enable it to be purchased by some department of the Government at scrap prices!

"I am not here to asperse anyone; certainly I have no rancor against the Navy or against any department of the Government; I simply have opposition to this bill. And I refuse to believe that any Government officer, or any naval officer, drew that bill for the purpose of confiscating this property in so mean and contemptible a manner. I refuse to believe it. I have many friends among the naval officers, and as a profession I have the highest admiration for them, and I refuse to believe any officer of the United States Navy drew that bill with the intention of doing such a mean and contemptible thing. Nevertheless, it will have that effect, and if passed in the form in which it lies before you it will be an everlasting disgrace to the Government of this country and to the people of this land!"

Legalized Permission to Transcend Limits of Fairness

Chairman Alexander asked the speaker to indicate the provisions of the bill which he thought would have that effect.

Professor Kennelly replied: "Certainly, sir. Section 6 states that after three months and within five years after the expiration of said three months, the Government, through the Navy Department, shall have authority to acquire, by purchase, at a reasonable valuation, any coastal radio station now in operation in the United States which the owner may desire to sell.

"There is nothing there to determine what is a reasonable valuation.

"After you have so far invalidated and destroyed your neighbor's property, he may be willing to sell at famine prices. And, of course, you have all heard the truism 'I do not care who makes the laws so long as I have the construing of them.' And with the permission for the Government to enter into competition with the coastal commercial radio stations, and with the power given them to regulate their opponents, it needs very little imagination to see what the effect of such competition and regulation would be upon their neighbors."

The Chairman's query as to whether Professor Kennelly understood the power to purchase and regulate would be accomplished by enactment of the bill met with the prompt rejoinder: "It certainly would have that effect."

The Hon. Frederick W. Rowe, one of the members of the committee, asked Professor Kennelly whether he held that the Government would be in a position to buy any station through the simple expedient of putting another station alongside it, or by competing with it.

"Without even doing that," was the reply. "They could accomplish it simply by taking the naval stations they now have, and then regulating the commercial stations."

"By using them for commerce?" asked Mr. Rowe.

"Yes," replied Professor Kennelly, "by using them for commerce, and then by regulating the other fellows who are in competition with them for that commerce. Of course, I believe they are all above any intention of doing that, but they will say, you must have this apparatus; you must improve this; that won't do; you must change this; and, by constantly harassing them and changing this, that and the other thing, and regulating them, they would eventually put their competitors out of business. They have that power; and the temptation to do so would be very great. I do not say that any officer of the Government has that in mind at this time; I won't asperse any officer of the Government to that extent. But I say this bill gives that power, and it would be a strong temptation, with that power, for any zealous man. If he felt zealous on behalf of his own department, he would undoubtedly transcend the limits of fairness and fair dealing in the exercise of his discretion. And we can not blame him.

Supreme Navy Power Means Massacre of a Necessary and Honest Public Servant

"This bill gives most oppressive and dictatorial powers. This kind of a bill is what we might expect of the German governor, Von Bissing, to promulgate for Belgium; this is what we might expect a military officer to lay before a conquered country and say, 'Do this or I will confiscate your property.' This is not the kind of a bill that we would expect from a free Government, which stands for liberty before the world, to lay before the people, its public servants, in time of peace, for their control. In time of war—that is another thing."

"You allude to the regulatory provisions running all through the bill which change the present existing law?" asked the Hon. George W. Edmonds, another member of the Committee.

"Yes, sir," replied Professor Kennelly. "I speak also against this bill, sir, on behalf of the Navy itself; or what I consider to be the best interests of the Navy itself. I hold that it is very important that in the next war this Navy of ours shall be supported and shall be strengthened to the utmost by all of our collective ability. I stand for that; I am heartily in favor of anything that will support our Navy in time of war. But I do not think in order to support our Navy in time of peace we should massacre a necessary and honest public servant.

"I think in order that the Navy shall be properly strengthened in time of war we must develop the radiotelegraphic art to the highest pitch. And if you give a monopoly of the radiotelegraphic art, under the possibilities of this bill, to any department of the Navy, you are giving it to somebody whose main interest is in something else. The Navy is a fine profession, but the Navy is not a radio engineering profession. You might as well offer a monopoly of the radio art to the professions of divinity or of law or medicine. It is not an aspersion on the medical profession, not an aspersion on the legal profession, to say that they are unfitted for the control and the monopoly of radiotelegraphy, as an art. The proposition only needs to be stated to be condemned; and yet the Navy is no more entitled to it.

Within Three Years the Air Would No Longer be Free

"Mr. Chairman," continued the speaker, "I have the honor to say I consider it is of the very greatest importance for the sake of the Navy itself that this art should be maintained at its very highest pitch and that America should be foremost and not hindmost in the international competition for the utilization of the ether and the surrounding atmosphere of the globe. Hitherto it has been a saying among all the people of the world 'The air is free.' This bill wants to make that saying a dead letter. If this bill passes, within three years the air will no longer be free from the use of anyone.

"The navy says, 'We are bothered by interference.' How much better is it for them to be bothered by interference in time of peace than to be bothered by interference in time of war. They say, 'Let us have no interference now; let us be comfortable and happy; and let us communicate with each other and with our brother officers on each other's ships.' But when foreign cruisers come over here, will they listen to those proposals? What happened off South America when the English commander, Admiral Craddock, was defeated in that fight? His wireless was jammed by his opponents. If he had had a superior wireless system, he would have been free from all radio hindrance and interference from his enemies. It was one of the circumstances that led to his defeat, that his wireless system was subject to interference.

"Now, what we must have, for the sake of ourselves and the Navy, for the sake of all of us, is a system which will be free from interference. And are you going to produce a system which will be free from interference by saying in time of peace that there shall be no attempt at interference? It is easy to have no interference when a monopoly exists. But the thing to seek is plenty of interference; so much that you will be forced to use your wits, to use your inventive genius to overcome it. And already great steps are being taken in that direction, and already the outlook in this direction is very hopeful for the future.

"Why, it is nothing by comparison with what the telephone has done in this country. It was in this country, in America, that all these important improvements have come about in the telephone, as a direct result of interference. I can remember, and I dare say my friends here remember, what it was in the early days of the telephone. You could not talk to your neighbor without hearing all the neighborhood. And that was a growing trouble. It was the haunting problem day and night of the telephone engineers—'What shall we do to get rid of this eternal eavesdropping of the world?' It has been now so thoroughly eliminated you could hardly realize from using the telephone today that there ever had been such a period. Why? Inventors came forward, all the brightest minds in the telephonic art were stimulated to do something to overcome this difficulty.

"But now if you are going to introduce a plan to suppress this interference because it has been causing a little trouble and been preventing some one Government officer from hearing another Government officer, of course, you will have a fool's paradise for the time being. But what of the hereafter; what of the radiotelegraphic art and the countless generations to come? We want the whole world to be benefited by this art; we want each neighbor to communicate with the other, and we want to have all of that progress in store for us hereafter. And therefore I say do not pass this bill, gentlemen."

Some Amateurs Will Discover Something Which Will be of Benefit

Professor Kennelly expressed the conviction that it was urgently necessary that the Navy be strengthened, but that it could not be strengthened in this way. "It can be pampered and weakened," he continued, "but it cannot be strengthened. The right way to do is to have the Institute of Radio Engineers and a lot of bright lads all over the country working on these problems and coming forward and offering various means for preventing interference, and saying 'I have now a scheme.' If it will serve, reward him by giving him encouragement. But if you attempt to do away with interference under the proposed régime, you would stifle that enthusiasm absolutely. Those men will not have any such enthusiasm if it is in control of some department of the Government, because they cannot hope to reap any benefit by finding a solution of these problems. They will say, 'Why, the Government takes, by confiscation, any invention it wants to appropriate; the Government takes my invention and gives me nothing.' They do that now. And what hope is there for reward or of benefiting our fellow creatures by having a solution of this problem?

"But if you leave them alone you can have this army of amateurs all over this country listening in with their little wireless stations and hearing the pulse beats of the world, as it were. All those young men are thinking, and some of them will discover something which will be of benefit. If you take this bill and use it as it will probably be used you will throw a pall of apathy and discontent and hopelessness over the whole situation. You will darken America and darken the atmosphere of the whole globe. Don't pass this bill!"

This vice-president of the N. A. W. A. stated that he wished to speak also on behalf of the amateurs. "It is not only the vested interests of people," he said, "who have put their savings into this enterprise for the benefit of the public; it is not only for the Navy, but it is on behalf generally of the amateurs of the country, for the young fellow who wants to communicate with his neighbors and utilize the atmosphere of the world—the circumambient ether, as it is called. It is him that I am thinking of; you will suppress him, too. So soon as you have scrapped and suppressed the power stations, the commercial stations, you will still be bothered in the antiquated system in undisputed control of the Navy that no longer has interference from power stations—it will still be bothered by this man here and this little amateur there, and some officer will say he cannot get rid of that interference or that he is being bothered by so-and-so, when 'John Smith is talking in Washington we cannot hear ourselves talking in New York.' And so they will appeal again to Congress to stop the amateur, and there will be no use of the circumambient ether except such as the Navy Department or some department of the Government wants."

The whole system, according to the speaker, would be one repression and star-chamber action and confiscation. There would be a dead silence in the air. It would be a silent globe.

"If you will go to some central radio station with a big tower anywhere in this country," continued Professor Kennelly, "and listen in, you can hear hundreds of people talking to each other, most of them without any interference at all—

only occasional interference. It is so when we are talking to each other in a room, using the same air. We have interference, don't we? One man has to be silent when another one wants to talk. We have to have etiquette; we cannot all talk at once. That is interference. For example, the same interference would result in the atmosphere in this council chamber; if you all talked at once, you could not hear me. And if you go to one of those stations and listen in, you will hear hundreds, perhaps even thousands, talking by radio, depending on how delicate the apparatus is and how far it can hear. If it was delicate enough and powerful enough, you could hear all the radio people in America talking; and they are all learning and all gaining some advantage. It only takes one-twentieth of a second from the time you close a key here for its impulse to get to Europe.

The Amateur Needs to be Protected Just as the Navy Needs Protection

"You will be putting all of that world of communication in time of peace in the hands of the Navy, to restrict for their own purposees, and suppress that interest of the amateur and make a desolate world of it. I do not want to see that state of affairs in America, the land of freedom. The amateur needs to be protected just as the Navy needs to be protected and as the commercial stations need to be protected. We all need to be protected. We have no quarrel, one against the other. We all have difficulties, but they are difficulties which sensible men can overcome. The only difficulties that cannot be surmounted are imaginary ones; the real difficulties are capable of being overcome. Here is a difficulty, the difficulty of interference, the difficulty that all messages cannot at present always be carried at the same time. Very well; let us be sensible. Come, let us take counsel; let us have representatives of the various parties in interest meet around a table, and when they shall have met around the same table we will find some intelligent means of overcoming this trouble. But don't give us a star-chamber means by which the Navy can issue the fiat that there shall be no trouble.

"In time of war the Navy wants the very best; it wants the very highest support, the most cordial support, of every one of us. Are we going to give that support by saying 'Take the whole radio art, and then slumber over it, because you are too busy with your own affairs to consider this and develop it. This is a mere detail to you; you have thousands of interests to take up your energy, and if you are going to fritter your time away upon this profession, you are no sailors; your profession demands you.'

"Take Captain Bullard. I had the honor of meeting him. Look at him. He was in charge of this naval radio service up to a little while ago. Where is he now? I understand that the Navy Department has called him away, and he has forgotten all about this by now. And by the time he is through serving on his ship, in his line of duty, he will find himself behind in the art. Are you going to put this art in the hands of officers who will be taken from one post to another and have all of their efforts thrown to the winds? You want the highest intelligence, the highest specializing in this work. It takes the best brains we have. We cannot be content with one-quarter of the brain of a man in another profession.

"We want the best the country can produce, and you will have that by leaving the country alone, by having national competition among the radio engineering profession fostered by the aid given it from commercial enterprises and the amateur. After they have developed it in time of peace, then should war come upon us, the Navy could come forward and say, 'Now, because the country is in danger, we want the whole thing.' And when that time comes, we will say, 'Everything we can do is at your command.' We will all doubtless support the Navy in that, and willingly. It is for the Navy's own sake, therefore, that I say, keep the Navy's hands off at the present time, in order that it can get a fuller control when the need comes."

Professor Kennelly called attention to the fact that this country has had war, on the average, every 30 years, and that it cannot be supposed we will never have another war, and we must look forward to having war again because a national habit of this sort can hardly be lost in a few generations.

"When it comes," he said, "we want to see America ready, gentlemen; we want to see the radio art supreme, and not to have it smothered by the restrictive monopoly of such a law. Should we have war, I want to see the naval officer helped; I want to see the Navy helped, not hindered, but assisted, and the best way to help is to keep hands off in time of peace and then give them the whole thing when it needs it, and when it will probably need it in a hurry.

The Commercial Company is Subject to the Call in Time of Need

"Now, let us have all the regulation you want. Let us have regulation to put the whole thing in the control of the President in time of need, so that the whole system can be taken over by the Navy for the protection of the country. In that I say amen. But in time of peace do not suppress everything in sight merely because a few men cannot get messages through with certain apparatus. That would be a crime, a great injustice."

"What would be the effect," asked the chairman, "should the Marconi Company monopolize the wireless? I mean any commercial company, not that company particularly, but any other commercial company?"

"Any commercial company?" repeated Professor Kennelly. "Any commercial company whatever that is a faithful servant of the public and doing its duty to the public and to the United States under the existing laws of the United States is subject to the call of all of its apparatus, operators, and equipment in time of need, is competent to carry out its work. There is far less danger of a single company's monopoly than of a Government monopoly."

The chairman then inquired whether there would not be some danger of the suppression of the development of the art from a monopoly.

"No; not anything like to the same degree," was the reply. "I would like to see several companies at work; I would not like to see all under one company, not even the manufacturing of apparatus all in the hands of one company. But even with one company in undisputed occupation of the field, there would still be an opening for every one to develop the apparatus which would find a purchaser in the open market. There would still be opportunities for everybody, under this Government and under the Constitution of the United States, to carry on reasonable radio communication in the use of the free atmosphere of this world. But to put all of that in the hands of the Government, to give the Government the power to suppress everything, then there will be no hope for any of us; we are all lost."

"You are assuming that the Government would pursue that very stupid policy," commented the chairman. "If I were an officer of the Government," responded Professor Kennelly, " in charge of stations which are competing for commercial service, to make a showing of returns on my books for the money I took in and turned in as cash receipts to the Treasury, I would do all I could to increase the amount of commercial service which I rendered. I would be doing my duty in enhancing that to the very utmost limit without injuring my conscience. And my conscience would probably be deadened if I were an earnest and zealous man, and I should probably trespass upon the rights of my neighbor and say, 'Look here; your rates are not suitable to me; your apparatus is not satisfactory to me; your wavelengths are not satisfactory to me; your decrement is not satisfactory to me. I want you to change this and that, and I want you to do so and so.' And I would hinder him and put all sorts of obstructions in his path. And in a little while, by following that policy, and by reducing my rates, I should own the whole thing.

"Without any further regulation at all for a good while everything needed can be accomplished. It has been the fact in the past and is now the fact that the only people complaining, apparently, are the people who have all the power now, who can take all the possible wavelengths from a meter to a hundred kilometers. The only people who cannot do the same thing are the commercial interests. The Government can use everything. The people who are complaining are the people who are not restricted; and the people who are not complaining are the people who are restricted. Is that fair? All we ask here is fair play, fair dealing, and fair play to the people who have their money in it; fair play to the Government; fair play to the departments; fair play to the amateur—fair play all around. Give us all a fair deal. And I say this bill, manifestly, is unfair."

"In your association you have, you say, about a thousand radio engineers?" asked Mr. Edmonds.

"Yes, sir," was the reply.

"And they are continually investigating and hunting up new methods in this art?" continued the questioner.

"More or less; I do not say all of them, but many of them are."

"And what you want to bring out particularly, I presume," commented Mr. Edmonds, "is that those men who are at present specialists are working ahead on the line which they will probably continue for the balance of their lives?"

"Yes, sir," was Professor Kennelly's response.

"But if this gets into the hands of the Navy, and it should turn out as you state it probably will, those men would, of course, go into other profession?" queried the representative.

Under Government Monopoly Engineers Would Have No Livelihood

"They would have no reasonable expectation of remuneration or livelihood by staying in their present profession," agreed the radio authority.

"Those Navy men are fine men, mind you, and nothing I am saying here is intended to reflect on them. But they are busy with their own affairs and busy with their profession, and busy with thousands of other things. A Navy officer's life is full of businesses and activities. And how can you expect a man with so many calls upon him to spend his time in developing the needs of this young and growing art. If he does, he is neglecting his duty."

"Has England, Germany, or France gone on and developed, independently, aerial stations for the navy?" asked Mr. Rowe.

Germany Aided Individuals Instead of Confiscating

"I understand," was Professor Kennelly's reply, "that all the Governments in Europe have Government apparatus and equipment. But some of them have permitted, and even fostered, individual ownership and individual development. For example, Germany has by its Government, instead of confiscating inventions or seeking to confiscate stations, helped private enterprise with her capital and with her brains and with her administration in order that when the Government wants to secure universal control, in case of war, they may be better off. That is the reverse of the policy that this bill suggests.

"The people in the commercial interests do not seek any legislative restrictions. They are getting along all right. They have no interferences to speak of. They have a little. But the only people who are complaining are the Navy Department, who naturally tend to get behind all the time. You cannot blame them. If we were in the Navy, we would do the same thing. We would have other business to attend to, and we would naturally tend to drop behind in these matters which are only little side issues to them. And it is vital to the whole world and vital to the Navy itself that it shall be kept up to the highest pitch by having as many of the brightest men as possible take it up and develop it; not just a few naval officers, here and there with a few hours to spare, taking it up and thinking about it."

"You are a radio engineer, I understand?" queried Representative Edward W. Saunders, of the committee.

"Yes, sir," was the reply. "Not by profession, but I am a radio engineer in the sense that I have taught radio engineering and have been acquainted with the art since its inception."

"Now, with respect to this art becoming a monopoly in the natural commercial development," continued Mr. Saunders, "is not there less reason for this becoming a monopoly in that way than either the telephone or the telegraph, by reason of the fact that this means of communication here is common to all the world without any expenditure, all the expense involved being in connection with the erection of transmitting and receiving stations?"

"That is right, sir," was the reply. "And if you leave it all alone and do not hamper it, this is far less likely to become a monopoly than any other existing means of communication."

"We hear more in this inquiry about the difficulties they have at sea on the vessels there," commented Mr. Saunders, "and, of course, we all agree it is very essential, so far as possible, that the communication with vessels at sea should be as uninterrupted and as definitely received as possible. Now, do I understand that that difficulty with respect to these vessels grows out of the character of the apparatus that they are using? Are they behind in the art in respect to the appartus they are using?"

The Worst Way to Advance is by Suppressing the Difficulties

"Partly so, sir," was Professor Kennelly's reply; "partly on account of the nature of the conditions. Ships naturally will be the last to benefit by improvements which are made on shore; because they must be standardized and more or less must all have the same kind of apparatus. You cannot be changing them all the time. But the improvements that are made on shore will gradually drift into the ships, so that they also will become in time the beneficiaries and sharers in non-interfering systems. The improvement is first made in the shore stations, and then it drifts into various ship stations and to the amateurs."

Professor Kennelly wound up his testimony by expressing the belief that it was the worst way to advance by suppressing the difficulties that have to be overcome. The commercial man, he said, naturally wishes to get in touch with the very latest thing in the commercial field, so far as he can, without being hampered. As for the inventor, Professor Kennelly held the same views as those expressed before the Committee by Professor Michael I. Pupin, namely, that experience has shown the inventor in the last few years that he has nothing to hope from the Government. The Government will help itself, and his only hope lies in gteting remuneration from a fair-minded commercial world.

AIRCRAFT AND WIRELESS ECONOMIC FACTORS

Wireless and the aircraft promise to be the two factors which will revolutionize the economics and sociology of the present generation, is the opinion of Henry Woodhouse, just as the railroad and the telegraph revolutionized the economics and sociology of the past generation.

The wireless telegraph and telephone and aircraft have opened unlimited possibilities. They promise to bring about the complete annihilation of space and distance, and in their prospective developed stage—which has been approaching in rapid strides—to do internationally what the railroad, the automobile, the telegraph, and the telephone have done within nations, rapidly mixing people and their interests, unifying interests and making the whole world truly a world nation.

Aircraft and wireless are to be the most influential factors in making the Pacific Ocean the world's central basin, succeeding the Atlantic, which became the central basin, succeeding the Mediterranean Sea upon the advent of the steamship. This will be brought about by the advent of aerial transportation and extensive use of wireless, combined with the commercial development of South and Central America, the northwestern part of the United States, Australia, Japan and China. This change is bound to come within ten years, and in the years that will follow the countries of South and Central America and Australia will develop into large nations.

An information bureau, from which weather reports will be sent by wireless to aviators and the vessel commanders of the Naval Coast Defense Reserve, will be organized by E. B. Dunn, the chief forecaster for the Government in New York.

From and For those who help themselves

Experimenters' Experiences.

The editor of this department will give preferential attention to contributions containing full constructional details, in addition to drawings.

FIRST PRIZE, TEN DOLLARS

How to Make a Receiving Tuner of Variable Range

How would you like to have a receiving tuner that would enable you to listen to Arlington or Key West, and then by a twist of a switch would permit you to hear a fellow amateur sending? Furthermore, suppose that you have tired of listening to these stations and wish to go back to the long wave-length stations at will. Would not such a receiving tuner be just the type you are looking for? By following the description and the accompanying drawings, you will be able to construct such a receiving tuner as I have, and one that will permit such things to be done.

The completed instrument is shown in Figure 1 in which is seen the loose coupler (preferably one of the Arlington type B transformers), the audiotron or some other vacuum valve detector, two .0005 microfarad variable condensers, the switch for changing from long to short wave-lengths and the switches for connecting either of the six small short lave loose couplers into the circuit.

Several small loose couplers (in this case there are six) are each wound with the exact amount of wire on them that is needed to receive from various amateur stations within range. The primaries are connected to the upper switch and the secondaries to the lower switch.

It will now be seen that by writing the call letters opposite the switch point any of six amateur stations can be listened to by simply shifting the double blade switch, obviating the necessity for shifting several switches simultaneously. This should be clear to the reader if he will examine the diagram of connections in Figure 13 where the position of all apparatus in the various circuits is shown.

The switch in the upper right hand corner cuts in and out the "A" and the "B" batteries. Figure 2 shows the hard rubber fibre or Bakelite panel and the positions of the holes to be bored for the switches and switch points. Figures 3, 4, 5, 6, and 7 show in detail the various switches employed and Figure 8 shows the back view. The sides of the top of the cabinet are shown in Figure 9 and 10 respectively. Figure 11 shows the pieces to be used inside to support the small loose couplers. In Figure 12 is shown an interior view with the side removed indicating the positions of the variable condenser and loose couplers, and the rods, which are employed to draw the primary and secondary windings apart, extending through the back of the cabinet.

The primaries of the coupler should

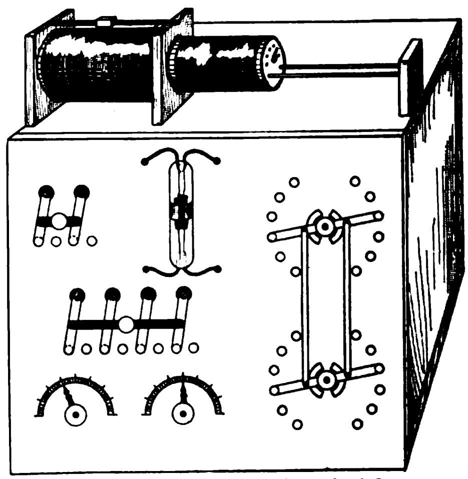
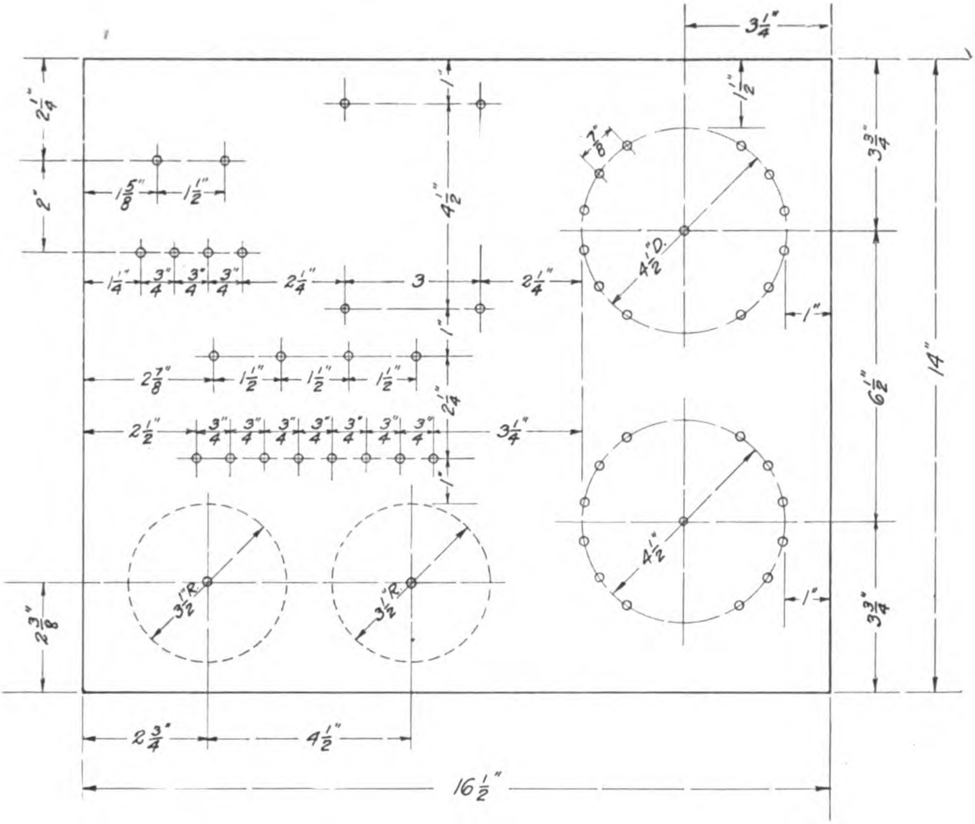


Figure 1, First Prize Article



— *Drilling Plan for Panel* —

Figure 2, First Prize Article

be wound with No. 24 S. S. C. or S. C. C. wire and the secondaries with No. 32 S. S. C. wire, on tubes 3 inches and 2½ inches in diameter respectively. They should be wound approximately to the wave-length of the desired station, which is found by connecting them to an aerial and adjusting the values of inductance until the maximum results are obtained. The leads should then be soldered to the switch points and the coupling varied till better results are obtained. Then, for more accurate adjustment, the variable condensers can be employed.

The builder of this apparatus may make changes according to conditions, but the general outline presented should be duplicated if a tuner is required in which the wave-length adjustment can be quickly shifted. The large loose coupler might, for instance, be placed inside of the box and its inductance values varied by a multi-point switch, or a greater or lesser number of small couplers may be employed on the interior, all of which depends upon the number of stations from which the builder desires to receive.

I have found a set of this type to be entirely practical and there seems to be no particular loss in efficiency in the use of several primary and secondary inductances.

Albert Upton, *Minnesota.*

SECOND PRIZE, FIVE DOLLARS
A Precision Hot-Wire Ammeter That Can be Easily Calibrated

The hot-wire ammeter has in the past been a very much neglected part of the average amateur's transmitting outfit. Unless he possesses the necessary "ready cash" with which to buy a commercial instrument, he must content himself with some home-made makeshift that gives only comparative values of the current flowing in his antenna.

There are a number of fundamental calculations that depend on the exact

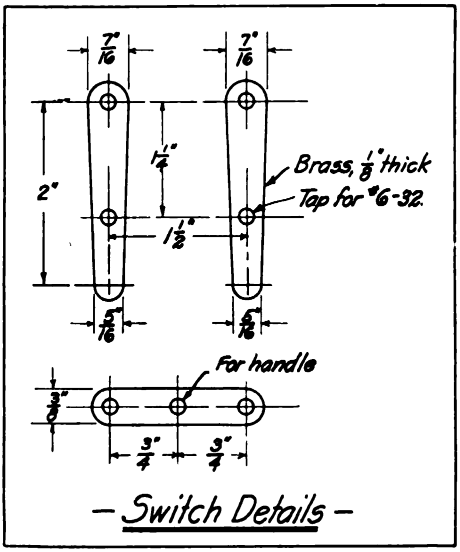


Figure 3, First Prize Article

value of the energy oscillating in the aerial, and a precision ammeter is therefore an essential to the advanced amateur's outfit. Most hot-wire ammeters (especially of the shunted

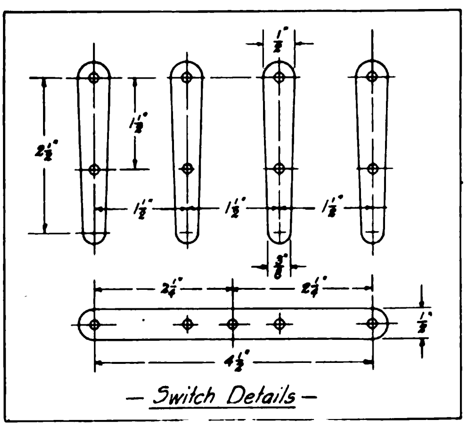


Figure 4, First Prize Article

type) cannot be calibrated on direct current and then be expected to indicate accurately on the very high frequencies employed in radio work unless mathematical corrections for "skin effect" are applied by means of the Kelvin formulae. Therein lies the chief drawback of home-made meters.

It is hoped that the ammeter described in this article will fill a long-felt want in that it can be calibrated on direct current and when connected in the aerial circuit will read as accurately as the highest priced instrument in the market. At the same time it is far more rugged and extremely simple of construction. If intended for use in a university wireless station where, in calibrating the meter, access can be had to a physics laboratory equipped for electrical measurements, it can be made an instrument of the highest precision.

Regarding the principle involved in the meter's operation: The idea is a distinctly new one, first having been

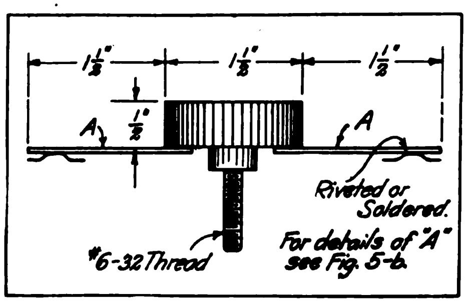
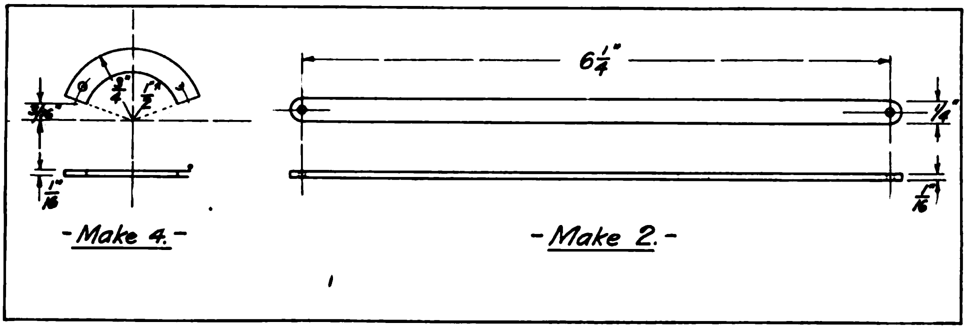


Figure 5, First Prize Article

suggested by Fleming in a foreign publication and afterwards developed further by the Marconi Company and by Charles S. Ballantine of the Radio Research Laboratory in Philadelphia. The ammeter for amateurs described in this article was designed from Mr. Ballantine's data.

All measurements of high frequency current depend on the heat loss developed in a small wire, this heat loss being commonly measured by some more or less crude mechanism which takes advantage of the expansion of the conductor. Now suppose we should solder a thermocouple to the center of this wire. The heat generated in the latter would give rise to a thermal E. M. F. in the couple and this E. M. F. could be measured by a millivoltmeter connected to its terminals. The scale

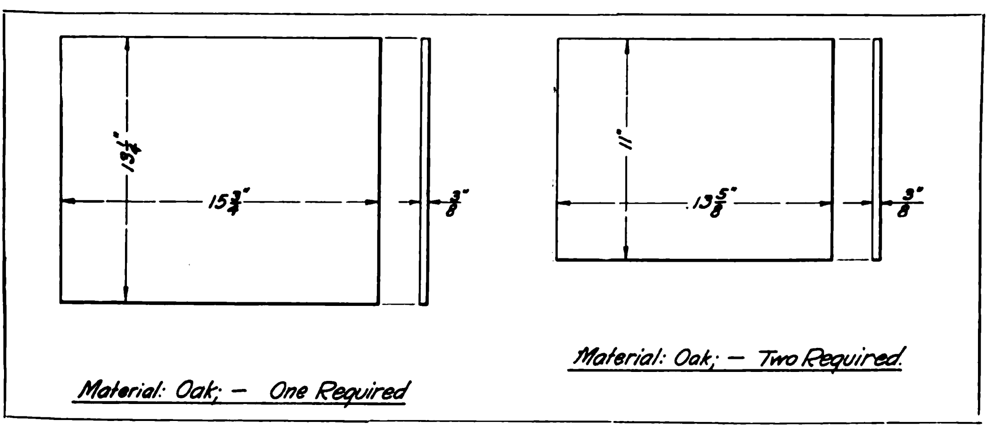


Figures 6 and 7, First Prize Article

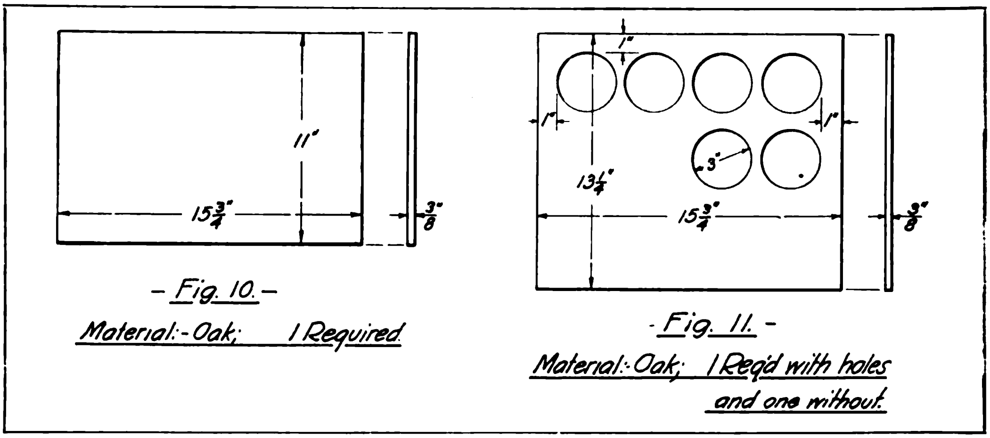
of the voltmeter could then be calibrated in terms of the root-mean-square current oscillating in the hot-wire. Such an instrument would be free from mechanical moving parts in the ammeter itself and the millivoltmeter could be located at any convenient distance from the high voltage leads. (See Figure 1).

But in order that an ammeter intended for wireless service may be calibrated on direct current, it is imperative that the high frequency resistance and D. C. resistance of the heating element be the same. This condition is approached in a wire of size No. 40 B. & S. On the other hand, a wire of this cross section cannot be used on currents in excess of 1.5 amperes, so that in constructing a precision instrument we are compelled to use a number of such wires in parallel. If the thermocouple be attached to one of them, the reading of the instrument will be proportional to a constant fraction of the total current, and this will be the same constant fraction as when used on high frequency. However, several wires in the same plane would lead to error when used in a radio circuit, due to the unequal distribution of the current in the system. If finally we eliminate this error by arranging the wires in the form of a cylinder, we have complete, in theory at least, the design of a precision ammeter.

Constructional details of such an instrument for amateur use follow: The hot-wires are six in number, each being a piece of No. 40 bare copper, 4 inches long. They are arranged in the form of a cylinder by spacing them at equal distances around the circumferences of two small metal discs (Figure 2), which form the terminals of the element. Turn these discs, 1 inch in diameter, from a piece of 1/16-inch brass sheet, and drill their centers for fastening to the posts A and B with



Figures 8 and 9, First Prize Article



Figures 10 and 11, First Prize Article

8/32 machine screws as shown in the perspective sketch of the finished instrument (Figure 3). At intervals of 60 degrees around the peripheries of both discs make small saw cuts with a fine hack-saw.

The terminal posts of ¼-inch square brass stock are drilled and tapped as indicated in Figure 2. The posts having been completed, secure the discs to them with the machine screws and fasten the assembled terminals in position 4¼ inches apart on a 6-inch by 2-inch base of ¼-inch bakelite.

The six No. 40 wires may now be placed in position by soldering their ends into the saw cuts in the edges of the discs, making certain that all of the wires are taut when the soldering is completed.

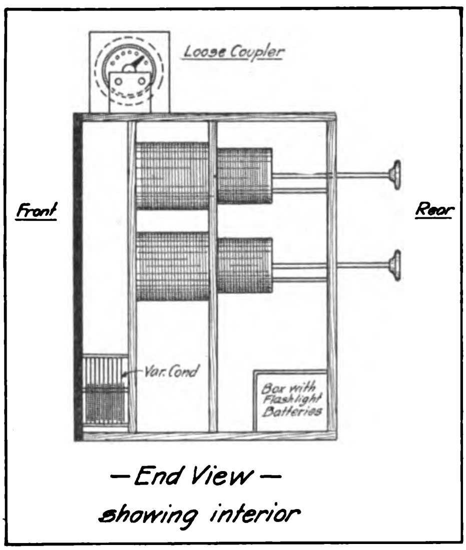


Figure 12, First Prize Article

Procure a piece of No. 36 soft iron wire, 3 inches long, and another piece of German silver of about the same size for the thermocouple. Twist their ends carefully together for a short distance and solder both to one of the two lower No. 40 wires with a small bead of solder. The two free ends of the wires forming the couple are secured to a pair of binding posts at one side of the base. These posts form the terminals for connection to the millivoltmeter.

The entire element should be enclosed in some sort of metal case, as shown in Figure 3, to afford protection from injury.

A few words as to the calibration of the ammeter may not be amiss. The simplest procedure is to connect the element in series with a battery, a rheostat and an accurate ammeter with a scale range of from 0-15 amperes (Figure 4). For various values of current, the ammeter and millivoltmeter are read simultaneously and a curve plotted with the ammeter readings as ordinates and the voltmeter readings as abscissæ. Or, better yet, the voltmeter may be fitted with a new scale and the values of current, as shown by the ammeter, marked directly upon it. It will be found that the calibration is very nearly linear, making the scale quite uniform.

For the benefit of any advanced students who may have access to a well-equipped laboratory and who desire to make a very accurate hot-wire meter, it may be profitable to describe briefly a more refined method of calibration. The ammeter in Figure 4 is replaced by a standard resistance of about .1 ohm and the IR drop across this standard is measured with a Leeds and Northrup type K potentiometer. The reading of the potentiometer divided by .1 then gives the value of the current with great accuracy. This method eliminates the calibration errors of the ammeter used in the first method.

M. K. Zinn, Indiana.

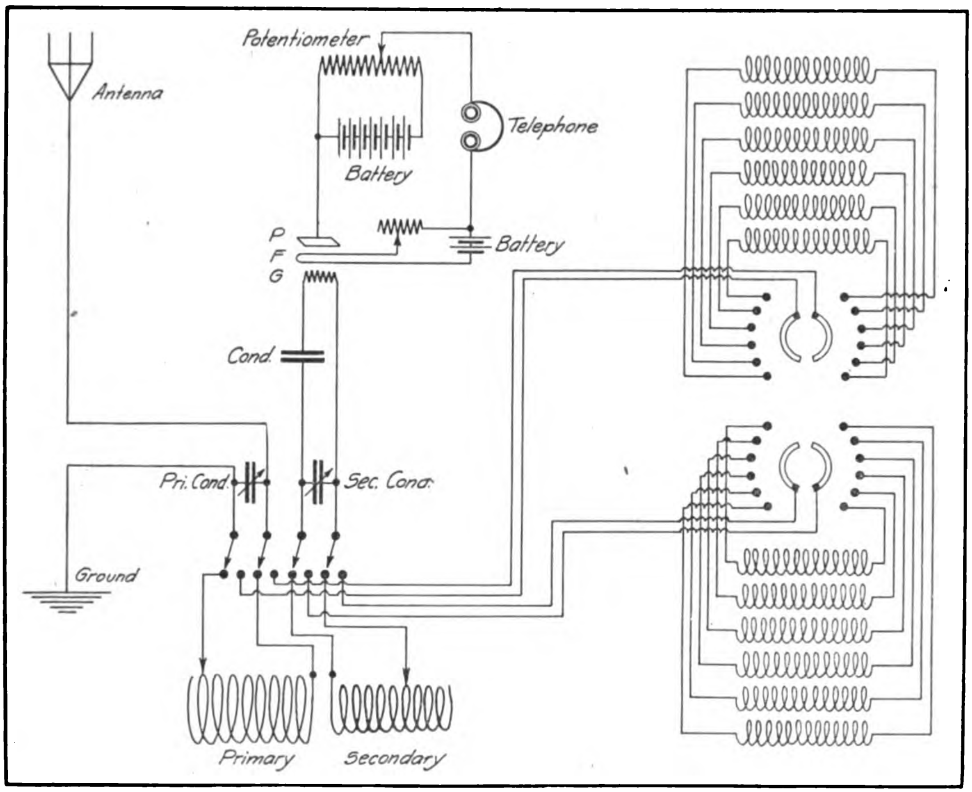


Figure 13, First Prize Article

THIRD PRIZE, THREE DOLLARS
An Arc Generator of High Frequency Current

Now that undamped transmitters are becoming so popular the amateur has no doubt wished to experiment with this type of apparatus, but has not been able to do so because of the difficulties of construction and the high cost of the commercial apparatus. The writer, not being able to purchase the latter, was forced to make use of the best material at hand to construct the apparatus. The purpose of this article is to describe the finished arc generator and to give information regarding how the different problems were solved. The results were gratifying and fully compensated the writer for his trouble.

The accompanying drawing fully illustrates the construction. The arc generator consists of a carbon and a copper electrode (Figure 1) burning in an atmosphere of alcohol vapor, the air tight chamber being formed by a piece of 4-inch pipe to the ends of which are clamped a fibre top and a slate base by means of 6¼-inch brass rods. The top carries the carbon electrode and the starting and regulating device, while the base supports the copper electrode. Asbestos packing in the form of discs is placed where the pipe comes in contact with the fibre top and slate base to assist in maintaining an air tight joint. These details are plainly shown in Figure 2.

The top of the arc chamber is a piece of ¼-inch fibre sheet cut to size, as per drawing, and bored for the six brass clamp rods, and the alcohol tube, one central hole being bored for the carbon rod holder. The base is a piece of slate 1 inch thick and cut to the size, as per drawing. Six holes are bored to correspond with the holes in the fibre top for the clamp rods. These holes must coincide with the ones in the fibre top and be true with them. A hole is bored in the center of the slate base to fit a piece of ¼-inch pipe. Two pairs of legs are attached to the base and the extremities of the legs are screwed to a sub-base, 8 by 10 inches, as per drawing. The asbestos packing discs are cut about ¼ inch greater in diameter than the pipe so that when clamped between the top and pipe and the base and pipe, the packing will project ⅛ inch over the edge. Use soft asbestos, not the wire laced type, as the latter is too hard.

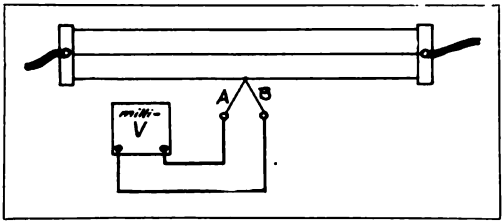


Figure 1, Second Prize Article

The hole in the center of the fibre top is tapped to fit the threads on the valve stem and when the latter is screwed tightly into the top, a good joint will result. Since the brass rod on the valve stem is ⅜ of an inch and the carbon ½ inch, a brass collar must be made, as shown in Figure 2, where a piece of brass rod is drilled on one end for the valve stem rod and at the other end for the carbon rod. Set screws are provided to hold the collar in place.

Some means must be provided to adjust the length of the arc and to start the flame. As shown in Figure 2, the adjusting device consists of an iron bridge, an adjusting screw and a spring. The bridge is bent, as per the drawing, and is clamped to the top by two of the six clamp rods. This is illustrated in the top view (Figure 3). The adjusting screw is a piece of brass rod threaded the entire length and fitted with a fibre handle. The spring is steel or brass. A fibre handle is attached to the end of the brass rod carbon holder to hold the spring in check and to serve as starting handle. This handle slides between the legs of the iron bridge, thus keeping the carbon from turning. A piece of lamp cord which serves to maintain the electric circuit when starting the arc is sol-

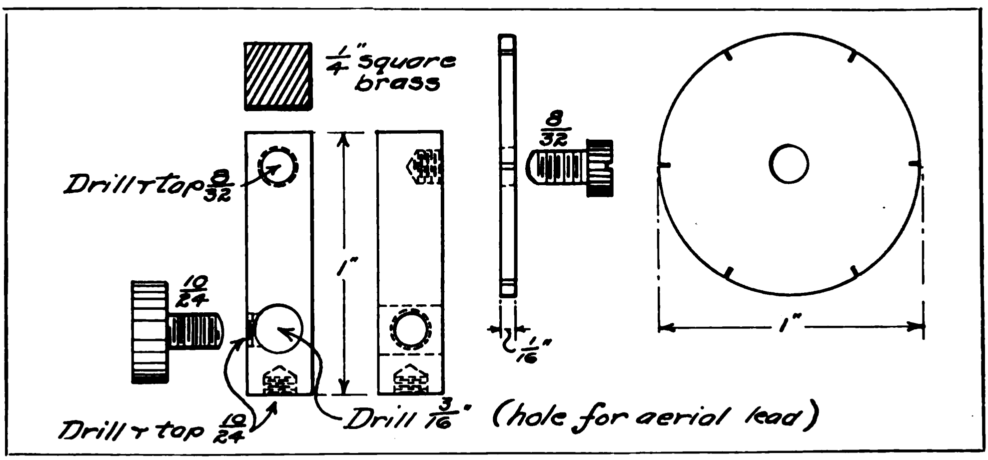


Figure 2, Second Prize Article

The parts most difficult to construct are the carbon electrode adjuster and the starting device. The best way to obtain a gas tight joint at the point where the carbon holder passes through the fibre is to procure the packing stem from an old valve and fit it with a longer rod.

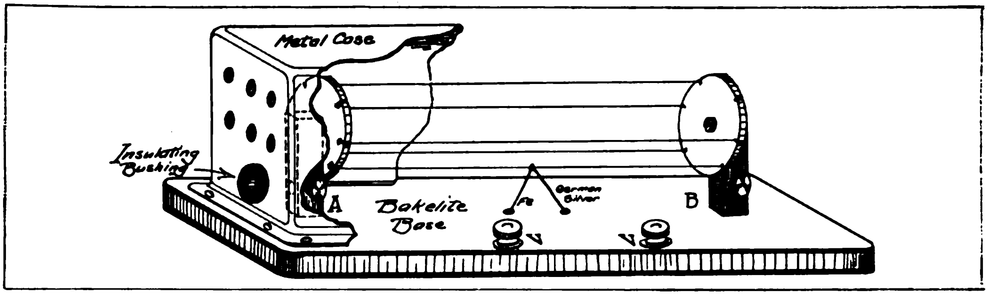


Figure 3, Second Prize Article

dered to the brass carbon holder just under the starting handle and the other end is soldered to either leg of the bridge.

The positive copper electrode is plainly seen in the drawing, but if made from copper it will prove expensive. One of cheaper construction can be made from an old brass lubricator as follows:

Remove all its attachments, leaving only the brass cylinder. The cylinder will have one opening at either end. The top opening is plugged with a copper plug which extends about an inch beyond the cylinder. The lower hole is bushed down to fit a ¼-inch pipe, but all other holes are stopped up with plugs. The ¼-inch pipe from the base of the cylinder passes through the center hole in the slate base and thus, by means of a nut on the pipe, the cylinder is clamped to the base. This pipe also serves as one side of the water circulation through the positive electrode, and to provide an outlet for the water a hole is bored in the bottom of the cylinder and a small pipe or tube fittted therein as shown in the drawing. It should be noticed that the copper electrode rests on the asbestos disc and before clamping the cylinder to the base some shellac should be placed on the packing to make a good joint

The alcohol container is an ordinary adjustable oil sight feed cup, mounted as shown in Figure 2. It is not important where the cup is mounted, provided it is out of the way. A small copper tube leads the alcohol to the arc flame. With the ordinary old cup it will be found impossible to stop the flow of alcohol entirely and as a remedy a small rubber washer may be placed under the needle stem.

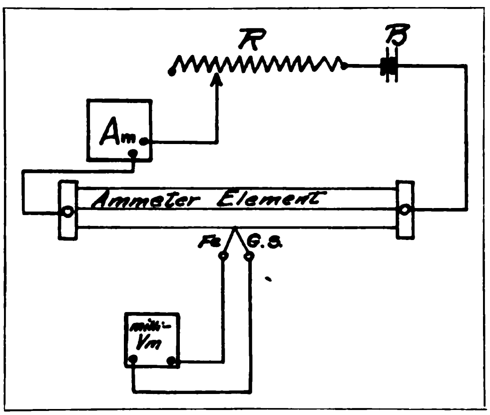


Figure 4, Second Prize Article

A very important attachment is the safety valve seen to the right of the completed arc. When the author first started the arc he was greeted by a loud report. Fortunately he had foreseen this and devised the valve shown. The safety valve is made from an upright brass valve to which is added a bridge arm and an adjusting screw which regulates the tension on the gate, thus determining the popping pressure. The brass arm is soldered to the valve proper.

If a little common sense is exercised in the construction of this apparatus no trouble will be experienced in the assembly. All parts are mounted on the top except the iron bridge. The slate base is attached by means of the legs to the sub-base. Then the 3-inch pipe forming the chamber is put in place so that the brass cylinder is exactly in the center and the asbestos disc projects evenly around the pipe. The top is next put on and the clamp rods are inserted. The bridge is held down by two of the rods and is next put in place after making sure that the starting handle moves up and down easily.

The packing in the valve stem should be just tight enough to allow the carbon holder to be pushed up by the spring. The alcohol is adjusted so that one drop falls every thirty seconds. Connections from the D. C. source are made to the small tube attached to the brass cylinder serving as the positive electrode and from either side of the bridge. The additional apparatus required to complete the set consists of an oil-filled variable condenser, an oscillation transformer, a resistance limiting the current to 6 amperes when operated on 110 volts D. C. Two choke coils are also provided and serve to prevent the high frequency current from backing into the generator.

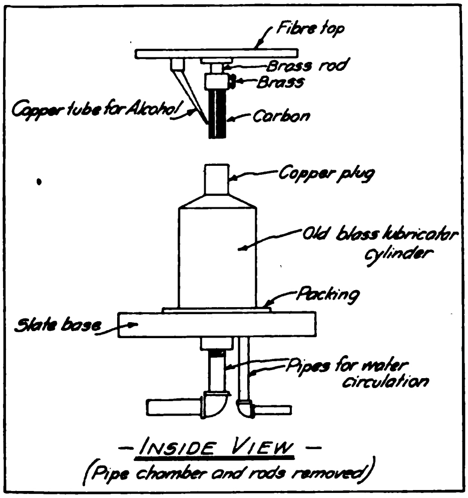


Figure 1, Third Prize Article

The arc generator which the author constructed, when used on 110 D C. consumed, 2 amperes and radiated 40 watts of high frequency current which is not so bad, but better results could be obtained if the arc is operated on higher voltages.

The writer would be glad to hear of the results obtained by others with this arc generator.

Louis Falconi, *New York.*

Although our contributor has described in detail the construction of an arc generator, he has neglected to give us the circuit for its operation. Generally such arcs are placed in series with the antenna circuit, but they function best with aerials adjusted for frequencies corresponding to waves of about 2,000 or 3,000 meters, and the use of such a transmitter would not be permitted by the Government authorities except in special cases. Some results will, of course, be obtained from the shorter wave-lengths, but usually the longer waves give the greater efficiency.—Technical Editor.

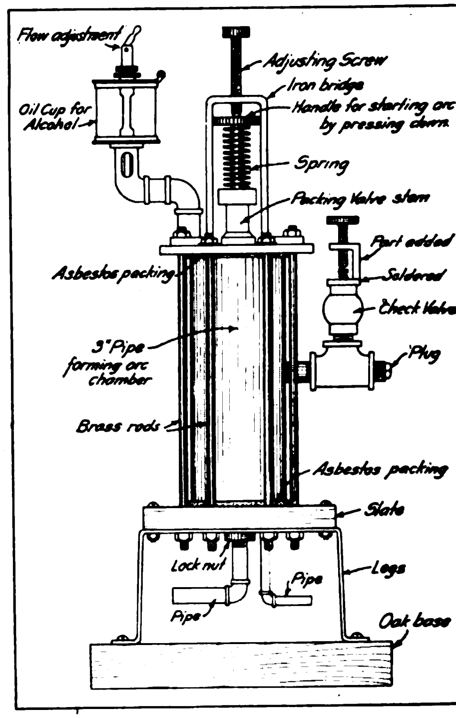


Figure 2, Third Prize Article

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Vacuum Valve Regulator For Amateurs' Use

Amateur experimenters have no doubt frequently observed that the filament of the vacuum valve detector, particularly when used in step-up amplification circuits, requires exceedingly close adjustment. This is particularly true of the tubular type of vacuum valve bulb which requires a filament rheostat of the closest possible adjustment.

A rheostat that we have found to be of great value for the vacuum valve bulb is shown in the accompanying drawing where a drum, D, is wound with a number of turns of No. 26 German silver wire, there being in sliding contact therewith, a contactor, S, which is also

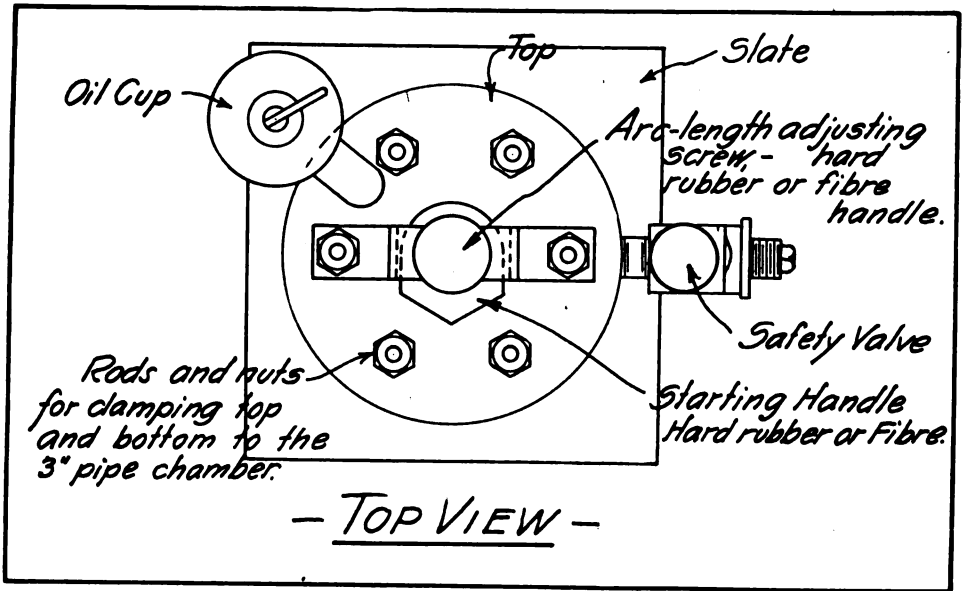


Figure 3, Third Prize Article

mounted on the threaded rod, R. By turning the knob, H, the gear wheel, A, acts upon the intermediate gear, B, and sets C into rotation, the contactor, S, moving from the front to the rear in accordance. One of the connections, that from the binding post, P-1, extends to the rod, R, but the other connection, that from the binding post, P-2, extends to the bearing upon which the rod, W, rests. By careful proportion of all parts, the contactor, S, will move at the proper rate to maintain contact with the wire on the drum at all times and throughout its entire length.

If a step-up vacuum valve amplifier is employed, one of these rheostats should be included in the lighting battery circuit of all valves. We feel that the builder of this rheostat will find it well worth while the labor and expense involved. Further, if it is neatly machined, and mounted on a hard rubber base, with the brass parts all lacquered, a very neat instrument will result.

F. E. FOWLER, F. W. MOORE, *Georgia.*

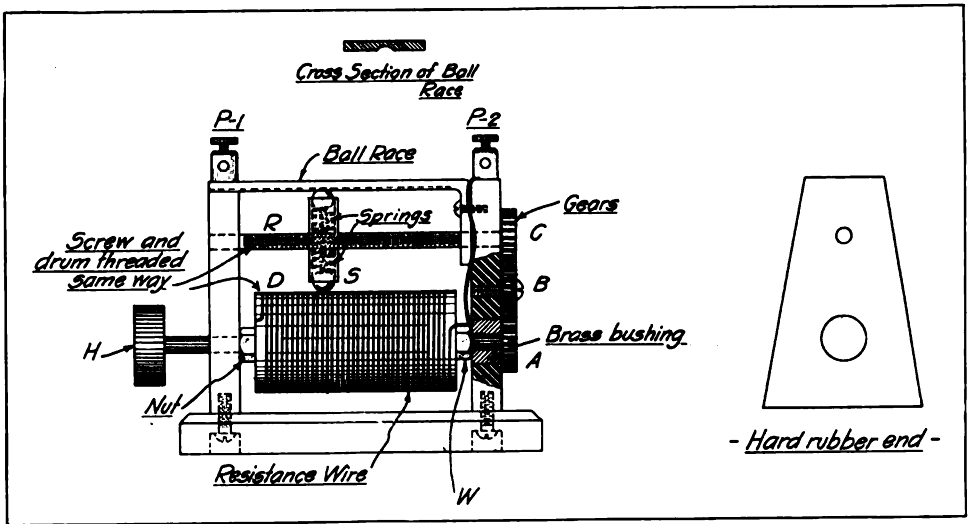
HONORARY MENTION
How to Use Burned-Out Moulded Condenser Sections

Not being content with throwing my burned-out sections of moulded condenser away and purchasing new ones to take their place (they cannot be exchanged after they have been burned out), I sought some means of restoring them to their normal condition, thus preventing them from going to the junk pile. I tried numerous heating processes and then discovered this simple mode of rendering them fit for active service.

After taking off the terminals and separating the lugs, I tested the lugs to find the location of the short-circuit (the break-down nearly always results in a short-circuit) which is generally in the middle of the section. The best method is to use a battery and phone.

After ascertaining the punctured plates, I placed the section on the table in an upright poston, and placed the sharp edge of a knfe along the line of one plate (these lines are easily seen along the edge of the section) and dealt it a sharp blow with the hammer. The section split along the punctured plate, which I easily removed.

I then placed the two parts together and after taping them, I replaced the terminals and found the section to be as efficient as a new one with the exception of a slight loss of capacity, which is accounted for by a slight increase in primary inductance of the oscillation transformer.



Drawing, Fourth Prize Article

Thus I overcame the one disadvantage of the moulded condenser, viz., having to discard it when punctured, and purchase new ones. I prefer the moulded condenser because it possesses all the advantages of the glass plate condenser, with the added efficiency of no brush.

JULIAN E. KRONE,
Virginia.

HONORARY MENTION

Results Obtained With a Regenerative Amplifying Circuit

In reply to E. E. Bucher's query in the December N. A. W. A. Bulletin, concerning regenerative vacuum valve receiving sets, I should like to report as follows:

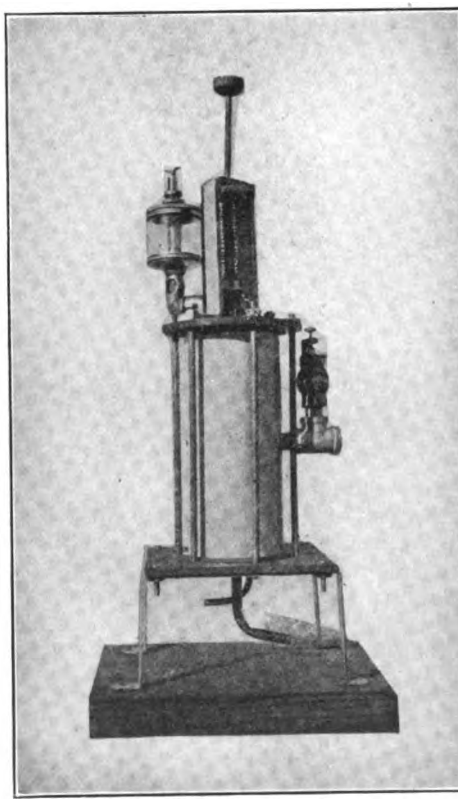
While my station was not in operation on the night of the big relay test, I have been getting some very satisfactory results, since then, with the hook-up supplied in the N. A. W. A. Bulletin.

For example: On the night of January 29th from half past eight until 11 o'clock (central standard time), I heard signals from amateur stations in sixteen different states, exclusive of my home state. These stations were distributed among all the districts excepting the sixth and the seventh.

A partial list of those heard on this one night, will be found on the following page.

Some of the nearer ones were read with the phones three or four feet away, while nearly all could, at least, be read with the phones pulled several inches from the ears.

It might be of interest to know that the aerial used was of the inverted L type,



The Assembly (Third Prize Article)

Call Letters	Location	Approximate Distance
5ZC	Dallas, Tex.	1100 miles
5AX	Shreveport, La.	1000 miles
5BV	Little Rock, Ark.	800 miles
9AI	Adams, Neb.	800 miles
9OC	Somerset, Ky.	450 miles
9GO	Duluth, Minn.	550 miles
9QK	Beaudette, Minn.	750 miles
9AMI	Montivello, Iowa	600 miles
9AGO	Davenport, Iowa	500 miles
9ALR	Waterloo, Iowa	500 miles
4AA	Athens, Ga.	650 miles
1ZM	Hartford, Conn.	500 miles
2AR	Poughkeepsie, N. Y.	450 miles
9MK, 9WO, and 9GV	Illinois	
9PI, 9OK and 9VM	Indiana	
8JL	Crafton, Pa.	350 miles
9XM	Madison, Wis.	700 miles
3NB	Vineland, N. J.	450 miles
8LJ, 8NH and numerous others in Ohio.		

consisting of six wires on 10 foot spreaders, 70 feet long and only 45 feet high at one end and 20 feet high at lead-in end. In addition the aerial had considerable sag, about half of it being not more than 20 or 25 feet from the ground. The station is in the basement. All of the instruments, with the exception of the phones and variable condenser, were home made.

I certainly believe it worth any amateur's time to experiment with regenerative amplifying circuits as they are simpler than a two-step amplifier and give very marked results.

F. J. SCUPHOLM, *Michigan.*

Twenty-seven St. Paul (Minn.) boys met at the Y. M. C. A. in that city recently and formed a radio club. The following officers were elected: President, Robert Hall; vice-president, Marlow Bergstrom; secretary-treasurer, Leon Fink.

CLOSE 800 STATIONS IN NEW YORK

More than 800 wireless plants have been dismantled by the police of New York City, who have been instructed to destroy all privately owned plants and to allow no station to operate except those controlled by the government, the military authorities and the police.

Rear Admiral Nathaniel R. Usher, commandant of the New York Navy Yard, has announced that he requested the co-operation of the Governors of New York, New Jersey, Connecticut and Vermont, as well as the Mayors of New York City, Newark, Jersey City and New Haven, in closing all private radio plants in the Third Naval District. This action, he said, was in accordance with the Executive order issued in Washington, April 6, directing that the radio plants not operated by the government or by its permission must be closed "to insure the proper conduct of the war against the Imperial German government and the successful termination thereof."

No distinction was made between outfits. All were dismantled, that of the schoolboy and the scientific man alike, and in each case the name, address and nationality of the owner of the plant were noted and will be forwarded to Washington.

With The Amateurs

In response to the call for men interested in wireless telegraphy and signal corps work, fifty-two men, representing the faculty as well as the undergraduates of Dartmouth College, met in Hanover, N. H., recently and organized the Dartmouth Radio Association. A constitution was adopted and the following officers were elected: President, R. S. Hayes, '19; secretary, J. R. Byers, '18; treasurer, K. W. Spalding, '20.

The Association aims to create interest in wireless and signal corps work, to train men in both branches, and to carry on wireless communication with the radio clubs of other colleges.

The members are divided into three classes: including respectively (A) men holding first grade commercial or amateur licenses; (B) men holding second grade amateur and cargo grade licenses, or who have had experience but have no licenses; and (C) beginners. Henceforth candidates for membership must present their names to an officer or member of the Association. The names must then be accepted by a two-thirds vote to elect the new member. It was decided that twenty-five cents should be collected from each member to cover expenses for the remainder of the year.

A call for fifty amateur wireless telegraph operators from Omaha, Neb., has been issued by Lieutenant W. W. Waddell, officer in charge of the Omaha naval recruiting station, as members of the Naval Reserve Corps. They will be used largely as censors of wireless messages, Lieutenant Waddell said.

Announcement has been made that Vassar College is in a state of "practical mobilization," wireless telegraphy being among the activities to which the students are devoting themselves as measures of preparedness.

A woman's class in wireless has been formed in Philadelphia by Miss Eleanor Bonsall. The members of the class are studying the art with the aim of utilizing their knowledge, if necessary, in war.

A published report is to the effect that atop a hotel, described as the tallest in the world, to be erected in Atlantic City, N. J., will be installed a wireless station for use by the Government.

C. W. Waggoner, an instructor at the University of West Virginia, lectured on "Wireless Telegraphy" under the auspices of the Coke Center Radio Club in Connellsville, Pa., on March 23d.

An informal discussion of the fundamental theories of wireless telegraphy took place at a recent meeting of the Radio Club of Union College in Schenectady, N. Y.

Twenty-five women and girls are planning to organize an auxiliary of the Connecticut Valley Radio Club of Springfield, Mass. A number of the prospective members of the auxiliary are students in Smith College.

The Peekskill (N. Y.) wireless amateurs have organized under the name of the Peekskill Radio Club. The officers are: President, John W. Dain; vice-president, Ernest W. Hawkins; secretary-treasurer, George I. Olson. The charter members of the club are John W. Dain, Ernest W. Hawkins, Clinton S. Ferris, Lester M. McCoy, William E. Murray, Donald S. Ferris, Arthur Mansfield, Harold Vogt, Charles R. Doty and Gilbert F. Oakley.

The North High Wireless Club, of Des Moines, Ia., has elected the following officers: President, Gerald Becker; vice-president, Malcolm Eaton; secretary, French Holbrook.

A wireless club has been formed at the Danbury (Conn.), High School, under the direction of Walter F. Burt. The following officers have been elected: President, Albert Verbyle; vice-president, Leslie Davis; secretary, Edward Van Hoesen; treasurer, Walter F. Burt.

Amateurs at West Grove, N. J., have organized the West Grove Radio Club. The names of the officers follow: President and treasurer, J. Robert Shafto; vice-president, Howard W. Jamison; secretary, William Yarrington, 113 Corlies avenue, West Grove. Meetings will be held the first and third Mondays of each month. Correspondence with other wireless clubs is invited.

Interest in wireless has grown to such an extent in Charlotte, N. C., that the Charlotte Radio Club has been organized. The officers are: President, Edwin Mathews; vice-president, Lowry Pressly; secretary and treasurer, Turner Finger, of 176 East Eighth street. Persons interested in the Club can obtain additional information by writing to the secretary. The Club expects to apply for a National Amateur Wireless Association charter.

Haddonfield, N. J., amateurs have formed a wireless club. Its headquarters are at 218 Park avenue.

The Utica (N. Y.) Radio Club has initiated a campaign to obtain $500 with which to obtain equipment.

Students of the University of Rochester, Rochester, N. Y., are planning to install a wireless set at the University.

A wireless club has been formed at the Lynn (Mass.) Classical High School. The following officers have been elected: President, Albert W. Quinn; vice-president, John O'Hara; secretary, Julian T. Webber. Albert W. Quinn, John O'Hara and Everett Philbrook have been named as members of a Committee on By-Laws and Rules.

The Onondaga Radio Association was formed recently in Syracuse, N. Y., at a meeting held at the home of Arthur Hinzpeter. The following officers were elected: President, Waldemar Vanselow; vice-president, Sydney MacKean; secretary, Arthur Hinzpeter; treasurer, James Newbold. All wireless amateurs in Onondaga County are invited to join the Association. Address communications to Arthur Hinzpeter, secretary, 234 Palmer avenue, Syracuse, N. Y.

The regular meeting of the Radio Traffic Association was held at its home, 486 Decatur street, Brooklyn, N. Y., on March 16th. The names of the officers of the Association follow: Chairman, Ferdinand C. W. Thiede; secretary, Albert R. Heyden; financial secretary, E. K. Seyd; treasurer, Clifford J. Goette.

The Radio Club of the Scott High School, at Toledo, Ohio, has thirty members. The officers are: President, Willis K. Wing; vice-president, Gardner Leach; secretary, Sewall Wright; treasurer, Carlton Mathis. Communications from other clubs are invited.

The Boy Scouts' Wireless Club has been formed in Memphis, Tenn. The officers are: President, Charles Wailes, Jr., of Troop No. 1-A; vice-president, J. G. Noshey, of Troop 3; secretary, James Sutton, of Troop 5; treasurer, Frank W. Ward, Jr., of Troop 21. C. A. De La Hunt will be in charge of the instruction.

The Bellevue Radio Chain, of Harrisburg, Pa., celebrated its third anniversary with a banquet held at the club's rooms at Rodgers avenue and Lincoln Highway. Charles A. Wray acted as toastmaster and the speakers included Charles C. C. Ragsdale, A. A. Rossmann, Samuel Thayer and W. V. Protzman. Mr. Rossmann described an instrument he has invented for amplifying signals. Mr. Rossman and Mr. Ragsdale were guests of honor. The officers of the club are: President, Charles A. Wray; secretary, G. Styber; treasurer, W. H. Hoobler.

A Medal of Honor to be Awarded by the Institute of Radio Engineers

THE Board of Direction of the Institute of Radio Engineers has decided to award annually a "Medal of Honor" to such persons who have distinguished themselves by unusual advances in the fields of radio telegraphy and telephony. It has been felt that some way should be found whereby valuable work in these fields of great and rapidly growing importance might properly be recognized by an authoritative engineering society. As is well known, the Institute of Radio Engineers, with more than 1,000 members here and abroad, and with sections in New York, Washington, Boston, Seattle, San Francisco (with others in contemplation), is the leading technical and scientific society in the wireless field. It is therefore recognized that a "Medal of Honor" from the institute will be a goal worthy of attainment by any investigator.

The appearance of the medal is shown in accompanying illustrations. The front is a symbolic representation of electromagnetic waves, indicating the interlinking of the magnetic and electric forces in their rapid path through the depths of space. The reverse side bears the inscription:

"To ...., in Recognition of Distinguished Service in Radio Communication" (followed by the date), the inscription being surrounded by a laurel wreath.

The medal is the work of the well known sculptor, Edward Sanford, Jr., of New York.

Medal of Honor to be awarded by the Institute of Radio Engineers

Inscription on the reverse side of the medal

The award will be made yearly at the April meeting of the institute to the person who, during the two preceding calendar years, shall have made public the greatest advance in the art of radio communication. The advance may be a patented or unpatented invention, but it must be completely and adequately described in a scientific or engineering publication of recognized standing and must be in actual, though not necessarily commercial, operation. However, preference is to be given to widely used and widely useful inventions. The advance may also consist in a scientific analysis or explanation of hitherto unexplained phenomena of distinct importance to the radio art, although the application may not be immediate. Preference will be given to analyses directly applicable in the art. In this case also publication must be full and in approved form.

The advance, furthermore, may consist in a new system of traffic regulation or control, a new system of administration of radio companies or the radio service of steamship, railroad or other companies, a legislative programme beneficial to the radio art, or any portion of the operating or regulating features of wireless. It must be described publicly in clear and approved form and must, in general, be actually adopted in practice. In all cases marked preference is to be given to advances made in the preceding year.

The medal is to be awarded under the following conditions:

At least thirty days before the April meeting the Board of Direction will call from a number of members and fellows of the institute, whom it may choose to consult, for suggested candidates. This provision will be waived wholly or in part for 1917 only.

In deciding upon the award the board at its April meeting, through those actually present or voting by mail, will nominate at least one, but not more than three candidates, in order of preference for the award. The names of these candidates will then be sent to each member of the board, who will have the privilege of returning a vote for one candidate. Four weeks after the April meeting the ballot will be read, and the candidate receiving the most votes will become the recipient of the award.

The official presentation of the medal to the successful candidate or his representative will occur at the May or June meeting.

COLUMBIA'S DEFENSE PREPARATIONS

Columbia University is preparing students to serve Uncle Sam by means of a regular course that will equip them in the art of wireless signalling operation of gasoline engines, piloting and seamanship and thus make them efficient as instructors in, or as members of the coast defence patrol. The class now contains 130 students.

Dr. George A. Sofer, of 391 West End Avenue, New York City, a graduate of Columbia, mapped out the course for the proposed school and agreed to take charge of it. The first thing he did was to turn over his seventy-foot gasoline boat for the use of the students in cruising about the Hudson River.

The school is divided into three groups. The first group is made up of those who are perfecting themselves in wireless signalling. It is composed of six Columbia men, all in the engineering department of the University, and all licensed wireless operators and signal men. They have had sea experience, having spent their vacations on ships. Professor Michael I. Pupin is the instructor.

The second group is made up of students which will become proficient in the operation of gas engines. The third group will devote its activities to piloting and seamanship.

The students are not to enroll in the navy, but are to prepare themselves to enroll at the end of their course of instruction as skilled men. Their course in the University will not interfere with their work in any way, and they are to devote most of their time to this instruction, which, it is agreed, is most necessary in view of the present situation.

Instruction in general signalling will take place in the open. Lectures, laboratory work and other instruction will be given in the University and a period of time will be spent on boats.

Just now the school has two boats at its command, Dr. Sofer's seventy footer and a deep sea fishing boat that has been chartered for the use of the students. Contributions are being made to a fund for the purchase of a fifty-four foot boat that will go thirty miles an hour. One of the students has contributed a hydroplane for the school.

Thousands of dollars will be required for the purchase of necessary equipment, and Dr. Sofer and others who are interested in the project hope that many patriotic Americans will lend their motor boats and yachts to the work that Columbia and her students are carrying on to help insure the safety of the country.

War Incidents

TO the list of wireless heroes that is daily growing as a result of the European war have been added the names of Marconi Operators Donnes and Taylor, of the steamship Laconia, which was torpedoed and sunk by a German submarine off the Irish coast on the night of February 25th, causing a loss of thirteen lives. Newspaper correspondents have called Donnes and Taylor the heroes of the disaster.

They were the last two survivors to leave the vessel, remaining by the apparatus to send out S O S calls until a British warship responded. They were picked up by lifeboats, little the worse for their experience.

More than ordinary interest is contained in perusal of the log books of wireless operators in days of warfare. The entries on the wireless log of the steamship Philadelphia during her voyage from New York to Liverpool and return well exemplify this statement. The Philadelphia left New York for Liverpool on January 27th and returned on February 22d. On February 3rd, just before eleven o'clock in the morning, the following entry was made:

"MBF (s.s. Saturnia, Donaldson Line) sends S O S many times and also this: Position 50.51 north, 12.20 west, S O S, torpedo just fired, chased, steering northeast by east."

"GCK (Crookhaven), answers him," runs an entry made two minutes afterward, "and then calls ZAAW (patrol boat) and sends particulars. I report to bridge."

"11.03 A. M.—MBF says: Still steering northeast by east, submarine on surface, chased."

"11.26 A. M.—MBF says: Course now northeast by north. Still chased and shelled.

"11.37 A. M.—MBF says: Submarine right astern now.

"11.44 A. M.—MBF says: We are steering northeast by north, position 51 north 12.13 west; have now lost sight of submarine.

"11.47 A. M.—MBF says: Submarine last seen 11.38 A. M."

Three ships were reported as being in distress on February 4th. The log book entries follow:

"9.10 A. M.—GLD (Lands End) says: S O S s.s. Floridian 8.55 A. M. 4th, position 50.42 north, 10.39 west, being fired on by submarine. (Newspaper reports are to the effect that the Floridian, of the Leyland Line was sunk on February 4th by a submarine.)

"February 4th, 3.30 P. M.—GLD (Lands End) says: S O S from GAV (s.s. Ghazee) off Galley Head, struck a mine."

Other little stories of the war on the sea are told in the folowing entries:

"February 15th, 8.54 A. M.—Some ship with a 60-cycle spark came in and said S O S and nothing more.

"8.55 A. M.—MLC (s.s. Celtic) gives S O S a few times and says B1.

"8.56 A. M.—MLC gives S O S and says struck mine, stand by for position.

"February 15th, 9.04 A. M.—MLC calls code station and gives position, 53.52 north, 4.38 west.

"9.16 A. M.—GLD (Lands End) sends MLC announcement out.

"9.18 A. M.—MLC says: Think we are sinking forward first.

"1.30 P. M.—GLD says: S O S from ZTN (not listed), fifteen miles northwest Fishguard; has been chased by submarine.

"February 21st, 9.10 A. M.—VCS (Camperdown, Halifax), sends following in message form to VCT (Sable Island): 12.23 GMT (Greenwich mean time) s.s. Sagona sends S O S signals reporting ashore on mud bank near Louisburg, probably to westward. Answer his signals, but take no further action as she is in good communication with VOR (s.s. Kyle), who will go to her assistance if necessary. MMB (s.s. Mackay Bennett) also in vicinity."

To be on a vessel that was twice menaced by submarines was the experience of C. C. Devin, Marconi operator on the steamship Rawson during a voyage from New York to Cherbourg, France and return. The following extracts from the operator's log graphically tell the story:

"October 25th, 5.15 P. M.—We are being chased by a submarine which has just sunk a vessel astern of us. Am standing by my wireless, awaiting orders. Ship rolling badly and making full speed ahead. Submarine following.

"5.45 P. M.—Went to bridge for orders.

"6.00—Broadcasted the following by captain's orders and signed no call: 'Submarine operating north 80, west true 23 miles. Carquets.' Ship's crew now in boats. GLD (Lands End) gives O. K. for submarine announcement.'.

"7.00 P. M.—The Rawson making for the French coast. (The submarine was later reported captured by destroyers which came to the vessel's assistance.)

"October 26th, 8.00 A. M.—Rawson anchored in harbor at Cherbourg, France."

The vessel left Portland, England, for New York, on December 6th, and on the following day Devins made this entry:

"The captain informs me that we were attacked at 5.30 A. M., while I was asleep by a submarine and hit by gunfire. Decides not to send messages as yet."

Evidently the attack of the undersea craft availed little, for Devin does not mention her farther. He made the following entry on the night of December 12th at fifteen minutes to ten o'clock:

"Hear some mysterious spark making V'S and signing no call. Spark sounds as if fixed roughly. Think it is German raider that is reported out in Atlantic. Sound rather near. Report to captain."

The Rawson arrived safely in New York Harbor on February 20th.

The American tanker Healdton was torpedoed by a German submarine and sunk off the coast of Holland on March 22. Among the survivors was the Marconi operator, Howard H. Parker, nineteen years old, a native of Philadelphia.

The Booth Liner Crispin was torpedoed by a U-boat on the evening of March 29 off the English coast. The vessel carried a gun and was equipped with Marconi apparatus. The wireless was wrecked by the explosion, and the Crispin afterward sank.

When the American freighter, City of Memphis was sunk by a torpedo from a German U-boat on March 17, there were two Marconi operators in charge of her wireless apparatus, J. Welch and P. J. Donahue. Both were rescued and landed at Queenstown.

A Petrograd correspondent says that a secret wireless station at Tsarskoe-Selo, which is suspected of having furnished communication in the past between pro-German Russian ministers and Berlin, has been discovered. Evidence which the new government agents have collected showed, it was said, this station was established by former Minister of the Interior Protopopoff, without the czar's knowledge.

SELECTED FROM MANY

I take this opportunity to say that the National Amateur Wireless Association is a wonderful organization, doing wonderful things. The Monthly Service Bulletin is full of interesting features and THE WIRELESS AGE is the only wireless magazine.

GEORGE E. BEECHER, JR., *Massachusetts.*

I received my charter member's equipment of the National Amateur Wireless Association, in good order and I wish to say that I am much pleased. The book "How to Conduct a Radio Club" is certainly a "hummer."

G. E. MORBUSCH, *New York.*

THE WIRELESS AGE is by far the best magazine I have ever read. I have seen comparisons made between the WIRELESS AGE and other magazines, but it seems to me that THE WIRELESSS AGE is so far superior to all other wireless magazines that no comparison can really be drawn.

OLIVER M. BLACK, *Massachusetts.*

Amateurs in the Navy

Real Recognition Given to their Value in the Reserve

By M. B. West (8 AEZ)

Member National Amateur Wireless Association, Radio Gunner, U.S.N.R.F.

THE nation is at war! The amateur has at last an opportunity to be of real service to the Government, and in a way that will not interfere with his career in civil life. The argument that the amateur would be of inestimable benefit in time of war has so often been made that it has at last been recognized.

It is clear to anyone that gives it a moment's thought, that without at least some preliminary training, most amateurs would fail miserably if suddenly placed in charge of a large radio station. It is with the intention to remedy this situation, that the Class 4, Naval Reserve, has been created.

As far as possible, it is hoped that amateurs enrolling in the reserve will at once ask for a short period of active duty so as to become familiar with the requirements of the radio work of the Navy. Then they will return home, and it is hoped will join one of the Drill Routes that have been organized in connection with the naval stations. The purpose of these drill routes is to perfect these amateurs in handling radio business according to the rules of the Navy.

And think what a difference it would make in amateur working conditions if all amateur business were handled in an orderly and efficient manner!

These drill routes will be placed under the direction of an officer of the Naval Reserves, and every effort will be made by them to assist amateurs in solving the many puzzling problems that arise in connection with their stations.

It is not necessary to enroll in the reserves, to join in the drill, but it is earnestly hoped that all will do so. So far this feature has been worked out more completely in the Middle West in connection with NAJ, the naval station at Great Lakes, Illinois.

Class 4, Naval Reserves, is a very liberal organization, and creates an opportunity that seems especially adapted to amateur needs. To enroll, you must be an American citizen, be able to send and receive at the rate of ten words per minute, and be able to pass the usual physical examination. On enrollment, members receive a yearly retainer fee of $12.00, until such time as they have perfected themselves sufficiently to be able to handle their work in a manner on a par with regular Naval practice. After such time they will receive an annual retainer pay equal to two months' pay of their corresponding grade in the regular Navy. In addition they receive travelling expenses to and from place of training, uniforms, meals and lodging and the regular pay from the time they leave their homes until they return to them. This is all clear money, and should be particularly attractive to students and others.

One feature that is especially liberal is that a member of the reserves, at his own request, will be discharged at any time during peace. Active service is not then compulsory, and orders to active duty are issued only at the request of members themselves, and will be arranged so as to interfere as little as possible with their regular business. The only time the reserves can be called for active duty is in time of war, when it is intended to use them at the less important land stations so as to relieve the regular officers and men for their active war duties. Information in detail can be secured from the nearest Naval Recruiting Officer, who will be glad to give any information required.

This is the first appeal to the amateur; if we are to live up to the reputation that has been made for us, we should respond gladly and willingly.:

At a meeting of the amateurs of Brockton, Mass., and vicinity held recently, Radio Inspector Gawler delivered an address. Inspector Gawler, who is enrolling recruits in the Naval Coast Defense Reserve, pointed out the need of radio men and urged the older members of his audience to offer their services.

The Annual Report of the American Marconi Company

THE annual report of the Marconi Wireless Telegraph Company of America for the year ended December 31st, which was made public on March 26th, says that after setting aside all reserves the net profits showed as increase of 46.56 per cent. over those of 1915. Included in the report is an account of the hearing on the radio ownership bill before the Congressional Committee on Merchant Marine and Fisheries during January, 1917, reprinted from THE WIRELESS AGE. The Hon. John W. Griggs, president of the Company, who signed the report, directs attention to this account and suggests that each stockholder communicate with his Congressman and Senator opposing the enactment of any legislation tending toward sole ownership by the Government of wireless stations.

The report of operations shows a net income of $336,040 before allowing for reserves, compared with $288,994 in 1915. Receipts for message traffic with ships indicated an increase of nine per cent. over the previous year.

"The income from investment of surplus funds, amounting to $98,107.98," says the report, "decreased $6,824.99 in 1916 in comparison with 1915, due to the fact that $8,961.48 interest was received on stock subscriptions during 1916, while in 1915 $17,922.96 was obtained. This reduction is explained by the fact that the stock previously subscribed for but not issued was during the year 1916 taken up.

"After setting aside all reserves the net profit for the year amounted to $259,888.80, or an increase of 46.56 per cent. over the profits for the previous year. This amount has been added to the surplus, increasing that account to $801,776.32 at December 31st, 1916, and the reserve set aside at that date against depreciation amounts to $439,716.63 additional."

Referring to the war, the following statement is made:

"The war conditions, preventing the operation of your transatlantic stations at New Brunswick and Belmar, New Jersey, and at Marion and Chatham, Massachusetts, remain unchanged. The British Admiralty still holds, for military purposes, the English plants constructed for exchange of traffic with this country. The continuance of the war has likewise rendered it impossible to inaugurate our direct service with Scandinavia."

The report refers to the successful inauguration of the service between the United States and Japan on November 15th, and says: ". . . . an increasing volume of traffic is being handled, under Government censorship, at a tariff one-third lower than that of the submarine cable. On the Pacific, as on the Atlantic, operations are restricted by war conditions, the Japanese stations being controlled by that Government. For the present, therefore, the new service is limited to traffic between San Francisco, Hawaii and Japan."

The Company's manufacturing activities as a result of the war are epitomized as follows: "Your company continues to manufacture apparatus for use by the United States army and navy, and recently has been awarded contracts for a large number of wireless sets of various types."

Brief reference is made to the suit involving the vacuum valve detector patented by Professor Fleming, in that part of the report devoted to the legal history of the year. "The Marconi patent, sustained by Judge Veeder in 1914," it is related, "is again in litigation with the Atlantic Communication Company and your company awaits an opportunity to examine Mr. Marconi as a witness in its behalf. This same Marconi patent is in litigation on the Pacific Coast, where an effort was made at Seattle to include a modified form of transmitting apparatus as being within the sustained claims, and we are appealing the case to the Circuit Court of Appeals."

That section of the report dealing with legal matters is concluded with the following two paragraphs:

"Under United States statute of June 25, 1910, your company is entitled to make claim for damages due to the appropriation of its patented property by the United States Government. Availing itself of its right, your company began suit in the Court of Claims of the United States in July, 1916, to recover its damages for the infringement of the patents of Lodge, Marconi and Fleming.

"The extent of the rights obtained by rival bidders for Government work under this statute of 1910 has been the subject of litigation. The United States District Court, Southern District of New York, construed the statute to authorize the making and selling by one Simon, a rival, unlicensed bidder for such work, and the Circuit Court of Appeals, Second Circuit, approved the decision. The Marconi Company promptly applied to the Supreme Court of the United States for a writ of certiorari, which was promptly granted, and we have, further, asked that court to advance the case on its calendar."

The action of Edward J. Nally, vice-president and general manager of the Company, in placing its organization, personnel and stations at the disposal of the President of the United States, following the severance of diplomatic relations between this country and Germany, is also related. "The officers of your Company are now in close co-operation with the officers of the various departments of the Government in order to render the best service possible in the event of national emergency," says the report.

Attention was directed to the fact that the Company had arranged to provide insurance for its employees. The details of this plan were related in a previous issue of The Wireless Age.

MARCONI MEETS EMERGENCY

The statement many times made that in emergency the Marconi Wireless Telegraph Company of America would place at Government disposal its facilities, equipment and personnel was acted upon immediately after the declaration of war. Division superintendents were instructed to apply for commissions in the naval reserve and to urge all operators under their jurisdiction to enroll under them. As we go to press numerous instances of prompt response to the call to the colors have already been reported. With the plan in full effect, the navy department will have at its disposal a great force of operators more skilled than any other professionals in the field.

Meanwhile, the manufacturing plant at Aldene, N. J., is being built up to three times its present capacity and a great force of workmen is engaged solely in turning out rush demands for equipment at the rate of forty complete sets a week. These wireless equipments vary from small power "submarine chaser" sets to 5 and 10 kilowatt installations for battleships and shore stations. Prominent officials in Government service have already given recognition to the indispensibility of this highly efficient auxiliary, under which the naval fleets will be radio equipped in record time.

THE SHARE MARKET

New York, April 10.

Bid and asked quotations in Marconi shares today:

American 2⅝-2⅞; Canadian, 1¾-2¼; English, common, 10-13½; English, preferred, 9-12½.

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

T. B. R., Detroit, Mich., inquires:

Ques.—(1) Although you have no doubt answered queries similar to this many times in previous issues of your magazine, will you state once more what you consider to be the most efficient equipment for an amateur that will comply with the law in every detail, taking into consideration the fact that the apparatus is to be operated from 60 cycle alternating current?

Ans.—(1) Beginning with the power apparatus, we advise the use of a ½ K. W. 60-cycle transformer, the secondary voltage of which is between 15,000 and 20,000 volts. This transformer should be arranged to have a certain amount of magnetic leakage, either by means of a special magnetic leaking gap or by design of the transformer proper. The transmitting key should be capable of withstanding current flow at ten amperes and should be fitted with silver contacts.

Although the oil plate condenser is frequently employed at amateur stations, we advise the use of the four copper plated Leyden jars of the type manufactured by the Marconi Wireless Telegraph Company of America. Four of these connected in parallel will give a capacity of .008 microfarad which is the correct value for use at the wave-length of 200 meters. Smaller capacities, of course, can be used, provided sufficient turns are added at the primary winding of the oscillation transformer. If an oil plate condenser is employed, it should consist of four plates, 14 inches by 14 inches, covered with tinfoil, 12 by 12 inches. These plates should be connected in parallel when the voltage of the tranformer does not exceed 12,000 volts, but for voltages in the neighborhood of 18,000, the series parallel connection will be required. A condenser with the same sized plates and the same capacity would then require sixteen plates in all, eight plates being in each bank and the two banks finally connected in series.

The oscillation transformer for this set may consist of four turns of copper tubing or single braid rubber covered wire, wound on a mandrel about 8 inches in diameter. The secondary winding may have eight or ten turns wound on a form 10 inches in diameter; the two windings should be arranged so that they can be placed in variable inductive relation.

Various sized aerials may be employed for sending at the 200-meter wave, full data for which appears on page 108 of the November, 1916, issue of The Wireless Age. From the curves given on page 109 of that issue, you will readily understand that a T aerial can have much larger dimensions for a given length of radiated wave than an L aerial.

The rotary spark gap for small sets should consist of a disc 8 or 10 inches in diameter, fitted with eight spark electrodes and should be revolved at various speeds, from 2,400 to 3,000 revolutions per minute. This gap can be mounted on the shaft of the motor or can be mounted on separate shaft and bearings and driven by a belt.

Ques.—(2) What are the operating characteristics of the closed core transformer as compared with the open core transformer?

Ans.—(2) Their operating characteristics are similar, provided they are properly designed. Certain step-up voltage transformers will draw abnormal primary current when connected to a condenser and spark gap, and consequently, unless a primary reactance is connected in series with the primary winding the transformer windings will burn out. Many amateurs find it much more convenient to construct the open core transformer, but either type will do the work.

Ques.—(3) I understand that the arc transmitters employed in the United States Navy operate at wave-lengths between 3,000 and 4,000 meters. How are these wave-lengths obtained with ordinary aerials?

Ans.—(3) The largest possible aerial is erected in the space at hand and the radiated wave boosted to 3,000 meters by means of large loading coils.

Ques.—(4) Can I receive the signals from arc transmitters on an ordinary crystal rectifier?

Ans.—(4) If your receiving station is located within twenty or thirty miles of such transmitters, the signals can be received, due to slight damping of the wave train caused by inequalities of the arc gap resistance.

A. B. L., St. Louis, Mo., inquires:

Ques.—(1) I am a beginner in the amateur field and do not understand how to adjust a crystal rectifier to full sensitiveness. Will you kindly explain how this can be accomplished?

Ans.—(1) The most sensitive adjustment of the ordinary crystal detector is found by experiment when receiving from a distant station or by means of a test buzzer. Generally some part of the circuit of an active vibrating buzzer is placed in inductive relation to the receiving detector circuit. For example: The circuit from a battery and buzzer can be completed through one or two turns of the primary winding of the receiving transformer, and when the buzzer is in operation a potential difference will be set up across the primary turns which will charge the antenna and cause it to discharge at a natural frequency of vibration. Then, when the primary and secondary windings of the tuner are in resonance and the receiving detector is adjusted to maximum signals, the best operating adjustment is secured. Trying different spots on the crystal will aid in obtaining the best results, the adjustment that gives the loudest signals being held.

Ques.—(2) Do you advise the construction of two receiving tuners at any amateur station, one for short wave-lengths and the other for long wave lengths?

Ans.—(2) For amateur working, we advise that two distinct receiving sets be constructed, one for the reception of spark signals up to 3,000 meters and the other for the reception of undamped waves up to 10,000 meters. Such apparatus is fully described in the book "How to Conduct a Radio Club."

Ques.—(3) How can I canculate the wave-length of an aerial previous to its erection and without the use of a wavemeter?

Ans.—(3) A complete answer to this question appears in the December, 1914, and January, 1915, issues of The Wireless World. In an article by Professor G. W. Howe, a method for calculating the capacity and inductance of various forms of aerials was presented. The average experimenter generally finds these calculations beyond his understanding and consequently various empirical formulae are employed.

A full set of curves calculated from the formulae contained in Professor Howe's article appears on pages 108, 109, 110 and 111 of the November, 1916, issue of The Wireless Age. These show the natural wave-lengths of aerials from 30 to 120 feet in length and from 30 to 100 feet in height, and cover the requirements of the average amateur station. In such calculations it must always be taken into consideration that when the secondary winding of the transmitter oscillation transformer is connected in series with the antenna, the length of the radiated wave will be increased somewhat, depending upon the amount of inductance inserted at the base. In the curve of page 100 in the November, 1916, issue, the natural wave-length of the aerials is given with 10,000 centimeters of inductance in series at the base. This inductance can conveniently represent the secondary winding of an oscillation transformer.

* * *

D. B. A., Chicago, Ill., inquires:

Ques.—(1) Is the amateur in all localities required to operate his transmitting station at the wave-length of 200 meters?

Ans.—(1) Special licenses are granted occasionally for waves in excess of 200 meters if the station is found after investigation to be of use to the United States in the event of war or other emergency; or if the amateur is well versed in the art and will use his station for experimental determinations, a license may be granted for the use of any wave-length provided the Government authorities are assured that the operation of commercial or naval stations will not be interfered with.

Requiring the amateur to work his station at the wave-length of 200 meters, works no hardship, because many are enabled with small size transmitters to work up to distances of 1,000 miles during the favorable months of the year. Amateurs in the eastern part of the United States frequently communciate with others in the Mississippi Valley district.

Ques.—(2) How can one be positively assured that the radiated wave does not exceed 200 meters?

Ans.—(2) The safest precaution is to purchase or construct a wave-meter and actually measure the length of the radiated wave. In the book "How to Conduct a Radio Club" an amateur's wave-meter, which can be constructed by any experimenter, is described, and the dimensions of an inductance coil which will give the sufficient wave-meter range to cover ordinary amateur sets are presented. A calibration table for the wave-meter is also contained in "How to Conduct a Radio Club."

* * *

A. L. R., San Francisco, Cal., inquires:

Ques.—(1) Why is it that when a 10-inch spark induction coil of the type manufactured by the Marconi Company is connected in series with the antenna system and is shunted by a spark gap, the spark discharge is not over 1 inch in length, whereas with the antenna system disconnected, the spark will jump a gap 10 inches in length?

Ans.—(1) This is due to the shunt circuit afforded by the capacity of the antenna. The current flowing into the condenser (which in this case, is the antenna) immediately lowers the difference of potential, and the length of the spark discharge is limited accordingly.

Ques.—(2) What is the best antenna capacity for the operation of these coils?

Ans.—(2) An aerial having capacity of approximately .0015 microfarad will give the best results.

* * *

G. A. R., Boston, Mass., inquires:

Ques.—(1) Which system of vacuum valve amplification gives the louder signals, the cascade amplifier or the regenerative circuit?

Ans.—(1) The regenerative circuit is recommended for its simplicity and because of

the fact that it requires but one vacuum valve bulb. The step-up amplifier gives very good results indeed, but practically equal results can be obtained by the usual regenerative circuit.

Ques.—(2) Is the regenerative circuit applicable for the reception of 600-meter waves?

Ans.—(2) Very good results have been obtained at this wave-length by that circuit.

Ques.—(3) Where can I obtain dimensions of tuning coils for various ranges of wave-lengths?

Ans.—(3) Such data and method of calculation are contained in the book "How to Conduct a Radio Club." The fourth revised edition is now on the press.

Ques.—(4) I have often heard that better signals are obtained with the Perikon detector by sending a small battery current through the crystal. Is this true?

Ans.—(4) If a potentiometer that will give the necessary fineness of adjustment is available, better signals will be received by the application of a small local voltage. Care must be taken that the current flows through the crystal in a certain direction which can be determined by experiment.

Ques.—(5) What is the power of the Marconi trans-Atlantic station at New Brunswick, New Jersey?

Ans.—(5) Three hundred K.W.

* * *

C. A. L., Minneapolis, Minn., inquires:

Ques.—(1) Has the Marconi station at New Brunswick, N. J., ever been employed for commercial working?

Ans.—(1) A number of successful preliminary tests were conducted with the corresponding station in Carnarvon, Wales, but because the Wales station was taken over by the British Admiralty, experiments were discontinued. The station will undoubtedly be put into commercial operation at the close of the European War.

Ques.—(2) I have often heard that an ordinary buzzer may be used for making undamped oscillations audible in a receiving set. Is this correct?

Ans.—(2) If the buzzer is connected to a wave-meter, to set the latter into excitation at a frequency slightly differing from the frequency of the incoming oscillations, undamped oscillations can be made audible on ordinary receiving apparatus, but the signals are not as clear as those obtained by the standard Heterodyne receiver.

Ques.—(3) What is the power of the transatlantic station at Tuckerton, N. J.?

Ans.—(3) The output of the alternator at maximum is 200 K.W., but the station is normally operated at about 140 K.W.

* * *

D. R. Q., Albany, N. Y., inquires:

Ques.—(1) In addition to the wave-meter which I already possess, what apparatus can I add that will enable me to determine the logarithmic decrement?

Ans.—(1) A small hot wire wattmeter having a range of .01 to .1 watt connected in series with the wave-meter will permit the decrement to be measured, as explained in the book "How to Conduct a Radio Club." A small ammeter ranged zero to 200 milliamperes can also be employed.

Ques.—(2) Where in New York City can examinations for a first grade license certificate be taken?

Ans.—(2) At the office of the chief radio inspector, Custom House, Bowling Green.

Ques.—(3) What sized motor is required to revolve the disc of the rotary gap?

Ans.—(3) In the average case a 1/8 h.p. motor having a normal speed of 2,000 to 3,000 revolutions will suffice.

Ques.—(4) What should be the diameter of the disc?

Ans.—(4) It may vary from 6 to 10 inches and it should be fitted with six or eight spark electrodes.

Ques.—(5) Can the disc be driven by a belt as well as by direct coupling to the motor shaft?

Ans.—(5) Certainly.

* * *

T. R. A., Douglas, Ariz., inquires:

Ques.—(1) What type of receiving telephone is considered the most sensitive?

Ans.—(1) The Baldwin telephone with mica diaphragm is generally considered the most sensitive for the reception of radio signals.

Ques.—(2) Where can such telephones be purchased?

Ans.—(2) From the Manhattan Electrical Supply Company, New York City.

Ques.—(3) Where can I obtain information concerning the resistance of various sizes of German silver wire and its current carrying capacity?

Ans.—(3) The average standard electrical hand book contains this information.

Ques.—(4) Would there be any advantage in constructing a rotary spark gap having two discs revolving in opposite directions, both being mounted on independent motors or by gearing or belting driven from the same motor?

Ans.—(4) None whatsoever.

Ques.—(5) What should be the diameter of the spark electrodes on the disc for a 1/2 K.W. amateur set?

Ans.—(5) They need be no more than 3/16 of an inch in diameter.

* * *

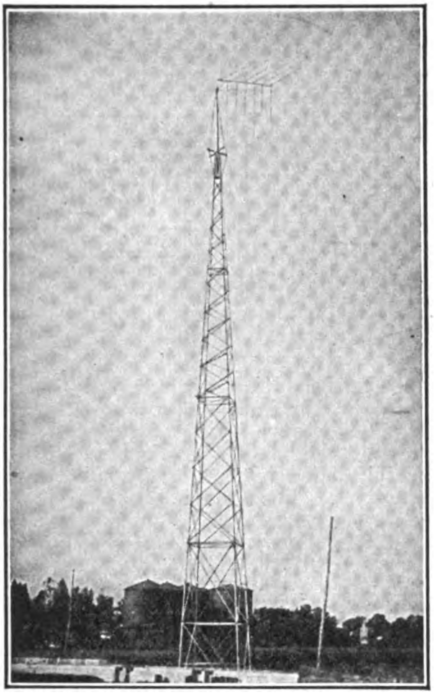
B. L. A., Washington, D. C., inquires:

Ques.—(1) Are tubular vacuum valve bulbs applicable for use in amplifying the circuit in the same manner as the oval types of bulbs?

Ans.—(1) They may be used the same way and will give practically equal results.

Ques.—(2) Is there any advantage in employing more than two bulbs in the cascade connection?

Ans.—(2) For ordinary amateur working, two bulbs will suffice. In any case there is no advantage in using more than three bulbs.



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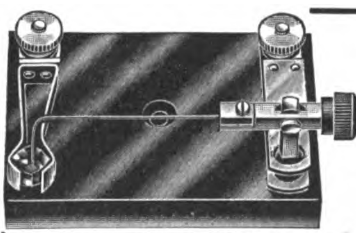

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Ques.—(3) I have been advised that a vacuum valve bulb is manufactured by the General Electric Company under a trade name, but I have forgotten it. Can you give me any advice?

Ans.—(3) The receiving bulb manufactured by the General Electric Company has been termed the "Pliotron," but we are not aware that it is being supplied to the market.

Ques.—(4) Where can I obtain information concerning the construction of the simple aerial ammeter for amateur use?

Ans.—(4) Note the instrument shown on page 101 of the December, 1916, issue of The Wireless Age.

Ques.—(5) Is a primary reactance coil required in all transmitting sets?

Ans.—(5) Not if the transformer is properly designed. Of course, if the primary power is to be reduced at certain intervals, a reactance regulator would be required, but not otherwise.

* * *

A. B., Chicago, Ills., inquires:

Ques.—(1) Where can I purchase a copy of a book devoted particularly to the construction of the induction coil?

Ans.—(1) The book entitled "Design and Construction of Induction Coils," by A. Frederick Collins, can be purchased from the book department of this magazine.

Ques.—(2) Please give the title of some book describing completely the construction of a Tesla coil?

Ans.—(2) The book entitled "The Construction of Tesler Coils," by Haller & Cunningham, can be purchased from the book department of this magazine.

* * *

T. B. A., Jacksonville, Fla., inquires:

Ques.—(1) I have noted from past issues of your magazines and books on wireless telegraphy, there seems to be a limit to the power consumed by an amateur's transmitting set irrespective of the Government laws. What is the upper limit?

Ans.—(1) The power input is limited principally by the dimensions of the closed circuit condenser which, in the case of the amateur's apparatus, can not exceed .01 microfarad. Even at frequencies of 500 cycles, the transformer cannot possibly consume more than 1 K.W. Power in excess of this value could only be used by providing a transformer with abnormally high secondary voltage, but this would require the use of a very long secondary spark gap which would introduce excessive damping and cause the set to operate inefficiently. The average amateur set cannot conveniently use more than ½ K.W. when operated at frequencies of 60 cycles. If power in excess of ¾ K.W. is employed, the set must be operated at a wave-length which exceeds the Government restrictions.

Ques.—(2) Is it necessary to obtain a license for a receiving station?

Ans.—(2) A license for such stations is not required.

A. B. L., Boston, Mass., inquires:

Ques.—(1) Please explain what is meant by a Marconi timed spark discharger and what is the function of such apparatus?

Ans.—(1) The Marconi timed spark discharger produces continuous waves by overlapping the antenna oscillations. If a number of rotary spark gaps, for example, are mounted on a common shaft, each of which is in series with a closed oscillation circuit and all are coupled to one aerial, then by revolving the disc at the proper velocity, the interval between sparks will be equal to the period of a group of oscillations, or it can be made a submultiple thereof. This will give practically a continuous flow of oscillations in the antenna circuit. The great advantage of this system over others lies in the fact that it does away with intricate high speed radio frequency alternators, does not require that the speed of the rotary disc be so carefuly maintained as in the case of the alternator, and, in addition, permits full use of the syntonic effects of the undamped wave systems. Usually the timed spark discharger consists of two large rotary disc dischargers mounted on a common shaft as well as a timing spark which performs the function of discharging the main disc discharger at the right moment. The condensers for these disc dischargers are generally excited with 5,000 volts direct current.

* * *

The "K" Brothers, Guttenberg, Ia.:

You are sailing in the same boat with a number of other amateurs, namely, your aerial is so close to the power wires that they act inductively thereon and induce interfering currents. Generally there is but one solution to this problem, and that is to either remove the power wires from the aerial or the aerial wires from the power line. You might try the balancing out system described in the book "How to Conduct a Radio Club" which in several instances has given good results.

* * *

O. G. E., Jr., Olympia, Wash.:

It would appear from your diagram that aerial B would receive the least induction from the high alternating current power line. Should considerable induction still be experienced, you might try the balancing out aerial described in the book "How to Conduct a Radio Club."

* * *

A. B. W., Belfast, Me.:

It is difficult to say just what station might have sent the press matter you copied. It would appear that some of the signals you have received were sent out by the spark station at Nauen, Germany. You might be able to hear this station if you had a very sensitive receiving set, but beyond this we can give no advice.

Regarding the two proposed earth connections: We believe that the 50 foot ground wire terminating in a well would give better results than the 150 foot ground wire which extends to the low water mark.

There is no difference between the wiring diagram of a vacuum valve tube with the so-called grid element on the outside of the bulb and the type with a sealed-in grid.

The ground for portable transmitting stations consists of a number of bare copper wires spread underneath the antenna and having a surface equivalent of the flat top, or preferably greater.

* * *

E. M., Bloomfield, N. J.:

You failed to give us the dimensions of the secondary winding of your receiving tuner, but irrespective of this your apparatus should respond to undamped waves with little difficulty. If you are familiar with the Continental Telegraph Code and the apparatus is found to respond at all (which it should) there is no reason why you cannot ascertain for yourself the maximum range.

The wave-length of the antenna you describe is approximately 800 meters.

Regarding your wiring diagram: We advise that a small variable condenser be placed in shunt to the head telephone.

* * *

S. H., Bellville, Iowa:

There is no better way of ascertaining whether or not amateur stations exist in your district than by consulting the Government Call List or the monthly list printed in the Monthly Service Bulletin of the National Amateur Wireless Association.

A 200 foot aerial is generally too long for the satisfactory reception of amateur signals. One about 110 feet in length gives the best results.

* * *

I. T. W., Peterborough, N. H.:

A complete set of regenerative vacuum valve circuits appears in the third edition of "How to Conduct a Radio Club."

* * *

J. W. C., Macomb, Miss.:

It is outside the scope of this department to give the complete constructional details of a 110 volt alternating current generator. One K.W. 60 cycle generator can be purchased for about $125. Your aerial, 125 feet in length, with an average height of 56 feet, has a fundamental wave-length of about 245 meters and a condenser of approximately .0005 microfarad capacity may reduce the radiated wave to 200 meters.

Replying to your last query: Alternating current generators of different manufacture are built for different speeds. Generally the small size generators revolve at the rate of 1,800 revolutions per minute. We cannot advise concerning the speed of the driving engine unless we know the diameter of the driving pulley and the diameter of the pulley at the generator.

* * *

W. G. M., Springdale, Ark.:

Simply rewinding your telephones to a higher resistance will not necessarily increase the sensitiveness unless it is done in such a way as to increase the magnetizing flux. If there is sufficient room on the bobbins for winding No. 40 wire, it may increase the sensitiveness of the telephone when used with crystalline detectors; but if the 'phone is to be employed in the local circuit of the vacuum valve detector, equal results will be obtained by a lower resistance receiver which is well constructed.

* * *

F. R. L., Jefferson, Wis.:

The National Radio School at Washington, D. C., gives a complete correspondence course in wireless telegraphy.

The radio communication laws of Great Britain are published in "The Year Book of Wireless Telegraphy and Telephony" which can be purchased from the Wireless Press, Inc., 42 Broad street, New York City.

In times of peace you are not required to obtain a license for a receiving station or to notify the Government inspector that it is being installed; neither is it necessary to take the oath of secrecy for the operation of such a station, but it would be considered a violation of the law if information picked up in this manner were distributed broadcast.

* * *

F. Y. F., Latonia, Neb.:

It would require 1,680 plates of glass, 8 inches by 10 inches, covered with tinfoil, 6 inches by 8 inches, to make a condenser of 1 microfarad capacity.

Either mineral seal or transil oil is employed for high voltage condensers.

* * *

T. W. B., Harrisburg, Pa., inquires:

Ques.—(1) I have a small generator that is supposed to generate six volts at 2,000 revolutions per minute. Can this be used to recharge a four volt storage battery?

Ans.—(1) It can be so used provided the current output is at least five or six amperes.

Ques.—(2) Could this generator be used to charge the storage battery while the battery is connected to the filament in the vacuum valve?

Ans.—(2) Yes, but since the voltage of the generator is higher than that of the battery, care must be taken not to burn the filament out.

* * *

H. J. H., Philadelphia, Pa.:

The call letters of amateur stations are assigned by the chief radio inspector, Washington, D. C.

The Phillips Telegraph Code referred to in "How to Conduct a Radio Club" is an abbreviated set of commonly used words for the transmission of press dispatches.

* * *

J. J. G., Kingsland, N. J.:

It is quite likely that the induction from your buzzer testing system is so strong as to destroy the sensitive adjustment of the crystal, and consequently you should use a looser coupling between the testing circuit and the receiving set.

Complete information concerning the construction of long distance apparatus for the reception of undamped waves appears in the book "How to Conduct a Radio Club," the fourth edition of which is now on the press.

* * *

C. H., Youngstown, Pa.:

The increase of capacity due to the use of shellac on tuning coils will not occasion great energy losses in the average amateur tuner.

The curves given in the November, 1916, issue of The Wireless Age will enable you to calculate the wave-length of your aerial or other aerials near this dimension.

* * *

J. Z. N. D., Port Jefferson, N. Y.:

It is not to be wondered at that you have had some discussion and argument concerning the wave-length of your aerial; simply knowing the length of the flat top will not aid in calculating the length of the radiated wave. The connections shown in your flat top are considered "freakish" and there is no advantage in zigzagging the terminal-connections in the way you have shown. It is well to adopt the usual construction; construct your receiving aerial of three or four wires in parallel, join them together at the base and connect the lead-in directly to the apparatus.

* * *

W. J. R., Dallas, Tex.:

The lead-ins of your flat top aerial should have conductivity equal to the wires in the flat top. It makes no difference whether the primary and secondary windings are wound in the same or opposite directions.

Regarding the taking of the taps from the two windings:

If the primary winding is on the left hand and the secondary winding is on the right, the first tap should be taken from the right hand end of the primary winding and the first tap from the left hand end of the secondary winding. This permits the used turns to be placed in direct inductive relation.

Insulated wire will do as well for a receiving aerial as bare wire. It will make no difference in the strength of signals.

* * *

P. L. B., New Haven, Conn.:

The diagram of connections you sent in is correct and there is no reason why the apparatus should not function properly. Try changing the connections in the inductively coupled transformer employed to repeat the oscillations of the wing circuit back to the grid circuit. Your diagram of connections is quite correct throughout and is the best we know of with the apparatus you have at hand.

* * *

A. W. H. Oklahoma City, Okla.:

The apparatus described on page 347 of the February, 1917, issue of The Wireless Age, connected to the arial you describe will respond to waves inclusive of 10,000 meters. As you suggest, the secondary loading coil should be wound with the same sized wire as the secondary winding.

A diagram of connections applicable to this apparatus is contained in the book "How to Conduct a Radio Club," the fourth revised edition of which is now on the press. A government call list of radio stations, including the United States amateur stations, can be obtained from the Government Printing Office, Washington, D. C., price 15c. per copy.

* * *

E. S., South Norwalk, Conn.:

If you will observe carefully how the laminations of an iron core transformer are stacked up, you will have no difficulty in understanding the Fourth Prize Article in the May, 1916, issue of The Wireless Age. The rectangular core when completed should have legs 3 inches square and the laminations should be piled up in the manner shown until these dimensions are obtained. There will then be sufficient room to wind both the primary and secondary windings.

* * *

J. E. S., Parnases, Pa.:

Your receiving transformer will respond to waves up to 7,000 meters provided a small variable air condenser is connected in shunt to the secondary winding.

A one pint leyden jar usually has sufficient capacity for a 1-inch spark coil.

The wave-length of the aerial you have described can be determined from the curves shown in the November, 1916, issue of The Wireless Age.

* * *

L. S., San Diego, Cal.:

A solution of carbon di-sulphide is generally employed to clean crystal detectors.

* * *

G. B. D., Merrick, L. I.:

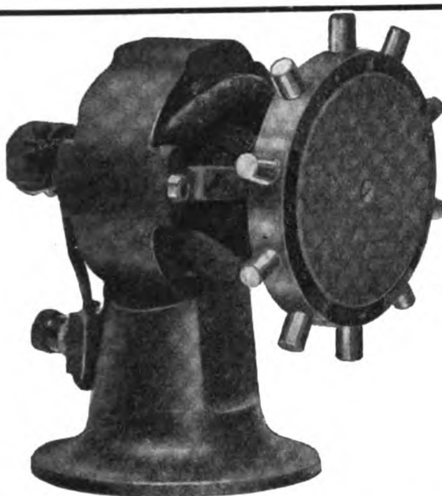
Your aerial, 220 feet in length, has a natural wave-length of approximately 320 meters, and it will be difficult to reduce its capacity sufficiently to radiate a 200-meter wave by means of a series condenser.

If this aerial were changed to have a flat top length of 110 feet with vertical height of 75 feet as you suggest, the natural wave-length would be close to 230 meters and a short wave condenser would be required to radiate a 200-meter wave. However, this aerial can be made to comply with the law by attaching the lead-in to the center; the natural wave-length will then be about 180 meters.

The correct condenser capacity for a 1-inch spark coil is best determined by experiment. A number of plates of glass, 8 inches by 8 inches, covered with foil, 6 inches by 6 inches, may be connected in parallel and different values of capacity tried out until the best spark discharge is obtained. Generally that capacity which will give a rather short discharge gap, not more than 3/16ths of an inch between blunt electrodes, will give the best results.

An oscillation transformer is not necessary, but is required by government law in order that the radiated wave may be pure and sharp.

A small oscillation transformer suitable for



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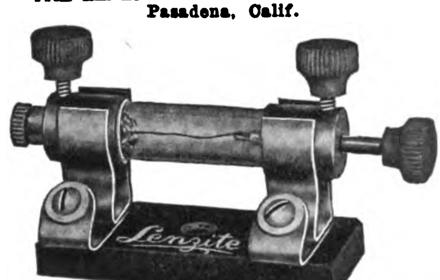

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spark coils is fully described in the book "How to Conduct a Radio Club."

Buzzer transmitters have often been employed in ship work for communicating at distances of thirty or forty miles. Such distances can only be covered when a vacuum valve amplifier is employed at the receiving station. Good results can be obtained by connecting a small fixed condenser of about .005 microfarad capacity in series with the antenna, the terminals of this condenser in turn being shunted across the contact points of the vibrator. The buzzer should be operated from a six-bolt storage cell.

You should be able to make these connections without a diagram.

* * *

H. B., Sheboygan, Wis.:

The natural wave-length of your aerial is about 125 meters. According to our calculations, the condenser connected to your thordarson transformer has capacity of .03 microfarad which is three times the size it should be to radiate a 200-meter wave. A condenser of .01 microfarad, or preferably of .008 microfarad, capacity should be employed for the 200-meter wave.

To determine the exact number of turns to be employed in the primary and secondary windings of your oscillation transformer, you should construct a wavemeter after the design given in the book "How to Conduct a Radio Club" and measure accurately the wave-length of either circuit. This will insure maximum efficiency, compliance with the law and will eliminate all guess work.

* * *

G. E. B., Lanesboro, Minn.:

According to our calculations the natural wave-length of your aerial, which has a total length of 1,200 feet, is approximately 750 meters, and will only be applicable to the reception of signals from long wave stations.

* * *

F. S. M. C. C., Mercer, Pa.:

So far as we are aware the tikker is the simplest device for making undamped oscillations audible.

Trans-Atlantic stations at Tuckerton and Sayville use some form of the oscillating vacuum valve circuit.

* * *

A. L. V., Cleveland, Ohio, inquires:

Ques.—(1) Where can I obtain a complete description of the Kolster decremeter?

Ans.—(1) A complete description of this apparatus was given in the Proceedings of the Institute of Engineers and also in Volume 11, No. 235, of the Bureau of Standard's publication (dated August 15, 1914).

Ques.—(2) Is it absolutely essential to employ an inductively-coupled oscillation transformer in connection with my armature set Can I obtain good distance effect by using a single helix?

Ans.—(2) The direct coupled helix will give as good results as the inductively coupled transformer, the only advantage of the latter being that the coupling can be very simply regulated by drawing the two windings apart. In order to radiate a pure wave with a direct coupled helix, you must provide three contact clips, one being connected to the antenna, the second to the earth connection and the third to the spark gap circuit. In this way the used turns of the antenna circuit can be placed at a distance from the used turns of the primary circuit which will reduce the coupling and therefore the damping of the radiated wave.

Ques.—(3) Where can I obtain a complete description covering the construction of the plates for a quenched gap?

Ans.—(3) This is fully covered in the fourth edition of the book "How to Conduct a Radio Club."

Ques.—(4) Will the quenched gap give good results on 60-cycle alternator current?

Ans.—(4) It will not give the high spark note obtainable from 500 cycle current, but in all other respects (if properly designed) will increase the efficiency.

* * *

G. W., Brandon, Wis.:

The two tuning coils you describe will not respond to waves of 1,700 meters unless they are connected in series, one being used as a loading coil and the other as a direct coupled oscillation transformer. If it is to be used with the linking circuit described in the book "How to Conduct a Radio Club" it would be advisable to wind the coil which is to act as the secondary winding with No. 28 S. S. C wire. The primary coil should be wound with No. 24 S. S. C. wire.

* * *

A. A. Laurium, Mich.:

Either the electrolytic rectifier or the mercury vapor rectifier could be employed in connection with the smoothing out condenser to operate your small arc. The mercury rectifier would probably give the best results. More specific information concerning the efficiency of these rectifiers can be obtained from the General Electric Company at Schenectady, N. Y., or from its New York City office.

* * *

A. O. Ames, Iowa:

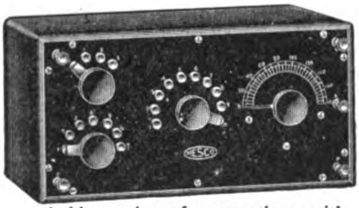
We have no data on the composition of the glass used in the Leyden jar manufactured by a German wireless telegraph company. We understand that the capacity of their large sized condenser is .1 microfarad.

Complete information concerning the various types of arc systems appears in the series of articles on "Radio Telephony" running serially in this magazine.

* * *

R. W. E., Independence, Canada:

The book "How to Conduct a Radio Club" explains the construction of the iron core auto transformer employed in the Armstrong regenerative circuit. We do not know which of the amplifying circuits in question is referred to, but if the transformer be employed for transferring the signals from one vacuum valve bulb to another, one of this type may be purchased from the Manhattan Electrical Supply Company, New York City.



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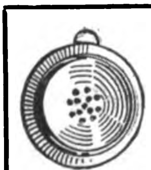

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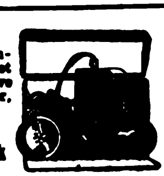

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IN THIS WAR PREPARATION NUMBER:

Signal Officers' Training Course

FIRST ARTICLE BY MAJOR WHITE

Military Wireless Instruction

SECOND INSTALLMENT BY E. E. BUCHER

Vacuum Tubes in Radio Telephony

SIXTH ARTICLE BY PROF. GOLDSMITH

Woman's Work in Wireless

AND A DOZEN EXCLUSIVE FEATURES

THE WIRELESS AGE

An Illustrated Monthly Magazine of RADIO COMMUNICATION

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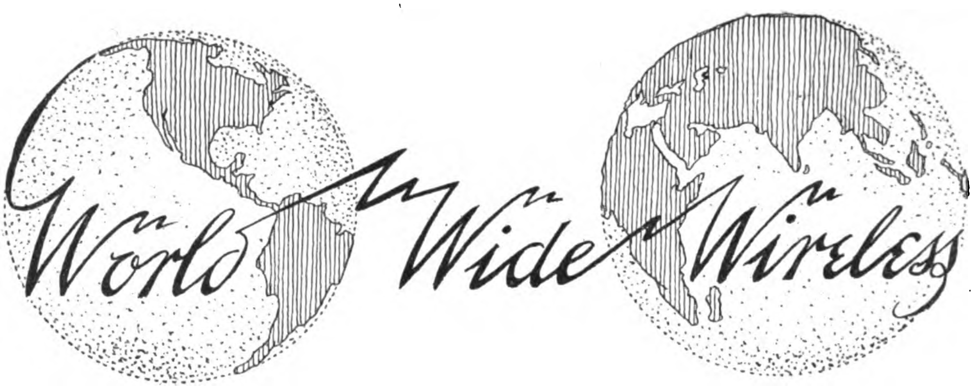


The Declaration of War

THE radio spark flashing through the ether has long since become recognized an inseparable corollary to all epochal events. That this highest of scientific arts should be the forerunner of a mighty nation going to war in the modern way was, therefore, to be expected, but the incidents of its employment have been found worthy of record for their dramatic elements alone.

It was in the afternoon of April 6th that war was declared. A few minutes after noon of that day the joint resolution of the House and Senate was signed by the Vice-President and but one formality remained to make the United States an ally of the Entente in the world war of democracy against autocracy. The document awaited President Wilson's signature, only two minutes; precisely at 1:13 his pen scratched across the parchment. Instantly, Lieut. Commander Byron McCandless at the window signaled across the street to the Navy Department, and while the ink was still wet on the historic war resolution orders were being flashed by wireless to the ships at sea; at the same moment all the countries of the earth were notified of this government's action.

Thus between ticks of a watch Uncle Sam's widely distributed fighting units were consolidated in purpose and the silent machinery of defense set in motion.

The wartime employment of this humanitarian agency has been many times described in these pages, but never, it seems, with the force that this incident brings home, both in portent of message and the feeling that it is our American voice—yours and mine—that spoke in the ether-waved message.

Making Ready for the Call to the Colors

THE mistaken idea which seems to be held in foreign quarters that America's young manhood will reluctantly respond to the call to the colors is due for an immediate upset. It is a national characteristic to wait for the "something doing" period before stirring to action, but once we know that it is our duty to enlist, the citizen training army will be enrolled almost literally overnight. As a matter of fact, men of military age are not shying at the draft; they merely want some assurance of active service—now that they have it, business careers and education will be instantly interrupted to serve the nation. The response in advance of the draft definitely supports this statement. Communications from readers of this magazine requesting enrollment have been gratifyingly numerous and men with exceptionally valuable qualifications for the navy and the army signal corps have offered their services without restriction, even when they had one or more dependents to consider. The enrollment for the Officers' Reserve Corps camps far exceeded the number to be accommodated.

Much still remains to be accomplished, however. There is a growing conviction that the United States, once embarked on its mission of placing an army in the field, will turn to careful consideration of a permanent policy of adequate defense of the wide territory we occupy. More men will be needed, both for the duration of the war and the permanent reserve. Skilled electrical signalmen will be greatly in demand.

Thousands of articles have been printed on the vulnerability of our coasts to invasion. The average reader knows now that once a European enemy got past the American fleet he could easily land an army anywhere at one of the 116 places along our northeastern coast and establish a base of strategical importance. And this is the fact. To illustrate its feasibility we have only to consider that the British landed 120,000 men on the Gallipoli Peninsula, in spite of the waters being heavily mined and the peninsula surrounded by hostile submarines.

While sensational disclosures of our weakness before an invading force have been liberally sown, little has been said of our plans for defense. Possibly many believe that such plans do not exist. But they do; and they are the result of very careful study by the General Staff over a period of eleven years. A special board has since been constantly engaged in revising from European experience the defensive plans for coast fortifications and directions for the mobile army to prevent an enemy seizing any permanent base on our coast. An outline of the use of the "service of information"—or the army signal corps—is given in the new book "Military Signal Corps Manual," prepared especially for amateur wireless men, and the principles of communication with mobile troops will be given in the Signal Officers' Training Course, which begins in this issue of the magazine.

For the communication service of an army of 2,000,000 men, as now proposed, the signal corps ranks would require every single qualified wireless amateur in the country. This is the time to prepare.

Excellent training courses have been instituted by colleges and universities for the months of May and June. A typical course is that of Columbia University, where through intensive study of field service students may learn the elements of signal corps duties. This course occupies a period of classroom study of seven weeks, the tuition fees being $54 to $60. This is an excellent way to grasp the fundamentals of military service, and it is cordially recommended. For those, however, who cannot overcome the handicap of home location or restricted finances, the same subjects may be mastered by close study of the self-training courses to be published in forthcoming issues of this magazine. Any carefully prepared military course is valuable; the principal thing is to get started **now**, to be prepared for any eventuality.

The Possibility of Utilizing Amateur Stations

It seems almost incredible that some owners of amateur wireless stations in New York delayed dismantling their sets for several days after the issuance of Secretary Daniel's order. The reason given in eighteen reported cases was that they didn't consider it necessary, as their equipment was not in working order. Of course the so-called reason was not heeded; it should never have been given, in fact, and these dozen and a half addle-pated amateurs may feel that the mere fact of raising the question has put them outside the ranks of the loyal Americans who hastened to comply with the regulation when war was declared. As an indication of the co-operative spirit shown, the Police Commissioner of New York reported that in that city alone 1,010 amateur plants in operation closed down immediately.

It is quite a hardship for amateurs to be silenced, but it must be remembered that the nation is at war and there are many problems for the Navy to solve unhampered. Wireless is but a small part of the work under its supervision and it is quite in order for every citizen to stand by the Government loyally as the military establishment prepares for action. The day is not far distant when the invaluable assistance to be rendered by amateurs will be recognized. But it is not now a propitious moment to direct attention to this defense auxiliary. All amateurs must be patient for months to come; study hard and await the time when, with greater problems out of the way, the Government will seek amateur assistance in accordance with a definite schedule.

Those who thoughtlessly disobey the closing-down edict should be immediately reported by their amateur acquaintances. Amateur experimenting is here to stay, and every serious devotee of the art should feel it a point of honor to see that all observe the order absolutely.

Hostile Communication on Short Wave-Lengths

Of great interest to the public was the recent statement of Lord Northcliffe that censorship, no matter how well planned, is relatively inefficient. "Some time ago," said this famous British journalist, "Marconi told me that he would undertake to erect a wireless plant that would demand some months effort on the part of our Government to locate, and that before it had been located he would be able to erect another at some other place in England."

We in the wireless field know that this is entirely possible; and that it may now be done by enemy agents in this country is not beyond belief. Short distances could be worked—say in communication with submarines off our coast—on wave lengths that are not audible to the Navy stations in commission. No doubt the Government has considered this possibility and in due time will arrange a wireless espionage system, utilizing amateurs. A definite plan for this auxiliary can be made up only by appointment of a representative board, and it is obviously useless to attempt its consideration until more vital naval questions have been disposed of. Individual efforts of amateurs to bring about measures of this kind will end in nothing; the cue is now to await the developments patiently, obey the law rigidly and prepare for eventual service by study of the advances in the art.

Meanwhile, all changes in the laws regulating wireless operation should be resisted. The present statutes have proven their efficiency; nothing can be gained by changes and considerable damage can be done. Amateurs have considerable unoccupied time on their hands now; each worker in the field should make it his duty to write regularly to Congressmen and Senators, stating clearly that the present law should remain as it stands.

The Father of Wireless Speaks

Ambassador Page has made public a communication from Mr. Marconi which in its warmth of expression seems a personal message to each individual wireless worker in this country. In his letter Mr. Marconi said:

"The sincere admiration and affection I have always felt for your great nation and the encouragement and hospitality invariably ungrudgingly extended to me by Americans, in carrying out my wireless work, render more intense the satisfaction which I feel, in common with my countrymen, at American participation in the great war, which we are fighting for the freedom of civilization.

"Having had the good fortune to work for years in your country and the opportunity of appreciating your democratic institutions, I rejoice at the knowledge that you now have become our ally, not only because it is the most eloquent confirmation of the justice of our cause and because it affords us most valuable material assistance, but also because it enables Americans and Italians to understand and appreciate each other much better.

"No political antagonism can exist between America and Italy. Both fought for freedom and are now fighting together for a common cause—the liberty of the world."

REAL BENEFACTORS AND ALLEGED INVENTORS

BY contrast the issues of the universe are determined. The noble spirit of the inventor of wireless has been so often disclosed in his words and actions that he has long been recognized the world over as a man of wonderful humanitarian instincts; by the same token, other men who have pursued wireless as an avocation have been disclosed both as charlatans and promoters of sharp business practice. Once in a while these latter come a cropper. The most recent instance of this kind concerns the career of a former amateur who secured considerable newspaper notoriety some five years back as a supposed shining light in amateur work and then threw discredit upon the whole field by being haled into court, shortly after the passing of the Radio Act, for operating a powerful 'phone station without a license. Now it appears that last December, this one-time amateur, Elman B. Myers, while in the employ of the de Forest Company, burglarized the Belmar station. He was indicted for breaking and entering and larceny and placed under arrest on April 25th. "The evident purpose of the burglar in entering the station," says the attorney's statement, "was to steal certain valuable patented articles and records of the Marconi Company and turn them over to the de Forest Company." Myers has been held without bail pending his extradition to the State of New Jersey for trial.

The incident speaks for itself. It is under such moral handicaps that the wireless art has labored since its inception. It is to be hoped that this is the last instance of the kind which will have to be recorded in a field mainly composed of thousands of genuinely earnest and sincere workers.

THE AWARD OF THE HONOR MEDAL, I. R. E.

AN item of genuine interest which we are able to announce exclusively in these columns, is the first award of the medal of honor of the Institute of Radio Engineers. It is to be presented to Edwin H. Armstrong in recognition of the valuable contribution to the art represented in his work in connection with receiving apparatus. This testimonial to the efficiency of the now familiar Armstrong circuit will be a popular one, and should prove a great incentive to amateur experimenting since Mr. Armstrong's regenerative circuit was evolved in his amateur days.

—THE EDITOR.

Signal Officers' Training Course

A Wartime Instruction Series for Advanced Amateurs Preparing for U. S. Army Service

By MAJOR J. ANDREW WHITE

Chief Signal Officer Junior American Guard

As editor of this magazine and acting president of the National Amateur Wireless Association during Mr. Marconi's absence at the front, I have had for the several years of the war a chance for observation of the American wireless field that has been of incalculable value in estimating our radio needs and resources. It has been my great privilege to sound the first note of preparedness warning in these pages and to observe with increasing gratification the spreading of the get-ready gospel through other technical journals. Fortunately, this preliminary work was thoroughly done; there is no longer any anti-military apathy to overcome and with the draft legislation enacted the business of training an army for service abroad will go through without any serious hitch, and certainly no opposition worthy of consideration.

We now, therefore, face a condition, not a supposition. The time has come for active participation in warfare by the readers of The Wireless Age. Some will be called to the colors at once. Others beyond military age will loyally, and, perhaps, impatiently, await their turn on a second call. And a great many will now begin to prepare themselves for the service for which they will be eligible with a few months added to their ages.

To all genuine Americans whose love for country means desire for service this series is dedicated. Much of the outline instruction embraced in these articles has already been imparted first hand to enrolled members of the Junior American Guard, sponsored by the N. A. W. A. and actively engaged in its work of military instruction for nearly two years. It is gratifying to state that a number of young men who embraced the opportunities of cadet soldiering when it was first offered through this means have now qualified as soldiers in the regular army and the militia. Some saw service on the Mexican border last summer and others have been cordially welcomed into the regular establishment for this war. The response to the appeal has been generous in twenty-one states; it is now hoped that wireless amateurs *in every state —and COUNTY—in the Union* will organize for Signal Corps instruction. In clubs where activities have been checked by silencing of apparatus, most important work may be carried on through military instruction. There may be a war behind this one; perhaps a war of invasion; preparation for maintaining military communication over the enormous territory of the United States cannot be begun too soon. Older men may "do their bit" by supervising the instruction; younger men may prepare for an eventual call to the colors; and it is hoped that those who go now into training may find some principles of value in this series for study in odd hours while in camp.

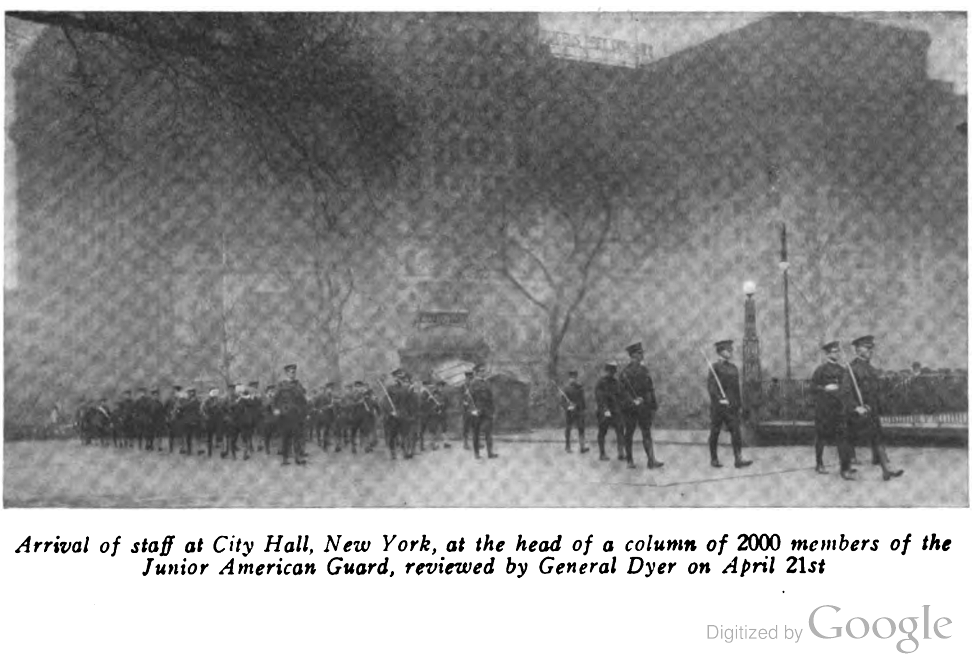
* * * * * *

To properly introduce an instructional series created by a condition, the inspirational factor must be stated. Briefly, it is this: Nearly every young man who has looked to military service—and hundreds have spoken to me personally on this subject—feels he is entitled to go to war as an officer.

It is a natural ambition. But the qualifications for leadership in the signal corps are not solely a superficial knowledge of electric phenomena and ability to inspire respect, as many imagine. Definite military knowledge—and a considerable amount of it—is *absolutely essential* with a signal officer. Most of my well-intentioned friends have believed that this could be acquired in a few weeks or months. They have realized the enormity of their task, however, once they have been given the outline of the soldiering requirements.

This outline is all that I purpose giving in the pages of The Wireless Age. The detailed information has been given in the book "Military Signal Corps Manual," which I have had the honor to compile with the invaluable assistance of Brigadier General George O. Squier, chief Signal officer of the Army, a vice-president of the N. A. W. A. and a soldier-scientist without a peer in the world. This book is now available and will be found particularly valuable to amateurs, I believe, because it has been specifically written for the citizen-soldier.

In considering signal corps units or-



Arrival of staff at City Hall, New York, at the head of a column of 2000 members of the Junior American Guard, reviewed by General Dyer on April 21st ganized in radio clubs, organizers must face a condition to which my attention has been drawn. There is a tendency among members to consider their knowledge of radio complete after attendance at a baker's dozen meetings. In signal corps of any cadet efficiency whatever, this viewpoint is ridiculous. Experience has proven that it requires about three years' instruction to make a non-commissioned signalman and double that time to qualify a soldier for a lieutenancy in signal corps. In consequence, the club that takes up military work seriously has embraced a subject of lasting interest. To promote the interest in instruction requires merely that the leader rule with firm discipline according to regulations, and conduct, in addition to the weekly drill, a school for privates seeking promotion. This latter instruction should be given at least *once a week* and 100 per cent attendance required of those who volunteer for the extra study.

* * * * * *

The U. S. Army requirements for men seeking promotion to the non-commissioned grade of master signal electrician may be used as a basis of estimate for the knowledge required of signalmen. Master signal electricians, it must be understood, are rated below second lieutenants, the M. S. E.'s grade being about equal to a quartermaster sergeant, senior grade. Yet this is the knowledge required, and the method of rating:

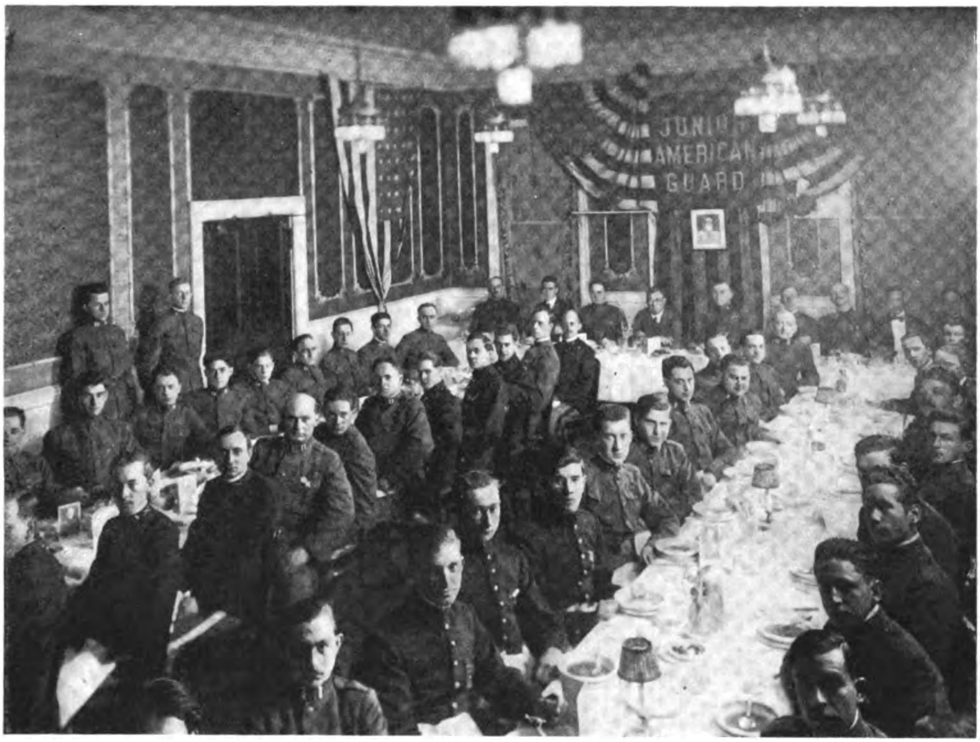
Value (units).

1. **Theoretical electricity and signal equipment** 100
   The voltaic cell, Ohm's law, primary and secondary batteries, telegraphy and the induction telegraph set, telephony, the camp telephone and the buzzer, cable and cable systems, aerial line construction, post telephone systems, small-arms target range signaling systems, technical equipment issued by the signal corps and requisitions and general maintenance regulations, tests of submarine cables, etc.
2. **Drill regulations for field companies** 10
3. **Gasoline engines** 10
4. **Army regulations** 5
   Arrests and confinements, commands, honors, courtesies and ceremonies, courts-martial, property accountability and disbursing, transportation, subsistence, etc.
5. **Algebra, not including quadratics** 10
6. **Regulations for U. S. Military telegraph lines** 5
7. **Army signaling** 5
   American Morse code, general service code, visual signaling by flag, torch, hand lantern or searchlight, heliograph, ardois, stationary semaphore, rockets, bombs, small-arms, guns, coston lights, Very pistols, cipher messages and improvised codes, etc.
8. **Commercial radio regulations.** 10
9. **Radiotelegraphy** 30
   Theoretical and practical.
10. **Telegraphy** 10
11. **Visual signaling** 5
12. **Record and recommendations.** 50
    Technical duty performed, etc.

Total units **250**

The foregoing subjects are covered in an examination occupying four days, as follows: First day, forenoon, three hours, electricity; afternoon, three hours, drill regulations and army regulations. Second day, forenoon, three hours, radiotelegraphy; afternoon, three hours, commercial regulations. Third day, forenoon, three hours, theoretical electricity, electrical signal equipment and army signaling; afternoon, three hours, regulations for U. S. military telegraph lines. On the fourth day three hours of the forenoon are devoted to algebra and three hours of the afternoon to gasoline engines.

The examinations are very thorough. For example, electrical knowledge embraces alternating currents; gasoline engine requirements include principles of engine, carbureters, electrical ignition devices, troubles and remedies. In radio a full knowledge of theory and practice is required. In telegraphy, candidates must show ability in transmitting and receiving in both codes, and in visual signaling, ability to transmit and receive ordinary messages at a minimum speed of 15 mixed letters per minute using the 2-foot flag kit. Thus, without further consideration of the exhaustive military knowledge required, it is immediately apparent that every amateur has lots to learn before becoming



Officers' dinner of local New York units of the Junior American Guard, at which the first presentations of commissions were made to the sixty successful candidates. At the speaker's table in the background, reading from left to right, are Major Vail, Lieut. Osmur, aide to Maj. Gen. Leonard Wood, Major White, General Dyer, and Majors Elliott, Nicholson, Erbeck, Schmerl and Roy

eligible to even a non-commissioned officer's grade in signal corps.

But it is the most fascinating study imaginable. Once the technical information is carefully packed away in responsive brain cells, the ability to command and the accomplishment of difficult drill evolutions and solution of field service problems in maneuvers presents itself for mastery in striving for the junior commissioned grades such as lieutenant. An amateur's club, fully uniformed and equipped and maintaining discipline according to army regulations is insured a long and successful existence. I know of a number of cadet organizations that have kept together constantly for ten or more years, and these studied only the comparatively uninteresting infantry drill. Among the Junior American Guard units is a cadet corps which was recently mustered in as a body into the national organization; at an official inspection which I made recently this unit presented to a member a *five-year* medal for 100 *per cent duty!* That record is indicative of how citizens are made into officers for wartime enlistment, and it speaks eloquently for the permanency of cadet military activities when properly conducted.

The practicability of this training is

best expressed in the official attitude of the War Department, as disclosed in the following extract from the book "Military Signal Corps Manual":

"The country must be prepared to prevent throughout the vast extent of its seaboard, the seizure and occupation of any one of many important points.

"The communications by which the first line and the reserves will be linked together and to the permanent works should, from the early efforts at concentration, be ample and effective, and so continue, for without them the whole army of the defense will become a mere aggregation of inert units.

"It is hopeless to suppose that the signal corps of the regular establishment can ever supply more than a leaven for the mass of men needed . . . or even that the militia possessing signal troops of approved efficiency can provide more than the framework of the organizations that will be required. The signal troops mobilized for war must be filled in by men drawn direct from civil life."

And again, quoting from the book:

"There are still people of intelligence who in practice think that the transmission of military thought is summed up in the use of notebook, the orderly, and his horse. But these are passing, and the trained soldier and educated volunteer understand the vital importance of time in military operations and the need for the immediate transmission of information. Hence, the necessity for a signal corps or its equivalent; for without its aid modern armies can no more be controlled than can great railway systems; the commander in the field remains blind and deaf to the events occurring around him, incapable of maintaining touch with conditions, and out of reach of his superiors or those under his authority, upon whom he depends for the execution of his plans. The brain lacks the power to control because the nerves are wanting. Time is the main factor in war; to arrive first with the greatest number of men, and with the clearest understanding of the situation, is to succeed. The last, and often the first, of these conditions depends upon the lines of information of the army.

"Half a century ago rapidity of transmission of information in campaigns was in general measured by the speed of the couriers; distant movements were left to take care of themselves or neglected, since, if discovered, they could only be reported after the event; immediate operations were limited; the chessboard was small. Now all this is changed, and if everything concerned in war and with the efficiency of armies should be of the best, certain it is that the nerves extending from the controlling brain to the striking arm—that is, the lines of thought transmission—should be the most perfect, the most rapid, and the most certain that science can give. Only the best should find a place. Air service, the radio, telegraph, telephone, and visual signaling apparatus, all must be supreme of their kind lest a club be placed in the enemy's hands, to our own destruction." This is a truth that every soldier knows in general, but it seems worth while to repeat that if a commander's service of information is better than that of his adversary he possesses wider knowledge and superior control; he selects with certainty his objective and arrives at it first; he perceives weakness before his own is discovered or strength before his weakness is known; he anticipates movements, alters dispositions, executes plans unknown to his enemy; in short, the successful soldier commands the situation by force of superior knowledge.

"It has been said that recent field experiments with troops have conclusively proved that for every specially trained signal corps soldier provided, not only is the field information service many times increased in efficiency, but that at least two men are returned to the firing line who would otherwise be removed therefrom to perform the inefficient and often impossible work of the orderly of the past. Since this messenger service must be provided, either through orderlies or trained signal troops, it is manifest that the provision of a minimum per cent of the total strength for this purpose results in increasing the number of men for the firing line instead of taking from that line.

"The duties of a corps for intelligence communication are not, however, confined to the transmission of information alone, though that is its principal function. For in addition to this service its troops will have plenty of fighting, if not of plain soldiering, to do, not only with the infantry at the outposts and at the outposts and at detached stations, but with the cavalry in reconnaissance work, and with both when serving with contact troops and with patrols. The chief duty of signalmen is, of course, to transmit information collected, but they are by no means to remain blind and deaf to the events taking place around them. They should gather all the information possible and transmit it, through the proper channels, to headquarters, as is the duty of all soldiers. Obviously, while signalmen have unusual opportunities for the collection of information in the enemy's country, they have at hand the means of transmission as well, and thus form one of the strongest corps of observers with an army. Still, it is not to be forgotten that an army has eyes and ears everywhere, and that the duty of obtaining information is imposed upon all. The chance of observation of a sentinel, a report from an outpost, the story of a prisoner or native may have value if sent in time to the proper authority. This is the first duty of the signalmen; but in addition signal troops, and especially the aviators, have become, even more than the cavalry, the eyes and ears of the army.

"The need for training and experience on the part of the officers and men engaged on this service is too obvious to need more than a mere mention and it will be here sufficient to quote, as an indication of expert opinion on this subject, the following remarks of a distinguished French officer:

" 'Information service fails especially because the world is ignorant of its principles, processes and modes of action. The transmission of intelligence demands special organs. Most armies give some telegraphic training to non-commissioned officers and troopers; it is lost time. Those partly informed are always incompetent; special-trained men are necessary.'

"This brief statement might be well considered a military axiom to be placed at the head of all treatises and laws affecting the army."

From the foregoing may be determined in a general way the value of a trained amateur when the nation is at war. In the articles of this series to follow, the method of study and the application of military knowledge thus gained will be covered. It is hoped that the readers of this magazine will recognize the importance of co-ordinated effort, that is, the desirability of applying the material in practical operation by the use of club members or other young men of the vicinity, possibly unskilled in a technical sense, but organized into a uniformed military unit. The course of instruction, which will have as its basis the book "Military Signal Corps Manual" can be successfully pursued by home study, of course, but it is obvious that better results can be obtained with a group learning signal duties by actual drill.

In the next issue I shall take up the practical side of organization of citizen-soldier Signal Corps and outline the preliminary technical and military instruction. Meanwhile, all amateurs who feel the deprivation of silenced apparatus and wish to prepare themselves or others for service to the nation at war, can well employ their time in gathering together twenty or more prospective recruits for enrollment, using the material contained in this article as an outline of what the cadet signal corps will attempt to accomplish for members.

Wireless Instruction for Military Preparedness

A Practical Course for Radio Operators

ARTICLE II

By Elmer E. Bucher

Instructing Engineer, Marconi Wireless Telegraph Company of America

EDITOR'S NOTE.—This is the second installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

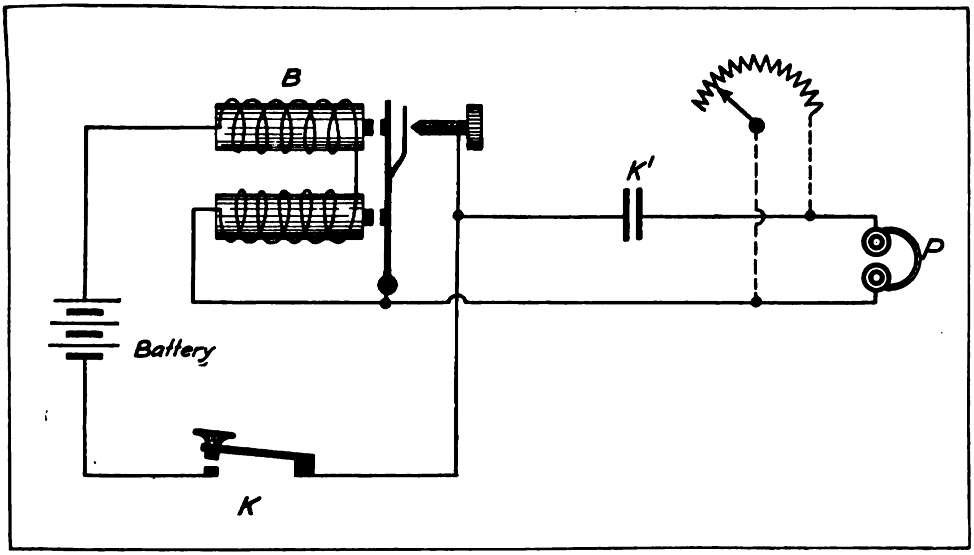


Figure 1

CODE PRACTICE.

OBJECT OF THE DIAGRAM.

To show the apparatus and circuits of a beginner's code practice set, for the production of artificial wireless telegraph signals.

PRINCIPLE.

The counter electromotive force of a vibrating buzzer charges the condenser K^1 in series with which is the head telephone P. A "buzzing note" is produced in the head telephone corresponding to the rate of interruption of the vibrator.

DESCRIPTION OF THE APPARATUS.

B, an ordinary electric buzzer is connected in series with a four-volt battery and a sending or signalling key K. Across the vibrator is shunted the circuit consisting of the one microfarad condenser K^1, the head telephone P and the shunt variable resistance.

OPERATION.

The sending operator (one thoroughly familiar with correct formation of the code characters) presses key K, whereupon the armature of the buzzer (if properly adjusted) is set into vibration.

The counter electromotive force of the buzzer winding in charging the condenser K^1 produces high-pitched buzzing sounds in the receiving telephone.

By regulating the shunt telephone resistance the strength of the sounds can be varied suitable to the ear.

SPECIAL REMARKS.

If the platinum point of the buzzer is attached directly to the soft iron armature (the buzzer spring being removed) a very high-pitched note, somewhat similar to that produced by modern 500 cycle spark wireless telegraph transmitters, will result.

INTERNATIONAL MORSE CODE AND CONVENTIONAL SIGNALS

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	— — • •
Ä (German)	• — • —
Á or Å (Spanish-Scandinavian)	• — — • —
CH (German-Spanish)	— — — —
É (French)	• • — • •
Ñ (Spanish)	— — • — —
Ö (German)	— — — •
Ü (German)	• • — —
1	• — — — —
2	• • — — —
3	• • • — —
4	• • • • —
5	• • • • •
6	— • • • •
7	— — • • •
8	— — — • •
9	— — — — •
0	— — — — —

Period	• • • • • •
Semicolon	— • — • — •
Comma	• — • — • —
Colon	— — — • • •
Interrogation	• • — — • •
Exclamation point	— — • • — —
Apostrophe	• — — — — •
Hyphen	— • • • • —
Bar indicating fraction	— • • — •
Parenthesis	— • — — • —
Inverted commas	• — • • — •
Underline	• • — — • —
Double dash	— • • • —
Distress Call	• • • — — — • • •
Attention call to precede every transmission	— • — • —
General inquiry call	— • — • — — • —
From (de)	— • •
Invitation to transmit (go ahead)	— • —
Warning—high power	— — • • — —
Question (please repeat after ......)—interrupting long messages	• • — — • •
Wait	• — • • •
Break (Bk.) (double dash)	— • • • —
Understand	• • • — •
Error	• • • • • • • •
Received (O. K.)	• — •
Position report (to precede all position messages)	— • — •
End of each message (cross)	• — • — •
Transmission finished (end of work) (conclusion of correspondence)	• • • — • —

Figure 2

INTERNATIONAL RADIOTELEGRAPHIC CONVENTION

LIST OF ABBREVIATIONS TO BE USED IN RADIO COMMUNICATION

ABBREVIATION.	QUESTION.	ANSWER OR NOTICE.
PRB	Do you wish to communicate by means of the International Signal Code?	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?............	This is........
QRB	What is your distance?........................	My distance is........
QRC	What is your true bearing?....................	My true bearing is........degrees.
QRD	Where are you bound for?......................	I am bound for........
QRF	Where are you bound from?.....................	I am bound from........
QRG	What line do you belong to?...................	I belong to the........Line.
QRH	What is your wave length in meters?...........	My wave length is........meters.
QRJ	How many words have you to send?..............	I have........words to send.
QRK	How do you receive me?........................	I am receiving well.
QRL	Are you receiving badly? Shall I send 20? ..... • • • ▬ • for adjustment?................	I am receiving badly. Please send 20. • • • ▬ • for adjustment.
QRM	Are you being interfered with?................	I am being interfered with.
QRN	Are the atmospherics strong?..................	Atmospherics are very strong.
QRO	Shall I increase power?.......................	Increase power.
QRP	Shall I decrease power?.......................	Decrease power.
QRQ	Shall I send faster?..........................	Send faster.
QRS	Shall I send slower?..........................	Send slower.
QRT	Shall I stop sending?.........................	Stop sending.
QRU	Have you anything for me?.....................	I have nothing for you.
QRV	Are you ready?................................	I am ready. All right now.
QRW	Are you busy?.................................	I am busy (or: I am busy with.......). Please do not interfere.
QRX	Shall I stand by?.............................	Stand by. I will call you when required.
QRY	When will be my turn?.........................	Your turn will be No. ....
QRZ	Are my signals weak?..........................	Your signals are weak.
QSA	Are my signals strong?........................	Your signals are strong.
QSB	Is my tone bad?...............................	The tone is bad.
	Is my spark bad?..............................	The spark is bad.
QSC	Is my spacing bad?............................	Your spacing is bad.
QSD	What is your time?............................	My time is........
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG	....	Transmission will be in series of 5 messages.
QSH	....	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for............?...........	Collect........
QSK	Is the last radiogram canceled?...............	The last radiogram is canceled.
QSL	Did you get my receipt?.......................	Please acknowledge.
QSM	What is your true course?.....................	My true course is........degrees.
QSN	Are you in communication with land?..........	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with........)?	I am in communication with.......(through........).
QSP	Shall I inform........that you are calling him?	Inform........that I am calling him.
QSQ	Is........calling me?.........................	You are being called by........
QSR	Will you forward the radiogram?...............	I will forward the radiogram.
QST	Have you received the general call?...........	General call to all stations.
QSU	Please call me when you have finished (or: at ....o'clock)?	Will call when I have finished.
*QSV	Is public correspondence being handled?.......	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?..........	Increase your spark frequency.
QSX	Shall I decrease my spark frequency?..........	Decrease your spark frequency.
QSY	Shall I send on a wave length of......meters?	Let us change to the wave length of......... meters.
QSZ	....	Send each word twice. I have difficulty in receiving you.
QTA	....	Repeat the last radiogram.

*Public correspondence is any radio work, official or private, handled on commercial wave lengths.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

Figure 3

QUES.—What is the approximate time required to make a dot?

ANS.—About 1-15 of a second (or in other words, the contacts of the key just touch for the shortest possible moment).

QUES.—What is the length of a dash?

ANS.—The length of about three dots or 1-5 of a second.

QUES.—What should be the spacing between the signals which form the same letters.

ANS.—Approximately equal to the time of one dot.

QUES.—What should be the space between two letters of a word?

ANS.—About the time required to make two dots.

QUES.—What should be the space between two words?

ANS.—Approximately the time required to make five dots.

QUES.—What letters of the alphabet should have the particular attention of the beginner?

ANS.—Such letters as C, J, P, Q, X, Y, Z.

QUES.—Why is this precaution necessary?

ANS.—Because if care is not taken to make the dots and dashes in such a way that they follow closely, the letter will be split up anl will form two letters.

To illustrate: C if improperly sent might easily be construed to read N, N; J might be made A, M; P might be made to form A, N and so on. The letter Y may be found particularly difficult and if improperly sent would easily make T, W.

The dots and dashes for a particular letter must be conjoined, equal spacing being used between them so that the listener can easily distinguish a single letter or numeral.

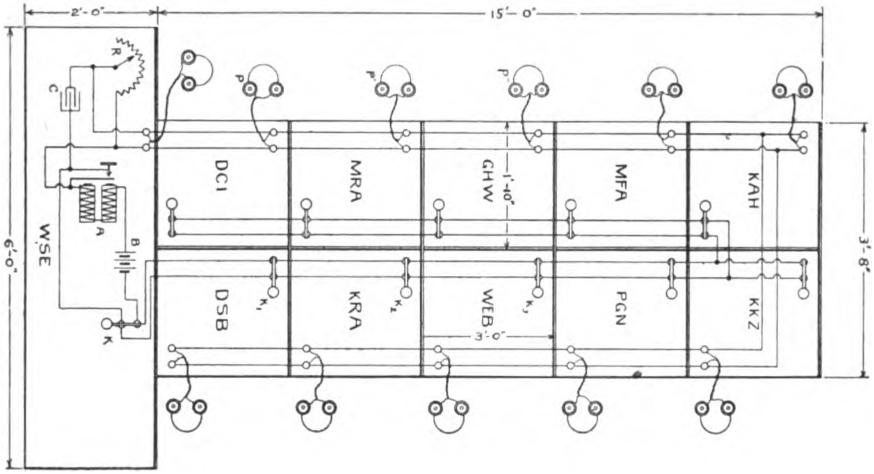


Figure 4

OBJECT OF THE DIAGRAM.

To show how a buzzer practice table may be wired up to accommodate several students at a time.

PRINCIPLE.

The counter electromotive force of the bell buzzer at the master table energizes several head telephones connected to binding posts at the learner's table. The instructor sits at the master table and dispatches traffic individually to the learner or to the class as a whole.

DESCRIPTION OF APPARATUS.

The electrical equipment is the same as Fig. 1 with additional telephones and keys.

The learners' telephones are connected in shunt to the instructor's telephone; likewise the learners' keys are connected in shunt to the instructor's sending key.

The learners' table is divided into several compartments allowing sufficient room for free movement of the arm of each student. Call letters are assigned to each operating position.

OPERATION.

The function of this apparatus is the same as Fig. 1.

Only one student can send at a time.

The instructor sits at the master table and calls stations individually, dispatching traffic to and from, after the manner at commercial land stations.

SPECIAL REMARKS.

Interfering or "jamming" is to be avoided. Buzzer signals should be cut down to a point where they can just be heard, in order to train the ear of the student to receive weak wireless telegraph signals.

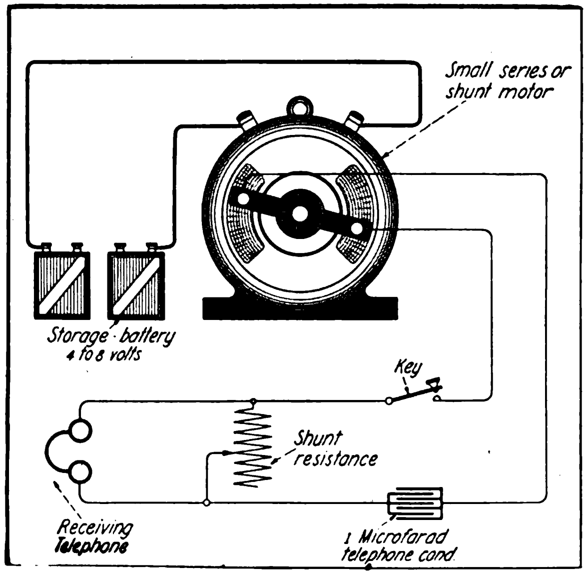


Figure 5

OBJECT OF THE DIAGRAM.

To show how a small series battery motor can be used to produce artificial wireless telegraph signals.

PRINCIPLE.

The counter electromotive force of the armature windings charges the condensers, the condensers flowing in and out of the condenser, setting up a buzzing note in the head telephone.

DESCRIPTION OF APPARATUS.

A small 4, 6 or 8-volt battery motor energized by storage or dry cells.
One small Western Union telegraph key connected in series with the head telephone.
One ½ to 1 microfarad condenser connected in series with the head telephone.

SPECIAL REMARKS.

(1) If signals in the head telephone are too loud, a small variable resistance can be connected in shunt. The resistance should be adjusted until the note is just heard.

(2) For instruction regarding the transmission of wireless telegraph traffic consult "Traffic Rules and Regulations," particularly rules 74, 75, 76, 77, 78 and 79. Also note punctuation and other signs in rule 80, and particularly the method of asking for a repetition of a message or sentence as shown in rule No. 99.

(3) The instructor is advised to familiarize students with the methods of traffic procedure immediately they are able to copy at a rate of from 8 to 10 words per minute. The "Q" signals should be included at the beginning; querying by telegraph among students should be reduced to a minimum, as the "Q" signals cover all requirements under ordinary operating conditions.

ELEMENTARY ELECTRICITY AND MAGNETISM.

In order that the student may understand the operation and manipulation of wireless telegraph apparatus, it will be necessary for him to have a knowledge of:

(1) The magnet;
(2) The production of electrical currents;
(3) The phenomena surrounding electromagnets;
(4) Construction and operation of motor generators;
(5) Construction and functioning of transformers;
(6) Functioning, care and maintenance of storage batteries.

QUES.—What is the final object of this elementary instruction?

ANS.—To lead, step by step, to an explanation of the apparatus for the production of radio-frequent currents.

QUES.—What is meant by a radio-frequent current?

ANS.—An alternating current which, in commercial wireless telegraphy, covers all frequencies from 10,000 to 1,000,000 cycles per second.

QUES..—What is the use of such currents?

ANS.—When made to flow in a properly "tuned" or "synchronized" vertical conductor such as a copper wire suspended from a mast, which is connected to earth at one end, they will set into motion electric waves by which wireless correspondence is conducted from point to point.

QUES.—Name the principal parts of the apparatus for the production of radio-frequent currents.

ANS.—(1) The motor generator; (2) the step-up voltage transformer; (3) the high voltage condenser; (4) oscillation transformer; (5) spark discharge gap.

QUES.—What does this apparatus compose?

ANS.—The principal elements of a transmitting set for the production of what are termed damped electrical oscillations.

QUES.—Name some of the qualities of an electrical circuit, with which the functioning of wireless apparatus is particularly concerned.

ANS.—The qualities of capacity, inductance and resistance, each of which will be discussed in their proper order in the text to come.

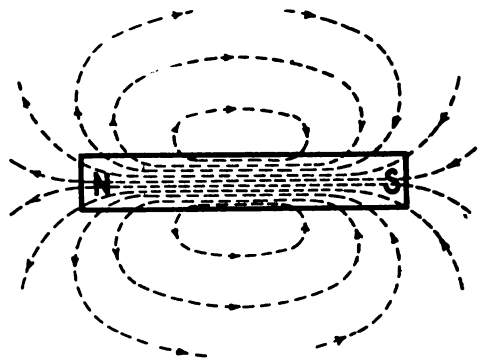


Figure 6

OBJECT OF THE DIAGRAM:

To show a simple bar magnet and the assumed direction of the magnetic field.

PRINCIPLE.

Only iron and steel manifest the property of magnetism to a marked degree.

Steel when once magnetized retains its magnetism permanently.

Soft iron loses its magnetism when the magnetizing influence is removed.

The magnetic field of a bar magnet is more strongly evident at the ends of the bar, which are called the magnetic poles.

If a bar magnet is suspended by a thread, one end will point toward the north magnetic pole of the earth. This end is called the *north pole,* the opposite end the *south pole.*

The general direction of the lines of force can be shown by sprinkling iron fillings on a piece of paper under which is placed a bar magnet. The filings will arrange themselves into a series of well-defined lines which are called *magnetic lines of force.*

The space subjected to this strain is called the *magnetic field* and the total lines of force crossing a given space are termed the *magnetic flux.*

Magnetism may be induced in the bar by placing an external magnet near to the bar or in actual contact with it.

SPECIAL REMARKS.

(1) If an iron bar is plunged into a pile of iron filings, the majority of the filings will adhere to the ends of the bar and there will be little attraction at the center. It is therefore evident that the magnetic field of a bar magnet is more dense at the ends than at the center.

(2) No matter how soft iron may be when it has once been magnetized and the external magnetizing influence is removed it will retain a certain number of lines of force. These are called the residual lines of force and the iron is said to possess residual magnetism.

QUES.—What is a permanent magnet?

ANS.—A magnet which retains its magnetism when the external magnetizing influence has been removed.

QUES.—What is a temporary magnet?

ANS.—A magnet which exhibits the property of magnetism when under the influence of an external magnetic field and which loses it immediately the outside influence is removed.

QUES.—How is the capability of any substance for conducting magnetic lines of force expressed?

ANS.—By the term permeability.

QUES.—What is the base from which the permeability of various magnetic substances is rated?

ANS.—Air is taken as unity. Steel possesses much greater permeability than air and iron greater permeability than steel.

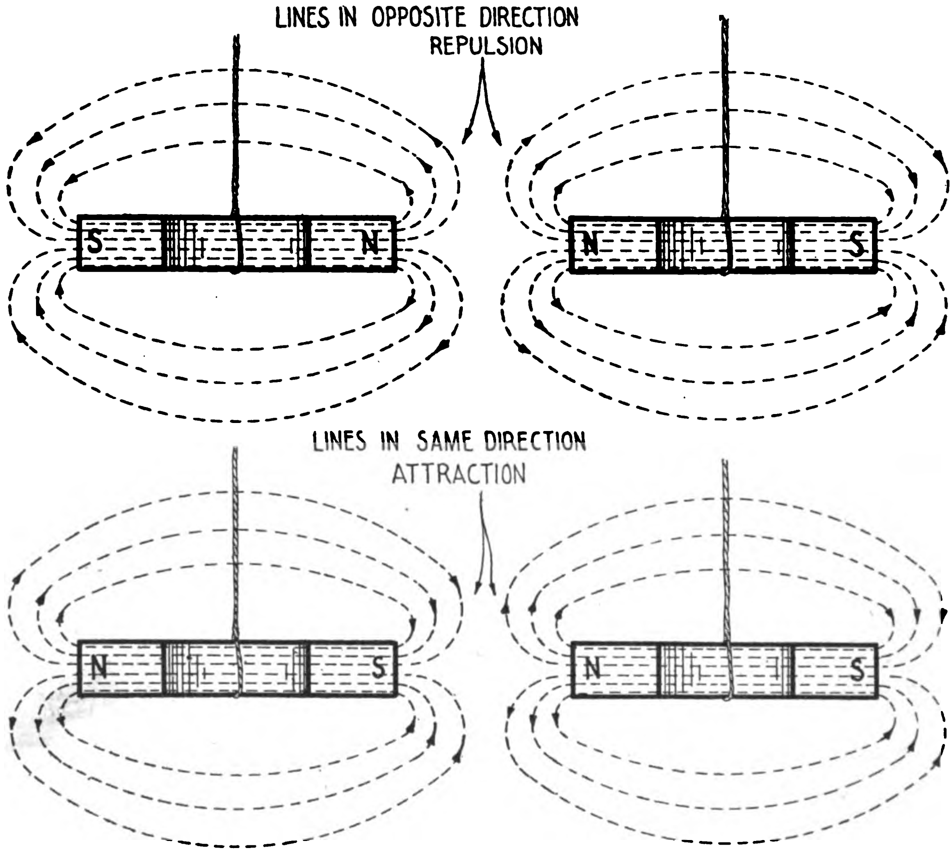


Figure 7

OBJECT OF THE DIAGRAM.

To show the attraction and repulsion of "north" and "south" magnetic poles.

PRINCIPLE.

Like magnetic poles repel; unlike poles attract.

DESCRIPTION OF THE APPARATUS.

In the upper half of the diagram (Figure 7) two bar magnets with two north poles adjacent are suspended by a string, and when brought near to each other they are found to repel. On the other hand, in the lower part of the diagram, two bar magnets, with north and south poles adjacent are suspended by a string, and they are found to attract each other.

SPECIAL REMARKS.

(1) If a magnetic substance such as a bar of iron is suspended free to move in a magnetic field, it will tend to turn and lie parallel with the field, or as is more often said, will take such a position as to accommodate through itself the greatest number of lines of force.

(2) If a permanent magnet is suspended free to move in a magnetic field (such as suspending a bar magnet above a stationary magnet) it will tend to take a position parallel with the field. but in a particular direction, that is, its internal lines of force will be in the same direction as those of the field.

QUES.—What use is made of this phenomenon?

ANS.—Advantage of this fundamental principle is taken in the design of many electromagnetic devices and in electrical measuring instruments. In fact, this phenomenon is encountered in practically all electrical apparatus where mechanical movement depends upon a magnetic field.

QUES.—What is meant by a magnetic circuit?

ANS.—It is the path the lines of force take in passing from pole to pole of a magnet.

QUES.—What is the general direction of the lines of force in a magnet?

ANS.—It is assumed to be from the south to the north pole inside the magnet and from the north to the south pole outside the magnet.

QUES.—What is the best conductor of magnetic lines of force?

ANS.—Soft iron.

QUES.—State a use of the bar magnet.

ANS.—The original navigator's compass is the best example of its use. The compass needle will take up a position parallel with the magnetic field of the earth and will point in the direction of the earth's north magnetic pole which is located in the vicinity of Hudson Bay, and which is several hundred miles south of the north geographical pole.

The compass needle can also be used to detect the presence of electrical currents in a conductor and will, in fact, show the direction of the flow of current.

(To be Continued.)

The Last Voyage of the Sibiria

By H. LAWTON POTTS
Second Operator

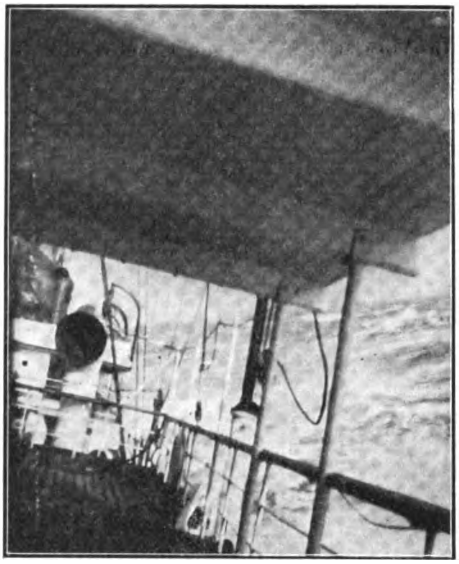
THE Sibiria was an old Hamburg-American liner, built twenty-five years ago for the China trade in which she became notorious as an opium smuggler. Finally she became a tramp steamer and veritable stormy petrel, with her log books filled with entries as interesting and thrilling as fiction.

Prepared for a six weeks' voyage. the vessel steamed away from New York last August, bound for France. She was loaded with sugar and when she was unloaded at Havre it was found that her bilge pipes had been hacked open by a German sympathizer. As a result the water had seeped through the cargo throughout the voyage, causing thousands of dollars' worth of damage. She struck bottom twice in the mine fields of the English Channel, bringing about considerable trepidation among the members of the ship's company, for they believed that she was about to be blown up In consequence of the bumps she received

The author as he was snapped by a camera man on board ship

she went into dry dock when she arrived at Plymouth, England, remaining there for twelve days.

Then this vessel of varied history pointed her nose seaward again and for twenty days the North Atlantic churned us about until we reached the snow-covered shores of Labrador. Through the Straits of Belle Isle and up the St. Lawrence we steamed, touching at Montreal and Sidney, Nova Scotia. At the latter port we filled our bunkers with coal and took on a cargo of grain and benzol, after which we began our voyage to London, where it had been planned to turn the vessel over to the British Government. Once fairly out in the Atlantic, we found ourselves tossed about in the teeth of a typical November storm. Our path was a continuous succession of scenic railway dips and we were compelled to ride waves that threatened to overturn the Sibiria and smash it to pieces. Sleep was impossible and it was necessary to lash down or stow away all articles that were movable. It can be related as an example of the violent manner in which the ship



A photograph taken in a storm from the deck of the Sibiria

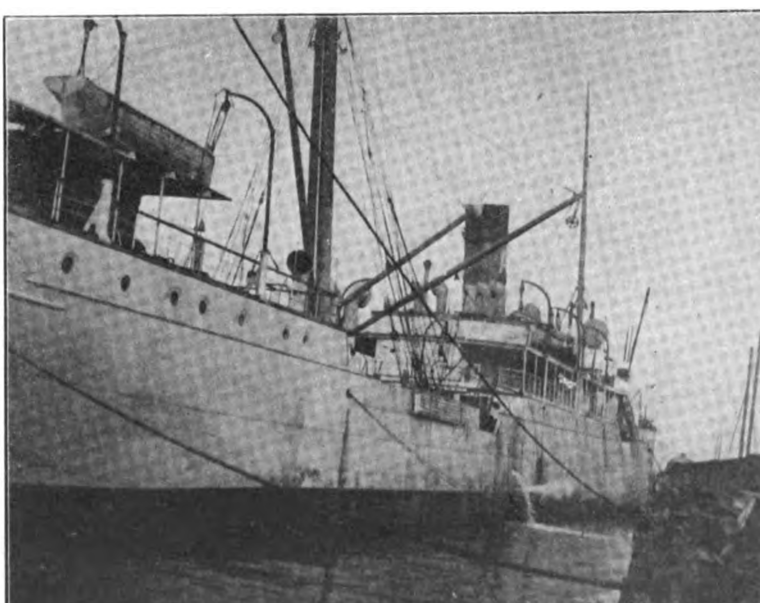
pitched about that when the vessel's pet cat wanted to cross the wireless cabin she either fell head over heels against the wall, or, if she wanted to go in the opposite direction, she had to climb up, inch by inch, as if she were ascending a slanting board.

It was not until the Scilly Islands were sighted that the high seas diminished. We were then within about two days' voyage of London and I looked upon our adventure as practically at an end. In this view, however, I was mistaken, for the day before we expected to reach our port of destination the ship stranded. She instantly began to pound dangerously and great seas which swept over her added to the peril. Word came from the captain to send the S O S and the appeal was answered by all of the French and English shore stations as well as a considerable number of war vessels and merchantmen. Two British torpedo boat destroyers came to our aid and stood by for a day and a night. They could not approach us, however, because of the danger of grounding.

Meanwhile, the great seas had swept the decks clear of all articles that were unsecured and the engine rooms filled with water a half hour after we struck. The situation was not without an element of considerable danger. Huddled together in wet clothes on the boat deck, we were completely at the mercy of the chill November gale. None of us expected to leave the ship alive and some of the Spanish oilers and firemen, in a desperate attempt to seek safety, lowered one of the lifeboats. The heavy seas permitted it to live only a few minutes, however.

The life-saving crews from Deal and

(*Concluded on page* 686)



The ship of varied history about which this narrative is written

Cape May's New Station

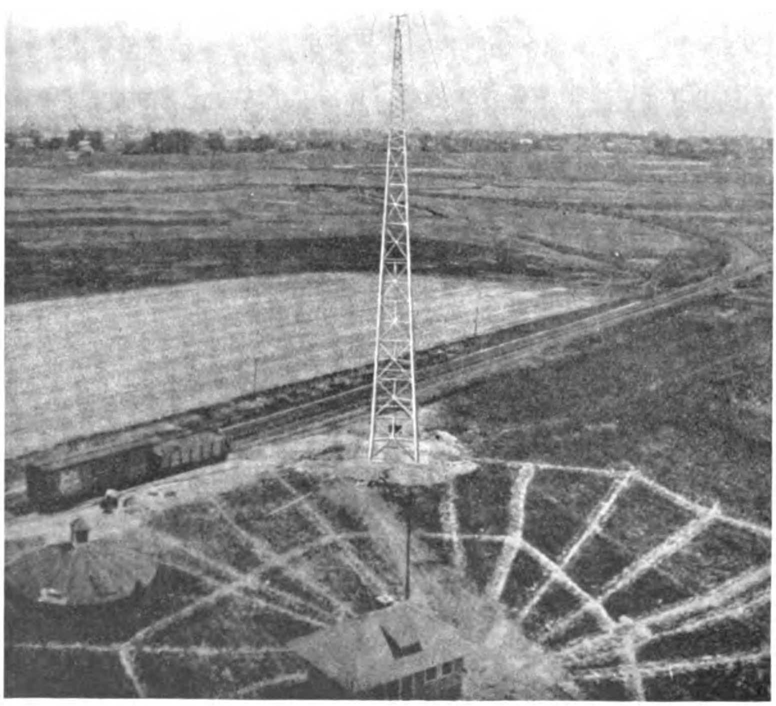
·A Description of the Equipment and Some Extracts from the Log Book

"MARCH 18th, 2:30 A. M.—s. s. Proteus, off Key West, Florida, calls us and says our signals are very fine. (Distance approximately 950 miles air line.)"

"March 18th, 3:15 A. M.—PJC (Willemstad, Island of Curacao), calls and says our signals very good, through static. (Distance approximately 1,300 miles air line.)"

These extracts from the log book of the American Marconi Company's new Cape May (N. J.) station, attest the efficiency of its equipment and operation. The station was opened for service on March 12th.

The first Cape May station was built in 1910 atop the Hotel Cape May. A few years afterward another station was erected on a plot of ground owned by the Pennsylvania Railroad, near the beach. This station was housed by a modest building and a wooden mast, 180 feet in height, was erected. The mast



Effective view of 150-foot tower at Cape May, showing the trench marks of the new ground system. The tower carries an aerial of four silicon bronze wires which enter the receiving station from the center of a 350-foot span

Station building with Manager E. M. Hartley in the door

was wrecked by a storm in 1915 and plans for a new station were made.

Located about a mile from the old station and one-half mile from Cape May, the new Marconi link is built on the property of the Cape May city waterworks. A two-story frame structure, the plans for which were drawn by John B. Elenschneider, construction engineer of the Marconi Company, houses the equipment. On the first floor is the operating equipment, containing a transmitter and receiver. The top floor, or attic, is used as a storage room.

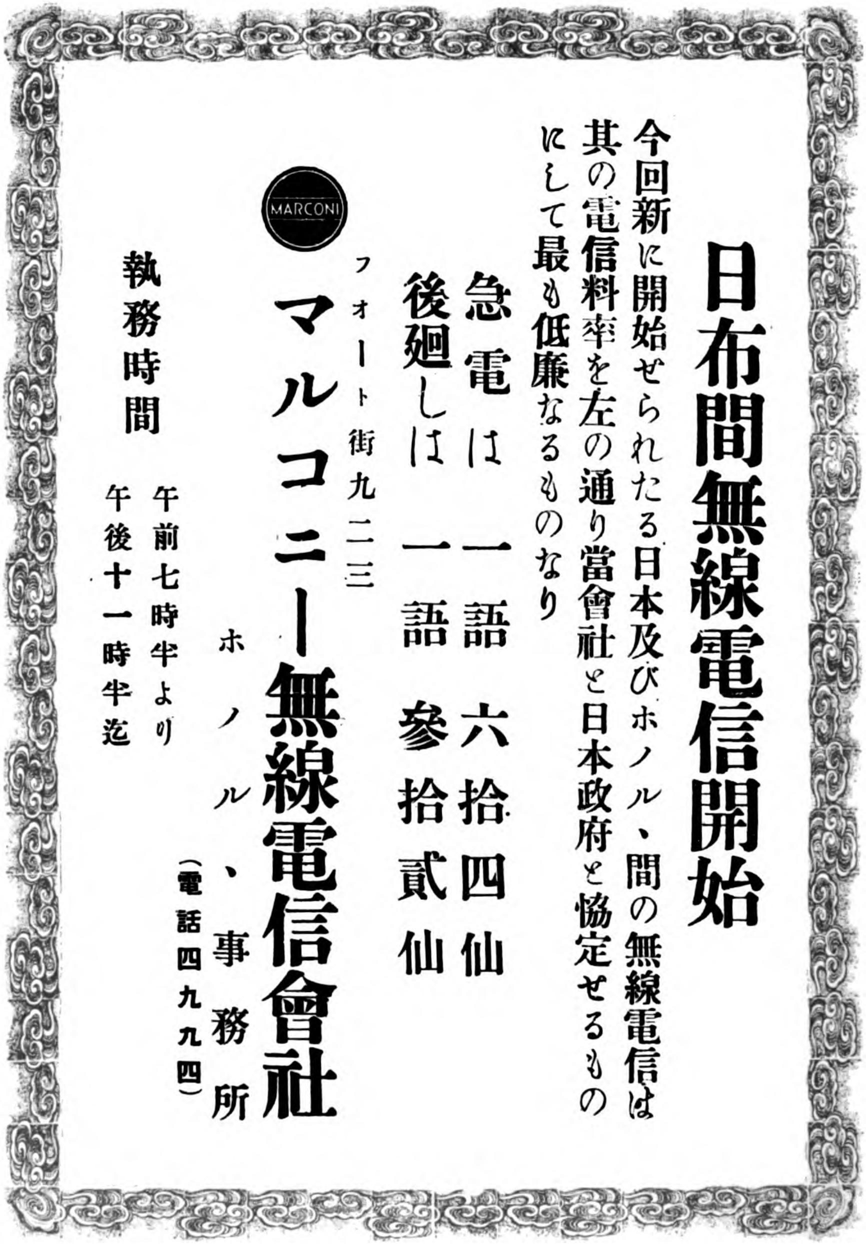
The transmitter is a Marconi new type panel set, which is employed in shore stations where 60-cycle single phase current can be obtained from electric light companies' plants. The spark gap is of the non-synchronous type, with an approximate frequency of 1,100 per second, which gives a high, clear note, different from that of the quenched spark gap. As a result the signals are distinctive and easy to read through interference by other stations.

The transmitter is tuned for three wave-lengths, 300, 450 and 600 meters. By throwing a switch which actuates the primary and secondary circuits and the coupling, changing the primary, secondary and coupling simultaneously, the operator can shift quickly from one wave-length to another. In the case of the 300-meter wave, the operator inserts a short wave condenser in the antenna by opening a jumper which is ordinarily across this series capacity when working on the longer wave. The transmitter can be easily adjusted for any power from 1½ k. w. to 3 k. w., this being accomplished by an adjustable transformer reactance. Ordinarily the set is worked at 2.4 K. W. power, which gives an antenna current of twelve amperes when operated at a wave-length of 600 meters.

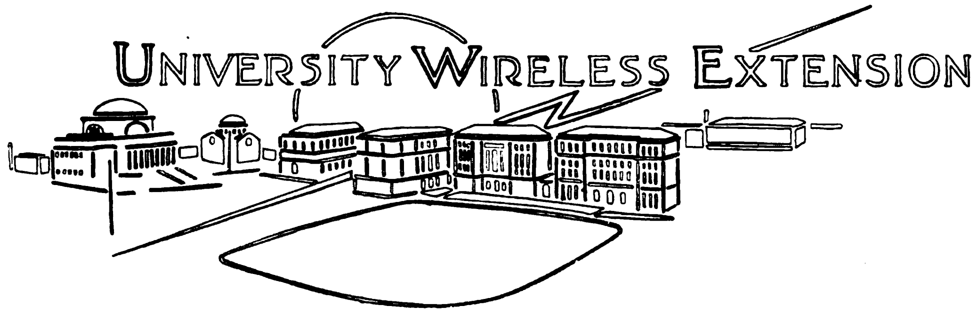
The receiver is of the 101 Marconi type. The antenna, of the four-wire T type, is suspended between the new galvanized steel tower erected by the Marconi Company and the Cape May City water tower. Each of these towers is 150 feet in height. The natural period of the antenna is 398 meters. This pe-

New Cape May station, showing the antenna and towers riod was chosen because of the fact that the station can operate on a wave-length of 450 meters without inserting a series condenser in the antenna. The capacity of the antenna is .00062 microfarad. A large wire netting connected to a great number of galvanized pipes which run vertically into the earth to a considerable depth, makes up the ground.

The installation was under the supervision of the construction engineer of the Marconi Company. Tests with different Marconi stations along the Atlantic coast took place following the installation.



Reproduction of advertisement in newspapers of Japan announcing the opening of the Marconi wireless service between that country and the United States



Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE VI

(c) **VACUUM TUBE OSCILLATORS.** There has arisen within the last few years a new and important type of sustained radio frequency generator, namely, the hot cathode vacuum rectifier, usually with three internal electrodes. As will appear, the ease and certainty of control of currents formed by pure electron streams in a vacuum has rendered these devices suitable not only for use as generators, but also amenable to telephonic modulation and control of the radio frequency output. In the following discussion, however, we shall consider only tube construction and the associated circuits enabling the generation of radio frequency currents. The modulating methods for radio telephonic purposes will be considered together with the station apparatus under a later heading.

Since the mode of action of the devices described here is still, in many cases, under judicial consideration in the courts of this country, we shall confine ourselves to giving without comment the explanations advanced by the various investigators.

We shall consider first electron currents through a vacuum. If the filament *FF* in Figure 61 is heated to bright incandescence by the filament battery *FB* (regulated, if necessary, by a series rheostat in the battery circuit, not shown) there will be emitted from the filament a copious stream of ~~negative~~ electrons that is, small charges of negative electricity. A definite number of these are emitted from the filament per second for each centimeter of length of the filament. The number emitted depends markedly on the temperature, increasing excessively rapidly as the higher temperatures are attained. For example, Dr. Saul Dushman of the General Electric Company found that

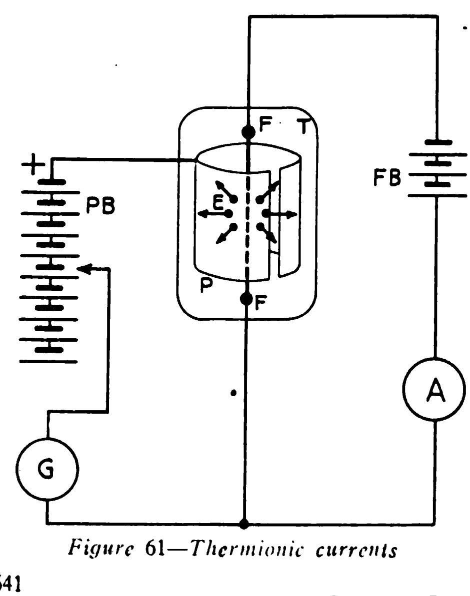


Figure 61—Thermionic currents

the current per square centimeter of filament surface increased from about 0.14 ampere per sq. cm. at 2,300° absolute to 0.36 ampere per sq. cm. at 2,400°. The values for 2,500° and 2,600° were respectively 0.89 and 2.04 amperes per sq. cm. It is quite obvious that the highest temperatures of filament consistent with not burning out the filament and a reasonably long filament life are desirable if large currents are to be passed through the tube.

Suppose that the cylindrical metal plate be placed around the filament as indicated at *P*. Suppose further that a battery, *PB*, and galvanometer *G* be connected in series between plate and filament. If the negative side of the battery be connected to the plate, practically no current will flow through the galvanometer. If, on the other hand, the positive side of the battery be connected to the plate, negative electrons will be attracted to the plate, returning to the filament at the lower point, *F*. Using the ordinary convention for the direction of current flow (which is opposite to the direction of flow of the electron stream), we say that a current flows from the plate to the filament. The device is therefore a rectifier, since it permits the flow of current from plate to filament, but not vice versa. This form of the device has been used by Fleming since 1906 as a detector for radio receivers. In a highly evacuated form, it has recently been developed into the new Coolidge X-ray tube and the so-called "kenotron" or high voltage, high vacuum rectifier of the General Electric Company.

The current through such a device in the plate circuit obviously depends on the plate potential. In general, the more positive the plate, the higher the electron velocity across the space between filament and plate, and the greater the plate current. There is, however, a clear limitation to this increase of current. At any given temperature, only a given number of electrons can be emitted by the filament per second, and when all of these are drawn to the plate per second, no increase in plate voltage will cause an increase in plate current. This is called the *temperature limitation* of plate current. In Figure 62, it is illustrated at *B*. In the lower portion of the curve the current increases (as can be shown by mathematical analysis) with the three-halves power of the applied plate voltage, but at *B* we reach the limiting current value at the given temperature and the curve bends sharply to *C*, whereafter the plate current remains constant unless the temperature of the filament is raised. In the portion *AB* of the curve, the current from the plate to filament is actually given by the equation:

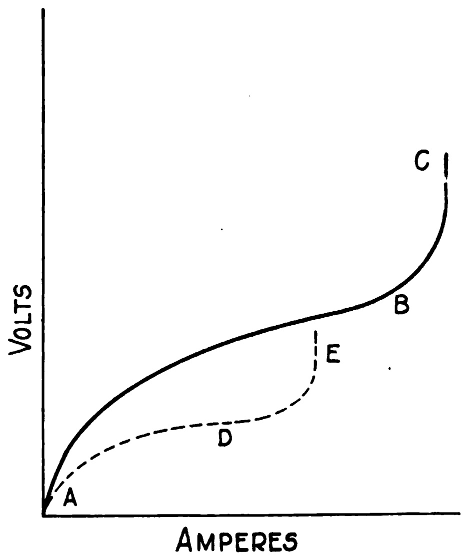


Figure 62—Relation between voltage and current for pure electron rectifier at a given temperature

$$i = 14.65(10)^{-6}\frac{l}{r}e^{3/2}$$

where i is the current in amperes in the plate circuit, l is the length of the filament in centimeters, and r the radius of the cylinder in centimeters. The curve *ADE* is for a lower temperature, and therefore also for a lower limiting current.

There is a second type of current limitation at a given plate voltage which may prove very serious in practice in high vacuum tubes. This is the so-called *space charge limitation,* and depends on the following considerations. If the plate voltage has a given value, increase of filament temperature will increase the plate current to a point *B*, but not further. This is due to the following effect: The cloud of negative electrons surrounding the filament at any time act as a large negative charge in its neighborhood, and consequently repels all electrons which are or tend to be emitted by the filament, thus choking back the electron current stream. If the charge in the space surrounding the filament becomes sufficiently great, no increase in temperature at a given voltage will produce any further current. Either the plate voltage must be increased or the bulb construction altered so as to diminish the space charge. Bringing the plate and filament close to each other will diminish the space charge effect. The effect is indicated at *B* in Figure 63; and, for a lower applied plate voltage, at *D* with the dashed line.

In considering the current-carrying capacity of vacuum tube rectifiers, Dr. Dushman gives data as to the current in milliamperes per centimeter of filament length at a safe working filament temperature. Thus, with a filament 0.005 inch (0.012 cm.) in diameter, 0.030 ampere can be safely emitted per centimeter of length. Under such conditions, the filament heating current will represent 3.1 watts of power per centimeter of length. For a filament 0.01 inch (0.025 cm.) in diameter, these figures become respectively 0.10 ampere and 7.2 watts per unit length. This gives an indication of what may be expected from tubes of ordinary dimensions based on these thermionic currents.

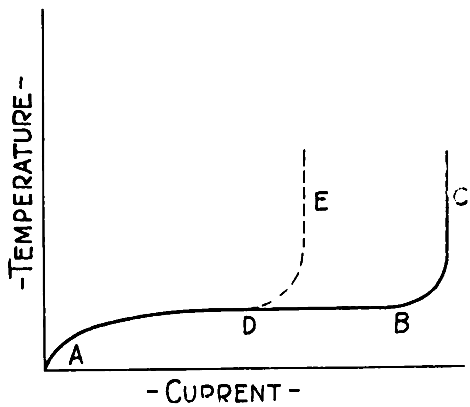


Figure 63—Space charge limitation of thermionic current at a given plate voltage

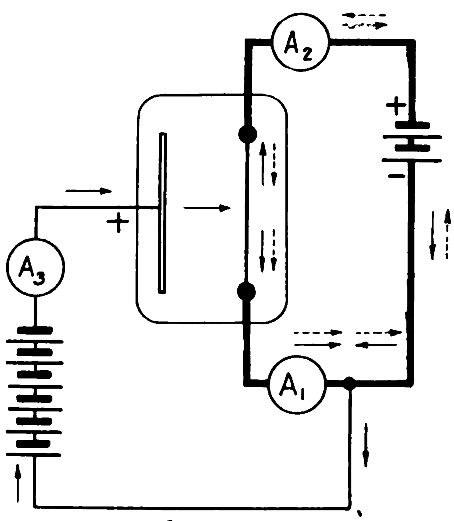


Figure 64—Illustrating combined lighting and thermionic currents

A curious effect is encountered when the joint filament heating and thermionic (pure electron) currents are combined. In the filament heating circuit shown in Figure 64, the current circulates in the direction indicated by the dotted arrows. Under normal conditions, therefore, the ammeters A_1 and A_2 read the same. If, however, the plate circuit is closed, and a current indicated by A_3 appears in that circuit, its direction of flow will be as indicated by the full line arrows. (It is understood that the direction of current flow is opposite to that of the negative electrons, in accordance with the commonly accepted convention). It will be noticed that the plate current, A_3, will flow *outward* from *both* ends of the filament. Consequently, at the lower end it will assist the lighting current, while at the upper end it will oppose it. So that, if A is the true lighting current, the readings of the ammeters will be given by $A_1 = A + A_3$ and $A_2 = A - A_3$. With small tubes, such as might be used for receiving, this effect is of no practical importance, but on larger, heavy plate current tubes (with filaments already worked near the burn-out point) it may become serious.

This effect has been ingeniously minimized by Mr. William C. White, to whom much of the recent development of the pliotron is due, through the use of the circuit shown in Figure 65. Here the filament is lit by the alternating current from the secondary of the transformer *T*. The connection of the plate circuit is made to the middle of the supply secondary winding. A similar method might be applied to connection to the middle point of a storage battery (or three-wire direct-current generator) used for the supply of lighting current.

We have assumed so far that the vacuum within the bulb was practically "perfect"; that is, a few ten-millionths of a millimeter of mercury or less. Furthermore, by the use of elaborate exhausting and internal heating methods, it is assumed that the electrodes have been thoroughly freed from any occluded gases so that the tube will remain constant in operation. (See Dr. Langmuir's paper appearing in the September, 1915, issue of the "Proceedings of the Institute of Radio Engineers.") Such perfection of vacuum is not easily obtained or maintained, and tubes containing or evolving gas will show markedly different effects from those described. In the first place, the current between plate and filament will be much increased. The reason for this is the following:

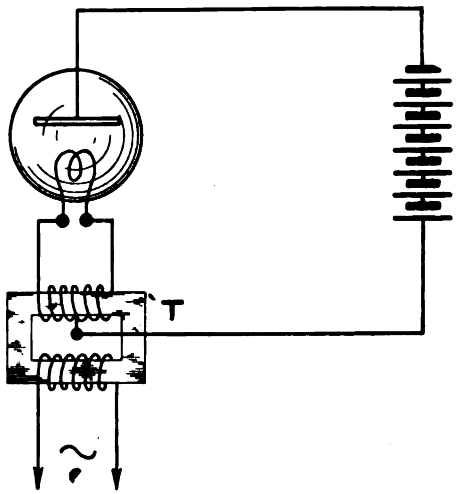


Figure 65—General Electric Company-White method of plate circuit connection

The rapidly moving electron stream will ionise by impact the gas molecules; that is, dissociate the atoms into ~~negative~~ electrons *and positive ions*. These positive ions will recombine with the "electron cloud" surrounding the cathode, thus neutralizing and destroying the effects of the space charge. In consequence, tubes in which gas (and consequently positive ions) are present will pass greater currents at low plate voltages than with the extremely high vacuum tubes. Among tubes having present positive ions and diminished space charge effect) are the original de Forest audions and the von Lieben-Reisz oxid filament tubes. At first sight, it might seem that the presence of positive ions and increased current in the plate circuit was an unmixed advantage, and there is no doubt that it constitutes a convenience in ordinary detector tubes in that it permits the use of comparatively low plate voltages. On the other hand, it has at least two marked disadvantages.

The first of these is the fairly rapid filament deterioration of such tubes when any considerable plate current passes. The presence of positive ions leads to ionic bombardment of the negatively charged filament. The positive ions are comparatively massive (in relation to the negative electrons); and when they strike the filament at fairly high velocities, the surface is rapidly damaged. This is not at all the case for the high vacuum "pure electron discharge" tubes, where positive ions are not present. Furthermore, when used to pass any considerable amount of plate current, the gas-containing tubes may become dangerous in that the gaseous ionization may rise to the familiar "blue glow" point. At this point continuous and progressive ionization of the gas occurs together with greatly increased plate current.

While they may not be much more than an inconvenience with small tubes, with large tubes at high plate voltages it may lead to disastrous currents and consequent violent tube destruction. For these reasons, very high vacua are desirable in tubes, except possibly for small-sized detectors.

It is a fact, though not well known, that the usual Fleming valve or rectifier can be used to produce sustained oscillations when shunted by a circuit of large inductance and small capacity without any third electrode or control member. This method is not used in practice because of the high voltages required, the troublesome large resistances in the feeding circuit, and the very rapid deterioration of the tube and its irregular operation.

For the production of sustained radio frequency oscillations from vacuum tubes, a third or control member may be employed. This may be in the form of a perforated plate or a grid of wire placed between the plate and filament so that the electron stream must pass through the meshes of the grid. The remarkable mobility of the electron stream permits of ready control of the current between plate and filament. Dr. Langmuir has stated that the current between plate and filament with the control member inserted is given by the equation:

$$i = 14.65(10)^{-6}\frac{l}{r}(e + k\,e')^{3/2}$$

where i is the current in amperes in the plate circuit, l the length of the filament in centimeters, r the radius of the surrounding plate (of cylindrical form) in centimeters, e the voltage in the plate circuit, e' the grid potential (relative to the filament), and k a constant. The constant, k, is dependent on the spacing of the grid wires, the distance of the grid from the plate and filament, and the construction of the tube. Roughly speaking, the finer the spacing of the grid wires, the larger the constant k and the smaller the grid potential variations which will completely control the plate current. The danger with fine grids is that small positive potentials will produce excessively large plate currents. With a coarse grid, the control voltages must be larger, but the danger mentioned above is minimized.

The control energy required for producing the requisite grid potential variations is quite small and herein lies the remarkable amplifying (and oscillating) power of the device. Aside from grid leakge and grid charging currents there are no sources of energy loss in the grid circuit inside the bulb.

A typical grid potential-plate current curve is given in Figure 66. It will be seen that for large negative grid potentials (at A) practically no current flows in the plate circuit. From B to C the current through the plate circuit varies practically linearly with the applied grid (negative) potential, and it is in this range that the tube should be worked for radio telephonic oscillation or control. At C, the plate characteristic begins to flatten, until at D practically no further increase of plate current can be produced by more positive grid potential. The flattening of the curve at D may be caused either by temperature or space charge limitation of the plate current and determines the rating of the tube.

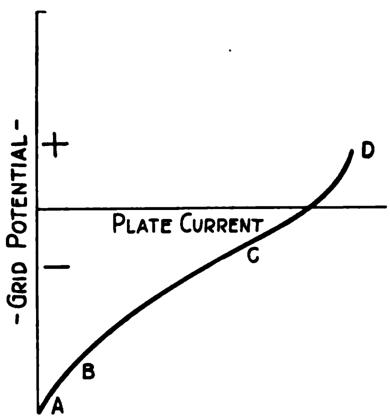


Figure 66—Relation between grid potential and plate current for pure electron amplifiers

In Figure 67 is illustrated the mode of action of the electron relay as an amplifier of alternating current. The alternator, *A* (which may, of course, be replaced by the oscillating circuit condenser terminals), is connected to the grid and filament of the tube. The plate circuit is supplied by the Battery *B* which, we shall assume, readily permits the passage through it of alternating current. If this last is not true, a large condenser must be shunted across the battery, thus by-passing the alternating current without interfering with the direct plate current. In series with *B* are connected the direct current ammeter A_1, the alternating current ammeter, A_2, and the primary of the transformer, *T*. It is assumed that A_1 does not impede the flow of alternating current in the plate circuit; otherwise it may have a condenser placed in parallel with it. The secondary terminals, *X*, *Y*, of the transformer *T* constitute the output terminals of the amplifier or "repeater."

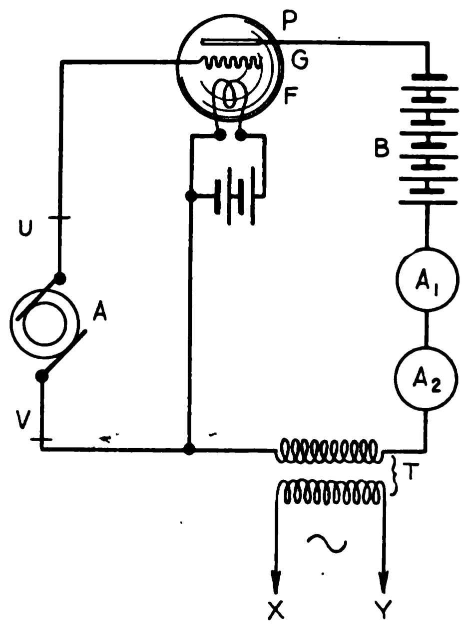


Figure 67—Amplification of alternating current energy

Under the conditions shown, the plate current will remain at the steady value indicated by *AB* in Figure 68 so long as the alternator, *A*, is not running. The effect of closing the alternator circuit is shown at *BC* in Figure 68. In the figure the median value of the portion, *BC*, is taken as equal to that of *AB*; that is, it is assumed that the fluctuating current swings up and down around an average value equal to the original direct current. This is generally not the case; since grid circuit rectification, flattening of the grid potential-plate current characteristic, or occasional positive grid charges may cause the average plate current to go up, remain fixed, or drop when the alternating potential difference is applied to the grid and filament. In any case, however, the pulsations in current in the plate circuit will be marked if the grid potential variations are sufficient, and there will be available at the terminals, *X*, *Y*, the amplified energy. As shown, the device may obviously be used as an audio or radio frequency amplifier, and is indeed so employed respectively in the transcontinental wire telephone lines and in ordinary receiving radio sets.

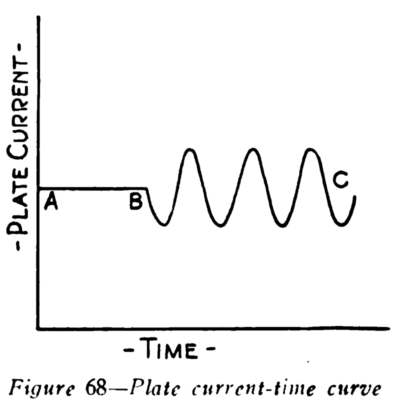


Figure 68—Plate current-time curve

It has been pointed out that the energy delivered at the terminals, *X*, *Y*, is many times greater than that required at the terminals, *U*, *V*, of the alternator. For example, there may be available at *X*, *Y*, 10 watts, while only 1 watt is required at *U*, *V*. It would immediately seem that if one of the 10 watts available at *X*, *Y*, were transferred back to *U*, *V*, by coupling or otherwise, the alternator might be removed, but the system would continue to sing or oscillate steadily as a generator of alternating current. A typical circuit arrangement, shown by E. H. Armstrong, for securing this so-called "regenerative coupling" is given in Figure 69.* It will be seen that the arrangement is similar in principle to Figure 67, except that the alternator, *A*, has been replaced by the oscillating circuit, *L L' C*, or rather by the condenser terminals of *C*. In addition, there has been added the coupling, *L' L"*, between

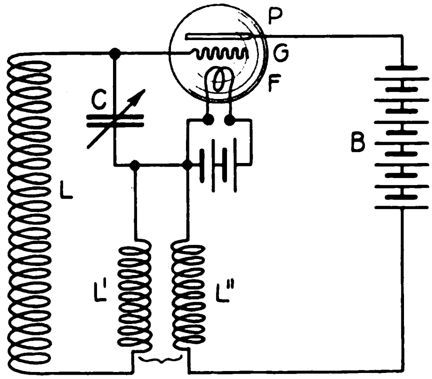


Figure 69—*Oscillating circuit*

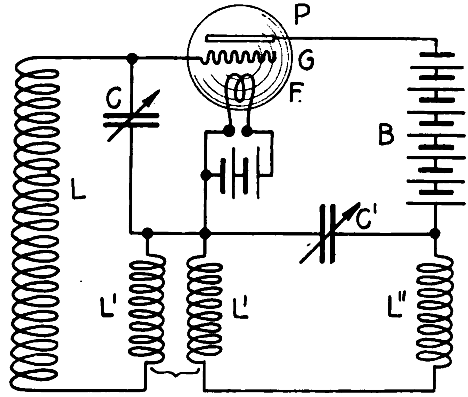


Figure 70—*Plate circuit tuning in oscillating circuit*

the grid circuit, *L L' C*, and the plate circuit, *L" B*. A system such as that shown will oscillate vigorously if the circuit constants are properly chosen. The output energy is in general obtained by coupling to a coil inserted in the plate circuit. It is this type of oscillator, which, used as a detector also, is so directly applicable to long distance beat reception; and has accordingly been widely applied for that purpose.

An improvement on the simple circuit of Figure 69 has been shown by Armstrong, and is given in Figure 70.* It contains an added inductance, *L"*, in the plate circuit and a condenser, *C'*, across the terminals of *L'* and *L"* whereby the plate circuit may be tuned to the same frequency as the grid circuit or approximately so. The efficiency and output of the oscillator are generally increased by such an arrangement; but, on the other hand, the complexity of apparatus and difficulty of adjustment may sometimes become undesirable.

In working with the various types of oscillating circuits to be shown, it is quite essential that the grid connection shall be to such a point of the conjoint grid and plate circuits that the electromotive forces placed on the grid are in the proper phase relation to the alternating current produced in the plate circuit, otherwise the system will not persist in oscillation.

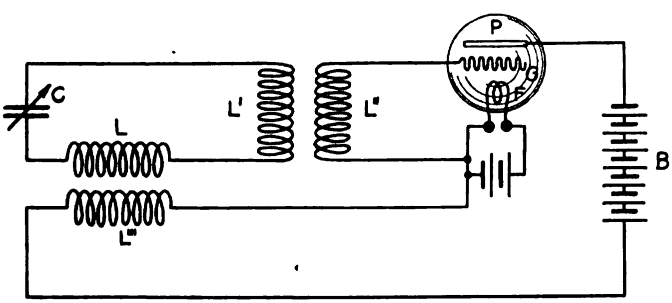


Figure 71—*Meissner oscillating circuit,* 1913

A form of oscillating circuit of simple electrical nature, due to Dr. A. Meissner of the Telefunken Company, and invented by March, 1913, will be next considered. The circuit is shown in Figure 71. It will be seen that the grid and plate circuits are coupled, but indirectly through the tuned circuit *L L' C*. The inductance, *L* of this circuit is coupled to the plate circuit, while the inductance, *L'*, of the same circuit is coupled to the grid circuit. In consequence, sus-

* "Proceedings of the Institute of Radio Engineers," Volume 3, Number 3, September, 1915.

tained alternating current will be produced in the circuit, *L L' C*, as previously indicated. In practice, resistance can be inserted in the circuit, *L L' C*, for absorbing the output of the system; and in fact, the capacity, *C*, (and the resistance just referred to), are replaced by the antenna when radiation is desired. Another form of circuit used by the same company, and the joint invention of Count Arco and Dr. Meissner in 1914 is shown in Figure 72. It differs from that previously shown in that the intermediate coupling circuit is replaced by a direct inductive coupling between grid and plate circuits. This coupling, *L L'*, links the grid circuit to the tuned, absorbing plate circuit, *L' L" C*, which, as before, may either contain the antenna or be coupled thereto.

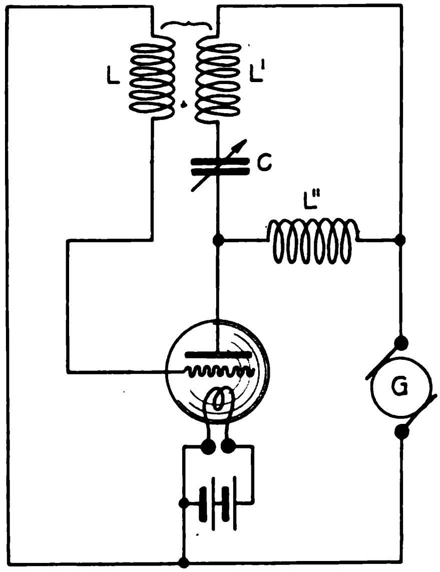


Figure 72—Arco-Meissner oscillating circuit

An interesting type of bulb was used by Dr. Meissner in his experiments; and a photograph of this bulb is shown in Figure 73. Bulbs of this sort give current amplifications up to thirty times. It must be at once mentioned that these are *not* high vacuum bulbs, an atmosphere of mercury vapor being purposely provided by the small piece of mercury amalgam shown sealed into the small side tube at the bottom of the tube. The result of this vapor and the oxide-coated Wehnelt (heated) cathode is that the tube in operation shows a continuous blue glow.

As has been stated, the filament is a platinum strip, about a meter (3 feet) long in all, 1 mm. (0.04 inch) wide, and 0.02 mm. (0.002 inch) thick. It is thinly coated with a mixture of calcium and barium oxides, and is brought to a bright red heat by a current of about 2 amperes from a 28 to 32 volt storage battery, the current being regulated by a 5 ohm variable series resistance. Considerable heating power is, therefore, required; and the source of this power must be an extremely constant one.

The plate circuit is fed from a 220 volt source which may be an ordinary dynamo with choke coils in the supply leads to cut down the incidental noises. The plate circuit current is about 0.01 ampere, and the dark space interrupting the blue glow above the grid can be used for rough indication of the current through the plate circuit. As will be seen, the plate itself of heavy aluminum wire.

The grid is a perforated aluminum wire, the size of the perforations being about 3.5 mm. (0.14 inch). It will be noted that all connections to this bulb are made through the

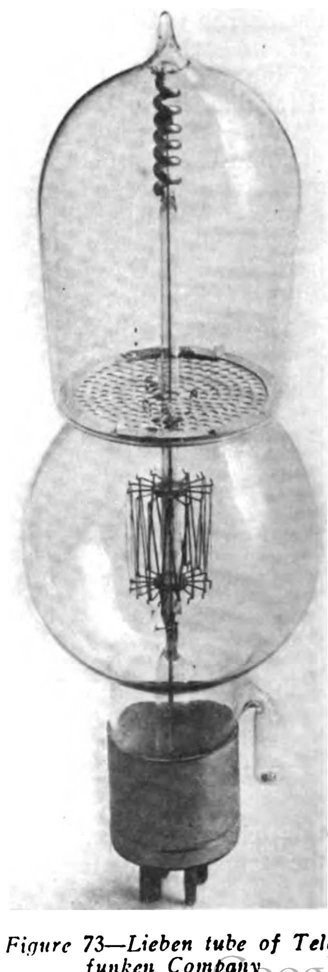


Figure 73—Lieben tube of Telefunken Company

bayonet socket in the base, this being so arranged that the bulb can be placed in its socket only in the correct position. The lives of these tubes are claimed to be 1,000 hours or more.

When used as an oscillator, wave-lengths as short as five or ten meters have been obtained, and with great constancy. Using a plate voltage of 440 (instead of the usual 220), twelve watts has been transferred to an antenna, corresponding to an antenna current of 1.3 ampere in a 7-ohm antenna at 600 meters wave-length.

This is the sixth article of a series on "Radio Telephony," by Dr. Goldsmith. In article VII, in the July issue, he continues the discussion of vacuum tube circuits in radio telephony and describes the 1914 Franklin circuit used by the English Marconi Company, also noting another form of transmitting circuit. The de Forest experiments are described and the pliotron or three-electrode tube is discussed. The use of banks of tubes is reviewed and the construction is described. A modified vacuum amplifier and oscillator, the "dynatron," is presented, its combination with the pliotron is noted and the development thereby of the four-electrode device, the pliodynatron.

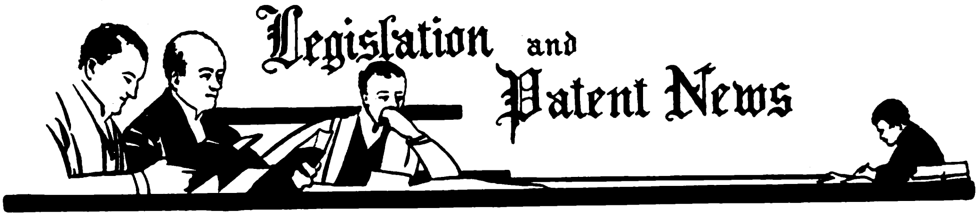
BOOK REVIEW

THE WIRELESS TELEGRAPHISTS' POCKETBOOK, by J. A. Fleming, M.A., D.Sc. The appearance of this little volume by Dr. Fleming brings home to us an appreciation that radiotelegraphy has established its right to rank as an exact and practical science.

In the early days all adjustments and improvements had to be effected by trial and experiment, and these empyrical methods were slow, laborious and costly. All that for many years past investigators have been accumulating in formulae and methods of calculations for practical wireless telegraphy, with a minimum of labour, and leaving nothing to chance, Dr. Fleming has collated and set forth with the clarity of diction for which he has attained a wide reputation.

For the benefit of those who have allowed their mathematical knowledge to "rust," the mathematical notes to which the first chapter is devoted will prove of great assistance. Without diving too deeply into the "Science of Figures and Formulae" this chapter gives exactly what is necessary for the intelligent appreciation of the more peculiarly radio telegraphic chapters which follow. Next in order is a section devoted to units, dimensions and systems of measurement. All the units and every kind of measurement needed by the wireless telegraphist, engineer or investigator are carefully and clearly set forth, the instruments themselves and the principles on which they are based coming in for treatment both valuable and interesting. Features of all systems are dealt with, the Arc system of Wireless Transmission, the Goldschmidt High Frequency Alternator, the Fessenden Heterodyne Receiver, and so on.

The third chapter—one of the most valuable in the book, as far as wireless engineers are concerned—deals in masterly style with high-frequency resistance and inductance measurement. The difference between high-frequncy resistanc and steady resistance, the caluculation of high frequency resistance of wires, self and mutual inductance with its calculation and measurement—all these form subjects of the greatest importance, and the numerous formulae provided will be found of the greatest use. Further chapters treat of high frequency current and voltage measurements, capacity measurement and predetermination, methods of measuring wave-lengths and decrement, and numerous other vital subjects.



Fleming Valve Sustained Over "Audion"

THE Circuit Court of Appeals, for the Second Circuit, New York, handed down on May 8th a unanimous opinion in favor of the Marconi Company, in its suit brought against the de Forest Radio Telegraph and Telephone Company for infringement of the well-known Fleming patent.

The case was originally brought in the United States District Court of the Southern District of New York by the Marconi Company on this Fleming patent, alleging that the de Forest Company's so-called "Audion" was an infringement.

The defendant, the de Forest Company, set up a counter claim, alleging that the Marconi Company's apparatus infringed some six or more de Forest patents. In the Trial Court Judge Julius M. Mayer held that the Marconi Company's Fleming patent was a patent of great merit and of value, and was valid and had been infringed by the de Forest "Audions"; he also held that the Marconi Company's apparatus did not infringe the seven patents of the de Forest Company. The Marconi Company confessed that two other de Forest patents were good patents and that the Marconi Company had used them to a slight extent.

In affirming the decree of Judge Mayer Judge Hough, speaking for the Circuit Court of Appeals, said:

> "Utilization of the Edison effect does not mean that the use of Edison's apparatus or any modifications thereof as a detector was easy or simple. The admitted fact that years passed, and detectors of various kinds, from the coherer to the crystal, acquired vogue before anyone thought of using Edison's curiosity of electricity for the discovery or translation of Hertzian waves, has proved enough on this point. Fleming was the first to disclose an apparatus for this purpose."

And again Judge Hough, speaking for the Court of Appeals, said:

> "Therefore the first question (as stated by appellee) is substantially this: Was it invention to use 'as a detector of wireless waves, an Edison hot and cold electrode lamp'? This is a question of fact and we arrive at the conclusion of the Lower Court, that at the date of Fleming's application it was not known to men skilled in the radio art that a rectifier would act as a detector, or that anything that would rectify oscillations of low frequency could rectify waves of the order used in radio communication.
>
> "Edison's patent stated a fact and suggested a tantalizing mystery, because even he did not pretend to state, or assert that he knew, why his 'effect' took place. His disclosure remained (so far as we can discover from this record) a laboratory problem until Fleming applied it (whether with a wrong theory or a right one is immaterial) to a new and very practical field of usefulness."

Summarizing, Judge Hough said:

> "We have no doubt that Fleming's patent displays invention, and of a very meritorious device."

As to the patents which the de Forest Company alleged that the Marconi Company had been infringing, the Court of Appeals held that six of them were not infringed and that the seventh was void. The result, therefore, of this opinion seems to be that the Marconi Company has underlying or basic patents for what are called "vacuum" detectors, and that the de Forest Company has two patents for improvements of the Marconi-Fleming patents for these devices.

The Control of Wireless

Federal Government Monoply or Private Enterprise?

A Complete Summary of the Arguments Made for and Against the Proposals

An Informative Guide for Those Who Wish to Gain a Clear and Concise View of the Subject

PART I.

Shall the United States Government monopolize the means of wireless communication throughout the country, or shall private commercial enterprise be permitted to encourage and develop the art as it has done in the past?

Herewith is given a concise resumé of the arguments for or against the proposals as brought out in the recent hearings before the Committee of the House of Representatives as to the merits of the bill contemplated for the regulation of radio communication. They are so arranged as to give the reader a clear and lucid understanding of the subject and enable him to arm himself with the telling weapons of the highest expert opinion.

The Government side was presented by naval officers and leading members of the administration.

The side of the commercial interests and research workers was presented by the foremost wireless experts of the country, scientists, and trained officials of the companies engaged in the business of wireless communication.

Whose arguments were the more convincing?

The testimony of Government witnesses is printed in Roman.

The testimony of those favoring the maintenance of private control of wireless enterprise is printed in italics.

JOSEPHUS DANIELS, Secretary of the Navy, said, in advocacy of Government monopoly of radio communication, that the Navy Department as the principal user and the most extensive buyer of radio apparatus in the United States, had the strongest influence in developing apparatus since the early days of the use of radiotelegraphy in this country, by constantly requiring manufacturers to incorporate new ideas which the department found necessary. The Navy Department was convinced that Government operation and control of all stations used for commercial purposes, other than those on board merchant ships, was necessary on account of the mutual interference between stations and for other reasons. He reasoned that to permit the greatest amount of business, Government and commercial, being done through consistent changes in apparatus, through systematic apportionment of and prompt and frequent changes of wave-lengths, and through standardized methods of operating, one management was necessary.

Radiotelegraphy, said Mr. Daniels, had been regarded as a natural Government monopoly for other reasons, since only by the closest regulation could the best use of this art be obtained, not only for commerce and safety at sea, but for military purposes. Radiotelegraphy was a strict Government monopoly with the larger number of foreign nations, and in these foreign countries where commercial stations were permitted, the Government control was generally so strong as to amount to a monopoly. The department strongly recommended that the committee provide for the purchase of all stations used for commercial purposes.

Thomas Ewing, United States Commissioner of Patents, informed the Committee that he was personally not in favor of complete Government ownership.

The big power stations would not be numerous, he said, and they could be controlled under regulations which could instantly be put in force in emergencies. The question, he thought, that Congress had to take into account was where it was going to draw the line. There was a present situation and there were future possibilities. The present situation was that we had an instrumentality for communication that was of great importance to the Government and to commerce, and we should get the benefit of it. The future possibility was that it might be made very much better. "My theory, and my objection to the theory of Government ownership," said Mr. Ewing, "is that if the Government takes over the wireless business, it will largely be the end of the development of wireless. I am opposed personally—I do not speak for the department, because the department is not interested, but I happen to be the Commissionr of Patents and am interested in that way—to the idea of shutting out or seriously limiting, or limiting any more than is necessary, the field of operation or of private enterprise in the development of wireless."

Mr. Ewing added that there was one other thing he would like to say somewhat by way of apology. Ever since he had been on the committee that drafted the bill under discussion, he had been rather in an attitude of opposition to the Navy Department, which had always been strongly for greater control, and, in fact, for Government ownership, and he wished to say that it was not at all from lack of appreciation of some splendid work the Navy Department had done in this field. But he did not think that the Navy Department, or any department of the Government, was organized for purposes of investigation and development of the sciences and arts such as wireless, and that if the Navy Department got control of it, it was not at all probable that the advance would be such as would eventuate if the field were left open largely to private enterprise.

Representative Rufus Hardy of Texas, of the Committee, at this point asked Mr. Ewing whether any private monopoly in wireless had yet been established in this country.

"No, there is no monopoly," was Mr. Ewing's reply.

Representative Hardy inquired whether, if the Government were taken out of the wireless business, there would not be made an effort for commercial uses especially, by a large enterprise, to monopolize the wireless industry. Mr. Ewing expressed the opinion that such a situation might result in a single wireless company controlling the entire business, and that if such a result ensued, it would be because such an eventuality was eminently desirable. If a private company won out, it would be because the wireless field lent itself to that method of development.

Representative Hardy asked Mr. Ewing whether his objection to Government ownership was based on the idea that if the Government became the owner, then all future development would stop. "I think it would check all future development," was the reply. "My reason is," continued Mr. Ewing, "that the private owner, whether monopolistic or otherwise, is in business to make money. It is a commercial concern and the problems are treated as commercial problems. Where development is possible, if it pays it will be financed. The men who have displayed talent will be employed for that purpose and will not be assigned to other duties. If the Navy Department has control of the wireless, men will be selected according to Navy discipline; a man who has succeeded in one particular line will be transferred to another line simply because of Navy discipline. The men are not selected because they are investigators; they are selected to make naval officers and the thing is treated as a Navy matter, not as a matter for the development of wireless."

Mr. Ewing instanced the case of Captain Bullard, who was formerly the head of radio work, his successor now being Commander Todd. Captain Bullard, he said, had been ordered off to other work, which supposedly was not wireless, since, he said, the Navy does not pick out a man who distinguishes himself in wireless, saying, "You devote your life to wireless." The navy man has to be *trained primarily as a naval officer, while in private life the wireless man devotes his life to the art. Mr. Ewing repeated that he was not criticizing the Navy Department, but that, as a matter of encouraging scientific investigation, the Government was not a shining success in comparison with private enterprise.*

Government Ownership Definitely Proposed

Newton D. Baker, Secretary of War, said in behalf of the measure that the features which were of especial interest to the War Department were those which looked to Government control and supremacy in the field of wireless operation. He said that the War Department was as one with the Navy in believing that the time had arrived for the establishment of the complete supremacy of the Government in the wireless field.

Representaive Rufus Hardy of Texas, a member of the Committee, remarked that there was a general disposition to shy at the term "Government ownership," and he asked the Mr. Baker whether, in his opinion, the only complete control would be ownership.

Secretary Baker replied that he did not shy at the word, but he preferred to deal with ideas rather than words, and when a word had obtained a bad reputation which it did not deserve, he sometimes avoided it. When asked by Mr. Hardy whether it was possible to frame a bill so as to permit progress outside of the Government and at the same time to give the Government complete control, Mr. Baker replied that that would be very much like having two companies running railroad trains on the same track without complete control by one of the companies. He added that in his opinion unfortunately the transmission of wireless messages was a matter in which interferences were so destructive that unless someone controlled the means of transmission, nobody could succeed in it.

Mr. Baker said that he did not think it absolutely necessary to forbid private use of the wireless, but he thought the proper plan was to make the Government establishments supreme in the field and to make the advantages of the Government facilities so great that private agencies would desire to withdraw in favor of the Government. "As I understand the purpose of this bill," he added, "it is to provide for operation, through the Navy Department, of the coastal stations, placing the Navy Department in a position where private agencies will desire to transfer their operations to that department, ultimately leading to a monopoly in wireless transmission in the Government through the Navy Department."

Professor Alfred N. Goldsmith, director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York, stated his belief that Government ownership and competition in a field like the radio field, where returns are at best very limited, would effectively strangle all private enterprise and cause this country to drop rapidly back into an inferior position in this art. The Government, he said, had never shown any tendency toward constructive improvement in commercial lines and had rightly left these to individual initiative.

This policy had been amply justified in other communication lines. It was now proposed, suddenly, to alter entirely the formerly successful policy, and to take over a partially developed field, just when those who had devoted their lives to its development were beginning to reap the fruits of their labor. The futility and injustice of such an attitude, he thought, were equally marked. He added that it could be safely asserted that not one per cent of the improvements in the field of radio communication had originated with any Government department. The advances had all been due to the commercial companies and their research engineers.

Federal Capital to Force Commercial Withdrawal

Commander D. W. Todd, United States Navy, strongly supported the point of view of the Navy Department that the Government should own all the radio stations of the country, not only the coastal stations but also all high power stations and others that handle commercial business. The commercial stations, he said, must withdraw from the field because they could not compete with the Government. The latter was a monopoly, backed by tremendous capital, and the Government stations were furnished, through the liberality of Congress, with the best apparatus, and must take over the whole wireless field in the end.

Commander Todd stated that the Navy Department, and the War, Commerce, Labor and Treasury Departments, had gone beyond the proposed bill in advocating Government ownership. The bill suggested in a mild way, such ownership, but now they felt strong enough to come out flatfooted and say that they believed in total enforced Government ownership, with the result that exceptions should apply only until exceptions were all eliminated by purchase of the privately owned stations in the excepted localities. The stations in Alaska should be bought; those in Hawaii and those in the West Indies should be bought, very unquestionably and positively, as an urgent military measure of prime importance. He hoped to see the bill amended to effect a complete Government monopoly within two years.

Two Viewpoints on Practice of Other Nations

Foreign Governments, said Commander Todd, had been farsighted to establish wireless monopolies from the first. In the European countries, where the Governments did not maintain a complete monopoly, the commercial stations were regulated so carefully that it was practically Government ownership. The Navy Department, he stated, proposed to handle the commercial work of the country better than the commercial people were doing at the present time, in that the Navy Department would be able to work in their communications with its own, and there would be no further correspondence about interference, and disputes between operators and stations, and questions of where stations should be located, and how they should be operated. He added that the ultimate result of the bill under discussion would be complete Government ownership within five years.

Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, stated that it was impossible to formulate legislation which would forsee and provide for the future usefulness of radio communication. It was just as impossible to formulate legislation which would place on the Navy Department or any other Government organization the responsibility for increasing the commercial use of radio communication in its present state of availability. He reasoned that if the Navy Department had been given a monopoly of the telephone when that means of communication was first developed, the United States would not have today, as it has, the greatest telephonic development of any country. And yet the telephone had not supplanted the telegraph. It occupied an entirely new field created for it by the persistence of private enterprise.

The Government, Mr. Nally pointed out, has not the experience to be gained only in business getting. The Government's sole function is to spend; it does not have to earn money before it can spend it. Its method is a complete reversal of business methods. It can spend money that it does not earn. Commercial companies must earn so that they can spend. Other great nations recognized that commercial companies have contributed to the value of the art, and while England, and Germany, and France, and Italy, and Canada, and other countries had made and were making the most of radio possibilities, still they had left the development of the art to commercial companies, even assisting them by subsidy, and financial allowance.

Mr. Nally called attention to the fact that radio communication was in the very infancy of its possibilities, yet there was already an investment of $40,000,000 *in its commercial development in* *the United States. Rightly considered, all this investment, representing the latest and most powerful stations, and trained organizations, was an adjunct to the Government in times of military necessity. If opportunity for development were left open, this investment—this equipment and the personnel—would increase, and all were completely at the disposal of the Government in times of need. In view of these considerations, it would seem that where the development of an industry which lent itself naturally and completely to the possible military necessities of the country, and over which the Government was exercising complete control, there did not exist a single valid reason for making such an industry a Government monopoly.*

The abandonment, said Mr. Nally, of the ideal of the universal intelligibility of wireless was to abandon its future development, but such abandonment was inherent in a Government monopoly of the art, as could readily be seen from the limitations of the jurisdiction of a Government, and the cumbersomeness of its international representation. A good deal had been said, Mr. Nally commented, at the hearing by the proponents of the bill as to the need for taking over existing high power stations. It was not clear whether they wished them solely for Government work or to do a commercial business in competition with the cables. If, for example, this Government were to take over the Marconi's New Jersey stations, he did not see how it could operate them for commercial service with Great Britain, except through a connection with the Marconi Company of England, which owns the corresponding stations in Carnarvon and Towyn. If it takes over the Sayville and Tuckerton stations, now the property of private companies in America, would they continue to work with the privately owned stations in Germany? And in what way would the Navy or the Government benefit through such an arrangement?

From every possible point of view, held Mr. Nally, there was not a sound reason for placing the Government in the commercial radio business. There were controlling reasons of every character why this should not be done.

Deliberate Intention to Ruin Commercial Business

Captain W. H. G. Bullard, United States Navy, said that he regarded as one of the strongest points for the so-called Government control the fact that the proposition was quite different from the general proposition of Government ownership of other public utilities, in view of the fact that the means by which communication was effected, the atmosphere, was a medium to which title could not be given by anybody or to anybody, and in that respect it was quite different from any other form of communication, such as the telegraph, telephone, or cable, where distinct title could be given to the right of way and to the cables themselves, and the material features which could be turned over and deeds given to the owners. But this was an impossible proposition with regard to the use of the atmosphere. It was free to everybody, and thus being free to everybody, it seemed to him that it should be under the control of one management, and the only management that was in position to control it was the Government.

Captain Bullard said that as a matter of fact, the Navy Department stations now were well ahead of the art. The department had not been stifling the art in the past, but had been encouraging it, and was encouraging it every day. So the department could never fall behind, and if the radio were all under one control—as he believed the Government only could and should be in control—all the inventors in the art of radio and all the engineers working at it would know that there was one central office where they could go with their ideas and obtain encouragement, and where they would feel they could be assured of encouragement.

Captain Bullard added that he had made thorough investigations abroad of wireless conditions, both through written reports and his personal tours in Europe, and his impression was that most of the leading countries owned their coastal stations and that their high-powered stations were operated by the Governments, or apparently, not directly by the Government, but by Government help to such an extent that the Government controlled the operation. It might be private capital that built them, but they were controlled by the Government, and when it came down to the last word it meant Government ownership. They tried and tried to explain that such was not the case, but, as a matter of fact, it was the case.

When asked by Representative George W. Edmonds of Pennsylvania, a member of the Committee, whether, when the Government had taken possession of the coastal stations, the next thing would be a request for authority to take possession of all the high-power stations, Captain Bullard replied: "I believe so, eventually. Yes. It is all tending to that, in my opinion."

"In other words," suggested Mr. Edmonds, "it virtually tends to Government monopoly and the elimination of commercial wireless absolutely?"

"Absolute Government monopoly for all purposes. Yes," replied Captain Bullard.

"The only point, then," commented Representative William S. Greene of Massachusetts," is that you would practically ruin their business."

"Ruin their business," assented Captain Bullard," and that is the reason that the offer is inserted to buy their stations at a fair valuation."

"Who is going to make it fair?" asked Mr. Greene.

"Some commission or somebody who would be appointed by Congress," was the reply.

"It would not have any value after it was ruined," suggested Mr. Edmonds.

"Of course not," replied the Captain.

Government Subsidy Suggested for Art's Development

Professor M. I. Pupin stated that things were within the reach of those who were studying the whole situation which would transform the entire aspect of the wireless art. These things were being done because the Government did not own the wireless. And if the Government owned the wireless they would not be done. "I will tell you the reason why," said Professor Pupin. "I have a great many friends among the officers of the Army and Navy and I would not for the world do anything which would hurt their feelings. I maintain that the Government is not and never will be in a position to develop a new art. That must be left to private enterprise and private initiative. It is a question of psychology, and there is no use arguing about that. It is a fact well understood everywhere that a new art is not developed and cannot be developed by the Government. Even the German Government has not taken possession of the wireless art and will not take possession for some time to come. Because the German Government understands that this is a young art, and should not be intrusted to the Government for its development, it leaves it to private enterprise. And I should say that if the United States Government is anxious to prepare this art for the national defense, the wisest thing for it would be to subsidize private enterprise to develop the art for the national defense as much as possible and as soon as possible. That would cost a great deal less and give very much better results than Government ownership."

Professor Pupin asserted that if the Government in the past had decided to take the then new art of electro-magnetic telegraphy into Government ownership, there would probably have been a regulation that no telegraph wire should be near another telegraph wire—no nearer than, say a mile or two miles, in order to overcome the interferences from which telegraphy suffered at that time. Had that policy been pursued in 1845 and 1846, up to 1860, it would have been necessary to place the telegraph wires at a distance of a mile apart or perhaps ten miles. But that was not done, thank God! The inventive genius of the American mind and American enterprise went on and solved this problem in a most satisfactory way by the Wheatstone automatic system, which en-

abled the wires to be placed right alongside of each other, within eighteen inches, so that one could have any number of wires on a one-pole line today. Professor Pupin then pointed out that in the proposed bill the Government insisted that wireless stations should not be placed except here and there in order to overcome interference. The heads of Government departments were to be called upon to decide the matter, while the wireless engineers, experts and men capable of building up the wireless art would have nothing to say. He called attention to the fact that Government officials had testified that wireless telegraphy was different from other methods of electric signaling, since radio uses the air, the ether, while in telegraphy and telephony each man has his own circuit. This theory, Professor Pupin contended, was wrong. So far as magnetic force was concerned, the same medium was used in ordinary telegraphy and ordinary telephony as in wireless. They all used the atmosphere; they all used the infinite medium. There was no distinction between the two methods at all, and for that reason, so far as interference by the acts of man and the acts of God were concerned, both had the same difficulties and had to go through the same history of development.

Arbitrary Rules Fatal to Progress

If the Government, argued Professor Pupin, meant to take possession of the wireless art and establish industrial research laboratories and go into the art of manufacture, then all would be well and good. But the proposed bill as it stood, with the other laws existing and the other historical conditions of Government work existing, meant nothing else than a blow to wireless telegraphy. If the Government intended to impose arbitrary rules upon wireless operators, upon private enterprise operating wireless stations, that control would kill the art in his opinion, even without ownership. If it were found necessary to control the transmission and reception of wireless signals, the Government should do it in conjunction with recognized electrical authorities—wireless authorities.

Secretary Redfield of the Department of Commerce, advocating the acquisition of private stations of the commercial companies by the Government, said that the principal features of the bill under discussion were the provision in section 5 by which all Government radio stations were to be open to the transaction of general commercial business in competition with radio stations operated by private commercial companies, and the provision in section 6 by which the Navy Department was authorized to purchase at a reasonable valuation any coastal radio station which the owner might desire to sell. These two propositions must be read together, stated Secretary Redfield, as the department would not favor, and assumed that the Committee would not care to consider, a proposition to put the Government of the United States as a permanent policy into competition with private corporations in the business of exchanging commercial radio messages between ships at sea and coastal stations in the United States. The two propositions taken together, he said, contemplated the establishment of a Government monopoly under the Navy Department in the exchange of radio messages between the coasts of the United States and ships at sea through the exclusive ownership and operation of all coastal stations by the Navy Department except in so far as the other departments of the Government were required to maintain and operate radio stations. The department was disposed to believe that the bill should also provide for the purchase and operation by the Navy Department of very high-powered stations used for transoceanic radio communication between the United States and foreign nations.

The two systems of coastal stations, stated Secretary Redfield, one owned and operated by the Navy Department and the other by private companies, not only involved an economic waste to the people of the United States but they also at times and in places interfered with each other and prevented each other from efficient operation owing to the imperfect development of the art of radio communication.

The Service to Shipping in Commercial Operation

The Hon. John W. Griggs, President of the Marconi Wireless Company of America, pointed out that for fifteen or sixteen years the Marconi Company had been operating to develop the wireless art for the purpose of making a profit for the investors—the stockholders. It had developed what is known as a ship to shore business, so that in connection with its manufacturing of apparatus which was carried on at its factory, it was making at the present time a trifling profit over and above its expenses, but not enough to justify a dividend upon its stock. The coastal stations, Mr. Griggs said, served not only as points of communication with ships going up and down the coast and in order to transmit intelligence to or receive intelligence from the mainland; but they also served as supply depots for the Marconi Company; and the lessees of the apparatus, when they signed a contract, were assured by the company that with these stations at designated points along the coast, at any time they put into the ports where these stations were located, they could get any new parts for their apparatus which they might need, or get their apparatus repaired. Also they could, in the event of an accident to or the illness of their operator, obtain a new one.

"I may say right here," emphasized Mr. Griggs, "that if the Navy Department were allowed alone to carry on these coastal stations, they would not be able to provide supplies, make the repairs, and furnish the additional operators which the Marconi Company does, and which it is part of the latter's contract to give the lessees, of which there are now about 500 sailing the Atlantic, from one port to another. In addition to this development of the ship-to-shore business, in connection with the legislation that requires it, the ultimate large purpose of the company from the beginning has been to establish trans-Atlantic communication in competition with the cable lines for the benefit not of the military department of the Government, but for the benefit of the commercial people of the United States—not to the exclusion of the Government, but for its benefit as well as for the larger benefit of business and commerce of the American people. It took a long period of experimentation; it took a long period of preparation and construction to reach that point where we were ready to do that business. The company has expended nearly $5,000,000 in the construction of stations on American soil prepared to carry on the transoceanic business with foreign countries.

"Now, what good has the Marconi Company done for the world since it was organized?" said Mr. Griggs. "Read the list, an enormous long list, of lives that have been saved from sinking ships at sea. The benefits to mankind and to the world, in saving property and life, of the Marconi Company, are enough for the Government, if it had a right to recognize those things, to give it an enormous bounty. And yet it has had nothing in the way of profit. And why do people invest in a stock company, in a new enterprise like this, similar in its character to the Bell telephone? Is it not because after years of preparation they expect to see a time come when they will reap a profit for their long waiting? And that is the position of the stockholders of the Marconi Company. They have reached a position where, prior to the European war, they could see before them great profits, and where in the ship-to-shore business they are already reaping a measurable profit from a by-product, as we call it.

Public to Bear the Burden of Development

"This is an American commercial enterprise, entered upon in good faith, with good money behind it, reached almost to the point of satisfactory profits. And now you are asked to pass a bill under which the Government, directly or indirectly, can force us to let the Government take our property, and you are providing a method by which we can go to the Court of Claims, and at the tail end of a judgment, ask Congress for an ap-

propriation to pay the judgment, and get what? Merely the material value of our stations. Is that just? Is that just treatment of those stockholders who have put their money in and developed this business and developed this art until it has attained its present dimensions and present great degree of usefulness?

"What is to be done? Why, when they have appraised the value of these stations, with proper depreciation for wear and tear, and have paid two or three millions of dollars, or five millions of dollars, into our treasuries and the business of the company is gone, we can declare a dividend among our stockholders. We always have money enough to pay our debts, thank Heaven, and we can divide up what is left with the stockholders, and they can go off with 40 cents on the dollar, or 50. But they ask, 'Where is the balance we paid into this company?' 'Why we spent it in getting it in shape for the Government to take it over at the cost of the material which we had on hand at the present time.' And do you think that the answer to that suggestion will be complimentary to the bill that enforced that result?

Alleged Desire to Sell Coastal Stations Repudiated

"That that is in contemplation appears from the evidence that has been brought out before this Committee. Commander Todd, I think, and some of the others said. 'Why we estimate we can get all of these stations, long distance and all of them, now at an appraisement of $5,000,000. But if you wait a few years they will be worth twenty.' Why will they be worth twenty millions? Becase of the appreciation of the material? No; but because the company will have realized its hope and expectation in bringing these stations to an earning point. And then if the company attempted to tear them down when they were showing an earning capacity on $20,000,000, the very stones would cry out in protest against it."

Captain W. H. G. Bullard, United States Navy, said that the proposition as it stood at present, was that the Government stations should be open to commercial business, which meant that the Government stations would then be legally and lawfully competing with the present commercial stations. The latter could go along and operate just as long as they pleased, so long as no interference took place, but from Captain Bullard's experience, he said, the commercial companies would in a very short time come to the Government and ask that the stations be taken off their hands, since it was a well known matter that the coastal stations were kept up and operated at a loss simply because they were necessary parts in a chain of transmission.

Representative Edward W. Saunders, of Virginia, a member of the Committee observed that the theory of the bill evidently was not to forcibly or by any manner of compulsory process take over the wireless. But he thought that it created conditions under which private operators in the course of time would have to give up operations.

Captain Bullard admitted that the private companies would have to give up. If the provision as proposed by the bill were approved by Congress, the Government could then cut the rates so much under the commercial companies that no one would patronize them.

Mr. Nally, on behalf of the Marconi company, observed that much had been said during the hearing given by the Committee to the proponents of the bill, about the willingness, even the anxiety, of the commercial companies to dispose of their coastal stations to the Government. So far as the Marconi Company was concerned, said Mr. Nally, no one had been authorized to make any such statement, and he could only think that with the Navy Department the wish was father to the thought.

It was not stated, Mr. Nally pointed out, who should determine on the reasonableness of the valuation which the Navy Department might wish to place on property belonging to commercial interests. The values which had already been stated by the spokesmen for the Navy before the Committee were perfectly ridiculous in the light of the Marconi Company's investment, and the figures which they mentioned as being *adequate for the purchase of the coastal stations and the high power stations of the entire country represented far less than the investment of the Marconi Company alone.*

The Marconi Company's principal business, Mr. Nally stated, was that of selling service. While it did manufacture some apparatus for sale, yet this branch of its business was merely collateral and was not its principal object. which, he repeated. was to sell service. For this reason it did not sell apparatus to ships, but it sold to ships certain service for a certain sum per month, just as the telephone company or electric light company sold its service to a customer. In order to give perfect service and to make the apparatus which it installed on ships serviceable in the greatest degree, it had erected and maintained land or coastal stations from the most northerly point on the Atlantic coast to the most southerly point; on the Gulf, on the Great Lakes, and on the Pacific coast to northerly Alaska. These stations were erected and were maintained as the essential, and indeed vital, link in ship and shore service, and the long list of rescues at sea and of lives and property saved because of the ready response which ships in distress at sea had been able to obtain by reason of these coastal stations, co-operating with other ships at sea. made a long and honorable record of which any company might well be proud. And this tremendous service in the salvation of life and property already rendered by wireless had earned for it at least the right to be developed and made useful and available to the fullest possible extent. Such development, he maintained, could come only through private enterprises.

This is the first of a series of articles on the important subject of radio control which will appear regularly in this magazine.

SECRET STATION DISCOVERED

When a dismantled wireless set and numerous volumes written in German were discovered in the room of a man in Bridgeport, Conn., April 25th, he was placed under arrest. He told detectives that he had lived for some time in Berlin and belonged to a club there.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

required by the Act of Congress of August 24, 1912, of "The Wireless Age," published monthly at 42 Broad St., New York, N. Y., for April 1, 1917.

State of New York, County of New York: Before me, a Notary Public, in and for the State and county aforesaid, personally appeared J. Andrew White, who, having been duly sworn according to law, deposes and says that he is the editor of "The Wireless Age," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations. printed on the reverse of this form, to wit: (1) That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Wireless Press, Incorporated, 42 Broad St., New York, N. Y.; editor, J. Andrew White, 233 Broadway, New York, N. Y.; managing editor, none; business manager, A. Fogal, Jr., 42 Broad St., New York, N. Y. (2) That the owners are: Wireless Press, Inc., owner; John Bottomley, 233 Broadway, 851 shares. (3) That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: none. (4) That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) J. ANDREW WHITE

Sworn to and subscribed before me this 17th day of April, 1917.

J. BOTTOMLEY, Notary Public.

(My commission expires March, 1918.)

Radio Science

Military Engineering Study

HOW the strategic conditions of our coasts and our naval inadequacy place a heavy bond of obligation on American engineeers was the subject of an absorbing address recently delivered by Prof. W. L. Cathcart of the University of Pennsylvania. The keynote of the address was that war today is largely engineering. Beginning with the single fighting vessel, it is immediately seen that it is a monstrous power plant representing the highly specialized skill of marine, mechanical, metallurgical, steam, electrical, chemical and radio engineering. Both in construction and operation these ships depend on skilled personnel, working with the high efficiency of long training. The engineer is, therefore, cautioned to give thoughful consideration to our military problems and consider his individual ability to safeguard the national welfare.

It was pointed out that we need a great navy because:

First, with unequalled wealth inviting spoliation, this Republic is the most vulnerable and ill-defended of all the great Powers. Second, our territory is immense, stretching from Eastport, Maine, to Manila, more than half around the world. Third, there is the factor of distance with regard to that territory, which factor has no parallel in Europe. Fourth, the fact that the United States Navy is really a "Disunited States" navy, since, like Russia with her Baltic and Black Sea littorals, we have two widely separated coasts, linked in our case by a canal which may fail us in a crisis either by slides, or by treacherous or direct attack with high explosives on its locks.

It is bad enough to be helpless, but to provoke attack is worse, was the professor's contention. While we have been militarily negligible, we have staggered diplomatically under national policies such as the Monroe Doctrine which, though just, are as war-breeding as any that history has known. Engineers, in considering how important is the supplementing of their technical knowledge with its military application, are reminded that our immunity from attack, thus far, because of this Doctrine, has been due chiefly to two conditions: the lack of means for the swift transfer of fleets and armies across the Atlantic, and the extreme delicacy of the balance of power in Europe. The progress of steam navigation has swept the first of these away, and as for the second, who dare predict political conditions in Europe when this war closes? Prof. Cathcart quoted Elihu Root, former Secretary of State, as follows:

"Our danger is not now, but later, when peace has been made and the great armies are free, when rulers and governments look about for ways to repair their losses, and when the great spaces and ill-defended wealth of the new world loom large on the horizon of their desires. . . . Then must be determined whether the Monroe Doctrine has behind it the sincerity and courage of a great nation, or is to be surrendered as an idle boast."

Accepting definitely the consensus of military opinion that invasion can be repelled only by an adequate and mobile navy, we have to consider that, lacking naval bases in both the Caribbean and the Pacific our fleet is tied to our shores, and our naval arm is cramped and palsied. Under such conditions as these, the General Staffs of the strong military powers of Europe and Asia must smile sardonically at our guarantees of independence and our virtual protectorates of the weak West Indian lands. At this time the United States is too feeble to defend itself. Its declarations as to the protection of these southern republics are, in effect, but "scraps of paper."

The New York navy yard is taken as an example of our amazing naval unpreparedness. Owing to its strategic position and its unlimited resources, this yard should be our greatest naval station. Instead, it is, in its approaches, not only a nuisance to the navy in peace, but in war might readily prove a fatal trap for ships caught in it under certain conditions. The reasons are: First, its water front is congested, and it cannot receive even a moderate fleet. Second, its single approach, that from the Bay, has channels so shallow that large battleships can reach the yard only when wind and tide serve, and in war a damaged battleship, down by the head or stern, could not reach it at all. Third, when ships get there, they must stay after their repairs are completed, until wind and tide combine to let them out again. Fourth, when thus trapped, these ships might readily be sunk by gun fire in war, since a superior enemy fleet could easily get near enough to the coast to shell the yard.

The Kiel Canal has been of vital service to Germany during this war. Without it, she could not have held her Baltic coast against British dreadnaughts convoying troop transports. Every dollar of the ninety-four millions she spent on it has been repaid a thousand-fold in her defense. Now, we could have a largely similar waterway from Sandy Hook through Long Island Sound to the open sea between Montauk Point and Block Island, if the channels through New York harbor and at Hell Gate were deepened. This waterway would not only add incalculably to the effectiveness of our fleet in war, but would keep the New York yard from being a dreadnaught-trap under hostile fire. Our ships could at least flee from it up the Sound.

At Norfolk, our other great coast yard, the channel abreast the dry dock is but 525 feet wide. The 600-ft. Pennsylvania has been docked there, but only by canting her across the channel at an angle to the dock, and at imminent danger of serious damage to the ship. It is not pleasing to think of war conditions there, with half a dozen great ships vitally needed outside the Capes, and yet all crowded in that narrow channel waiting their turn to twist into that dry dock.

As to the conditions south of Hatteras, Rear Admiral Edwards says:

"There is not a dry dock, owned by the Government or by anyone else, on the South Atlantic and Gulf coasts which will take any of our super-dreadnaughts. There is not a single stationary or floating crane on these coasts which will remove from, or install in, a battleship either a modern turret gun, a Scotch marine boiler, or an assembled low-pressure turbine of the kind now fitted in our large naval colliers, tankers, and battleships."

The situation as to dry docks is very grave. To date, we have a total of twenty-one dreadnaught battleships built, building, or authorized. Of this total, all but the four oldest are too large to be docked at any navy yards, except those at New York, Norfolk and Bremerton on Puget Sound, and that at Pearl Harbor in Hawaii when the dock now building there is completed. And, further, the Naval Act of 1917 also authorized four battle cruisers, and the pending Naval Bill will probably appropriate for two more battle cruisers and four battleships. Of these ten ships, the battle cruisers certainly, and the battleships probably, will be too big to enter any of our existing naval drydocks. At present, with our larger ships limited thus to but two naval docks on our eastern coast, the possibilities, after but one great battle there, seem appalling.

It is true that the dock at Balboa, which is large enough for any ship that can pass through the Canal, is now available, and that two naval docks have been authorized recently, one at Philadelphia, the other at Norfolk. But heretofore the average time for building a naval dock has been seven years. In fact, for so deep a dock as battleships require, this time is always uncertain. Time and again the character of the soil and the hydrostatic pressure of its entrained water have sprung costly surprises on the builders.

So, an adequate dry dock system to meet the exigencies of early war is at this time virtually impossible for our navy. The hazard of a dreadnaught fleet costing nearly half a billion dollars for lack of a few dry docks at three or four millions each, will scarcely commend itself to the business sense of this nation.

The point of the question discussed is that, after a possible battle, a battered dreadnaught may have to limp its slow way through many miles of perilous waters, with imminent danger of foundering, of destruction or capture. A damaged ship, which may be saved by quick docking after battle, will have to sink, as matters stand, unless she can be beached in some near-by harbor of refuge and coffer dams built.

The measures to provide adequate communication facilities under these conditions is an engineering problem of obvious interest to workers in the radio field. So, too, is the equipment of the enormous fleet of small craft needed to engage submarine flotillas and maintain communication with the strategical land bases.

As a conclusion to the appeal for members of the engineering profession to study the needs of defense, Rear Admiral Fiske is quoted:

"There are no other men in the United States so immediately and directly powerful in developing the fleet and naval stations as the engineers. While the strategist estimates the general situation, and determines the application of the general principles of strategy to each situation as it arises, and while the tactician handles the units of personnel and material in actual battle and in preparation for it, it is the engineer who provides the strategist and the tactician with the mechanisms with which to carry out their respective and collective aims."

It is the engineer who enables the strategist and the tactician, and who often forces the strategist and tactician, to put his art abreast the developments of the physical arts and sciences, and to take advantage of them.

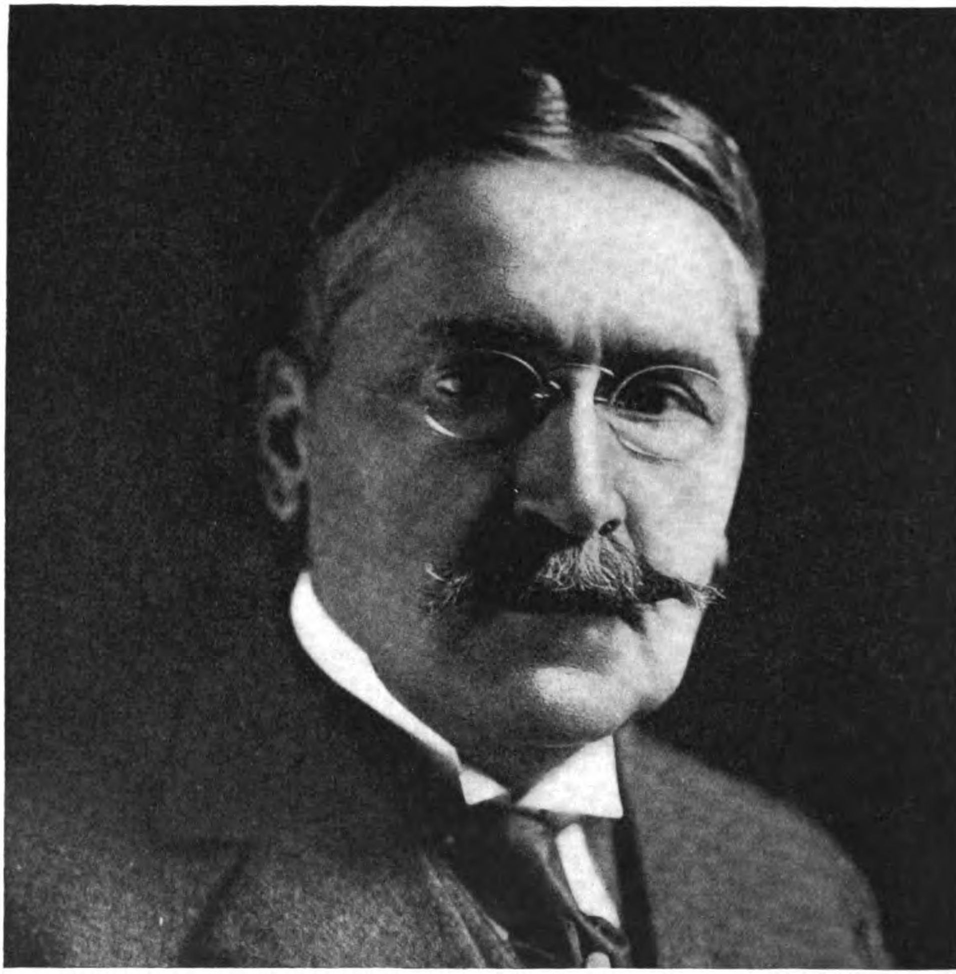
DUMMY ANTENNAE FOR TESTING

The Electrical World notes that when electrical engineers test a dynamo machine they are not likely to disturb engineering operations in other buildings, or even in other parts of the same building. When, however, they test a radio plant of considerable power they are likely to disturb the ether for hundreds of kilometers in all directions. A need arises, therefore, for a dummy antenna, or a radio load for testing radio generators, which shall not seriously stir up and vex the ether in the vicinity. The problem is to load the generator but to suppress the output beyond a short range. This is a problem in radio inefficiency, and is just the reverse of the ordinary problem of the radio engineer, which is to load his generator as efficiently as possible, so that the effects may be manifested at a great range.

A dummy antenna is then described. which consists evidently of a bed of horizontal galvanized iron wires in five layers, so arranged as to be capable of forming an air condenser of adjustably variable capacitance up to about one-thirtieth of a microfarad. With such a capacitance carrying 250 amp. at 20,000 cycles per second, the voltage, neglecting all losses, would approximate 64,000. Sixty-four kilovolts driving 250 amp. in quadrature would develop 16 megawatts of reactive power. An active power rating of 200 kw. would thus only demand a little more than 1 per cent of dissipation factor.

Michael I. Pupin the Man

The Story of His Rise from Immigrant Boy to World Renowned Scientist



Perhaps there is no more interesting personality in the wireless world than that of Professor Michael Idvorsky Pupin of Columbia University. In addition to being the inventor of the art of electric tuning and the electrolytic detector, he is professor of electromechanics at Columbia University, and president of the Institute of Radio Engineers. He is also connected with various scientific societies. His arrival in the United States as an immigrant boy, his struggles to gain a livelihood and an education and the details connected with his rise to the pinnacle which he now occupies are graphically told in an article in the Columbia Alumni News by Dr. Cary T. Hutchinson.

A STOCKILY-BUILT immigrant boy of fifteen landed at Castle Garden in the fall of 1874. Having lost his hat on the way over and coming from a semi-oriental country, he walked up Broadway wearing a red Turkish fez. This excited the mirth of the newsboys in the neighborhood of the Battery, and they pounced upon him. A ring was formed by onlookers and a fight ensued, and the newsboy was soundly thrashed. This was young Pupin's introduction to the United States; he started here with a fight and he has been fighting in good causes ever since. The sky was at this time darkened by a maze of overhead wires, and the boy, engaged in his hereditary occupation of fighting, little dreamed that a few years subsequently his great invention was to be the means of putting these wires underground.

Pupin came from the town of Idvor (hence his name), in Hungary, on the Danube, across the river from Belgrade. His family, with some thirty-five thousand other families, all pure Serbs from old Serbia, had been settled there by Austria in 1690, for the purpose of defending the military frontier of Austria against the incursion of the Turks. They were given land in return for which their sole duty was to give military service to Austria. So Pupin's readiness to fight is easily explained. He ran away from Austria, with another boy, attracted by the alluring advertisements displayed by the steamship companies of a free land across the seas. His family still are there—several were in the service of the Austrian Empire at the outbreak of the war—but being Serbs, they seized the first opportunity to escape and were of the regiments that deserted the Austrian cause and joined with Russia.

After this fight, he returned to Castle Garden (with his red fez), whence he was taken by a foreman looking for sturdy laborers, and carried to Delaware City, Maryland, to drive a mule team; subsequently, he worked on other farms in Maryland, New Jersey and Delaware, finally ending in the service of a pious Baptist farmer in New Jersey, who took him to church. Suspecting an attempt to convert him to protestantism, he ran away one Saturday night; to hide his tracks, he ran through fields and woods, and the next morning, very tired, crossed a bridge leading over a canal and entered a large town, exhausted by hunger and exertion. After buying a loaf of bread, he seated himself under a high tree near some academic buildings and under the genial influence of the spring sun, and physical fatigue, he fell asleep, and had a dream—that the academic institution, in whose shadow he had fallen asleep, had conferred an honorary degree upon him for distinction in science. This institution, Princeton, has not yet risen to its unique opportunity, and other institutions of equal prestige, such as Columbia and Johns Hopkins, have forestalled it.

Young Pupin gradually worked his way to New York, doing anything that came to hand: from 1875 to 1879, he was busily engaged in earning his living and gradually picking up a knowledge of the language, principally through the reading of newspapers and signs on buildings. He had an omnivorous curiosity; his encyclopedia was the Sunday issue of the New York Sun, then under Mr. Dana. He worked in a cracker factory, in a grocery store, as a shipping clerk, running errands—doing anything that came to his hands to earn a living. At the same time, he attended night school, at Cooper Union and elsewhere, studying at every opportunity that presented. By 1879, he had managed to save up $311, enough to permit him to enter Columbia, so he took the entrance examination and passed with high honors, getting free tuition, which was essential to him. He was attracted to Columbia, rather than to some other college, by the Columbia victory at the Henley Regatta—again the love of physical prowess.

During his freshman year, he had a very monotonous time socially, owing to poverty and too serious attention to his studies: he knew few of his classmates, as he worked all the time, the result being that at the end of the freshman year, he received two first prizes, in Greek and Mathematics, giving him one hundred dollars each, a matter of vital concern to him, but his classmates looked upon his distinction in studies with a certain lack of enthusiasm. This welcome money was supplemented in his freshman vacation by sweating for three months, cutting hay and fighting mosquitoes in the Hackensack meadows, his entire earnings being $75, over and above the living that was given him.

His sophomore year started under

more favorable auspices. In October, 1880, the class championship was to be decided between the freshman and sophomores by a wrestling match of representatives of the two classes. The freshmen selected as their representative a young giant, of a family famous in Columbia's annals, and the sophomores saw themselves defeated by the mere prestige of this champion. Pupin, however, volunteered to meet the giant and was reluctantly accepted by his classmates, despising a prize man in Greek and mathematics. The result was a quick and decisive victory for the sophomores; Pupin was carried on the shouldeds of his classmates to Fritz's saloon in Forty-ninth street, where a celebration was carried on all afternoon, of a kind that is left to the imagination.

From that time, he had no difficulty in getting on. He was made class president, and every opportunity was given him to utilize his scholarship by private coaching in Greek, Latin, mathematics, and even in wrestling. When he was graduated he had saved up enough money to permit going abroad to study physics and mathematics. Leaving this country then in June, 1883, after receivhis A.B., he went to Cambridge, intending to study under Maxwell, ignorant of the fact that Maxwell had died four years before. This, although he expected to become a student in physics, shows how little knowledge he had of the world of physics at that time. When informed of Maxwell's death, he was also told that a good substitute for Maxwell had been found in Lord Rayleigh, to which he replied that he had never heard of Lord Rayleigh. Nevertheless, he studied at Cambridge for a year and a half in Mathematics and Physics, and then went to the University of Berlin, where he remained until 1889, studying principally under Helmholtz, in what was then known as "physical chemistry," really thermodynamics.

While abroad, in 1889, he married a sister of Professor Jackson of Columbia. She died in 1896.

He was given the Tyndall fellowship in 1885 by Columbia, yielding $650 a year; he returned to this country in 1888, at the request of Columbia, to confer regarding the establishment of a course in electrical engineering, of which he was asked to become professor on the theoretical side—Professor Crocker being chosen to conduct the applied work. These arrangements went into effect in the fall of 1889 and Pupin and Crocker worked harmoniously for twenty years at Columbia.

Pupin knew little at that time of the theory of electricity and less of electrical engineering—yet he had the audacity, early during this period, to oppose the Edison interests, who were themselves fighting against the introduction of the alternating current into commercial use. Pupin sided with the advocates of the alternating current, believing them to be fundamentally right. As a result, strong representations were made by financial interests to Columbia, practically demanding his removal on the ground of his immaturity and crudeness. The method that he guessed to be right, was right; his engineering instinct guided him correctly in a matter of fundamental importance, regarding which he had no detailed knowledge.

Pupin took up research work at Columbia from the start of his career there. He first interested himself in electrical resonance and electrical currents in rarefied gases; the results of this work were the inventions in electrical tuning, practiced universally today in wireless telegraphy. These were patented, the Marconi Company buying the patents in 1902.

When wireless telegraphy became prominent in 1896, he invented a simple method of electrolytic rectification of high frequency oscillations at the receiving station; this general method of receiving wireless signals, that is, the rectification of high frequency oscillations, is now in universal use in the vacuum tube rectifiers. His work in electrical discharges in rarefied gases led him to take up the study of X-ray; he was the first in this country to repeat the Roentgen experiments and the first to use X-rays practically for surgical purposes, having made in January, 1896, an X-ray photograph of the late Prescott Hall Butler, who had over a hundred small shots in his brain, all of which were successfully taken out by the late Dr. Bull, guided by his photograph.

This X-ray work interfered with Pupin's health, so he abandoned it for the study of electric transmission of power and in particular the mathematical theory of sectional electric conductors. The outcome of this work is the well-known "Pupin-Coil," now universally used in telephony and telegraphy. This invention of Pupin's has done more to extend the sphere of telephonic work than all other inventions together, since the original invention of the telephone; it is known in France as the "Lignes pupinizé" and in Germany, as "Pupinizierte Linien." Striking illustrations of the value of this invention are the existing New York-San Francisco telephone line, the Boston-Washington underground cable line, and the submarine cable between England and Holland—all of these are impossible without the "Pupin-Coil." The American Telephone and Telegraph Company is now preparing to lay an underground cable between New York and Chicago—the cost of obtaining even a poor equivalent of this service in any other way would be absolutely staggering.

Pupin, as is well known, is an ardent Serb. His activities for years have been directed largely to helping the Serbs in this country, and since the war, to the assistance of Serbs both here and abroad. He has been for a long time President of the Slavonic Immigrant Society and President of the Serb Federation, a mutual benefit organization comprising the greater number of Slavs in this country, nearly all Austrian subjects, who have abandoned Austria for this country, and who hate Austria as cordially as does Pupin. He is also Honorary Consul-General of Serbia here.

One incident that his friends know of illuminates his character: In the early stages of the war, he personally guaranteed contracts for railway material and supplies for Serbia to the extent of $250,000, or more, without the slightest guaranty from Serbia or any other source that the money would ever be paid back to him.

Pupin has received many scientific honors; he is a member of too many scientific societies to enumerate, and an officer in several of them. Just now, he is President of the New York Academy of Sciences, and a member of the Council of the National Academy of Sciences. He received the Elliott Cresson medal for distinction in Physics, in 1906; the Herbert Prize of the French Academy in Physics in 1916; the gold medal of the National Institute of Social Science in 1917. He is also a member of the National Research Council and of its Executive Committee, and of the National Advisory Board for Aeronautics, established by the United States Government.

Although a devoted believer in the Serb race and its traditions, there is no truer American citizen than Pupin; none who would make greater sacrifice for this country in time of need—even though against the interests of the Serbs. Columbia honors herself in honoring him.

MARCONI IN U. S. WITH U-BOAT DESTROYER

Ferdinand, of Udine, Royal Prince of the House of Savoy, son of the Duke of Genoa, captain in the royal Italian navy, and first cousin of Victor Emanuel, King of Italy, entered the American Capital on May 23rd amid salvos of welcome and applause, bringing with him Marconi, inventor of wireless, and the distinguished War Commission which the Italian Government has sent to the United States.

Most inspiring among the suggestions which came with the Italian Commissioners is the buoyant promise that the murderous U-boat of the Germans has found its master. The invention is announced as Marconi's, to whose new "submarine killer" the Italian Commissioners credit the destruction of fourteen German and Austrian U-boats in the last month.

Marconi is modest, as always, but the Italian Commissioners are inspiringly enthusiastic over the remarkable achievements of the inventor.

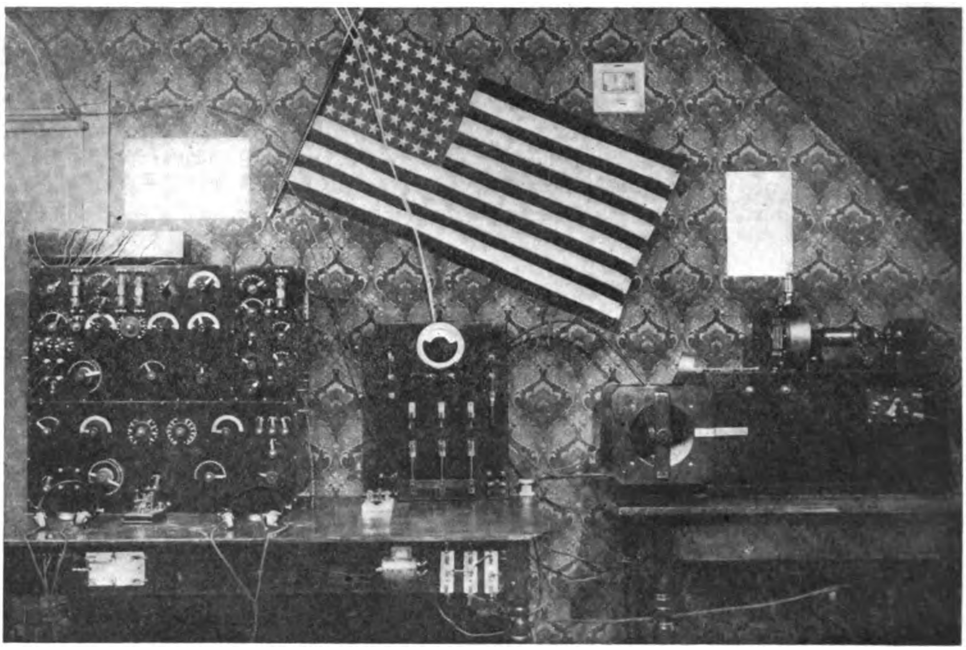
It is reported that Marconi will go into executive session with Edison in the perfection of the weapon for which the world and civilization waits on land and sea, and the combined brains of the two wizards will be consecrated to the mighty task.

9 ZF Winner of Efficiency Cup

By 9 XE

National Chief of Relay Communications

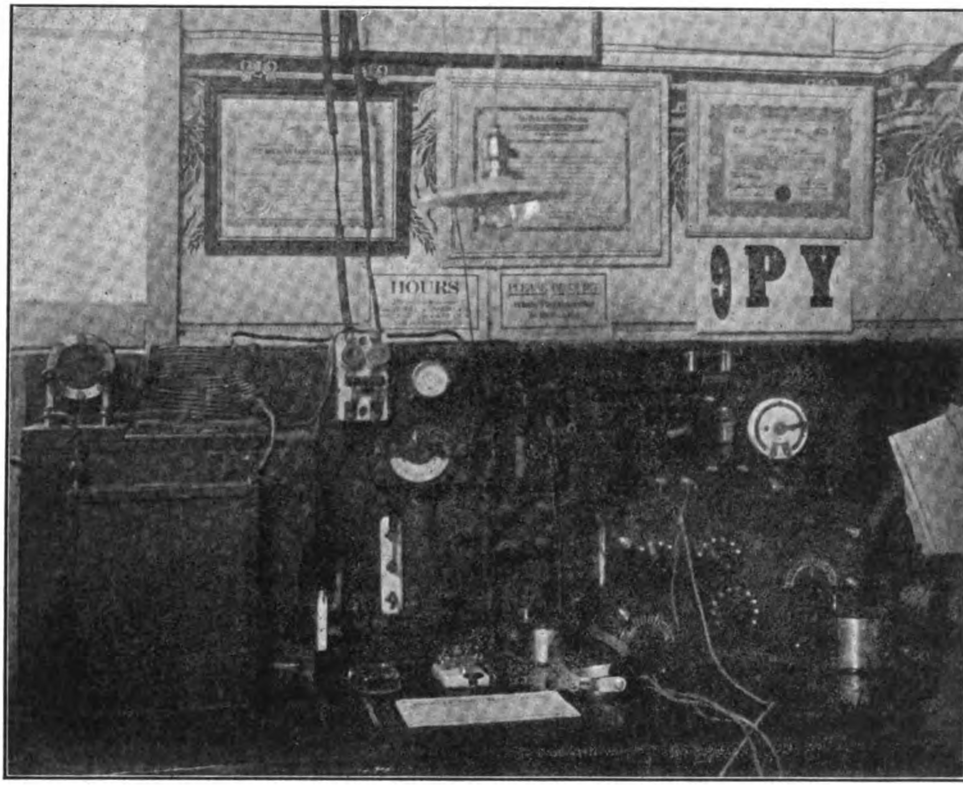
NATIONAL AMATEUR WIRELESS ASSOCIATION



Station 9 ZF, owned by E. F. Doig, who was awarded the trophy for efficiency and equipment

E. F. DOIG, of 848 South Emerson Street, Denver, Col., has been awarded the cup donated by 9 XE to be presented to the owner of the most efficient and best equipped amateur wireless station in the United States. 9 ZF, Mr. Doig's station, is embraced in the Colorado Wireless Association's chain. W. H. Smith is associated with Mr. Doig in the operation of the station.

A record of messages handled at 9 ZF from January 13th to March 18th shows that 251 communications were sent and received, a number of these being transmitted from coast to coast. This station had a strategic position in



Station 9 PY owned by S. W. Pierson of Carrollton, Illinois

the last Washington's Birthday Relay, held under the auspices of the National Amateur Wireless Association. In fact, without the assistance of 9 ZF, it would have been impossible to obtain the results which were achieved. Although the Denver station is on the membership books of practically all of the radio clubs its operators did not decline one message.

In the receiving cabinet of 9 ZF is a large loose coupler for the reception of signals from long wave stations. A smaller receiving cabinet is used for the smaller wave stations. Also included in the equipment are a short wave regenerative receiver and an amplifier which can be used in connection with each of the other sets. The station, which is of I. K. W. power, radiates from twelve to fourteen amperes on a wave-length of 425 meters. The oscillation transformer is made of edgewise-wound copper strips.

There are three towers, one of them being 90 feet in height, and the other two 75 feet. One aerial has six No. 12 aluminum wires, 150 feet in length, and the other is 200 feet in length and has four stranded aluminum cables with seven strands of No. 14 in each cable. Mr. Doig, assisted by Mr. Smith, made nearly all of the apparatus.

Mr. Doig's station recently worked directly with 2 PM in New York City, and it has frequently worked with 6 EA in Los Angeles, Cal. It has accomplished excellent results in the movement to interest amateurs in the United States Coast Reserve. Mr. Doig is secretary of the Colorado Wireless Association and Mr. Smith is chief operator. The cup will be held for one year by 9 ZF and if won again in 1918 will be retained by the Denver station for all time.

This Trans-Continental Relay a Record Breaker

Two N. A. W. A. Members Organize Successful Chain of Communication in a Night

By Willis P. Corwin (9 ABD)

RELAYING a message across the continent and receiving back the answer two hours later, is a record which will stand in the annals of amateur wireless as the pioneer achievement in the field. It will probably be of interest to all wireless amateurs to learn that this was accomplished on February 6th, when a message was relayed from New York City to Los Angeles, California, in record time. Not only was a message sent from coast to coast, but an immediate reply was relayed back to the New York station.

A trans-continental message had been planned for some time, and several tests had been made; but all efforts proved a failure until the night of February 5th and the following morning. In some instances the proposed routes were made up of stations that had never done any successful work, in others some one station would prove a failure, and when everything seemed substantial in the way of stations, atmospheric conditions would prevent any successful work. On the night of the initial success atmospheric conditions were ideal and we owe our achievement to old man QRN as well as to ourselves.

The author's station is in the center of the state of Missouri, approximately one-third of the distance from New York to Los Angeles. Amateur stations are heard as far East as the coast and as far West as Denver, Colorado, successful work being done with several of the Eastern stations and with stations as far West as Denver. As the Denver station had been working Los Angeles, a trans-continental relay seemed possible beyond a doubt.

At midnight, February 5th, I heard at my station, 9ABD, of Jefferson City, Missouri, Alfred J. Manning (8JZ) of Cleveland, Ohio, talking to 2PM in New York City, the station operated by Faraon and Grinan. As I had worked with W. H. Smith (9ZF) in Denver, the night before, and had heard 9ZF talking to the Seefred brothers (6EA), of Los Angeles, California, I saw the possibilities of a trans-continental message, and called 9ZF with that in mind. He answered and I told him that I had heard 8JZ talking to 2PM and asked him to try to get 6EA, while I got a message from 2PM, for 6EA through 8JZ. Smith said that he usually worked 6EA a little later, but told me to go ahead and get a message from 2PM, and he would try to get 6EA and QRX for the message. I immediately called 8JZ and told Manning, of Cleveland, of the possibility of a transcontinental relay and asked him to get a message from 2PM for 6EA. Manning agreed and called 2PM, and Faraon and Grinan gave 8JZ the following message:

Seefred Brothers, 6EA,

Los Angeles, Cal.,

Here's hoping you receive this message tonight. Best regards from the East.

Faraon and Grinan, 2PM.

8JZ gave the message to 9ABD. In the meantime 9ZF had succeeded in getting 6EA and both of them were standing by for the message. 9ABD gave it to 9ZF, who called and sent it to 6EA, but the latter was bothered with QRM from Government and commercial stations and asked 9ZF to QRX till they quieted down a little. They waited for some time, but the commercials must have been sending press for they never let up, so 9ZF repeated the message several times until 6EA had it O. K.

The message left New York at exactly one thirty A. M. eastern time, and arrived at Los Angeles shortly before midnight western time. A reply left Los Angeles at midnight. It read as follows:

Faraon and Grinan, 2PM,
New York City.
Thanks. Same to you from the West.
Seefred Bros.

The stations that handled the West bound message were all standing by for the QSL and no trouble was encountered on the return; 2PM had the reply at three thirty A. M., two hours after the first message had been forwarded. As the reply was filed in Los Angeles at midnight it took an hour and thirty minutes to get the first message to the Western coast and about thirty minutes to relay the reply back. The time between the two terminals has a difference of four hours and is a little confusing, esespecially as the writer is going by Central time, so these figures are only approximate. I am sure, however, that the return message did not take over fifty minutes at the most, as I heard 9ZF give 6EA his O. K. and heard 8JZ give the message to 2PM and also heard 2PM's O. K.

It will be noticed that no previous arrangements had been made. The first time that two minds met in regard to this relay was when I asked 9ZF to try to get 6EA and hold him till a message was secured from 2PM. No special instructions were followed, the operators just acted naturally and handled the messages as they would handle any other message, and as each one gave the first message to the station west of him, the western station gave him an O. K., and asked the latter to QRX for the reply, "even if it takes till daylight."

The Eastern stations deserve a little extra credit as they stood by for two hours. 6EA and 9ZF also deserve special credit as the distance between them is over 1,000 miles. The other distances covered were approximately 800 miles each, with the exception of the distance between Cleveland and Jefferson City, which is a little over 350 miles.

This relay shows the good work that the amateurs of the country are doing. Although a trans-continental message had never been relayed before in such a short time, a great many have been handled since the first of the year. This is due to the good work of Smith, of Denver (9ZF), who has handled practically all the coast to coast messages. On the night of the relay 2PM heard 9ZF and 9ABD, and 9ABD heard 2PM.

This first real transcontinental message relayed in one night is the beginning of a new era in the history of the amateur wireless stations. We amateurs are indebted to Uncle Sam for his generosity and now in a time when he needs our services we will show our appreciation, I am sure.

MARLBORO CLUB'S ANNIVERSARY

The Radio Club of Marlboro, Mass., recently celebrated its first anniversary in its club rooms. Messrs. Wallace, Williams, Brigham, Bailey and Temple addressed the members of the organization.

WAR WILL NOT INTERFERE

It has been announced that the members of the St. Paul (Minn.) Radio Club will continue their study of wireless, despite the dismantling of its set by the Navy Department as a result of the war.

Resolutions in which members of the Connecticut Valley Radio Club, of Springfield, Mass., agreed to volunteer their services to the United States Government were adopted at a recent meeting of the Club.

It has been announced in St. Paul, Minn., that students of Macalester College have formed a class in wireless telegraphy. Preparedness was the prime motive for organizing the class.

James Clifford delivered a lecture on wireless at a recent meeting of the Evansville (Ind.), High School Wireless Club.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

The Construction of Light Supporting Masts Made of Metal

I have constructed a mast for the support of antennae built entirely of metal, the total cost of which was just a little more than $5. The material complete with the guy wires, weighed a little more than forty-five pounds.

The most striking advantage of a mast constructed along the lines I am about to describe is that it has no parts likely to suffer from the weather except the aerial hoisting rope which can be replaced at a cost of about eighty cents. This mast in its present form was designed by C. H. Ziesenis. A mast of the same construction was in use at an early date at station 9 DM, owned by Harry Ziesenis. At the suggestion of the latter, a slight change was made in the construction of my mast and, as it is considered an improvement on former types, a description of it may be of interest to the readers of THE WIRELESS AGE.

The mast itself is a piece of common, 27 gauge, galvanized corrugated leader pipe, 2 inches in diameter, such as is used to carry water from the roof gutter to the cistern. The 2-inch size is recommended not only because it is less expensive, but also because it is very much stronger than the larger sizes. It is highly important that corrugated leader pipe be used, as the smooth type has considerably less strength. In fact, the corrugated pipe is so stiff that a 10-foot section, laid across a couple of supports, will hardly bend with the weight of a 100-pound boy, while thirty feet of the pipe may be pried up into a horizontal position over a support 2 feet from one end. As many readers are probably aware, no gas pipe or timber of similar size would withstand such a strain.

In order that the mast may be rigid, the sections of the pipe are connected together by lock-jointed sleeves of

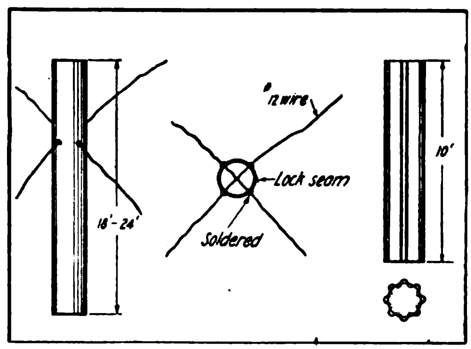


Figure 1, First Prize Article *Figure 2*

galvanized iron, approximately 2 feet in length. A tight fit is necessary; in fact, the sleeves should be so tight that they can be forced on only by throwing one's whole weight on them.

As will be seen from Figure 1, four nail holes are punched through the sleeve at the center and a couple of 36-inch pieces of No. 12 galvanized iron wire are crossed through the holes and soldered into place. These wires serve a double purpose—they keep the pipe from telescoping and also provide fastening to keep the guy wires from sliding down.

At the end of each section, a disc of

galvanized iron is soldered fast to keep the pipe from cutting into the section below. The disc, which is

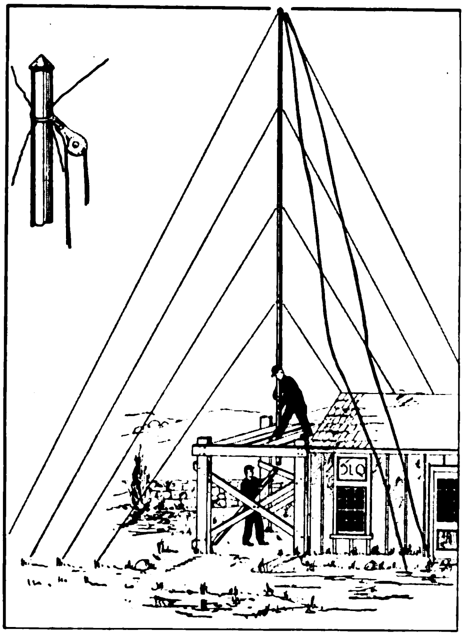


Figure 3, First Prize Article

shown in Figure 2, is essential and should be of heavy gauge metal.

This work having been completed, 3-foot pieces of No. 14 galvanized wire are now attached to the sleeves by passing them twice around and twisting the free end and one of the "tails" tightly together with the long end. A one-piece porcelain wiring knob is now attached to the long end to act as a strain insulator. It is important that the joints be well made as they cannot be re-made later.

The next step in the order of construction is to force the sleeves on the lower ends of the section, giving particular attention to bringing the end of the pipe into contact with the cross wires. If desired the top of the sleeve may be "crimped in" and soldered to the pipe to exclude rain. As shown in Figure 3, the top section is also capped by a sleeve supplied with a small conical roof soldered on water tight. The top guys and the pulley are attached to this sleeve.

The position of the guy anchors should be located in advance and in so far as possible they should be set 180 degrees apart if three sets of guys are used, and 90 degrees apart if four sets are employed. It is also recommended that they be placed not nearer than half the height of the mast, that is, thirty feet from a 60-foot mast. In fact, it is better to place them farther out at a distance equal to the height of the mast. Guys longer than this, however, are not desirable as they must be excessively tight to prevent violent vibration on windy days. One set of guys should be placed straight back of the aerial.

If guys are cut by mere guesswork, a needless amount of wire is wasted. By drawing a plan of the mast, the back length can be calculated in advance. The constructor should draw the mast to scale, letting ⅛th of an inch equal one foot, and he should drop lines from the points on the mast, which represents the joints, to the points on the ground which represent the guy anchors. The length of these lines is then measured in eighths of inches which correspond to feet. To this should be added four feet for making fastenings to the anchor. All this will be clear from Figure 4.

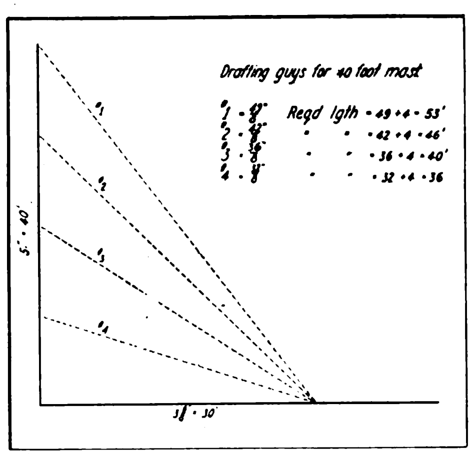


Figure 4, First Prize Article

If the anchorages are at different distances from the mast, a separate drawing must be made for each. This may seem a needless amount of labor, but it takes only about fifteen minutes and is likely to save hours in erecting the mast.

In order to carry on properly the work of erection a scaffold, 12 to 13 feet in height, should be constructed with room enough to allow two people to stand on it. In my experience I found thirteen feet a desirable height, as it readily permits one to put the ten-foot sections into place. The opening in the center of the scaffold should be about two feet square and must be directly over the place where the mast is to stand. A good-sized rock or piece of 2-inch plank should be laid first to act as a mast foundation. Any building contractor in the neighborhood will lend the lumber for the scaffold.

The guys are now laid out for the top of the mast, while the other guys are coiled up and laid in order so that no time will be wasted in pawing them over in order to free them and clear them from twisting and tangling.

The first three sections of the mast are now put together, the top end pushed through the opening in the scaffold and the top guys attached. The rope is put through the pulley and the ends firmly tied together. Then the mast is shoved up at a slant till the second set of guys can be attached, after which it is "up-ended."

In order to complete the erection of the mast at least two assistants are required, one or two to hold the ends of each set of guy wires (in fact three to six people are required for a mast with three sets of guys) while a helper unrolls the guys and brings up the sections as they are needed. The person in charge of the work stands at the base of the mast under the scaffold and inserts sections, attaches guys and directs the guy-holders.

The safety of the whole mast now depends upon the person in charge, and it must be distinctly understood that he has control and that no one is to argue with him. All unnecessary conversation should be avoided in order that his commands may be understood. These orders may be simplified by numbering the guys so that "North! number two!" means that the holder of the north guys is to tighten the second wire from the top. Similarly, "South! slack three!" means that the south guy No. 3 is to be given more slack.

As they are required, new sets of guys are unrolled by the helper and passed over the edge of the platform, down through the opening to the chief, who attaches them to the insulators. Then the mast is lifted till he can get another section underneath, while the helper distributes the guys to the holders.

Given a good helper at the bottom of the mast, a pair of lifters who can do their work without straining and above all, a calm day and helpers who will attend to orders without "back-wash," an 80-foot mast can be erected in a couple of hours. My mast was erected, in fact, with a strong and a very cold north wind blowing. Matters were delayed while frozen fingers were thawed out, but notwithstanding the erection took no more than an hour and three-quarters.

Since that time we have erected 45 and 50-foot masts of this sort in half an hour. Very short masts of three sections can be erected without a scaffold in about fifteen minutes.

As to the guys for the mast, I believe No. 16 galvanized steel wire to be of ample strength, although at stations 9 LQ and 9 DM No. 14 wire was used. The guys are not to be made tight as their purpose is to balance the mast rather than to hold it rigid.

Reverting again to the strength of the mast. Last February we had a severe sleet storm. One mast of this type "stayed put" although the aerial finally gave way after it had accumulated more than 60 pounds of ice. All the guys were sheathed in ice half an inch thick, while the 70-foot mast itself carried an inch of ice. According to my calculations the horizontal pull at the top of the mast was over 300 pounds, while the dead load was not far from 400 pounds. The showing is the more remarkable as the mast was not guyed at all joints, but only at 15-foot intervals.

It is quite likely that a metal mast will

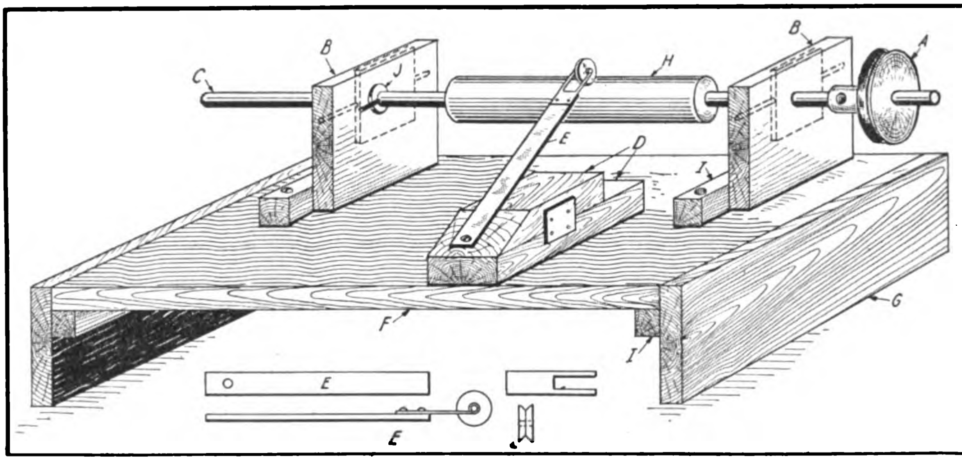


Figure 1, *Secon d Prize Article*

be viewed with distrust by some who fear induction losses. The losses may be minimized by breaking up the guys by means of porcelain knobs (using four in the two upper sets of guys and three in the lower sets) and by insulating the whole mast from the ground by means of a paraffined plank or a marble slab, such as a piece of table top which has been well boiled out in clean paraffin. I have found by experiment that when using an umbrella aerial the insulation of the mast from the ground is especially important.

Both in my station and at station 9 DM marble slabs are used under the mast and, while there are considerable fireworks at that point, the loss does not seem to be important at staion 9 LQ. The latter has a fairly constant winter range of 400 miles when using 225 watts, while station 9 DM has repeatedly covered distances of 950 miles with 870 watts input.

It should be taken into account that the strength of the mast is due entirely to the shape of the pipe and damaged pipes are worthless. Even a small dent, except very near the end, is sufficient cause to throw away the entire section or joint, while rust spots, if severe, would have a similar effect. If the zinc has just peeled, further rusting can be prevented by a touch of asphaltum varnish or paint. To prevent rusting at the point where the cross wires pass through the sleeves the wires should be soldered at these points but not with zinc chloride. The constructor should use "Nokorode" or Allen's soldering paste. If these precautions are observed there is no reason why a mast of this sort should not last for years with no attention beyond the semi-annual renewal of the rope for hoisting the aerial.

In the event that any of the readers of this article decide in favor of this mast, I should like to hear the results of their experiences.

S. KRUSE,
1,538 Kentucky Street,
Lawrence, *Kansas*.

SECOND PRIZE, FIVE DOLLARS

A Winding Machine for Transformer Coils and How to Make It

Although I have seen published several constructional sketches for hand winders for winding secondary coils and tuning coils, none of them have been really practical for the amateur. The one that I have designed is to be used in connection with a sewing machine without any alterations whatever except lengthening the driving belt.

This machine has been used by myself and others for several months, and we have been able to wind one section of a 3-inch spark coil with No. 38 wire in a couple of hours. With the aid of the guide shown in Figures 1 and 2, the experimenter will have no difficulty in winding the layers perfectly even without overlapping. This is a matter of great importance in the winding of transformer coils.

The drawings accompanying this article are largely self-explanatory. However, a little explanation of the operation may not be amiss. Place the left hand on the coil to regulate the speed, and the forefinger of the same hand to assist in guiding the turns evenly, using the right for the operation of the guide "E."

To mount this device, simply place the winder on the sewing machine without fastening, according to Figure 2, allowing some play in the strap for the regulation of speed. It is also to be noted that no machine work is required in the making of this device unless such construction is desired. If the builder is unable to secure the pulley, A, the ends of two large spools, sawed off and nailed to form a V, will answer the purpose.

The dimensions of the various parts follow:

A—1½ inches or 2 inches in diameter (any size will be suitable); B—5 inches by 2½ inches wide by ¾ of an inch (standards); C—10 inches by ½ inch or ⅝ of an inch diameter (shaft); D—Two pieces, 2½ inches wide by 1½ by 7 inches long, cut as shown, and fastened to permit shifting of piece holding guide in or out; E—6 inches by ¾ of an inch wide by 1-16 of an inch thick sheet iron. A thin piece of brass or tin turned over to receive a nail forming a shaft for the small guide pulley and then fastened to sheet iron as shown; F—15 inches by 8 inches by ¾ of an inch thick (base); G—8 inches by 4 inches (sides); H—Piece of broom handle bored to fit over shaft; I—¾ of an inch square.

The standards, B, are nailed to the pieces, I, and they in turn are screwed to the base so either end can be removed whenever it is necessary to remove the coil. Also the dotted lines on the standards represent borings which permit hot lead to be poured around the shaft after it has been lined up. These make good bearings. Two small holes bored in the shaft inside of the standards to receive a small nail are backed by a washer which will keep the shaft in perfect alignment.

No shear or difference in diameter is shown in the arbor, H, for the reason that I have found it more advantageous as shown and have made allowance in the diameter to permit winding a thin piece of cord the entire length of H and fastening it into place.

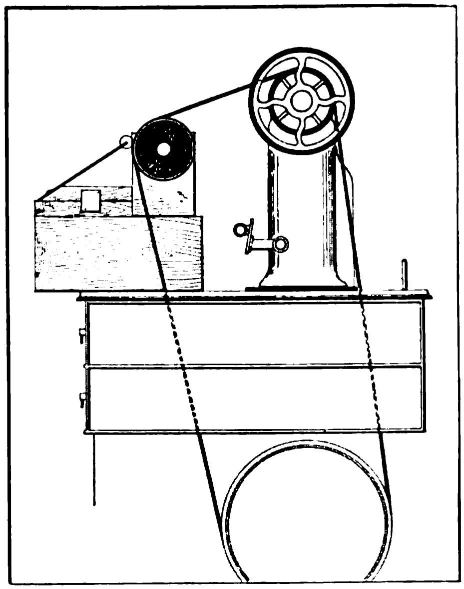


Figure 2, Second Prize Article

If the core is built upon that, it is only necessary after it is completed, to reverse the machine unwinding the cord. This will permit whatever is being wound to be removed without danger of pulling it apart.

Lattimer W. Reeder, *New York.*

THIRD PRIZE, THREE DOLLARS

A Long Distance Receiving Set Which Has Proved Successful

I have described in this article a simple long distance receiving set which can be constructed by any experimenter at a minimum of expense. The fundamental idea of this receiving transformer is shown in the accompanying photograph. It will be noted that there are three tuning coils. The center coil is the primary winding of the oscillation transformer, the one at the right is the secondary and the one at the left the regenerative coil, which is connected in series with the local telephone circuit of the vacuum valve.

Excellent results can be obtained by the use of this receiving tuner. Connected to an aerial 250 feet in length, 30 feet in height, which was shielded by buildings and a hill, the two German stations at Nauen and Hanover have been heard and their signals read except when atmospheric electricity has been severe. On one occasion the Eiffel Tower station in Paris was heard.

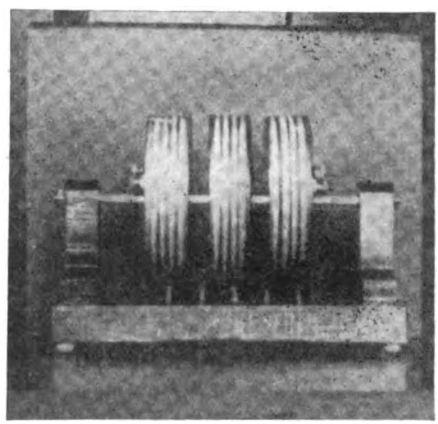
In the construction of this tuner the three cores for the coils should be made first. They are made of wood and are first cut out roughly on the band saw. Then they are turned down upon a lathe. The grooves, which are ¾ of an inch in depth, may be cut with a small round nose chisel. When the grooves are cut the cores should be taken from the lathe and a ¼-inch hole bored through the center of each. Next, the holes where the binding posts are to be mounted should be laid out and drilled. They should be countersunk so that the head of the binding post screw will not protrude below the surface of the wood. The depth of the countersink, of course, depends upon the length of the screw the builder has on hand. Five holes should be drilled along the edge of the disc through which the taps are brought from the coils. These holes may be drilled with a No. 40 drill. This work having been done, the cores are ready for winding.

The winding is easily accomplished by mounting the cores on a lathe. The core can be clamped between two nuts on a threaded piece of ¼-inch rod inserted in the hole at the center of the core and the rod held in the chuck of a lathe. The lathe should be run slowly and the wire fed into the slots by hand. When one slot is completely filled up to within about 1-16 of an inch of the top, a tap should be brought out through one of the holes drilled for that purpose, after which the next slot in order can be wound. A tap is then brought out from this and the next slot filled with wire, taps being brought out from successive windings until all are completed. Particular care should be taken to wind each coil in the same direction. In the tuner which I constructed the No. 30 double cotton-covered B. & S. wire was used.

The base and end supports are now to be made. The base is cut out of a piece of wood and sandpapered and finished. The choice of wood rests with the builder. The end pieces can be laid out on a piece of wood and cut with a hand saw. After this they should be sandpapered and finished and when they are thoroughly dried they may be screwed to the base.

The rod on which the coils slide is of ¼-inch brass, threaded for one-quarter No. 24 brass nuts at the ends. Quarter-inch holes should be bored in the end pieces to mount the rod.

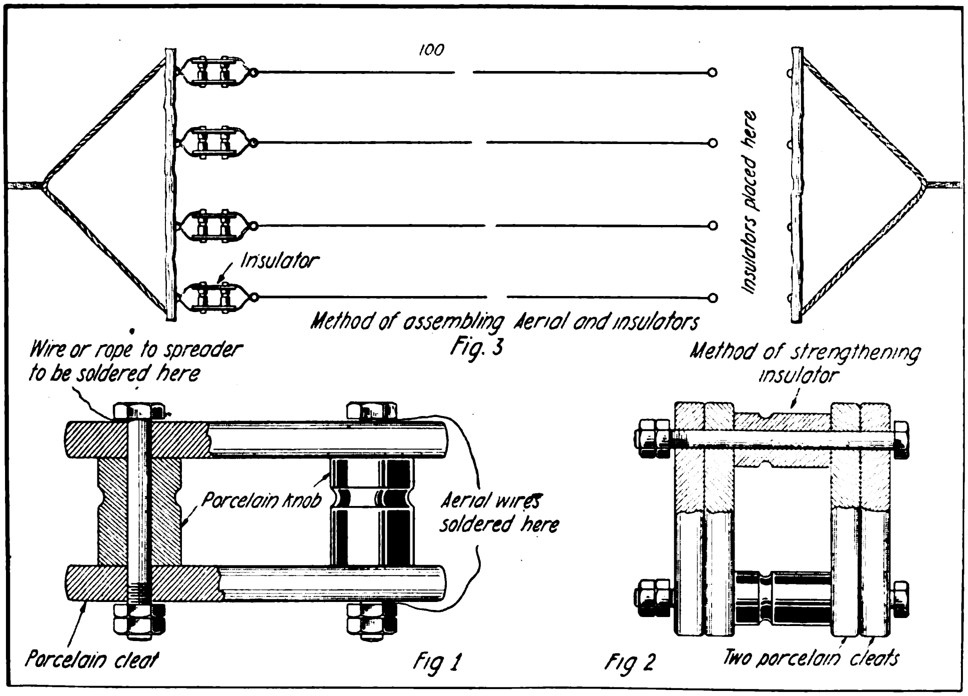
The various parts of the tuner may now be assembled. The taps from the center coil are taken through small holes bored in the base and fastened to the binding posts. These taps keep the center coil from moving along the rod. The binding posts used upon the tuner shown in the drawing were taken from ordinary battery nuts and thumb-nuts. As



Illustration, Third Prize Article

will be noted, small rubber feet were fastened to the base of the tuner.

When this apparatus is first connected up, there may be trouble in making the bulb oscillate, but by changing the connections of the coils until the right combination is found the bulb will be found to be a persistent oscillator. Nearly all of the tuning will be done by variable



Drawings, Fourth Prize Article

condensers and by varying the coupling between the coils.

It is the usual custom for one doing radio experimental work to look askance at any apparatus in which the wire is wound in layers, but the results obtained by this tuner would seem to show that in some cases at least the layered winding is not as inefficient as is believed. The writer does not claim to be the originator of this scheme of three coils in inductive relation to each other as this circuit is in use by many other experimenters, but he is positive that if the tuner is carefully made, first class results will be obtained.

F. N. Tompkins, *Rhode Island.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

An Aerial Insulator That Will Stand the Test of Service

An aerial insulator can be made from porcelain cleats, knobs and bolts as shown in Figures 1, 2 and 3. Although this insulator when completed will not be as good looking as the manufactured article of to-day, I have found that it will stand much wear and strain and will afford a fair degree of insulation.

To a considerable extent, the drawings are self-explanatory. The builder will note that the only materials required are: One pair of porcelain cleats, two porcelain knobs and two bolts with two nuts on each end.

The insulator as assembled is shown in Figure 1 and as connected in the aerial circuit in Figure 2.

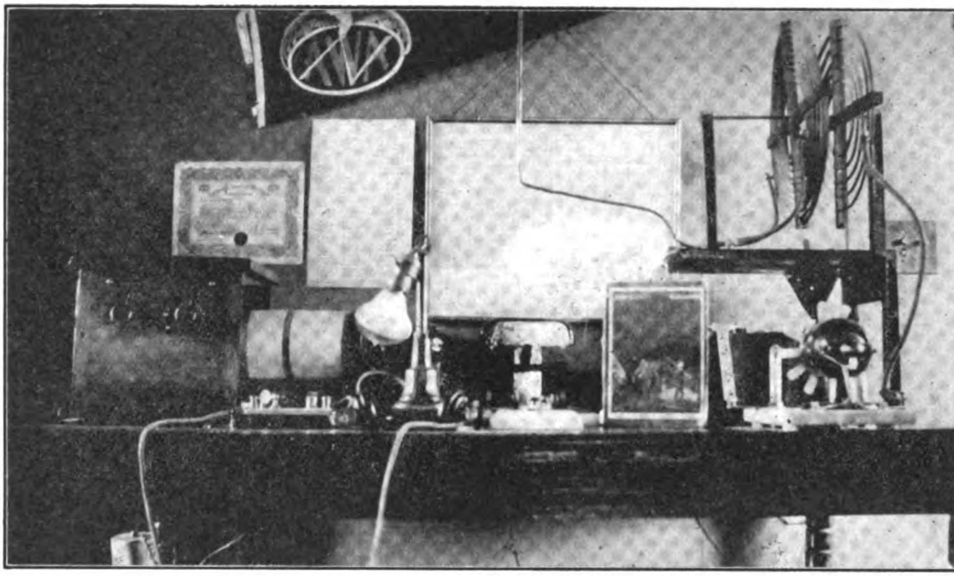
Insulators of this construction have been found strong enough to hold an aerial 100 to 200 feet long, consisting of four wires erected at a height of 100 feet. In fact, they withstood the strain during a sixty-mile an hour windstorm. A larger aerial may be employed by putting the knob between four cleats as shown in Figure 3.

Maurice Stephens Miranda, *New York.*

HONORARY MENTION

How the Difficulties of Erecting a Mast Were Overcome

In this article I have presented my plan for erecting a mast. I believe this is one of the hardest problems with



M. M. Dye's station (Honorary Mention Article)

which the amateur has to contend, but I am glad to say that I have at last succeeded in solving it.

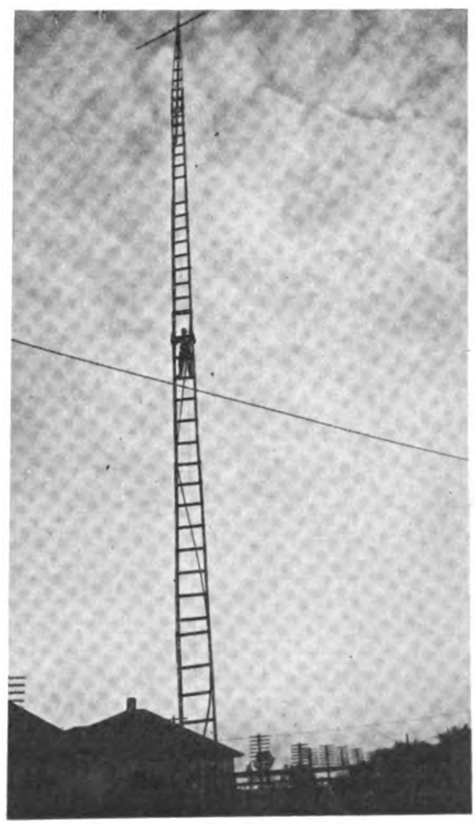
The mast and my radio station are entirely of my own construction. In fact, I raised the mast unaided. To explain briefly, I purchased 150 feet of 1-inch by 3-inch by 18-foot lumber for $2.75, two pounds of No. 8 nails and then constructed six ladders made in 18-foot sections, tapering them from 3 feet at the the bottom to a point at the top.

The mast was raised in the following manner: The first section was put into position and held there by four guys. I then used the top section for a boom and lashed it at the middle and to the top of the first section of the mast. Then I tied the second section to the halyard at the middle and in this manner the successive sections were raised into position and nailed and bolted together.

My mast has six sections, 18 feet in length with a 2-foot lap at the joints. I can go to the top of it without danger and also can extend it to greater height at any time desired. My call letters are 5 BJ.

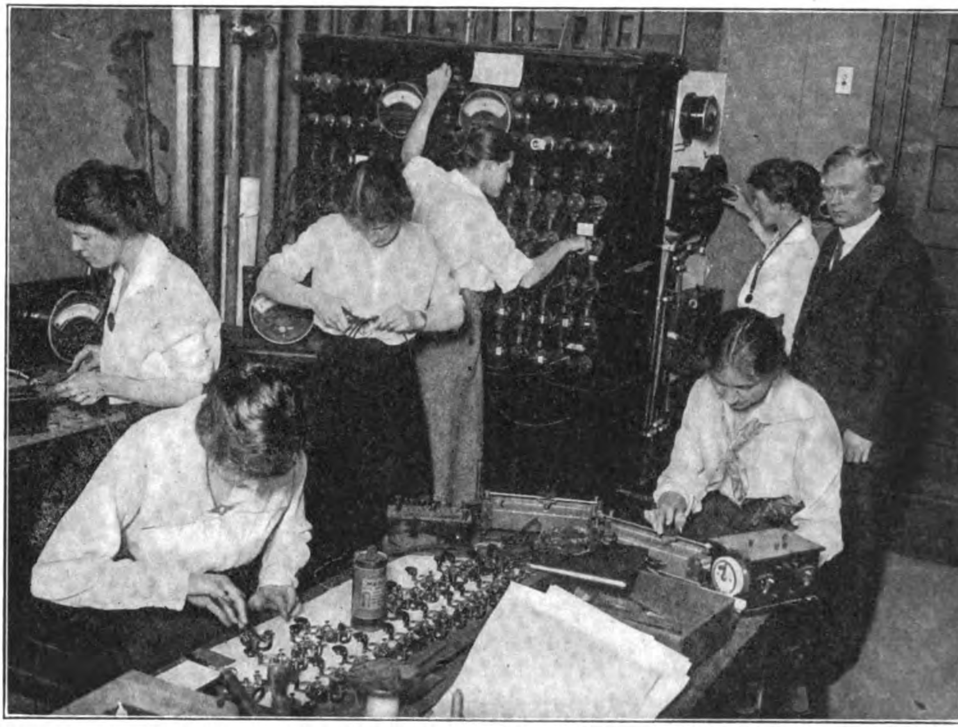
The entire cost of the mast totalled $10. I spent about $4 for the lumber and approximately $6 for the guy wire.

M. M. Dye, *Texas.*



The mast described by M. M. Dye

Woman's Work in Wireless



Girls at work in the laboratory of the wireless school at Hunter College

Plans have been completed for the amalgamation of women's wireless instruction by the organization of a Woman's Division, National Amateur Wireless Association. The self-training courses prepared for THE WIRELESS AGE are to be adopted by the National League for Woman's Service, to be supplemented by the advanced instruction described in this article.

ONE of the results of the entrance of this country into the European war has been the movement to fit women into occupations ordinarily filled by men. It has fallen to the lot of Mrs. Herbert Sumner Owen to supply the nation with women wireless telegraphers and a radio class has been established at Hunter College, New York City, to carry out the plan.

Mrs. Owen had for a considerable time been making attempts to establish a class for women students of wireless. With the change in public events came a distinctly favorable attitude toward the project. At the same time the National League for Women's Service was organized and Mrs. Owen laid her plans before Maude Wetmore, its president. Then the question of obtaining the necessary wireless apparatus was considered. Edward J. Nally, vice-president and general manager of the Marconi Wireless Telegraph Company of America, and David Sarnoff, commercial manager of the Marconi Company, were consulted and the wireless class was outfitted without cost. The apparatus is the same in every detail as that used at the Marconi School of Instruction in New York.

Doubt was at first expressed as to the attractiveness of this new field of work to the women themselves. Applications, however, were received in greater numbers than could be accommodated, and the first class, consisting of twenty-five women, was opened on March 12th.

The second-class of thirty was opened on April 2d, a third class April 15th, and a fourth class on May 3d. The sessions take place four evenings a week, from 7:45 to 9:45. Each class has one of the students as a commandant. At twenty minutes to eight the class is called to order by its commandant, the roll is called and the "salute to the flag" is given. The door is then locked and remains so for the entire period, so that the tardy members of the class shall not disturb the earnest workers.

The first hour is given over to technical work, the second hour to code. The class is made up practically of self-supporting women, school teachers, clerks, typists, stenographers. etc. There are a few who are of the leisure class.

In fixing the cost of tuition, it was kept in mind that the usual self-supporting woman gets less than a man doing the same work and has comparatively more responsibilities. She decided that $18 would be advisable as a fee for the course of six months. The class will go right ahead with this work, taking no vacation during the summer months.

"This is primarily a preparedness measure," said Mrs. Owen. "Women have shown what they could do in other fields of work. Even now they are signing up as motor drivers or enlisting as clerks or stenographers in the navy. Why, then, haven't we women wireless operators? They have proved their ability as line telegraphers. Why can't they do their bit in this field of work? There are, I believe, not more than a half dozen women radio operators. In time of war men who could do the work on shipboard or at the outposts would be kept at the little island stations attending to their machines. It was for this purpose that the school was opened—to let girls take the places of experienced men operators and release them for more urgent duty.

"Apart from being a war measure, the field offers great possibilities as a profession. In the fifteen years since Guglielmo Marconi sent his first message across the seas by radio telegraphy, the work has grown by leaps and bounds.

"After our girls complete their course they will take the same examinations that men take in the United State Navy. Compared to other fields now open to women, the prospects are good. They begin as assistants with a salary of $30 a month and board. A regular operator gets $60 and maintenance. This rises to a maximum of $120 a month. In those cases where operators are needed for greatly isolated spots, like the Philippines or the Hawaiian Islands, special inducements are offered. Of course, this will mean a new socialization. People will have to accustom themselves to the idea of a woman working alone, away from her immediate family."

The Advisory Board is composed of the following men: Professor Michael Idvorsky Pupin, president of the Institute of Radio Engineers, and professor of electro mechanics, Columbia University, New York City; Professor Alfred N. Goldsmith, director of the radio laboratory, College of the City of New York; Professor Lewis D. Hill, physics department, Hunter College, New York City; Edward J. Nally, of the Marconi Company; Gano Dunn, past-president of the American Institute of Electrical Engineers and president of the J. G. White Engineering Corporation, and John Stone Stone, vice-chairman Radio Engineers' Committee on National Defense. Mrs. Owen is in constant touch with these men. No step is taken without their approval and endorsement. L. R. Krumm, chief radio inspector of the Bureau of Navigation of the United States; lectures to the class. Professor L. D. Hill has charge of the laboratory work. Otto Redfern, also a member of the United States Navy Radio Bureau, and W. C. Hilliker are code instructors.

Mrs. Herbert Sumner Owen is chairman of the National Committee and also of the New York City committee, which has as its members: Mrs. Goelet Gallatin, Mrs. F. Hovey Allen, Miss A. E. Hickenbottom, dean of Hunter College; Miss Lilian M. Snow, registrar of Hunter College, and Mrs. Samuel Strauss.

David Sarnoff spoke before 100 women of the National Woman's Service League, at 38 West Thirty-ninth Street, New York City, at noon, on March 15th.

"There is nothing mysterious about wireless work, and there is no reason why a woman should not do it as well as a man," he said.

"When war comes, and it is, of course, not far off, a large fleet of small boats or yachts probably will be equipped to constitute the body known as 'the mosquito fleet' of submarine chasers. These will take their orders from shore and larger boats by means of wireless. At first utilization of the amateurs and boys probably will be made. Six months from the beginning of hostilities probably 4,000 to 5,000 vessels will be equipped with wireless.

"If the amateur supply is exhausted, and it is considered feasible, they will be apt to take men out of the telegraph or postal service and send them to sea. Women will come in here to fill vacancies. It is possible they will be sent to sea, if the necessity is great enough and their patriotism and courage permits."

The Marconi School has opened its doors to a limited number of the more advanced students for an intensive course of training. Ten of the young women are now taking advantage of this opportunity. Miss Helen Campbell, Miss Elsie Merz, Miss Elisabeth Rickard, Miss Georgina B. Davids, Miss Nell Van Hook, Miss Elise Von R. Owen, Miss Rebecca Parker, Miss Damian Thompson and Ellen J. Cook are among those enrolled.

From all over the United States and Canada Mrs. Owen found applicants for this radio training. Great care is taken to ascertain that the applicant is a loyal American and the oath of allegiance is administered to each student who becomes a formal member of the class.

While the United States has not specifically signified its need of these women's services, it is an open secret that expert radio operators, men or women, will be much sought after within a year. That these girls realize the opportunity placed within their grasp, has been commented upon by all who have seen the class at work; its enthusiasm, absorbed and concentrated attention, clearly indicates the earnestness of the students.

"I try to impress upon each woman who comes to me as a would-be member of our wireless class, that this is no pink tea," said the chairman of the National Committee. "It is hard, gruelling work. Each student must give me her personal pledge that unless something happens which makes it impossible, she will continue her work for the entire course and go up for her test.

"I think a very interesting and stimulating sidelight was thrown on the attitude of mind of these girls and women by a little happening the other day. It was when the parade of Lexington Day was suggested and we were invited to take part in it. The girls told me that if I wished them to do it they would, but that they hated to take the time from their class work and thought they could not spare it. One girl volunteered to take the part of Pauline Revere in the automobile assigned to our division and the others stayed in their classrooms and worked. Doesn't that seem to express a very fine spirit of earnest service? I tell them in my various minute addresses which I give at intervals, to peg away at their work, that every half hour which they give to concentrated effort they are practically giving to the service of our country. They are preparing in the truest spirit to lay their gift on the altar."

One of Mrs. Owen's deepest convictions is that she can not emphasize too much the necessity of serious work. She says "I have no patience with a slack piece of work. It is time and money wasted for anyone to dabble in wireless. Go the whole way or leave it alone. If you want something easy don't take up wireless, and if you do take it up make it worth while. Nobody will want you unless you are a crackerjack."

She also emphasizes the point that women radio operators will challenge the attention of the public and will be objects of criticism. "Look at poor Jeanette Rankin," she said, "One woman and forty-nine men voted the same way, but because she was a woman in a new position every newspaper in the United States held up to the public attention what she voted, how she voted and why she voted. This is the way it will be with the girls and women who go first into the field of wireless telegraphy. We must be extra good, for a mistake that no one would notice if committed by a boy or man, will be held up to ridicule if made by a woman in a new field. Naturally it is so because women have to show what their capabilities are under these new conditions."

Commander John B. Patton, U. S. N., of the Third District of the United States Naval Reserve, made some informative remarks recently on the subject of woman as wireless operator.

"There is this feature of the problem," he answered, "that after she has taken her preparatory work she may take her three months' confirmation, and if she chooses to remain in the reserve may for four years thereafter collect her retainer of two months' full pay annually without performing any service during the remainder of her enrollment if there is no war. In the event that she is a chief operator she would receive $132 a year."

WOMAN WIRELESS STUDENTS THANK THE MARCONI COMPANY

At a recent session of the Wireless Class for Women, National League for Women's Service, Hunter College, New York City, the following resolution expressing thanks to the Marconi Wireless Telegraph Company of America and Edward J. Nally, its vice-president and general manager, was adopted:

"Whereas, The Marconi Company has most generously presented to the Wireless Class for Women of the National League for Women's Service, the complete necessary equipment of apparatus for their training,

"Be It Resolved: That the undersigned members of the two classes now in session at Hunter College, New York City, offer their heartfelt thanks and keen appreciation of his kindness to Edward J. Nally, vice-president and general manager of the Marconi Company."

The resolution was signed by Mrs. Herbert Sumner Owen, chairman of the National Committee of the League; L. R. Krumm, Government Radio Inspector; Lewis D. Hill and Otto Redfern.

Mr. Nally acknowledged the resolution in a letter to Mrs. Owen which is in part as follows:

"It has been a genuine pleasure, as well as a rare opportunity to unite in the efforts being made by so many patriotic young women in the service of our country, and it is with the sincere hope that what they are doing will result not only in good to our country, but in increased opportunity to our young women that the Marconi Wireless Telegraph Company of America has been glad to co-operate with them and with you. Will you please, also, extend to the instructors, Messrs. Redfern and Krumm and to Prof. Hill of Hunter College, my appreciation and thanks for their untiring efforts, and my congratulations upon the success of their labors."

Police Wireless a Demonstrated Success

Views of Commissioner Woods Regarding the System Installed in the New York Department

Wireless telegraphy, which has won many triumphs on land and sea, has proved its worth in a new field—police work. In New York City Marconi stations have been installed at Police Headquarters in Manhattan and at Police Headquarters in Brooklyn, while a set on the police steamer Patrol facilitates the task of guarding the water-front and the craft in the harbor. The system has now been in operation for several months. That it is a demonstrated success is shown by the following statements by Police Commissioner Arthur Woods of New York regarding the use of the art in the department which he heads:

WIRELESS communication has been proven as dependable as the telephone or telegraph service and it has the added advantage of requiring less protection in time of serious trouble. Wires can be cut and communication stopped unless a large force is on hand as a guard. But if the radio station and its power supply are protected, communication cannot be interrupted.

This opinion is based on the practical application of the art in police work —its usefulness as a measure of protection in the event of flood, fire and earthquake, as a means of saving life and property, and in detecting and preventing crime.

Many things are possible in New York, and some of them spell "trouble." It was with this fact in mind that wireless was established in the Police Department. The San Francisco earthquake, the Baltimore fire, the Galveston flood—these disasters all provided illustrations of the value of an indestructible means of communication.

Great and unavoidable calamities visit every large city. Social unrest and economic stress cause some of them, while others are brought about by natural causes, such as earthquakes and floods. And the perils of great fires should not be forgotten. It is during such times that it is of vital import that order be maintained and that life and property be guarded. The responsibility for this rests upon the police and the wireless is an invaluable aid to them during these periods.

Perhaps no better illustration of the worth of the art could be pictured than its application during such disasters when it becomes necessary for policemen in large numbers to be dispatched to the points of danger and the means of communication commonly used has failed. By transmitting orders by radio, policemen can be summoned from headquarters to the scene of disaster even though the danger points be located at a considerable distance from headquarters. Meanwhile the officials at headquarters can keep constantly in touch with policemen at the danger points by means of wireless and give them the necessary orders and instructions.

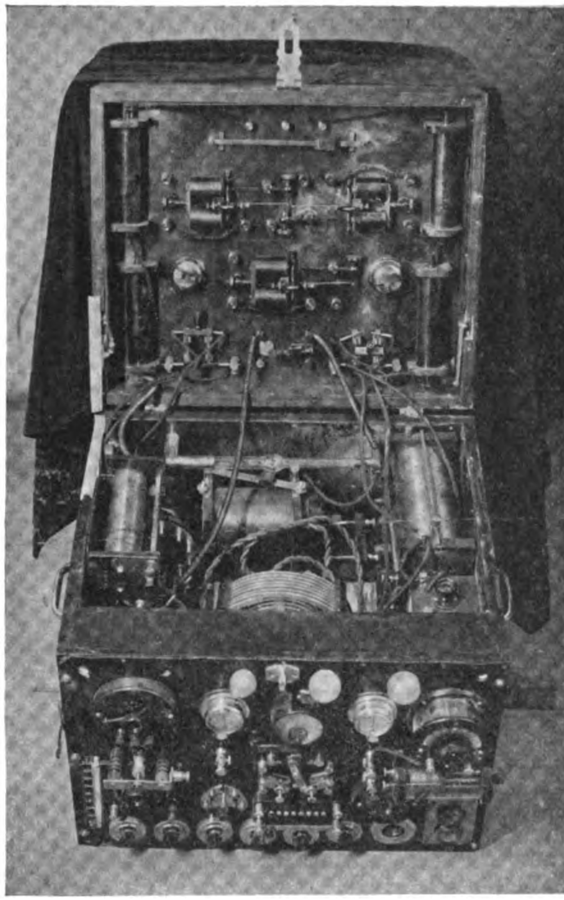
The introduction of wireless in the police department followed the appointment of a "Preparedness Committee" made up of the various police inspectors of the city. Consequent upon the instructions they received to recommend measures for the conduct of the police in time of emergency, a wireless telegraph department was established at headquarters and a class in wireless formed under the direction of Sergeant Charles E. Pearce, who is in charge of the police radio work.

A I K. W. quenched spark gap wireless set was installed on the fifth floor and an aerial was placed on the roof. Interest in wireless among the men in the department was aroused, their diligence in studying the art being shown by the fact that all of the thirty members of the police class have passed the examinations qualifying them to obtain Government licenses to operate stations of any class.

The putting down of mutiny and disorder on the craft in waters near New York is a phase of police work which wireless facilitates. In the past the chief difficulty connected with this work was the inability to quickly dispatch word of the events to headquarters, However, wireless has now been installed on the police steamer Patrol and headquarters is enabled to keep in communication with the steamer while she is cruising about. For instance, Police Headquarters in Manhattan received word recently that two coal barges were drifting, a menace to navigation, in the Hudson River off Fort Lee. Headquarters quickly notified the Patrol by wireless and the latter towed the barges out of the path of other craft. There is the instance also of the steamer D. L. Crowe going ashore on Romer Shoals, the sending out of an S O S by the stranded craft, the reception of the appeal by the station at headquarters, the dispatching of the police steamer Patrol to the rescue and the notification of the Brooklyn Navy Yard, which also sent a revenue cutter to the Crowe's aid.

At some future time arrangements might be made whereby wireless plants, owned or co-operating with Police Department authorities, surrounding towns and cities could aid in the capture of criminals and the recovery of stolen property. If, to illustrate, a stolen automobile has been traced to New Jersey a description of the machine could be broadcasted by wireless and relayed throughout that state.

I have cited only a few of the examples of the use to which the Police Department has put wireless. The future holds many possibilities, among them being the establishment of a wireless service in each of the borough headquarters of the city and the various police inspection districts. And, in my opinion, the efficiency of the nation's police would be increased by the establishment of a wireless police service in each city of the United States.



The wireless apparatus which a swindler used as a "money-making" box

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Following the arrest of a German in New York City recently, detectives took possession of a small black box which the prisoner in his representations to his dupes claimed would reproduce American bank notes placed in it for a day. When Sergeant Pearce, examined the apparatus he recognized it as parts of a portable wireless set capable of receiving messages from places as far distant from New York as Germany.

The set is made up of apparatus of American manufacture, similar to that in many amateur stations. Wireless men said that it could pick up messages from points 5,000 miles away with the proper connections made and the substitution of several missing parts.

An interesting feature of the case was the illustration it brought out of the progress made in police work. It is likely that the seizure of the apparatus by policemen five years ago would have resulted in considerable perplexity regarding its nature. However, the installation of wireless in the department and the training received by its members in radio work has given policemen knowledge of the art which they are able to put to use in various ways.

THE LAST VOYAGE OF THE SIBIRIA

(*Concluded from page 637*)

Walmer had not been idle, but their efforts to reach us were futile. The seas were as threatening as ever at ebb tide, but the ship had sunk farther into the sands and rode somewhat easier. One boat reached a point within a few hundred yards of the Sibiria, but was compelled to put back. We were quite cheerful for a time, despite the failure of life savers to effect a rescue, but in the evening when the tide began to come in and the ship gradually sank lower and lower in the sands some of the hardiest among the ship's company began to lose heart.

How desperate our plight was can be judged from the fact that a wireless message had been sent a few hours before to Dover, saying that if the lifeboats did not reach us that night there would not be any need for them in the morning. As the night wore on some of the destroyers near us began to play their searchlights on the ship and the surrounding waters. But we seemed as remote from safety as before until one of the engineers, who had been peering anxiously out of a port hole in the smoking room, where we had sought refuge, yelled that a lifeboat was in sight. There was a rush to the embrasures, and, in the glare of the searchlights, we could distinguish a small craft within a short distance of the ship. The rescuers had a difficult struggle to reach us, but their boat was of the self-bailing type and it battled valiantly with the seas. Notwithstanding, it took them almost an hour to get a rope to us. Then, as the waters tossed the boat toward the ship, the marooned men, one by one, jumped into the former craft.

But the danger was not past yet, for in this small boat sixty-eight men were crowded. The shipping of one of the waves would have capsized it, and so the next half hour was not without thrills, although the sense of danger was alleviated in a measure by the knowledge that we were in communication with the destroyer by means of signals in the Morse code. Senior Marconi Operator Blackstone transmitted the flashlight messages from the life-boats, using a pocket torch, and after we had cleared the sands a patrol boat was ordered to tow us to Kingsdowne, where we landed.

The Sibiria broke in two several days afterward, dying as she had lived—a stormy petrel to the last.

RACES TO PORT AFTER COLLISION

The Ward line freighter Sagua, with Marconi Operator F. A. Tierney in the wireless cabin, came into collision with the collier Binghamton off Barnegat, N. J., early in the morning of March 19th. Several vessels responded to the appeals for aid sent out by the Sagua and those on the freighter, with the exception of the captain, the wireless operator, mate, cadet officer and purser were taken off the damaged craft.

How Amateurs Are Responding to the Call to Arms

Organization of the Army Reserve Signal Corps

HOW well the National Amateur Wireless Association is carrying out its various aims is shown by the developments from day to day in the movement for national defense. One of the indirect outgrowths of the activities of the Association was the organiztion of the Army Reserve Signal Corps, a radio company, at a meeting in Chicago, conducted by Colonel Samuel Reber and Captain John C. Dillon, of the United States radio service. Colonel Reber is a member of the National Advisory Board of Vice-Presidents of the National Amateur Wireless Association.

When the idea of the National Amateur Wireless Association took practical form it was announced by the acting president of the Association that it would be possible to train a reserve force of competent wireless operators selected from the ranks of amateurs and that those ambitious to join the third line of defence could do so. Attention was called to the fact that in the event of an invasion of this country by an enemy the work of the wireless signaling corps would be of the utmost importance. The movement for preparedness among those active in wireless was given country-wide publicity through articles in THE WIRELESS AGE. Numerous military organizations were then established throughout the country in which members trained in accordance with army signal corps regulations.

The Chicago instance mentioned above is typical of the response. Twenty-two young men showed their sympathy with the movement by enrolling as members of the Army Reserve Signal Corps in Chicago. At the meeting, which was held in the Federal Building, Colonel Reber and Captain Dillon outlined the duties of the members of the company, pointing out what would be required of them both in time of war and during peace. About sixty persons attended the meeting. The first person to enroll in the company was Walter V. Benson. Others who joined were:

J. Lawrence Adams, William H. Ahrensfeld, Barney Baker, Albert Campbell, Charles E. Duncan, Edward P. Gerold, Richard J. Grant, J. N. Hinckey, James Hill, Sr., George V. Hillock, Robert E. Jelinek, D. V. Johnson, Manfred B. Krebs, Gustave Lov, M. R. McNeill, Irley Morrison, Joseph J. Novak, Charles G. Paxton, Henry M. Paynter, Millard Peachar and Raymond H. Perl.

There are many prospective members of the Corps. These include Edwin Werlein, Miron Pearsal, N. Miller, Harry Goldberg, Robert Gorrie, W. E. Carlson, L. E. Otwer, Robert Laidlaw, Raymond Eling, F. Fisher, John Born, L. Peterson, H. D. Stever, E. Brandt and J. E. Clark.

The Association announced recently that it would send its members, upon request, a form indicating the requirements and conditions for preliminary registration for possible Government service to be filled out and returned to the Association. The form will then be forwarded to the proper authorities in Washington for filing until such time as the service of the applicant may be needed.

Following this announcement, Joseph J. Novak, whose name is among those enrolled in the Army Reserve Signal Corps, wrote to the Association: "Noting your 'Call for Service,' . . . I wish to state that I, being a member of the N. A. W. A. . . . have already joined . . . the Army Reserve Signal Corps."

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

L. G. R., Buffalo, N. Y.:

The book entitled "Experimental Wireless Stations," by Philip Edelmann, will give you complete instructions for wiring up an amateur transmitting and receiving apparatus. Pertinent advice on this point is also given in the book "How to Conduct a Radio Club." Copies of these books can be purchased from the Wireless Press, Inc., 42 Broad Street, New York City.

* * *

N. C. D., Norfolk, Va., inquires:

Ques.—(1) I frequently hear the statement that the aerial circuit of a wireless station oscillates at a frequency between 30,000 and 1,000,000 cycles per second. Will you kindly explain how it is possible to obtain a current of such enormous frequency?

Ans.—(1) The statement is quite correct; in fact, frequencies of 1,000,000 and 500,000 cycles per second correspond to the 300 and 600-meter wave respectively. That is to say, when the current oscillates in the antenna circuit at a frequency of 500,000 cycles per second, the length of each wave radiated by the aerial will be 600 meters or approximately 2,000 feet. The length of the wave in any case, can be obtained by merely dividing the velocity of electricity, which is 300,000,000 meters per second, by the frequency of the antenna current. Bear in mind that each cycle of alternating current radiates one complete wave. Current of this frequency is obtained by periodically charging and discharging a Leyden jar through a coil of wire across a spark gap.

Current at frequencies up to 100,000 cycles per second can be obtained by means of high speed alternators or by means of a battery of vacuum tube bulb oscillators. The simplest method, however, of generating radio-frequency oscillations is to charge and discharge a Leyden jar from 300 to 1,000 times per second.

Ques.—(2) How is the frequency of the antenna oscillations determined?

Ans.—(2) By measuring the effective inductance, effective capacity and resistance of the antenna circuit. Usually the factor of resistance is ignored and the circuit treated as if it were practically a perfect conductor.

If the effective capacity and inductance of a simple open oscillator are known, we may use the following formula for determining the wave-length:

$$\lambda = 38 \times \sqrt{L \times C}$$

Where L = the inductance of the antenna circuit in centimeters, and C = the capacity in microfarads.

If a localized inductance is inserted at the base of the aerial, a certain correction factor must be introduced in this formula, which is fully embraced in the September, October and November, 1916, issues of The Wireless Age.

* * *

J. T., Lewiston, Mont.:

It would be well for you and other inquirers along this line to fully understand that a coil of wire does not possess wave-length in the sense which you have placed upon it. Of course any tuning coil has a natural time period of oscillation as an open circuit oscillator which can easily be measured, but to say a coil, for instance, has a wave-length of 5,000 meters and when connected in series with antenna circuit of 1,000 meters, the circuit will respond to 6,000 meters, is incorrect.

The possible wave-length adjustment of a circuit of this kind cannot be determined unless the inductance and capacity of the antenna system in series with which the coil is to be connected are definitely known.

* * *

D. N. R., St. Louis, Mo., inquires:

Ques.—(1) To what extent is the Marconi magnetic detector used as a commercial receiver for a ship?

Ans.—(1) It is used in the great majority of ship stations of the Marconi International Marine Communication Company, Ltd.

Ques.—(2) How does the sensitiveness of this detector compare with ordinary crystal rectifiers?

Ans.—(2) For waves of about 2,500 meters, this detector compares favorably with the best crystals of carborundum, but for the shorter wave-lengths, the carborundum rectifier is distinctly more sensitive.

* * *

D. S. H., Chicago, Ill., inquires:

Ques.—(1) Where can I obtain a historical

recount of the early development of wireless telegraphy, both in the United States and abroad? I desire this material for a college thesis.

Ans.—(1)—A historical resumé of the early development of radio telegraphy will be found in the "Year Book of Wireless Telegraphy and Telephony," on sale by the Wireless Press, Inc.

A fairly complete recount of the early work is also given in Chapter IX of the "Textbook of Wireless Telegraphy," by Rupert Stanley.

"The Principles of Electric Wave Telegraphy," by Dr. J. A. Fleming, sets forth this phase of the wireless situation in detail.

* * *

A. C. R., San Francisco, Cal., inquires:

Ques.—(1) I am a Marconi operator on one of the vessels equipped with a 2 K. W. 500 cycle panel type of transmitter, and I do not clearly understand how it is possible to construct a panel transmitter in a way that will permit the length of the radiated wave to be changed by merely throwing a switch handle. It has always been my understanding that in order to secure the maximum degree of efficiency with any type of transmitter, it is necessary to change the coupling for each change of wave-length. Am I correct in this?

Ans.—(1) It is not only necessary to change the coupling of the oscillation transformer for each change of wave-length, but this is actually done with the modern Marconi panel transmitter. However, instead of changing the coupling by shifting the relative positions of the primary and secondary windings of the oscillation transformer, the necessary change for each wave-length is effected by cutting in or out turns at the secondary winding. It has the same effect as moving the primary away from the secondary or vice versa. The correct number of turns for the proper coupling is found by experiment, but through skill obtained by practice, the inspector is enabled to tune a set of this type within one-half hour.

Ques.—(2) Why is a small reactance coil connected in series with the power circuits on this transmitting set?

Ans.—(2) To reduce the primary power to prevent arcing and excessive voltage at the secondary when the capacity of the secondary condenser is reduced. You, of course, understand that in the 300-meter position of this set only three jars are connected in parallel, but for 600 meters six jars are connected in parallel.

* * *

A. R. F., Schenectady, N. Y.:

Ques.—(1) Kindly explain the difference between spark frequency and oscillation frequency of a wireless telegraph transmitter?

Ans.—(1) The spark frequency of a transmitter is the term applied to designate the number of sparks discharging across the gap per second of time, and to a large extent it is a function of the frequency of the alternator which is charging the condenser; but in the case of an ordinary plain gap it is also governed by the length of the discharge gap, the capacity of the condenser, the voltage of the transformer and the design of the spark electrodes.

The oscillation frequency, however, is the term applied to the radio-frequent oscillations flowing through the condenser discharge circuit during the time of a spark discharge. The frequency of the oscillations in this circuit is governed strictly by the inductance, capacity and resistance thereof. Ignoring the resistance of the circuit, the frequency of the oscillations in such a circuit can be obtained from the following formula:

$$N = \frac{5{,}033{,}000}{\sqrt{L\ C}}$$

Ques.—(2) Is it possible for an amateur to construct an arc transmitter operated from 500-volt direct current, and would the fluctuations of the current on a trolley line prevent its practical operation?

Ans.—(2) An amateur could easily construct an arc transmitter, but it is found that ordinarily they do not operate efficiently on wave-lengths below 3,000 meters; consequently you would have to secure a special Government license even in times of peace for the operation of this set, and it is doubtful whether such permission would be granted.

Undamped short-wave transmitters have not proved a great success so far, although several systems which produce sparks in excess of 20,000 per second have been found to operate efficiently on the shorter wavelengths

* * *

F. R. A., Boston, Mass., inquires:

Ques.—(1) What is meant by the circular mil?

Ans.—(1) In wire measure, a mil is 1/1000th of an inch. The area of a round wire one mil in diameter is one circular mil. If a wire is three mils in diameter or .003 of an inch, then it has a circular mil area of nine circular mils.

* * *

A. D. R., Cleveland, O., inquires:

Ques.—(1) Where can I obtain a complete explanation of the Baldwin ampliphone which has been used so much of late in wireless telegraph work?

Ans.—(1) A complete description of the function of this telephone is given in the book entitled "Practical Wireless Telegraphy," copies of which can be purchased from the Wireless Press, Inc., 42 Broad Street, New York City.

* * *

N. I. D., Covington, Ky, inquires:

Ques—(1) In what respect does the so-called crystal crystaloi detector differ from ordinary crystal rectifiers?

Ans.(1) It merely consists of a mixture of filings sealed up in a space between two metallic lugs. By means of a buzzer tester attached to the detector circuit, the filings are made to cohere and by several tests a sensitive point of rectification is found. Unlike ordinary crystal detectors this one requires a stopping condenser of variable capacity and if one of this type is provided, better results will be obtained.

Ques.—(2) What is the relative sensitiveness of this detector?

Ans.—(2) We have no data at hand. Some amateurs report very good results, but we have nothing to show that the detector is more sensitive than ordinary galena or silicon rectifiers.

Ques.—(3) What is the natural wave-length of an aerial, 90 feet in length and 40 feet in height, consisting of four wires spaced about 2½ feet apart?

Ans.—(3) The natural wave-length of this aerial is approximately 155 meters.

Ques.—(4) What is the wave-length of a four-wire aerial spaced 2½ feet apart, the lead-ins being attached to the center and the flat top portion being 240 feet in length and 30 feet in height?

Ans.—(4) The natural wave-length of this aerial is about 210 meters.

* * *

A. B. G., inquires:

Ques.—(1) How can I test the relative sensitiveness of various oscillation detectors?

Ans.—(1) The sensitiveness of a number of detectors can be compared by means of a shunt box, *i. e.* a calibrated resistance connected in shunt with the head telephone. The receiving detector can be connected in the secondary winding of a standard receiving circuit and the secondary inductance placed in inductive relation to the coil of a wave-meter. If the wave-meter is set into excitation by a buzzer, sounds will be produced in the head telephone, depending upon the adjustment of the receiving detector. By carefully regulating the coupling between the wave-meter and the secondary coil, very accurate resonant adjustment can be obtained.

With the buzzer in operation, the resistance in shunt with the head telephone is gradually reduced until the signals just disappear and if the resistance of a telephone is known, its resistance can be added to that of the shunt (for the least audible signals) and the result divided by the resistance of the shunt. The resultant figure will indicate the increase of strength of signal over the least audible signals in the head telephone. With the coil of the receiving set and the wave-meter in the same position, other receiving detectors can be inserted in the circuit and if the buzzer is heard with lesser values of resistance in shunt with the head telephone it, of course, indicates that the second detector under test is more sensitive than the first one. The ratio of sensibility can be obtained from the ratio of the relative audibility factors.

E. W. T., Sidney, Ohio, inquires:

Ques.—(1) What is the wave-length of an aerial, 85 feet in length, 47 feet in height at one end and 30 feet in height at the other?

Ans.—(1) The natural wave-length is approximately 150 meters.

Ques.—(2) Do you favor connecting the terminals of the primary winding of a receiving tuner across an anchor spark gap connected in series with the earth lead?

Ans.—(2) This connection is feasible if a rugged oscillation detector is employed. such as the Marconi magnetic or a crystal of carborundum. Care must be taken to keep the gap at a minimum length to prevent excessive potentials being set up in the primary winding.

Ques.—(3) Please state the maximum possible height of an aerial that will permit transmission at the wave-length of 200 meters.

Ans.—(3) If a coil of approximately 10,000 centimeters is connected in series at the base to act as the secondary winding of an oscillation transformer, the antenna may consist of four wires, spaced 2½ feet apart, with a height of 100 feet and flat top length of 40 feet, or it may be 80 feet in height and 60 feet in length.

An aerial 60 feet in height with a flat top portion 80 feet in length will have a natural wave-length, with a small coil connected in series at the base, of approximately 200 meters.

* * *

R. W., Portsmouth, O.:

Ans.—(1) You can probably restore your vacuum valve bulb to normal operating conditions by increasing the voltage of the local battery. It may be that you have a defective cell in the high voltage circuit and it would be well to test them individually with a voltmeter.

Ans.—(2) Regarding the regenerative short wave receiver described in the April issue of The Wireless Age: You are advised that the note of the incoming signals will be distorted under certain adjustments, but a fair degree of amplification also can be obtained without destroying the normal note of the spark transmitter.

* * *

S. W. S., Jefferson, Ohio:

You are advised to purchase a copy of the book, "How to Conduct a Radio Club," which contains complete wiring diagrams for the connection of two multi-point switches to vary the inductance of the primary winding of a receiving transformer.

The receiving tuner you have described is not exactly well proportioned. We believe you would obtain better results by winding the primary with No. 24 S. S. C. wire and the secondary with No. 30 or No. 32 S. S. C. wire. If the tubes you mention are wound with this size of wire, the tuner will easily respond to waves up to 4,000 meters.

The loading coil you mention would, of course, increase the wave-length to a certain extent, but just how much would depend upon the dimensions of the aerial.

Your diagram of connections showing the position of the inductance taps is not altogether approved, because it does not permit sufficient closeness of adjustment. One of the switches on the primary inductance should be connected to the first ten or fifteen individual turns of the coil. The second switch should be connected in groups of ten or fifteen turns throughout the entire length of the winding.

* * *

W. W., Wichita, Kan.;

We cannot undertake to answer queries regarding the origin of mysterious wireless signals, nor the call letters of stations which are not listed in the International List or in the Government Call List.

Your second and third queries are fully answered in the book, "How to Conduct a Radio Club." It is found that the average receiving tuner gives the best response when the variable condenser in shunt to the secondary winding is set near to zero values of capacity. This affords a maximum voltage across the terminals of the crystal detector and therefore gives greater response. The reason you cannot use larger values of capacity at the secondary condenser is probably due to the fact that your tuning coil already has sufficient dimensions for resonance with the incoming signal; hence the addition of capacity across the secondary turns merely throws the circuit out of resonance and therefore decreases the strength of the incoming signal.

In the book, "How to Conduct a Radio Club," the dimensions of an inductance coil for an amateur's wave-meter in connection with a Mesco variable condenser are given. We cannot undertake to calibrate for you a wave-meter made up of a condenser and coil of other dimensions.

* * *

D. B. M. C. G., Aurora, Ill., inquires:

Ques.—(1) Please state the approximate wave-length, inductance and capacity of an inverted L aerial 100 feet in length and 75 feet in height, consisting of four wires of No. 14 copper wire spaced about 2 feet apart.

Ans.—(1) The capacity of the aerial is approximately .0004 microfarad, the inductance about 76,000 centimeters and the natural wave-length close to 220 meters.

Ques.—(2) Could the wave-length of this aerial be reduced to 200 meters by use of a series condenser?

Ans.—(2) A series condenser consisting of three plates of glass, 8 inches by 8 inches, covered with tinfoil, 6 inches by 6 inches, all plates being connected in series, would reduce the wave-length of this aerial to approximately 200 meters if the antenna inductance were properly adjusted.

H. C. B., Rochester, N. Y.:

To operate a 1/4 or 1/2 K. W. set at the wave-length of 300 meters, we advise you to employ a condenser of .008 or .01 microfarad. Each plate of glass 8 inches by 8 inches, covered with tinfoil, 6 inches by 6 inches, will have an approximate capacity of .0005 microfarad. Therefore twenty of these plates connected in parallel will have a total capacity of .01 microfarad. If a series parallel connection is required, you would need eighty plates, forty connected in parallel in each bank and each bank connected in series.

To operate a 3/4 or 1 K. W. set at the wave-length of 600 meters, the capacity of the condenser should be about .015 microfarad and you will, therefore, require thirty of the small plates connected in parallel, or for a series parallel connection 120 plates. Sixty plates should be connected in parallel in each bank and the two banks should be connected in series.

* * *

W. T. R., Weymouth, Mass., inquires:

Ques.—(1) Would it pay me for the trouble to purchase a second-hand automobile spark coil for transmitting purposes?

Ans.—(1) The secondary output of the average coil of this type will not permit a transmitting range in excess of four or five miles.

Ques.—(2) Would you advise the use of a condenser in connection with this spark coil? What should be its dimensions?

Ans.—(2) Lacking knowledge of the secondary voltage, it will be difficult to answer, but ordinarily a condenser of .003 or .005 microfarad will be quite sufficient.

* * *

E. S., South Norwalk, Conn.:

It is quite likely that the power line which you mention will cause some interference with the operation of your receiving set.

Ordinarily, for receiving purposes, two wires will give as good results as four wires.

The average amateur's transmitting aerial has four wires, spaced about 2½ feet apart.

Complete data for the natural wave-length of wireless aerials appeared in the November, 1915, issue of The Wireless Age. Note carefully the wave-length curves given in that issue.

* * *

J. R. H., Winnipeg, Manitoba, inquires:

Ques.—(1) I have intended to construct a wave-meter for a considerable time past, but as I have no means of calibrating one I should like to know if it is possible to construct a wave-meter which does not require calibration.

Ans.—(1) In the book, "How to Conduct a Radio Club," the dimensions of an inductance coil which is to be fitted to a certain type of Mesco variable condenser are given. If the dimensions of the coil given in this book are carefully duplicated, the wave-meter will not require calibration. A complete table of wave-lengths, which will be accurate within two or

three per cent., is supplied. This will be sufficient for the average amateur's requirements.

* * *

C. T. P., Stryker, O.:

The current output of the average crowfoot gravity cell is rather low and consequently you would require a great number of cells connected in series parallel to operate an induction coil. A battery of the Edison-Lalande type would give a greater current output and would be more satisfactory for the operation of low-powered apparatus.

You, of course, understand that amateur stations throughout the United States will be closed during the war, and consequently an answer to the remainder of your queries would be of little value for the present.

The "Military Signal Corps Manual," by Major J. Andrew White, will be placed on sale by the Wireless Press, Inc., within two or three weeks.

* * *

G. D. T., Ala.:

Regarding your query about aluminum electrodes for the Clapp-Eastham transmitters: We do not know where these can be purchased.

* * *

C. D. M., Port Lauderdale, Fla.:

Your calculations regarding the wave-length of an aerial are totally wrong. You cannot state that a loading coil has a certain wave-length in meters, say, for example, 300 meters, and that when connected in series with an antenna of 150 meters, the possible wave-length adjustment will be 450 meters.

The effect of any loading coil upon a given antenna circuit depends upon the inductance and capacity of the aerial, and unless these values are known, the possible wave-length adjustment cannot be calculated in advance.

You would do well to study the book, "How to Conduct a Radio Club," which will aid you in solving the problem set forth in your communication.

* * *

N. G., Whitewright, Tex.:

Your 1½-inch spark coil can be operated from a 110-volt alternating current by connecting a small sized electrolytic interruptor in series. You may have to insert a ballast resistance in series so that the coil will not draw excessive current.

The book, "How to Conduct a Radio Club," contains complete data for calculating the wave-length of your aerial and also gives dimensions of an oscillation transformer suitable for a 200-meter transmitting set.

* * *

F. T. H., Waterbury, Conn.:

Your aerial, 120 feet in length with an average height of 50 feet, has a natural wave-length of 205 meters, and if you will attach the lead-in wires to the center instead of to the end of the flat top, you can work this aerial at the wave-length of 200 meters without a series condenser.

A half-pint Leyden jar should give good results with a 1-inch spark coil provided the length of the spark gap is properly adjusted.

The average small spark coil gives a better sending range by connecting the spark gap directly in series with the antenna. Many amateurs, however, contradict this statement and say that they have been able to transmit farther with an oscillation transformer. Our experience, however, has been the reverse.

In many localities the Government authorities (in times of peace) will not permit an amateur set to be operated with the spark gap in series with the antenna. An oscillation transformer is positively required.

* * *

C. F. M., Detroit, Mich.:

Mere knowledge of the number of feet of wire included in a tuning coil does not give us sufficient data from which to make a calculation of the possible wave-length adjustment of your receiving set.

The buzzing sound you hear is undoubtedly due to induction from nearby power lines.

* * *

R. E. G., Lowell, Mass., inquires:

Ques.—(1) Where can I purchase a vacuum pump and glass battery jars of large size?

Ans.—(1) They can be purchased from Eimer & Amend, 211 Third Avenue, New York City.

* * *

J. H., Sharon, Pa.:

The aerial you describe has a natural wave-length of slightly less than 200 meters, and consequently you will not require a series condenser.

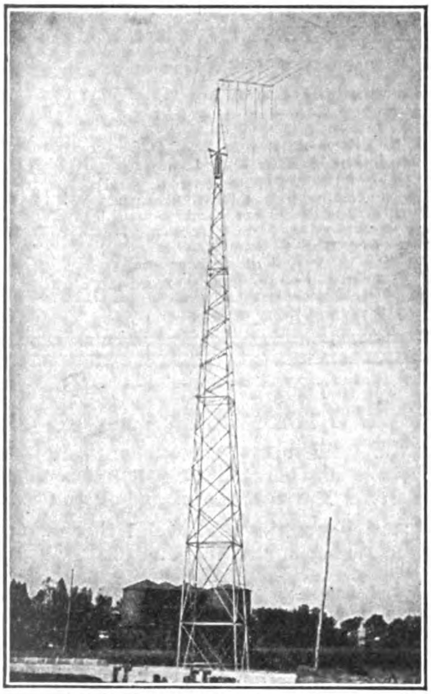
The regenerative receiver is the type of vacuum valve circuit where the local telephone circuit is coupled back to the secondary winding of the receiving transformer through a small oscillation transformer. Connected in this manner the oscillations of radio frequency repeated in the local telephone circuit by the vacuum valve are reinforced upon the grid circuit through a small oscillation transformer and increased strength of signals is thus obtained. The circuits for this receiver are fully described in the book, "How to Conduct a Radio Club."

* * *

J. W., Dorchester, Mass.:

The actual receiving range of a given receiving station is in any case best determined by experiment. There are so many conditions effecting the reception of radio signals and the possible range that it will be difficult to answer your query directly.

In time of peace, when you are permitted to use your receiving station, you should tune up to stations within range and look up the stations corresponding to their call letters in the Government Call List. In this way, after a week or two of experimenting, you will be enabled to determine the range of your apparatus.



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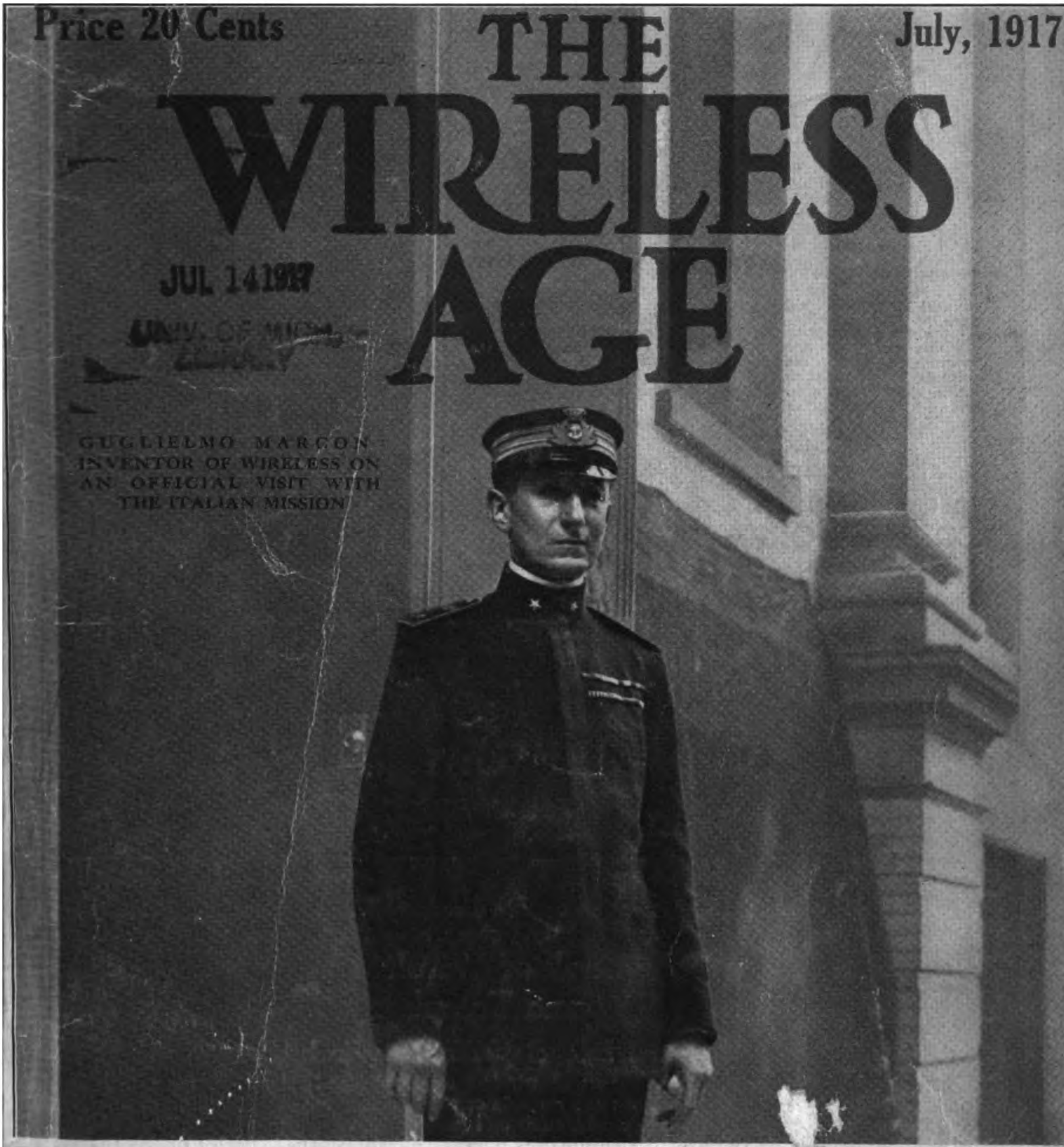
THE WIRELESS AGE



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THE NEW FACTOR IN WAR

ACCUSTOMED as most persons are to consider war as waste and devastation, it is hard at first to reconcile economics of a permanent order with a view of a nation in arms. Nevertheless, there is such a thing as an economic aspect to war. For mere consideration of the old saw which has to do with necessity being the mother of invention, starts a train of thought which makes it at once obvious that the new inventions required by exigencies which brook no delay have permanent and far-reaching values in the scientific advancement of the world.

Nothing is more significant, for instance, than the daily growing conviction that dominion of the air will ultimately transcend in military importance dominion over the sea, which last has always been considered the deciding factor in the conquest or defense of continents. Air superiority being obtained by preponderance of skill and equipment in the fields of aircraft and radio communication, command of sea and land, therefore, resolves itself largely into superiority of intellect and intensive application of a nation's scientific men. Confidence in the vision and resourcefulness of American military officers is not misplaced; they have no superiors in fighting leadership and will quickly absorb the knowledge of men experienced in the highly modernized warfare. It is obvious, therefore, that, backed up by the skill and resourcefulness of America's scientific men and industrial giants, the national initiative, courage and organized engineering skill will produce for the Allied Powers the means of obtaining the air superiority of flying machines and wireless.

In this situation lie tremendous possibilities for service to the nation in the radio field; inventiveness is more than ever at a premium and every worker in the art will best discharge his patriotic duty by beginning intensive study of military requirements and needs.

The experience of service under field conditions is of first value, and the way to enlistment is easy.

Laboratory or workshop experimenting for those who, for any one of a number of reasons cannot take the field, is an obligation recognized throughout the fraternity as the greatest in history. If ever in the period of the art's development unremitting application has been needed, it is now; this is no time for the wireless man to lose interest. The most important work still remains to be done within the confines of a single room or building; research and experiment is a patriotic function which all are required to discharge.

THE WIRELESS EQUIPPED AIRPLANE

THE very exigencies of war which give it an economic aspect also promote seemingly strange and unusual relationships. Each day sees some reversal of form in matters which have hitherto amounted to veritable traditions. It formerly was considered, old-timers will recall, a highly subtle form of humor to refer to the "horse marines." Yet the mental spectacle of a mounted soldier of the sea is hardly less reconcilable than the latest development of the Army Signal Corps—a 52-foot power boat which Yachting announces is now being built for this army corps. Just why our soldiers are sailors too in this connection, is revealed as a development of airplane work, the boats serving as tenders to the coast patrol, wireless-equipped 'planes.

To date, the wireless-equipped airplane has been considered a more or less theoretical proposition. But, meagre though details may be, reports of efficiency in this field are steadily coming back from the fighting zone. Where once the world was given to understand that wireless on aircraft had been tried early in the war, and quickly abandoned, it is now generally understood to be the combination of greatest reconnaissance effectiveness and fire control value. With power generation solved—as it seems to be—within the required lightness of weight, development of radio for airplane use will rapidly advance. Little can be learned yet of what the warring nations have accomplished in the field, but it is reasonably certain that American wireless men, under the spur of wartime necessity, can do as well, if not better, within the same limits of time.

There are two recent announcements of aviation development of especial interest. One is the claim of an inventor that the stabilizer has now reached a stage of perfection that the pilot can fall asleep at the wheel, allowing the airplane, through its automatic action, to alight safely. Even though this claim be slightly exaggerated, it is obvious that stability is a small cause for worry when at least one hundred airplanes rise for reconnaissance every day on the fighting fronts and fatalities are so few. Of even greater interest is the other announcement, that the wireless-equipped 'plane is the most valuable tool in the hands of our Allies for spotting submarines. It is a fact that aircraft flying overhead can trace the path of the submarine below the surface of the water, and by reporting its position by wireless warning is given to nearby merchantmen to escape or war vessels to destroy the undersea craft.

The Government's appropriation of close to eighteen million dollars for aerial preparation indicates conclusively how large the aircraft will figure in our military plans; where wireless-equipped, as a large percentage will be, wireless men will be needed for installation and operation. Under war conditions the art is growing, not being contracted as some might think. More and better opportunities exist right now than ever before, but the call is for perfection—knowledge is the quality sought. This is the time for intensive study, for amateur as well as engineer.

THE ROUND-UP OF GERMAN WIRELESS AGENTS

GERMAN spies and German agents have held the limelight lately and the startling disclosures of machinations wireless borne have set up a buzz of excited comment throughout the nation. The one clear item in the whole situation seems to be that uncovering plots to smuggle military information out of the country cause great surprise. Why this should be so is not clear. Certainly, if England has not yet been able to rid itself of German secret agents established there before the war, the United States has less chance of clearing out the many here who long have had virtually unrestricted sway for their German propoganda. That the German spy machine did not collapse with our entrance into the war is obvious; if anything, it was to be expected to carry on its function with renewed energy.

Exposure of the scheme to ship wireless equipment into Mexico created a sensation, for with the arrests of three plotters in New York the Commissioner noted that: "In a situation of this kind one is reminded that while our people did not even know of the departure of our destroyers for the war zone the news was published in Berlin four days ahead of their arrival on the other side. I take it, it is in the mind of the Government that this may be part and parcel of the same iniquity." When it was further announced that the elaborate plots of Germans had added one more failure by the seizure of the apparatus by our secret service agents the nation's figurative sigh of relief was tempered with a thought of future possibilities. So the details of the method of supplying apparatus were sought. Briefly, the facts disclosed were these: The apparatus shipped by Harry F. Perissi, New York agent of the Allgemeine-Electricitats-Gesellschaft, or General German Electrical Company, and his accomplices to the Mexican agents of that concern got no further than Vera Cruz, where it was seized through the work of agents of the United States Government, and is now in the possession of the Department of Justice. It did not get off the piers at Vera Cruz. This apparatus was shipped from New York in January.

It is believed that none of the apparatus sent into Mexico was ever put into operation. Some of the papers seized disclosed the activities of agents of the German Government who had been assembling wireless parts in the back of a store in Greenwich Street. During November several of the machinists working on the job, who were Americans, finding out what they were doing, quit their places, and when the owner of the property exhibited curiosity as to what was being done on the premises the "factory" was moved to another house in Greenwich Street, where, the police said, the outer room was disguised as the office of a tea and coffee importing house.

It is not clear why the German electrical concern which Perissi represented did not manufacture wireless plants in Germany instead of here. The police and detectives have found at least 150 plans for wireless outfits, drawn in great detail, and they have also found that all the plans and bills were approved by one man, supposedly a German agent, whose name is withheld until it is assured that he is not in New York. The authorities consider it probable that he is in Mexico. He is believed to have been assigned by the German Government to the task of establishing a system of wireless communication between America and Germany by means of stations in Mexico and Central America.

While the authorities feel confident that the German attempt to send wireless outfits from New York to Mexico was a failure, they are not confident that outfits were not sent to Central American countries and set up. There have been frequent reports of powerful wireless plants working from Central America, and some months ago the authorities at Colon found a complete outfit destined to a Central American consignee.

In view of this condition it would be interesting to know what steps have been taken to detect possible operations of Central American outfits of German origin. What the lay public may accept as reassurances are not so reassuring to wireless men. As an instance, the official word of Mexico that no station in that country exceeded 625 miles in transmitting range sounds impressive. But this distance spanned, with an ocean relay or two, would carry a message to Berlin. And so far as incoming instructions are concerned there are certainly no difficulties in receiving from Germany or hostile vessels and putting the messages over the border on short wave-lengths, undetected by naval stations. An espionage system made up from amateur stations now inactive would certainly detect in short order strange spark notes, if these existed, for the amateur man is familiar by long practice with virtually every note within his receiving range.

Once the bustle of war preparation subsides, the question of utilizing the valuable amateur receiving equipment will be a pertinent subject for Government consideration. At the proper time representative men in the experimental field should be summoned as a committee to work this out on a practical basis. Meanwhile, amateurs may be of real service in reporting promptly anything of a suspicious nature in wireless equipment. Several cases have been so reported to The Wireless Age and prompt action has been taken by the authorities in the various districts from which the information was supplied.

WIRELESS INVALUABLE IN WORLD EVENT

THROUGH correspondence from Bassett Digby in Stockholm an explanation is given why the United States was puzzled over the fact that the first announcements of the Russian revolution reached America from the Nauen wireless station, by way of Sayville, L. I., thus coming from Berlin. The explanation is quite simple.

The first word about the revolution, despatched by the Petrograd Telegraph Agency, was sent by wireless. It reached every capital in Europe simultaneously. The news at once went into print for home consumption in the neutral countries, Germany, and Austria. Some of the entente allies, however, including Britain, held up publication until they received confirmation from the ambassadors at Petrograd. British censors held up all news cables from neutral countries to America which dealt with the revolution until the Foreign Office got a wire from Sir George Buchanan, on the strength of which Bonar Law made his famous declaration to the commons of the abdication of the czar.

In the meanwhile Berlin, free of these restraints, relayed the message to Sayville by wireless.

Had not Marconi invented wireless telegraphy the Russian revolution would have been far bloodier—and it might not have succeeded.

Wireless played a tremendously important part in the democratic upheaval that freed the Russian people from the shackles of the old regime.

There was a period of grave danger in Petrograd when the revolutionaries seemed to be getting the upper hand and the adherents of the czar's corrupt ministry sought to hide themselves. For some hours the wireless stations in the capital were left without authorized supervision or direction. Any group of armed men representing themselves to be delegates of the Duma and producing forged authorizations could have taken charge and directed the despatch of military secrets invaluable to the German army. Such messages need not have aroused the suspicions of the operators, for they could have been in code.

Tidings of this emergency came to the ears of the war committee at the Duma, which immediately formed a wireless division in charge of Captain Roder.

First, strict control was gained over the stations in Petrograd and Finland. Then, one by one, the outlying wireless stations of the empire were talked to and won over to the side of the revolutionaries. In many of these outlying stations the old regime still held sway; the town and provincial governors were not yet dismissed. The stations agreed to accept any amount of messages from them, but merely to spike them without transmission. Thus cohesion between the governors was badly damaged.

In a few hours the Duma was in free communication with the wireless stations in Finland, Tsarskoe Selo, Moscow, Kronstadt, Turkestan, and Siberia. It was in close touch, too, with the Baltic and Black Sea fleets, and the naval station at Vladivostock.

Not taking any chances, the Duma rigged up a special supplementary station at its Tauris palace headquarters, so that should squads of Protopopoff's gendarmerie temporarily regain possession of the regular city stations communication with the world would still be possible. The Duma station was kept busy receiving foreign news and despatches from diplomatic sources in the allied countries to the west.

Telegraph and telephone service all over Russia in the meanwhile was broken or badly disorganized. The Duma station was used not only by the provisional government, but by the obstreperous and anarchic council of soldiers and labor deputies.

THE UNUSUAL EMPLOYMENT OF RADIO AT THE FRONT

FROM the same source comes an interesting description given by a Russian officer of one of the numerous little mobile field wireless outfits operating near the front. The whole wireless station can be unloaded from its auto truck, rigged up and be ready for work in twenty minutes. The seventy foot masts are hollow and madé in sections which are screwed together when taken off the truck.

The simple peasant soldiers, many of whom come from remote villages where wireless has never been heard of, are greatly fascinated by the station and like to stand around when they can get a chance and watch the flashing of the spark and listen to its song. "It sounds like butter in a frying pan," they say. They have coined a nickname for the men in the wireless crew, which, as near as possible in English, is "sparkers" or "the spark men."

Normally the station is quiet. In the little cabin, canvas walled and canvas roofed, sits an operator with a telephone cap clamped to his head, always waiting for instructions from "the line," which is another name the Russians have for the trenches.

Often it is absolutely quiet outside in the starry night around the station. Not a shot breaks the stillness. But through the operator's phone comes the uproar of rifle and machine guns, and the bombardments of the heavy batteries, for messages are phoned to him for transmission from dugouts right up on the firing line of the front, twenty or thirty miles away.

These little stations catch the entente's daily communiques, and those of the German and Austrian general staffs. They come at definite times. Sometimes one sees the operator hurriedly finishing a meal or refusing a third glass of tea. He explains that French headquarters will want to talk with him in a few minutes. And, sure enough, in a few minutes along comes France's communique. It is odd to stand a little way off and, glancing at the forlorn canvas hut and its two sticks, lost in the drifted snows, with no other signs of life in sight, hear the aerial voices of all Europe.

Officers visiting the station make a point of getting the right time. The operator nightly sets his watch by the midnight time signal flung out by the Eiffel tower in Paris.

The longest official communiques sent through the air every day are those of the Germans. They are signed by Ludendorf. From Germany, too, every day comes the Radio Gazette, in condensed form—a sort of aerial condensed newspaper, which is dilated and worked up into the daily flysheet newspapers distributed to the German troops on all the fronts.

The station does not have much to do at times of lull on the front, as then all the staffs are linked by telephone and telegraph wire. Its busy times come during the battles.

Some of the mobile stations do much service with floating cavalry units, by which they are prized. During the great Russian advance in Volhynia and Galicia last summer, for instance, cavalry squadrons kept in touch with their bases while pursuing the retreating Austrians almost exclusively by means of these auto wireless outfits that accompanied them wherever they went.

—The Editor.

INTERFERENCE BETWEEN RADIO STATIONS

ITS CAUSES, EFFECTS AND CURES

A Guide Compiled from Expert Opinion on this Important Subject

Part II of the Series, The Control of Wireless—Federal Government Monopoly or Private Enterprise?

Does interference between wireless stations of the United States Navy and those of the commercial companies prevail to a degree that their work is hampered? Is it avoidable? Who is to blame? Does it warrant the taking over by the Government of all commercial stations? Is its existence an incentive for the development of technical discovery and invention?

The following pages present an exhaustive review of all the arguments made on this subject, as brought out in the recent hearings before the Committee of the House of Representatives, held to decide the merits of the proposed bill for the regulation of radio communication.

The Government view was presented by leading members of the Administration and prominent naval officers.

The views held by scientists and heads of the commercial companies were advanced by men eminent in the field of wireless research and officials of wireless companies.

The testimony of Government witnesses is printed in Roman.

The testimony of those favoring the maintenance of private control of wireless enterprise is printed in italics.

Following is a list identifying those who expressed their views on the subject:

Hon. Josephus Daniels, Secretary of the Navy.

Professor Alfred H. Goldsmith, professor in Physics at the College of the City of New York.

George H. Clark, expert aid for the Bureau of Steam Engineering, Navy Department.

David Sarnoff, commercial manager of the Marconi Wireless Telegraph Company of America.

Hon. William C. Redfield, Secretary of Commerce.

Professor M. I. Pupin, of Columbia University.

Dr. L. W. Austin, expert in radio telegraphy for the Navy Department.

Professor Arthur E. Kennelly, of Harvard University.

Lieutenant S. C. Hooper, United States Navy.

Commander D. W. Todd, United States Navy.

George S. Davis, general superintendent wireless department, United Fruit Company.

Hon. Newton D. Baker, Secretary of War.

Professor Charles F. Marvin, Chief of the United States Weather Bureau.

Lieutenant R. R. Waesche, United States Coast Guard.

Captain W. H. G. Bullard, United States Navy.

Secretary Daniels: This mutual interference between stations has always been a very serious question. Many inventors have been and are working on the problem and great improvements in apparatus and methods have resulted, but the number of installations and the consequent extension of radio communication have increased faster than science has increased its possibilities as regards non-interference, while the constantly increasing distances over which these communications take place increase the difficulty to a very great extent. The net result is that the number of communications that can take place at the same time in a given area is still limited. One station or system must wait for another to finish; there are many chances for disputes, which sometimes are carried on between operators by radio, especially when the operators are not under strict control, adding to the time wasted. There is needless duplication of effort, and in cases of distress the confusion resulting from many interests attempting to render aid, get news, or satisfy curiosity, is very dangerous. To permit the greatest amount of business, Government and commercial, being done through consistent changes in apparatus, through systematic apportionment of and prompt and frequent changes of wave-lengths, and through standardized methods of operating, one management is necessary.

Professor Goldsmith: *The proposed act is untimely and useless as a means of eliminating interference, which should not be legislated out of existence by the extinction of healthy development, but avoided by sound engineering expedience. The success of the latter method of procedure is unanswerably demonstrated by the remarkable development of the wire telephone field along engineering lines. The proposed act is in this regard to the last degree reactionary and unimaginative.*

Secretary Baker: The transmission of wireless messages is a thing in which interferences are so destructive that unless somebody controls the means of transmission, nobody can succeed in it.

Professor Pupin: *If interferences exist on account of the present imperfection of the wireless art, then these interferences should be eliminated, not by legislation, but by perfection of the art.*

Commander Todd: Some gentlemen state positively that, with their devices, it is quite possible to have as many conversations as there are telephone wires, or something like that. They have been saying that since about 1909, but they have not yet been able to demonstrate the practicability of their devices. We still have the interference. These inventions are still just about to be given to us.

Professor Goldsmith: *The problem of interference is sure to be solved in the near future by technical means now under development by the companies, through such expedients as sustained wave radiation, beat reception, and certain other methods not as yet published.*

Secretary Redfield on the Disadvantages of Two Systems

Secretary Redfield: The two systems of coastal stations, one owned and operated by the Navy Department and the other by private companies, not only involve an economic waste to the people of the United States, who must support directly or indirectly both of them, but they also at times and in places interfere with each other, and prevent each other from efficient operation, owing to the imperfect development of the art of radio communication. Each deprives the other to an extent and at various times and places of its full measure of usefulness.

Professor Pupin: *In April,* 1914, *when our bluejackets had landed in Vera Cruz, the Navy could not force a message through between Arlington, or even Key West, and Vera Cruz. It was impossible, not because the Mexicans had a wireless apparatus which interfered with ours, and not because anybody else had* *it, but because there the static was going on in the Gulf of Mexico and prevented our messages from reaching Vera Cruz. Interference in wireless telegraphy due to static, is so serious that sometimes a wireless station can not receive a message for forty-eight hours or even twice forty-eight hours. These are the most serious interferences we have, and you cannot get rid of them by legislation. The only way to get rid of them is by perfection in the wireless art.*

Lieutenant Hooper: I have come to the belief that the interference question is absolutely unsolvable except by Government ownership of coast stations. It can always be proved, apparently, by the scientists, that we should not have any interference, but it cannot be done. In the operation there is interference all the time between the ships, between ship and shore stations, and between rival shore stations, and there always will be unless the Government takes over the coastal stations. I have heard it stated, even recently, that there is no interference between the Navy and shore stations, and yet you can go into any locality at any time and see that there is the most serious interference. You have two or three stations in a restricted area, and one has to wait until the other gets through. It would be much more efficient if you had just the one station there handling all the work, and there would not be any argument about it any time.

SUPPRESSION OF COMMERCIAL STATIONS WOULD NOT SOLVE THE PROBLEM

Professor Kennelly: *So soon as you have scrapped and suppressed the power stations, the commercial stations, you will still be bothered in the antiquated system in undisputed control of the Navy that no longer has interference from power stations—it will still be bothered by this man here and this little amateur there. The whole system will be one of repression and star-chamber action and confiscation.*

If you will go to some central radio station with a big tower anywhere in this country and listen in, you can hear hundreds of people talking to each other, most of them without any interference at all—only occasional interference. It is so when we are talking to each other in a room, using the same air. We have no quarrel, one against the other. We all have difficulties. The real difficulties are capable of being overcome.

Professor Marvin: As long as interference exists as at present, a proper distribution of the stations along the coast will improve conditions. In our Weather Bureau work we experience the ill effects of interference in the transmission of weather reports. There was a case reported a short time ago of a vessel trying to communicate its report to a Government coastal station, but could not do so on account of interference with one of the commercial stations operating at the same time. The commercial station was requested to desist, but declined to do so. These weather reports are made up at a certain hour in the morning and have to be forwarded at once. If they are received in time, we utilize them, but if they are delayed in transmission, our forecasts and warnings are issued without the information contained in those messages. And when those cases occur we do not know what the conditions at sea may be, and very great importance attaches to some of these reports. Naval vessels plying the coast, or merchant vessels, may know of conditions off the coast of which we have no knowledge, and the report from them, in conjunction with the reports from our land stations, gives us an idea of meteorological conditions that may enable us to send warnings of immense value to the shipping along the coast; whereas failure of a report of that kind to come through means a serious loss to the interests.

Mr. Davis: *Until the establishment of a system of stations by the United Fruit Company, there were no adequate means of getting information to the Weather Bureau in regard to storms or approaching storms which cross these waters at certain seasons of the year. I refer particularly to the hurricanes* *which pass up through the Caribbean Sea and the Gulf during the late summer months, and which have proven so disastrous to shipping and to the cities of New Orleans and Galveston and, in fact, to the entire Gulf coast. It is almost entirely through the fruit company's system of stations (and I think that the Weather Bureau will bear me out in this statement) that they are enabled to receive these observations in time to issue warnings which have saved millions of dollars in shipping in the Gulf and Caribbean Sea. True, there is still room for improvement in this service, and we are taking steps to the end that these "observer" messages on which the Weather Bureau bases their forecasts can be dispatched from any point in the Caribbean Sea to New Orleans, and thence to Washington in the shortest possible space of time after they are made. Some of these messages are sent in via the naval station at Guantanamo, but the great majority come in through stations of the fruit company's system.*

The relative opportunities for naval men and civilian scientists becoming wireless experts is covered by the remarks of:

Commander Todd: Ordinarily, in my position, I would stay fully three years ashore. My predecessor stayed nearly four years, but that was very unusual.

Having this matter in charge, I could stay longer by special arrangement.

But it would jeopardize my career. I might make myself a sort of a radio scientist and a very poor naval officer. I must go to sea to learn my profession and to keep in the game, so to speak. We are all anxious to be known as seagoing officers, efficient on board ship above all else.

Professor Kennelly: *Take Captain Bullard. He was in charge of this naval radio station service up to a little while ago. Where is he now? I understand that the Navy Department has called him away, and he has forgotten all about this wireless subject by now. And by the time he is through serving on his ship, in his line of duty, he will find himself behind in the art. Are you going to put this art into the hands of officers who will be taken from one post to another and have all of their efforts thrown to the winds?*

Dr. Austin: The claim is made that if these scientists were left to themselves they would solve this problem of interference; but of course we all know it has not been solved; and that it is only by regulation and control by one central body that successful working can be carried on. And a more complete control would, in my opinion, give even better conditions of working than those which we have to-day.

How Interference Brought About Telephone Improvements

Professor Kennelly: *It was in America that all the important improvements have come about in the telephone as a direct result of interference. In the early days of the telephone you could not talk to your neighbor without hearing all the neighborhood. Inventors came forward, all the brightest minds in the telephonic art were stimulated to do something to overcome this difficulty. But now if you are going to introduce a plan to suppress this interference because it has been causing a little trouble and been preventing some one Government officer from hearing another Government officer, of course, you will have a fool's paradise for the time being. But what of the hereafter?*

Lieutenant Hooper: The radio art is in its infancy now and there are a few big stations, but if they are allowed to go on increasing in number nobody will be able to work at all. It is something you can not see, and therefore you do not realize the conditions that exist. If you saw two trains trying to pass each other on the same track you would not permit it; it would be stopped right away. This is a similar condition; but you do not see it and therefore the seriousness of it does not dawn on you.

Professor Pupin: *Ordinary telegraphy and telephony by wires had the same experience in their early history as we are having in the wireless art. They had inductive disturbances of two different kinds, those produced in a wire by the operation of other wires, and inductive disturbances produced by God. Now although it is possible to get around the inductive disturbances produced by man through legislation, you can not get around those created by God, by means of legislation.*

Commander Todd: We must have flexibility in our range of wave-lengths in order to get away from the intentional interference of the ships of the enemy. The enemy will attempt to break up all our communication by sending signals on the same wave lengths we use. Therefore we must have a wide range of wave lengths from which to choose, and methods for shifting from one to another every few signals, if necessary, and in that way to keep ahead of them. It is understood that some nations have elaborate arrangements for interfering, and they have arrangements by which they can, at the same time they are interfering, get through their own communications. All this has been studied. We are doing the same thing and trying to do it better.

Government Ownership of No Avail in This War Emergency

Professor Pupin: *What legislation is going to prevent the enemy in time of war, from interfering with us? It is told by the English wireless operators who took part in the battle off Falkland Islands, that the Germans, as soon as the battle started, went up and down the scale of their wireless sparks for the purpose of making it impossible for the English ships belonging to that squadron to communicate with each other. How could any act of legislation or Government ownership have prevented that?*

Commander Todd: Unless Government ownership is accomplished, the time will come when one station will insist on saying that it has as much right to work as another station. Where interference is greatest, there are ordinarily three interests involved, the Navy and two others. We have a situation like that in New Orleans, another one on the west coast, in San Francisco, and are soon to have one in Hawaii. Their interests are involved, but without some special arrangements the stations can not work satisfactorily. All three, or more, stations could send together and all could receive together on different wave-lengths. This would make them come to terms with us. If they insisted on working or combined to divide up all the time between themselves, the Government stations could fall back on this and require them to give the Government communications half the time and relieve the Government stations of the necessity of "fighting for the air." There is no dignity in that.

Professor Pupin: *Let us have a committee, such as the National Advisory Committee for Aeronautics appointed by the Government. Let us have four Army and Navy men, four Government officials and four university men. And I think it would be all right to have some men representing the operating companies. Then when it comes to regulating the wireless art for the purpose of avoiding interference with the operations of the Army and Navy, we will have one motive in every member of that committee, the motive of patriotism, which will sweep everything else aside. We want to help the Army and Navy. We do not want to interfere with them.*

Lieutenant Hooper: I went to Key West and while I was attempting to work with one of our ships from the Key West naval radio station, one of the merchant ships passing close by Key West started to call the Marconi station at Tampa, Fla., which is several hundred miles away from Key West, and I was unable to receive anything from the ship I was attempting to work with, several hundred miles away, because the ship close by would insist on calling a station some distance away and trying to work with it, knowingly interfering, in spite of the international regulations. The ship close by should really have given her message to me as being the nearest coastal station; but the ships have operators who are loyal to the concerns for which they work. For example, if they are working for the Marconi company, they won't give their message to the nearest coastal station at all times, if by any possibility they can work with a Marconi station. In this case the passing ship should have given her message to Key West. They were within ten miles of Key West, but they did not do that, the operator insisting on calling a station 300 miles away and making so much noise I could not work with any ship, even the one which should have logically worked with me. If they had given the message to me at Key West, they could have done it on low power and it would have made no trouble.

Commercial Stations Superior To Those of the Navy

Mr. Sarnoff: *I say without hesitation that if the coastal stations in the United States are turned over to the Navy Department the service rendered from ship to shore will be highly inefficient, and there is no doubt about that statement. I have listened to the operations of the Navy wireless stations; I have heard them work with ships at sea and with other stations, and at the same time I have heard the commercial operators working with ships at sea and shore stations. The comparison is about from 25 to 75 per cent. in favor of the commercial station, and any good telegraph man who has handled the traffic will bear me out in that statement.*

Commander Todd: If the high-power stations of the commercial companies could work without interfering with the Government's high-power stations, in all circumstances, all would be right. The inventors and scientists are promising us immunity from this interference, promising us more communication in a given area. And they are succeeding to some extent. The apparatus is very much improved. But we are still far from getting so that we can have a great number of communications. The field is limited, and for that reason they cannot work many high-power stations without actual interference.

Professor Pupin: *If I had my own way I should produce as many interferences as I possibly could, for the purposes of development of the art, so that no ingenuity of man could interfere with a wireless operator when he receives. Things are being done to-day by well organized industrial research laboratories which will undoubtedly lead to wonderful results so far as preventing interferences produced by the acts of man are concerned.*

Captain Bullard: What we are concerned in primarily, and the basic principle of this bill, as I understand, is the prevention of interference with ships at sea, so that we can get messages to ships at sea, where there are no other means of communication with them.

Mr. Davis: *To facilitate radio work in general, to and from ships at sea in particular, no one questions but that the complete elimination of interference would facilitate it, but such elimination must come—as it has been coming for the past 10 or 12 years—by the development of science, due to keen competition and the hope of large returns by scientists and inventors which warrant their spending considerable sums in making experiments, rather than through control by any single administration or company.*

Mr. Clark: Now, a point I wish to bring out is that it is not the ship stations that are interfering. We are not claiming that. It is the shore stations that are interfering with the ships and with each other, as well as with the Navy. Commander Todd will show you a chart indicating how congested the wave-length situation is at the present time between 600 and 15,000 meters. All we desire is to bring the shore stations into harmony so that they will not intentionally or unintentionally interfere with each other. When this chart is shown and the suggestion which is evident is likewise shown, I think the necessity for regulation will be very clear.

Mr. Sarnoff: *When interference does occur, the majority of it must occur from ships, because there are more ship stations than there are coast stations. The proposed bill does not touch upon that question at all. It does not correct the condition in regard to the 600-meter wave length nor the 300-meter wave length, which is insufficient. If the Navy does take over the coastal stations, it will still have to handle the same volume of traffic that is handled by the commercial companies. The time limit will not be cut down, but it will be increased because of inefficient operation on the part of Navy operators. Therefore, how will it aid in solving the problem of interference?*

Lieutenant Waesche: There are a number of cases on record where delay in rendering assistance to vessels in distress has been caused by interference; in other words, the radio stations have not been able to disseminate this information quickly. Coast-guard cutters, being small vessels, cannot use effectively a wave-length of 1,800 meters, or greater, and therefore we are more or less bound by the London Convention to send all of our official traffic to the nearest coastal station. As a result, official business of the Government has to be carried on at times through commercial stations. If the Government controlled that commercial station, we would not have this interference, and would get better results, due to this close co-operation and due to their understanding our work, knowing exactly what to do with the messages when they got them, how to handle distress calls, and where our vessels are located, and all that, which would not be possible with the commercial companies.

Mr. Davis: *There are two things that make that interference—one is the sending of messages and the other is the law itself which requires you to use a certain wave-length for sending those messages. Now Government ownership is not going to reduce the number of messages sent; neither is it going to change the law. So that I do not see that we will be any better off, as far as interference is concerned, with Government ownership than we are now; in fact, either under the control of any one company or a Government department.*

Lieutenant Hooper on the Advantages of Naval Wireless

Lieutenant Hooper: There are a good many troubles because the commercial operators won't recognize any one coastal station as the controlling station. The commercial operators think that the commercial only ought to control, and they won't pay any attention sometimes to the naval station when they are told to keep quiet; and the naval operator will think that the naval station ought to control the situation and won't pay any attention to the commercial station. When the question of interference has to be settled immediately on account of a distress call, both sides try to take charge and refuse to give way to the other. That happens right along. I have heard a ship make an S O S, and then a disgraceful condition would follow where several shore stations attempted to communicate with the ship, and several ships and the nearest naval station and the nearest commercial station would all try to take control of the situation and nobody would obey orders from anywhere. Now there has got to be one company running the whole business; it has got to be the Navy or some commercial company, and then the operators will respect the rules of that one company. The Navy is better qualified to do it because the Navy operators are disciplined; they understand that they have to carry out orders; the military service always does have more disciplined employees.

Radio Science

RADIO CONTROLLED TORPEDO

CONTROL of a torpedo by wireless from shore or a distant point has been the subject of investigation by Arthur E. Ericson, of Manchester, Mass., the resulting mechanism having as its distinguishing feature the use of two distinct wave-lengths in transmitting control signals and two separately tuned receivers for operating the torpedo's steering mechanism.

In radiodynamics the selectivity problem is the greatest, and the invention illustrated seeks to overcome operation of the selective receiver by a hostile

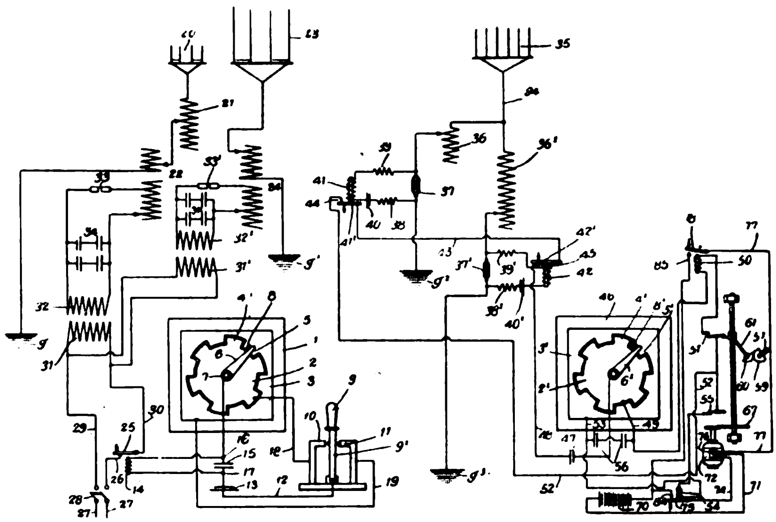


Figure 1—Sending station control *Figure 2—Torpedo control*

transmitter setting up forced oscillations. Under Mr. Ericson's plan an enemy transmitter must be capable of sending simultaneously two waves of exactly the same length employed in controlling the torpedo, otherwise the direction of the torpedo as gauged from the shore control would be little influenced by malicious interference. The great improbability of hostile stations being able to emit two waves of exactly corresponding length adds interest to this device.

The receiving station, or torpedo, is provided with cut-out devices, whereby the steering motor circuit is automatically broken whenever the rudder has been operated into its hardover position, either to port or starboard, so that further impulses designed to turn the rudder to the port or starboard side will have no effect when the rudder is already in its extreme position to that side.

For rotating the rudder a reversible motor is provided; this is connected, in one direction or the other, to a source of current by the energizing of one or the other of its controlling relays. The rotation of this motor in one direction or the other causes the rotation of a threaded rod upon which is mounted a threaded block which travels back and forth by the rotation of the rod, the block being connected to the rudder to rotate the latter in one direction or the other as the block travels in forward or reverse direction upon the rod.

At both sending and receiving stations, use is made of synchronously rotating contact makers, which alternately pass over contacts of a first and a second series, termed the "left contacts" and the "right contacts". A controlling switch at the sending station has two positions, in one of which a local circuit is completed to energize a controlling relay when the contact maker is in engagement with any contact or segment of the first series. When the switch is in the other circuit-closing position, the relay is energized when the contact maker engages any contact of the second series. Radio impulses are emitted while the controlling relay is energized. The radio waves received on the torpedo, or other unit to be controlled, cause the energizing of one or another of two relays, in accordance with the position of the controlling switch at the sending station. When the controlling switch is in its "left" position, impulses are sent out during the times the contact maker at the sending station is in engagement with the contacts of the left series. During such intervals of time, the corresponding relay at the receiving station on the torpedo is energized, resulting in the energizing of a local circuit, which causes the rotation of the rudder in proper direction to turn the torpedo to the left. When the controlling switch at the sending station is in its "right" position, radio impulses are sent out during the intervals of time in which the sending contact maker engages the contacts of the right series, during which time the other relay at the receiving station is energized, resulting in the closing of a local circuit, whereby the rudder is rotated in the opposite direction.

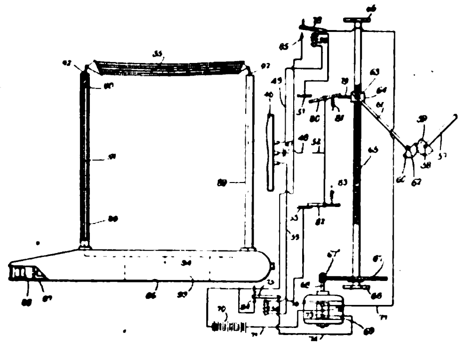
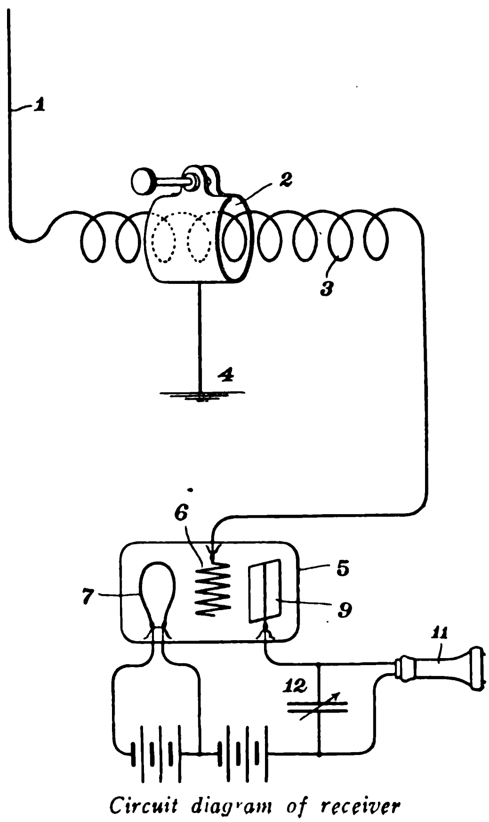


Figure 3—Rudder control of torpedo

NOVEL DESIGN IN RECEIVERS

Selectivity in wireless receiving apparatus, in combination with an improved method of amplifying signals, is the contribution of Elmer E. Bucher in a receiving method recently devised. The usual method of obtaining resonance in a receiver is superceded by the use of a metallic sheet or cylinder in electrostatic relation with a tuning coil, to one end of which is connected the vacuum valve detector. By adjustment of the cylinder shown in the accompanying diagram, a point will be found on the coil where resonance is obtained with the distant transmitter,



Circuit diagram of receiver

or at which the maximum potential is impressed upon the grid element of the valve shown at 6 in the accompanying drawing. This novel form of circuit connection to the detector is found to act as an amplifier of signals.

The merit of the method of varying the inductance of the antenna circuit is its simplicity, the multipoint switch and the usual sliding contact being dispensed with. In relation to the latter, it is noted that mechanical wear on the wire is reduced to a minimum and breaking soldered connections to inductance changing switches eliminated.

This system of tuning has obvious value for portable apparatus of military type which is subject to shock and vibration.

Strada's Wireless

by F. A. Hassler

AND who was Strada? The writer has tried to find out. All he knows is that the great Scottish Judge, Lord Kames (1696-1782), in his "Elements of Criticism," wrote that "Strada's Belgic History is full of poetical images, which, discording with the subject, are unpleasant, and they have a still worse effect, by giving an air of fiction to a genuine history." The rest of his remarks upon the Belgic historian do not concern us at this time.

From March 1st, 1711, to December 6th, 1712, the English people were daily instructed and amused by "The Spectator," which was conducted by Joseph Addison and Sir Richard Steele. A copy of the first edition of this work published in this country lies before me and in the number for December 6th, 1711, I read as follows:

"Strada, in one of his prolusions, gives an account of a chimerical correspondence between two friends by the help of a certain loadstone, which had such virtue in it, that if it touched two of several needles, when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time, and in the same manner."

Then we are told that these two friends each made dial-plates exactly alike, having letters of the alphabet instead of numbers upon their surface, and arranged the needles in a manner similar to the hands of a clock. These needles were placed on pivots so that they could move easily and point to any letter desired. No matter how many miles the friends were separated they could converse by simply moving the needles to any letter they wished.

Marconi—Man of Action

His Visit to This Country Reveals the Large Part He Has Taken in the World War

The degree of Doctor of Science was recently conferred upon Guglielmo Marconi by Columbia University. This photograph shows the inventor and Professor Benjamin Lawrence

A BRIEF explanation of the purpose of the Italian Missions' visit to this country was given by Guglielmo Marconi, a member of that mission, soon after his arrival in Washington.

"The purpose of this mission to America, of which I happen to be a member, is primarily to pay the respects of our country to President Wilson and to assure you all, through him, what a tremendous confirmation of all our faith of the last two years it is to have this nation of a hundred million people come to make common cause with us." said the inventor.

"We also intend to tell you how you can help us in many material ways other than your participation with troops and fleets. We need your coal and wheat and shipping now, but beyond that we hope to demonstrate to you that Italy will need your enterprise and capital after the war to do what the Germans have done heretofore in developing our industries. We want America to come to Italy to help us solve our industrial problems, as so many hundreds of thousands of our people have been coming to America to help you solve your problems by furnishing the labor. I believe that this emigration to America will be resumed as soon as the war is over, for even then Italy will have a surplus population. But in return for that we need your money and your organizing and inventive ability. Let a better understanding between the countries in these matters be one of the products to grow out of the war. Let the word America in Italy stand for what the word Germany has stood for, in a business way, in the past."

Referring to technical military problems, Mr. Marconi remarked that Italy had the most difficult front in Europe.

It is 540 kilometers long, and much of it extends over mountains 10,000 feet in height. To maintain this and to advance our lines, as the Italian armies have been doing very vigorously since the arrival of this mission in America, 4,000,000 men are under arms. Mr. Marconi explained that at the beginning of our participation. which was at a time when things were not going well with the Allies (that is significant of our motives), we were able to send enough men to the frontier to force Austria to divert 300,000 men from her operations against the then retreating Russians. Our entry into the war at that particular moment made the Russian retreat less disastrous than it otherwise would have been. That has been, for the most part, the nature of the military service which Italy has rendered her allies. She has kept engaged hundreds of thousands of troops who but for Italy would have been available for operations on the west and east fronts.

It has not been generally known that Italy gave Russia 300,000 rifles, millions of cartridges and thousands of motor lorries for her transport service. Mr. Marconi's personal participation in securing these in time for the Brusiloff advance is disclosed in the following letter which he received from the late Earl Kitchener:

War Office, 20th December, 1915.

Dear Sir William Marconi:

I am glad to learn from your letter of the 6th inst. that you have been so successful in your efforts to organize the manufacture of cartridges for the rifles which your Government has lent to Russia. General Delmé-Radcliffe has told me how invaluable your influence and advice have been, and I thank you most heartily for the great trouble which you have taken in this matter. It is of great value to know that I may rely on further help from you should the occasion arise, and I greatly appreciate your kind offer.

The question of the shipment of the cartridges from America is being gone into, and arrangements will probably be made to include them in shipments of other Russian supplies from that country. Perhaps it will be more convenient if we communicate direct with the Italian War Office on this point as soon as we are in a position to make a definite proposal.

With renewed thanks for all your help, believe me, yours very truly,

(Signed) KITCHENER.

The House of Representatives in Washington gave an enthusiastic reception to the inventor on June 2nd; the members of the commission were likewise cordially welcomed, but only the Prince of Udine and Mr. Marconi made speeches. Mr. Marconi said in part:

"It is my privilige to have lived in America for many years, and I flatter myself that I know Americans very well. I have learned to appreciate in America two things that I can express in two words—justice and fair play. You are ready to back anything that you think may be of good to the world, and you are ready to encourage any honest endeavor to advance science or the applications of science, and, although you are the greatest industrial nation in the world, although there is healthy competition—and it is only by that healthy competition there can be such progress —what you do here is always fair. I can say that with absolute conviction from the bottom of my heart."

France has sent three technical experts from her postal service to confer with the United States authorities on wireless and wire interference in war time. Seated at the table is Lieutenant Colonel J. B. Pomey, chief engineer of the Post Office Department; on the left is Lieutenant L. Routhillon, engineer, wireless service; on the right is Captain G. Valensi, engineer, research section

Four days later the father of wireless attended the commencement exercises at Columbia University, in New York. The inventor was among the candidates for honorary degrees. In presenting Marconi Dr. Butler said:

"Guglielmo Marconi—Plenipotentiary of the Italian Government in delicate and important negotiations relative to the war in which our countries are jointly engaged on behalf of free institutions; to whom has been granted the almost superhuman power to give wings to words that they may fly to the uttermost parts of the earth bearing messages from and to the heart of man, and whose name has already become a common noun, I gladly admit you to the degree of Doctor of Science in this university."

Mr. Marconi already possesses degrees from Oxford, Glasgow, Aberdeen, Liverpool and Pennsylvania, and besides being a senator and commissioned officer in the army and navy of Italy, has had bestowed upon him by the King of England the Honorary Knighthood of the Grand Cross of the Victorian Order.

Opportunity for Special Service!

THE Signal Enlisted Reserve Corps of the United States Army needs several thousand trained electrical men, particularly those experienced in radio work, including operators, construction men, maintenance men and electricians, and presents an exceptional chance for service. Ten Field Battalions are now being organized in the Eastern Department of the United States Army and it is expected that they will be mobilized in the near future.

The Signal Enlisted Reserve Corps, which will be a part of the new National Army, comprises both Field and Telegraph Battalions, the former serving with the various divisional headquarters in the field and the latter maintaining communication with interior bases.

The "Nerves of the Army" is a name aptly applied to this very necessary branch of the military service, with its lines of communication between the Commanding General of the Division and his cavalry, artillery and infantry brigades, as well as with regimental and battalion headquarters. In their electrical work the Signal Corps Field battalions maintain telegraph, telephone and radio communication, while in visual signaling they use wig-wag and semaphore flags and heliograph, in the day time; and at night flashlight and lantern.

In signaling parties, three or four men are often employed and there are, therefore, a large proportion of non-commissioned grades, such as Sergeants and Corporals. Competent men have excellent chances for promotion.

The Enlisted Reserve Corps is composed of men from 18 to 45 years of age, and is subject to only 15 days' annual service in peace, while in war time it may be called at the discretion of the President. Pay corresponds to the Regular Army, and uniforms are furnished as well as transportation to place of mobilization.

Enlistment for this exceptionally attractive arm of the service may be made by applying to the Signal Officers of the various Departments of the United States Army, as follows:

Eastern Department, Army Building, 39 Whitehall St., New York, N. Y.
Central Department, Federal Building, Chicago, Ill.
Northeastern Department, Nottingham Chambers, Boston, Mass.
Southeastern Department, People's Bank Building, Charleston, S. C.
Southern Department, Ft. Sam Houston, San Antonio, Tex.
Western Department, San Francisco, Cal.

Signal Officers' Training Course

A Wartime Instruction Series for Advanced Amateurs Preparing for U. S. Army Service

SECOND ARTICLE

By MAJOR J. ANDREW WHITE
Chief Signal Officer, Junior American Guard

THE past few weeks have seen the realization of many developments foreshadowed by predictions which have appeared in these pages. The demand for signalmen is increasing daily and, should the plans for the dominion of the air by airplanes be passed by Congress, the opportunities for radio men in the Signal Corps of the Army will surpass anything hitherto offered in the technical branches of the service.

Those among the readers of this magazine who are not of military age are face to face with the advisability of engaging in courses of intensive military study. The day of universal liability to service is at hand and military training is assured as a national obligation for future generations. The obvious advantage of securing admission to the signal service is disclosed not only in the higher rates of pay but in the unusual opportunities for promotion and recognition of technical skill.

The aviation section of the Army is a branch of the Signal Corps. At present its proportions are decidedly limited, but the probable extent of its future expansion is revealed in the following interview with Brigadier General George O. Squier, Chief Signal Officer of the Army and vice-president of the National Amateur Wireless Association. He had been quoted as being in favor of regiments and brigades of "winged cavalry" to put the "Yankee punch" into the war. Commenting on the $600,000,000 airplane building programme that is to be laid before Congress by the Council of National Defence, Gen. Squier said:

"By the 'Yankee punch' I mean a characteristically American way of working to get big results. We have a reputation of looking at old things from a new angle, and there is no reason why the American Army, when it takes the field, should not live up to what they stand for. The field of glory for us will be in the air, sending our myriads of airplanes over the German lines to teach Germany that we have come to win.

"Airplanes are the logical fighting machines for Americans, because we are an imaginative people, and when our imagination strikes fire nothing can stop us. We are impatient of plodding methods, a nation of individualists. We are willing to send our hundreds of thousands to the front if needs be to dig holes and burrow in the soil for interminable months, but we don't get enthusiastic over the idea. We want something that appeals to our knack for inventing things, for getting over obstacles in an original way. And the air way is our way.

"It might be of interest to point out that all of the picturesque features in the matter of invention and innovations of a startlingly modern nature have been, up to now, advertised exclusively by the German side of the European argument. The talk of coming Zeppelin raids, of artillery ponderously magnificent, of schools of U-boats was spread through Germany. Every housewife, every butcher boy in Germany impatiently awaited the results of the Kaiser's sensational inventions. And when Count Zeppelin's monsters went after England with bombs while 'Big Berthas' began dropping unbelievable gigantic shells into Belgium, it was a signal for the German spirit to go wild with patriotism.

"I haven't the slightest doubt of the Yankee's nerve and ability to endure any hardship as well as—perhaps better than—the citizens of any other country. But what I am considering is how to give American qualities to our brothers in arms at their maximum efficiency.

"The answer gained is airplanes and yet more airplanes. Every young American worthy of a name would be keen to join our flying army. The game ideally suits our national temperament. With the wealth we can devote and our unqualified facilities for manufacturing there is no reason in the world why we should not be able to produce in a comparatively short space of time an overwhelming aerial fleet.

"An army in the air, regiments and brigades of winged cavalry, mounted on gas driven flying horses, could blind the eyes of Germany until her gunners, absolutely deprived of range finders, would be put out of business by the Allied artillery.

"The modern type of land war is dependent upon two things above all others: aviation and artillery. They are co-operating elements in a fighting army, and against an enemy a flying machine is a terror and a menace to big guns. That airplanes are positively essential for directing artillery fire is an axiom among military men who have seen action in the sort of battles being fought on the Western front.

"The magnificently obvious thing, then, is to knock out Germany's eyes by a thrust through the air. But my idea would be something vastly larger than a thrust. An inundation of airplanes would better express the idea in its magnitude. Sweep the Germans from the sky, blind the Prussian cannons and the time would be ripe to release an enormous flock of flying fighters to raid and destroy military camps, ammunition depots, military establishments of all kinds. The idea is so vast that it would read like the dream of an old-fashioned fiction writer. No young boy could be concerned in a story of adventure more wonderful than this 'Yankee punch' should furnish to actual experience. And the Prussians have never dreamed of an expedition so mighty or so sensational. Our air programme should have the effect of working both ways—crushing the nerve out of Germany and inspiring our folks at home with renewed enthusiasm for the war.

"We have seen Germany time and again take 100,000 or 200,000 back or forth for the gain or loss of a little ground. Then there is more digging in, more building of shelters, more living in the mud and dust, burrowing like moles. Our young men cannot go wild over warfare in the trenches, however splendidly they will do their duty. But put the war into the air—and watch us fight!"

This message of inspiration should be the signal for every reader of the

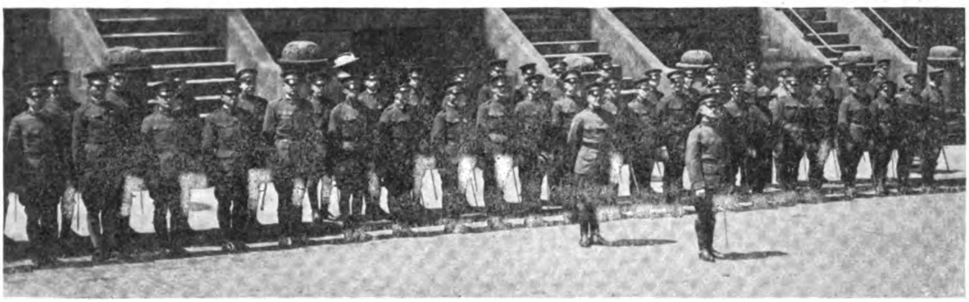
A demonstration of preparedness in New York; 1800 members of the Junior American Guard on parade

WIRELESS AGE to prepare. Wireless operators by the hundred are needed for the air program, young men in the best of physical condition and trained as military observers. More wireless operators and engineers will be needed at the field stations for receiving, in fact, as has been said before in these columns, every available amateur in the country can be used in Uncle Sam's fighting forces.

The process of training a civilian for military duty is more than a perfunctory one, however. Young men subject to the draft know that they will attend encampments for this purpose and remain there for months of arduous work before seeing service. It is well for the younger men to realize also that in this war, or one which may follow, their turn will eventually come. This is the time to prepare. The summer vacation season is here and the woods and fields call. The time formerly spent in enjoyable loafing or sportsmanship pursuits should be profitably devoted to mastering the rudiments of military training.

Probably the most effective and quickest way of accomplishing this is through placing local radio clubs on a military footing, or gathering together the amateurs of a neighborhood and organizing as a cadet signal corps company. Through the arrangements made by the National Amateur Wireless Association with the Junior American Guard the facilities of this organization are made available for all wireless men.

It is necessary only to secure the services of an ex-army man or National Guardsman of experience to take military command for purposes of instruction. A man of this type can usually be found in any community, failing which



The type of men who are preparing young Americans for military service in the future is illustrated in this view of the officers of the 1st Brigade, N. Y., Junior American Guard

attendance at summer cadet posts such as that of the Junior American Guard at Stony Point, N. Y., can be arranged for. Uniforms are necessary; the interest is best sustained and the purpose of military drill made clearer when all persons in the ranks present the same appearance. The cost is small; an excellent grade of khaki uniform, consisting of coat, breeches, cap and leggings may be secured from Junior American Guard headquarters, 52 Beaver Street, New York, for $3.85 or $4.00 delivered out of town. Instruction may then be immediately begun.

Recruits in the Signal Corps of the Army receive their first instruction as infantry, the purpose being to accustom men to act as one and obey commands without question. The initial step in the instruction is known as the School of the Soldier. This is very elementary instruction, but important because it teaches the recruit the courtesies of the service and how to stand, face and march when in ranks.

The extracts which follow are from the writer's "Military Signal Corps Manual," in which volume the instruction of individuals, squads, sections, companies and battalions is given in detail.

GENERAL PRINCIPLES AND OBJECT OF INSTRUCTION

The certain transmission of information and orders from commanding officers to their subordinates and information from subordinates to commanding officers, regardless of conditions or terrain (the country in which the military unit is operating), is the ultimate object of all training.

The instruction is designed to develop resourcefulness, initiative, and self-reliance for the Signal Corps men of all grades. The regulations prescribe the method of training in the ordinary duties of field companies and battalions of the Signal Corps, and all members must be so thoroughly drilled in these duties that in the excitement of action they may be performed readily, naturally, and as a matter of second nature.

Since varied conditions arise in handling signal corps troops, no hard and fast rules can be laid down to cover all conditions; much is left to the energy and ingenuity of the officers and noncommissioned officers.

Instruction must therefore be conducted with a view, first, to drilling the personnel thoroughly in their habitual duties; and second, to afford officers and men practical experience in dealing with the situations and difficulties which arise in campaign.

A progressive order is to be followed in all instruction, commencing with theoretical instruction in the smallest unit and proceeding to the larger one, culminating in field maneuvers.

Thorough training of the individual soldier is the basis of efficiency. Precision and attention to detail are required in this instruction, for from it the soldier must acquire that habit of implicit obedience to orders, and of accurate performance of his individual duties, which is the indispensable requisite for efficiency in combined training. Drills should be frequent, but short.

Recruits are assembled in small squads for the beginning of their instruction. As the instruction progresses it may be consistently carried on by sections, platoons, or by the entire company. This principle also applies to technical training, particularly to visual signaling, telegraphy and telephony. Grouping according to progress and efficiency should be strictly carried out; those who lack aptitude and quickness should be placed under experience instructors.

The training of the recruit includes instruction in the duties of sentinels, the care of equipment, packing of field kits, tent pitching, pistol practice and the customs and courtesies of the service, in addition to his training as a signalman.

The instructor of each unit is its immediate chief, and should be given all due latitude in conducting the instruction, and be held to strict accountability for results attained. The habit of self-reliance and a feeling of responsibility for the instruction of their respective units, as well as the proper feeling of pride in these, may thus be developed among the subordinate commanders.

The instructor always maintains a military bearing and by a quiet, firm demeanor, sets a proper example to the men. Faults should be corrected without nagging.

The drill regulations are furnished as the guide. In the interpretation of the regulations, the spirit must be sought. Quibbling over the minutiæ of form is indicative of failure to grasp the spirit. Drills and ceremonies are disciplinary exercises designed to teach precisive soldierly movements, and to inculcate that prompt subconscious obedience which is essential to proper military control. To this end, smartness and precision should be exacted in the execution of every detail.

GENERAL RULES

Movements that may be executed toward either flank, are explained as toward but one flank, it being necessary merely to substitute *left* for *right,* or the reverse, to have the explanation of the corresponding movement toward the other flank.

Any movement may be executed either from the halt, or when marching, unless otherwise prescribed.

All movements on foot not especially excepted may be executed in double time. If the movement be from the halt, or when marching in quick time, the command *double time* precedes the command *march;* if marching in double time, the command *double time* is omitted.

To hasten the execution of a movement begun in quick time, the command:

1. Double time. 2. MARCH is given. The leading or base unit continues to march at quick time, or remains at halt if already halted; the other units complete the execution of the movements at double time and then conform to the gait of the leading or base unit.

If, in forming elements abreast of each other, the command:

1. Company (platoon, etc.). 2. HALT be given during the movements, only those elements halt which have reached their new position; the others continue the march and halt on reaching their positions.

For the purpose of correcting errors while marching, the instructor may command

1. In place. 2. HALT, when all halt and stand fast. To resume the movement the commands:

1. Resume. 2. MARCH, are given.

To revoke a preparatory command, or being at a halt, to begin anew a movement improperly begun, the instructor commands: "as you were," at which the movement ceases and the former position is resumed.

The first essentials of military drill, as given to the recruit before he is allowed in the ranks are outlined in the following.

This instruction has for its object the training of the individual recruit, and afterwards the squad. It must be given with the greatest attention to detail.

The instructor explains briefly each movement, first executing it himself, if practicable. He requires the recruits to take the positions unassisted and does not touch them for the purpose of correcting faults, except when they are unable to correct themselves. He avoids keeping them too long at the same movement, although each should be understood before passing to another; by degrees the desired precision and uniformity is exacted.

In the instruction of the recruit, frequent short rests are given in order that the men may not be unduly fatigued.

The instructor takes advantage of these rests to instruct the recruits in the customs and courtesies of the service, the duties of the orderlies, the proper manner of receiving messages from and delivering them to officers, etc., so that when the recruit finally reports for duty he will not only know his prescribed drill thoroughly, but will know how to conduct himself as a trained soldier.

For the individual instruction, a few recruits, usually not exceeding four, are placed in single rank, about 4 inches apart.

POSITION OF THE SOLDIER, OR ATTENTION

Heels on the same line and as near each other as the conformation of the man permits.

Feet turned out equally and forming an angle of about 45 degrees.

Knees straight without stiffness.

Hips level and drawn back slightly; body erect and resting equally on hips; chest lifted and arched; shoulders square and falling equally.

Arms and hands hanging naturally, thumb along the seam of the trousers.

Head erect and squarely to the front, chin drawn in so that the axis of the head and neck is vertical; eyes straight to the front.

Weight of the body resting equally upon the heels and balls of the feet.

TO ASSEMBLE

To teach recruits to assemble, the instructor first places them in a single rank arranged according to height, the tallest man on the right; intervals of 4 inches are maintained between men, as nearly as practicable. The objects of the interval, it is explained, are to give freedom of movement in marching. Recruits are directed to open out the right elbow slightly until the left elbow of the man on the right is lightly touched, the elbow is then withdrawn. This is repeated several times and the recruits are then instructed to fall out and the man on the right being placed in position, they are instructed that at the command fall in they successively and quickly take their places in rank as before.

THE RESTS

Being at a halt, the commands are FALL OUT; REST; AT EASE; and, 1. Parade. 2. REST.

At the command *fall out*, the men may leave the ranks, but are required to remain in the immediate vicinity. They resume their former places, at attention, at the command FALL IN.

At the command *rest*, each man keeps one foot in place, but is not required to preserve silence or immobility.

At the command *at ease*, each man keeps one foot in place and is required to preserve silence or immobility.

1. Parade. 2. REST. Carry the right foot 6 inches to the rear, left knee slightly bent; clasp the hands, without constraint, in front of the center of the body, fingers joined, left hand uppermost, left thumb clasped by the thumb and forefinger of the right hand; preserve silence and steadiness of position.

To resume the attention: 1. Squad. 2. ATTENTION.

The men take the position of the soldier.

EYES RIGHT OR LEFT

1. Eyes. 2. RIGHT (left). 3. FRONT.

At the command *right*, turn the head to the right oblique, eyes fixed on the line of eyes of the men in, or supposed to be in, the same rank. At the command *front*, turn the head and eyes to the front.

FACINGS

To the flanks. 1. Right (left). 2. FACE.

Raise slightly the left heel and right toe; face to the right, turning on the right heel, assisted by a slight pressure on the ball of the left foot; place the left foot by the side of the right. Left face is executed on the left heel in the corresponding manner.

Right (left) half face is executed similarly, facing 45 degrees.

"To face in marching" and advance, turn on the ball of either foot, step off with the other foot in the new line of direction; to face in marching without gaining ground in the new direction, turn on the ball of either foot and mark time.

To the rear. 1. About. 2. FACE.

Carry the toe of the right foot about half foot-length to the rear and slightly to the left of the left heel, without changing the position of the left foot; face to the rear, turning to the right on the left heel and right on the left heel and right toe; place the right heel by the side of the left.

SALUTE WITH THE HAND

1. Hand. 2. SALUTE

Raise the right hand smartly until the tip of the forefinger touches the lower part of the headdress (if uncovered, the forehead) above the right eye, thumb and fingers extended and joined, palm to the left, forearm inclined at about 45 degrees, hand and wrist straight; at the same time look toward the person saluted. (Two) Drop the arm smartly by the side.

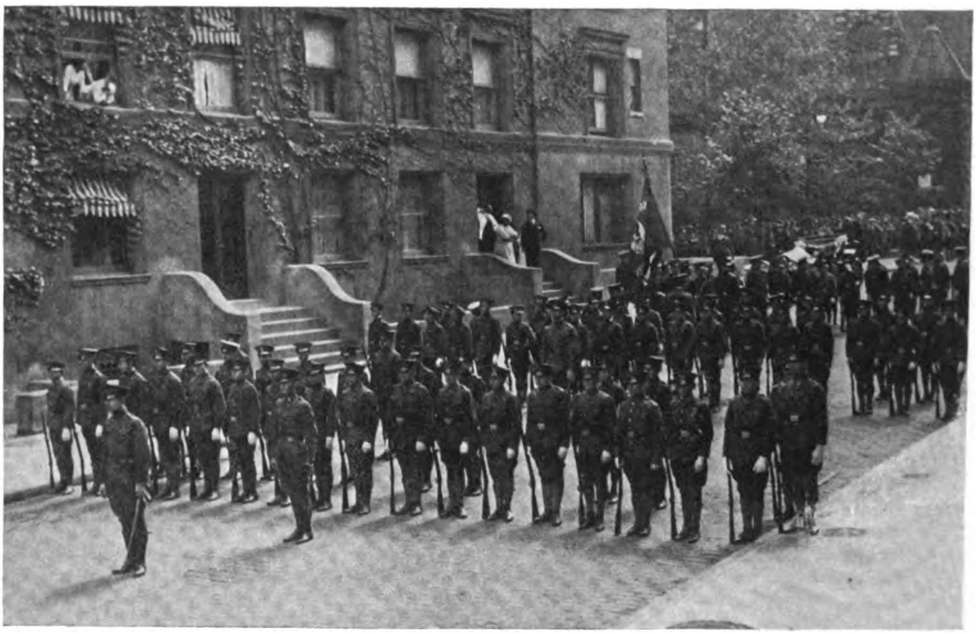
STEPS AND MARCHING

With the exception of right step, all steps in marching executed from a halt begin with the left foot.

The length of the full step in quick time is 30 inches, measured from heel to heel and the cadence is at the rate of 120 steps per minute.

The length of the full step in double time is 36 inches; the cadence is at the rate of 180 steps per minute.

The instructor, when necessary, indicates the cadence of the step by calling 1, 2, 3, 4, or left, right, the instant the left and right foot, respectively, should be planted.



Companies of the Washington Heights Battalion, Junior American Guard, drilling as infantry; an illustration of the position "attention"

The arms hang naturally, the hands moving about six inches to the front and three inches to the rear of the seam of the trousers.

All steps in marching and movements involving march are executed in *quick time* unless the squad be marching in *double time*, or double time be added to the command; in the latter case double time is added to the preparatory command. Examples: 1. Squad right, double time. 2. MARCH.

QUICK TIME

Being at a halt, to march forward in quick time: 1. Forward. 2. MARCH.

At the command *forward*, shift the weight of the body to the right leg, left knee straight.

At the command *march*, move the left foot smartly straight forward 30 inches from the right, sole near the ground, and planted without shock; next, in like manner, advance the right foot and plant it as described; continue the march. The arms swing naturally.

Being at a halt, or in march in quick time, to march in double time: 1. Double time. 2. MARCH.

If at a halt, at the first command shift the weight of the body to the right leg. At the command *march*, raise the forearms, fingers closed, to a horizontal position along the waist line, take up an easy run with a step and cadence of double time, allowing a natural swinging motion to the arms.

If marching in quick time, at the command *march*, given as either foot strikes the ground, take one step in quick time, and then step off in double time.

To resume the quick time: 1. Quick time. 2. MARCH.

At the command *march*, given as either foot strikes the ground, advance and plant the other foot in double time; resume the quick time, dropping the hands by the sides.

TO MARK TIME:

Being in march: 1. Mark time. 2. MARCH. At the command *march* given as either foot strikes the ground, advance and plant the other foot: bring up the foot in rear and continue the cadence by alternating raising each foot about two inches and planting it on a line with the other.

Being at a halt, the command *march*, raise and plant the feet as described above.

THE HALF STEP

1. Half step. 2. MARCH.

Take steps of 15 inches in quick time, 18 inches in double time.

Forward, half step, halt, and *mark time,* may be executed one from the other in quick or double time.

To resume the full step from half step, or mark time: 1. Forward. 2. MARCH.

SIDE STEP

Being at a halt or mark time: 1. Right (left step). 2. MARCH.

Carry and plant the right foot 15 inches to the right; bring the left foot beside it and continue the movement in the cadence of quick time.

The side step is used for short distances only and is not executed in double time.

BACK STEP

Being at a halt or mark time: 1. Backward. 2. MARCH

Take steps of 15 inches straight to the rear.

The back step is used for short distances only and is not executed in double time.

TO HALT

To arrest the march in quick or double time: 1. Squad. 2. HALT.

At the command *halt*, given as either foot strikes the ground, plant the other foot as in marching; raise and place the first foot by the side of the other. If in double time, drop the hands by the sides.

TO MARCH BY THE FLANK

Being in march: 1. By the right (left) flank. 2. MARCH.

At the command *march*, given as the right foot strikes the ground, advance and plant the left foot, then face to the right in marching and step off in the new direction with the right foot.

TO MARCH TO THE REAR

Being in march: 1. To the rear. 2. MARCH.

The command *march*, given as the right foot strikes the ground, advance and plant the left foot; turn to the right about on the balls of both feet and immediately step off with the left foot.

In marching in double time, turn to the right about, taking four steps in place, keeping the cadence, and then step off with the left foot.

COVERING AND MARCHING ON POINTS

The instructor indicates two points and requires recruits, in succession, to place themselves upon the prolongation of a straight line through these points and then to march upon them both in quick and double time.

It is demonstrated to the recruits that they cannot march in a straight line without selecting two points in the desired direction and keeping them covered while advancing.

A distant and conspicuous landmark is next selected as the point of direction. The recruit is required to choose two intermediate points in line with the point of direction and march upon it by covering these points, new points being selected as he advances.

Careful execution of the foregoing is essential to the success of the Signal Corps unit. Too great care cannot be taken to have this first instruction perfected, for without it, the later use of wire carts and wireless in the field will not be efficiently executed and its military value will be negligible.

In the so-called School of the Soldier outlined in the foregoing, amateurs will find sufficient necessary preliminary drill to occupy the evenings or days of the weeks which will intervene until the next article appears.

Wireless Instruction for Military Preparedness

A Practical Course for Radio Operators

ARTICLE III

By Elmer E. Bucher

Instructing Engineer, Marconi School of Instruction

EDITOR'S NOTE.— This is the third installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

ELEMENTARY ELECTRICITY AND MAGNETISM

The Production of Electrical Currents

FRICTIONAL ELECTRICITY

Although the phenomenon of electrification by friction is of interest in so far as the production of so-called **positive and negative electric charges** is concerned, the apparatus for the production of these charges has no direct bearing or relation to modern instruments for the production of currents of radio-frequency; hence the subject will be gone over briefly.

(1) It is found that two such elements as glass and silk when rubbed together exhibit the property of electrification, and will attract like bodies such as bits of paper, wools or feathers. These bodies are then said to be in a state of **electrical charge.** The glass is said to possess **positive** electrification, the silk **negative** electrification.

(2) If a glass rod is rubbed with a piece of silk and is touched to a pith ball suspended by a light thread, the ball will be repelled by the rod, but on the other hand, if the same pith ball is placed near to a stick of sealing wax which is rubbed with cat's fur, the pith ball will be attracted.

(3) Because it has been observed that the electrification produced on glass by rubbing it with silk will have an opposite effect upon an electrified body (such as a pith ball which has previously been electrified by touching it to a charged glass rod) from that of a stick of sealing wax when rubbed by flannel, the terms **positive and negative electrification** have been adopted.

(4) These are purely conventional terms that have no foundation other than that they were convenient to denote the foregoing phenomenon.

(5) A **positively electrified body** is one which has the same effect upon other electrified bodies as a piece of glass when rubbed with silk, and a **negatively electrified body** is one which acts upon another electrified body like a stick of sealing wax rubbed with cat's fur or flannel.

(6) The kind of electrification placed upon glass by rubbing it with another material depends upon the material. Glass, for instance, when rubbed with cat's fur possesses negative electrification, but when rubbed with silk positive electrification. Most electrical textbooks or handbooks have a table showing the various elements which, when rubbed together, will create electric charges.

(7) When electrified bodies are freely suspended, the following effects are observed:

(a) BODIES WITH LIKE CHARGES WILL REPEL.

(b) BODIES WITH UNLIKE CHARGES ATTRACT.

(8) When bodies possessing electric charges are placed in contact, all signs of electrification disappear and they are then said to be discharged.

(9) If bodies containing positive and negative charges are joined together by a wire, a **temporary flow of electrical current** will take place through the wire, and if the electrification is constantly supplied, a continuous flow of current will take place through the wire.

(10) Charged bodies, if connected together by a silk thread, will not discharge, but if joined by any of the metals, such as silver, copper, iron, steel, etc., the charges will neutralize; hence, those materials which conduct electric charges from point to point are termed **conductors** and those which do not permit the free passage of electrical charges are termed **insulators.**

(11) A body which is supposed to have an excess of electrical charge is said to be **positively electrified** and that which has less is said to be **negatively electrified.** This is not known to be the case but is merely assumed.

(12) Hence when a body with a positive charge is joined to one with a negative charge by means of a copper wire, it is generally assumed that an electrical current flows in the direction from the positive charge towards the negative charge.

(13) Whenever positively charged bodies are placed near one another they tend to move together and the space between them is in a state of **electric strain.** This strain is called the **electrostatic field,** and the space is said to contain **electrostatic lines of force.**

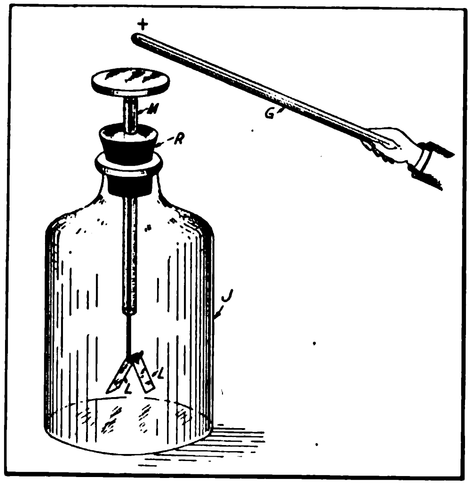


Figure 8

OBJECT OF THE DIAGRAM.

To show the use of the apparatus known as the electroscope.

PRINCIPLE.

When an electrical charge is given to the gold leaves they will diverge or repel one another, and thus show the presence of an electrostatic charge.

DESCRIPTION OF THE INSTRUMENT.

A glass jar, J, having an insulating stopper, R, carries the metal rod, M, on the end of which are hung strips of gold or aluminum foil, L, L.

OPERATION.

If an electrified glass rod, G, with a positive charge is brought near to the upper terminal of the electroscope, a charge of the kind it possesses will be repelled to the leaves and a charge of the unlike kind will be drawn to the upper end.

Hence a positively charged glass rod will place a negative charge on the upper end of the electroscope and a positive charge on the gold leaves.

A negatively charged body brought near the upper terminal will place a positive charge on the upper end and a negative charge on the leaves.

SPECIAL REMARKS.

(1) To determine the sign of an unknown electric charge, proceed as follows:

(a) Rub a piece of sealing wax with cat's fur;

(b) Touch electroscope with sealing wax;

(c) The leaves of the electroscope now possess a negative charge;

(d) Bring charged body with unknown electrification near to the terminal of the electroscope;

(e) If the leaves show greater divergence, the unknown charge possesses the same electrification as the gold leaves, i. e., a negative charge;

(f) If when a body of an unknown charge is brought near to the electroscope the leaves collapse or tend to fall together, the unknown body possesses a positive charge, that is to say, the negative charge on the leaves is drawn towards the upper end.

(2) When an electrified body is brought near to another not electrified, there will be induced in the end of the uncharged body nearest to the charged one, electrification of opposite sign, but in the far end electrification of the same sign.

(3) Thus a positively charged body will induce a negative charge in the end of a body brought near to it.

(4) The charge thus placed in the uncharged body is said to be caused by **electrostatic induction.**

(5) The separation of the gold leaves is a measure of the potential difference between a charged body and the earth.

(6) The term **potential** in electricity is analogous to pressure in water systems. It is the difference of potential between two charged bodies which causes an electric current to flow.

(7) A body which is positively charged is generally considered to be one which has a **higher potential** than that of the earth.

(8) A body negatively charged is considered as one which has a **potential lower** than the earth.

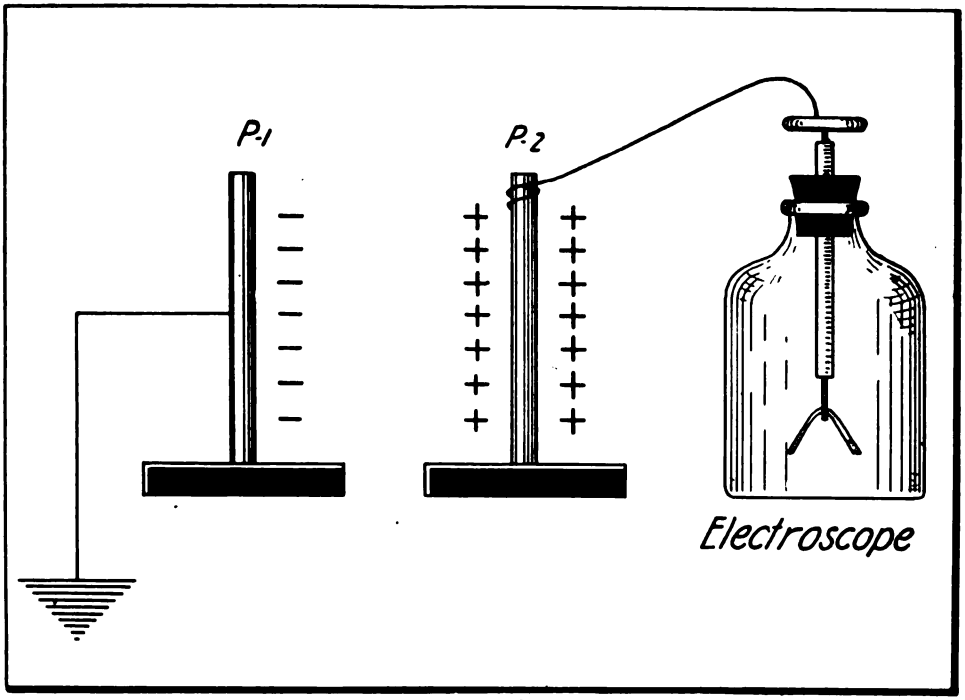


Figure 9

OBJECT OF THE DIAGRAM.

(1) To show how the capacity of a conductor can be increased by placing it near to another conductor.

(2) To show the fundamental principle of the condenser.

PRINCIPLE.

The capacity of the plate, P-2, is greatly increased by bringing it near to another metallic plate, P-1, connected to earth.

DESCRIPTION OF THE APPARATUS.

Two copper plates, P-1 and P-2, are mounted on insulating stands.

P-1 is connected to earth. P-2 is joined to an electroscope by a copper conductor giving an electric charge by one of various means.

OPERATION.

If a positive charge is given to plate P-2 the gold leaves of the electroscope will diverge and as P-2 is placed nearer to P-1 the gold leaves will fall together.

The further from P-I, P-2 is placed the greater will be the divergence of the leaves and the closer, the less the divergence.

SPECIAL REMARKS.

(1) If plates P-1 and P-2 are placed very close and a number of additional charges are supplied to P-2, the normal charge of P-2 will be restored as shown by the divergence of the leaves, that is to say, P-2 returns to its original **electrical potential.**

(2) It is to be especially noted that, inasmuch as a greater quantity of electric charge is required to raise P-2 to its original potential when placed near to P-1, it is said that the capacity of P-2 for holding an electric charge has under these conditions been increased.

(3) It should now be clear that the capacity of a body is measured by the amount of electricity which must be placed upon it in order to raise its electrical potential to a definite value.

(4) The apparatus of Figure 9 is called a **condenser** and a condenser always consists of **two metallic plates** separated by an **insulating material** which may be air, glass, micanite, hard rubber or any of the well known insulating materials. The most common form of electric condenser is the **Leyden jar.**

The Production of Electrical Currents.

In order to produce a steady flow of electric current in an electrical circuit, two conditions are necessary.

(1) There must be maintained a steady electrical pressure known as electromotive force or potential difference;

(2) A suitable conducting path to pass the current.

(1) A metallic circuit in which a current flows with little opposition is said to be a **conductor.** One which offers considerable resistance is known as **a partial or fair conductor** and a substance which greatly impedes the flow of electrical current is termed an **insulator.**

(2) Conductors, therefore, are distinguished from insulators by their ability to transmit electric charges from point to point.

Conductors
In the order of their increasing resistance.

Silver
Copper
Gold
Aluminum
Zinc
Iron
Platinum
Nickel

Insulators
In order of their increasing resistance.

Dry air
Shellac
Paraffin
Resin
Silver
Wax
Glass
Mica
Ebonite
India Rubber
Silk
Paper
Oils

(3) There is no hard and fast line to be drawn between a conductor and an insulator. All so-called insulators conduct electricity to some extent and all so-called conductors possess varying degrees of **resistance** according to the material.

(4) The **specific resistance** of any material is the resistance of a piece of unit length and unit cross section at an arbitrarily adopted degree of temperature. It is, in fact, the resistance of an inch cube of any substance at the temperature of melting ice.

(5) Silver is taken as unity and the relative resistance of any other material is calculated from this as a base.

(6) For example, with annealed silver taken as a unity or 1, the specific resistance of German silver is 13.92 and for platinum 6.022.

(7) **Resistance** may be defined as that property of a conductor which opposes the flow of an electric current, the spent energy being manifested in the form of **heat.**

METHODS OF GENERATING ELECTROMOTIVE FORCE.

HOW ACCOMPLISHED.		NAME OF DEVICE OR APPARATUS.
(1) By friction.	Rubbing Together of two unlike materials, such as silk and glass.	Frictional machine.
(2) By chemical action.	Chemical action of a liquid upon two unlike elements such as copper and zinc.	Primary or secondary batteries (storage cells).
(3) By mechanical motion.	The dragging of a copper conductor through a magnetic field.	The dynamo or generator.
(4) By thermal action.	The heating of the junction of two metallic elements.	The thermo couple.

QUES.—What are some of the effects of the flow of an electrical current through a metallic conductor?

ANS.—(1) The production of a magnetic field;

(2) The heating of a wire;

(3) The electrochemical decomposition of a liquid.

QUES.—What is meant by an electrical circuit?

ANS.—The term circuit is applied to the entire path through which the transference of electrical energy takes place.

QUES.—What is an electrical circuit ordinarily composed of?

ANS.—It generally consists of a number of pieces of electrical apparatus, joined together, either in series or in parallel, which in turn are connected to a source of electromotive force.

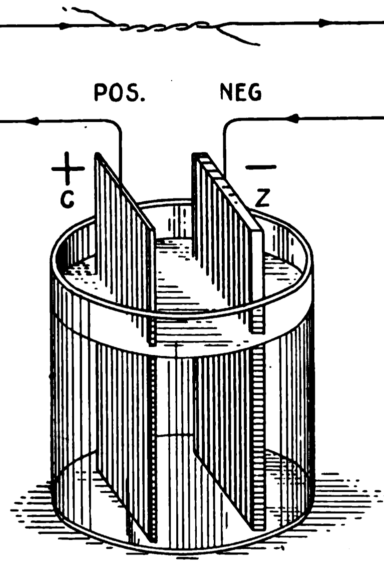


Figure 10

OBJECT OF THE DIAGRAM.

To show fundamentally the construction of an electro-chemical cell, i. e., one type of apparatus for the generation of electromotive force by chemical action.

PRINCIPLE.

Two unlike metallic elements, such as copper and zinc, when placed in a dilute solution of acid or alkali exhibit signs of electrification and either element takes a higher or lower electrical potential than the liquid. When the terminals of the plates are joined together by a copper wire, an electric current will flow through the external circuit.

An electroscope placed near to the zinc terminal will show the same electrification as appears on silk when rubbed with glass.

DESCRIPTION OF A SIMPLE CELL.

A glass jar partially filled with a dilute solution of acid or alkali has a plate of zinc, Z, and a plate of copper, C, slightly separated.

OPERATION.

When the outside terminals of the plates are joined together, an **electric current** will flow through the wire.

During the flow of the current, the zinc strip gradually wastes away; the consumption of the zinc, in fact, furnishes the energy to drive the current through the cell and through the external circuit.

The chemical action within a copper and zinc cell during the flow of current may be summed up as follows:

(a) When the current starts to flow the sulphuric acid attacks the zinc plates and forms zinc sulphate;

(b) Some of the hydrogen in the solution is liberated and it appears on the copper element;

(c) Many of the gas bubbles cling to the copper plate which tend to insulate it from the liquid.

(d) The accumulation of hydrogen gas also tends to set up a pressure against that produced by the cell proper;

(e) These two actions tend to reduce the flow of current and when the electromotive force of the cell drops, or in other words, its ability to deliver an electric current is considerably reduced, the cell is said to be polarized.

QUES.—How may polarization of an electro-chemical cell be prevented?

ANS.—In three ways:

(1) By chemical methods;

(2) By mechanical methods.

Example of Chemical Methods.

(1) The destruction of the hydrogen by the addition to the solution of bichromate of potash or nitric acid;

(2) The use of a double fluid cell such as the Daniell cell which consists of a zinc plate immersed in zinc sulphate and a copper plate immersed in copper sulphate. In this cell the material driven out of the solution at the copper plate is metallic copper rather than hydrogen. In its most commonly used form, this particular type is known as the gravity cell;

(3) The packing of manganese dioxide about the carbon or positive plate of a cell. The hydrogen is slowly attacked by the manganese dioxide which, to a large extent, will prevent polarization.

Example of Mechanical Methods.

(1) The agitation of the liquid or actual shaking of the negative element of the cell to destroy the accumulation of hydrogen bubbles;

(2) Corrugating or roughening the surface of the negative element which causes the gas to form into large bubbles and slowly rise to the surface.

In a simple cell which is not supplied with means to prevent polarization, current will only flow for a short time. Such a cell is usually classified as an **open circuit** cell.

In cells in which polarization does not take place, such as the gravity cell, current can be taken from it for a period until the zinc is consumed or the liquid spent. Such cells are known as **closed circuit** cells.

Closed circuit cells generally deliver low values of current and are required to be kept on closed circuit continuously in order that the two solutions may not diffuse.

EXAMPLES OF COMMONLY USED ELECTRO-CHEMICAL CELLS.

Type	Positive Element	Negative Element	Solution	E.M.F. Volts	Remarks
Daniell Cell	Zinc "crow-foot"	Copper	Zinc sulphate Copper sulphate	1.08	Continuous service
Leclanche Cell	Zinc rod	Carbon plate inside porous cup	Ammonium chloride sal ammoniac	1.5	Momentary currents of intermittent service.
Bichromate Cell	Zinc plate	2 carbon plates	Sulphuric acid and bichromate of potash	2.1	Momentary current zinc must be withdrawn when cell is not in use.
Edison Cell (R. R. type)	Zinc (zinc plate on either side of a copper element)	Black oxide of copper	Caustic potash	0.7	Continuous service

SPECIAL REMARKS.

(1) The so-called **dry cell** is not really dry.

(2) The zinc plate is used as a container and the carbon plate is placed in a moist paste which generally consists of one part of zinc chloride, one part of zinc oxide, three parts of plaster paris, one part of crystals of sal-ammoniac and two parts of water.

(3) It should be understood that the terminal of the copper plate of an electro-chemical cell is known as the positive terminal, but the immersed portion is known as the electro negative element; whereas the terminal of the zinc plate is known as the negative pole, but the immersed portion is the electro positive element.

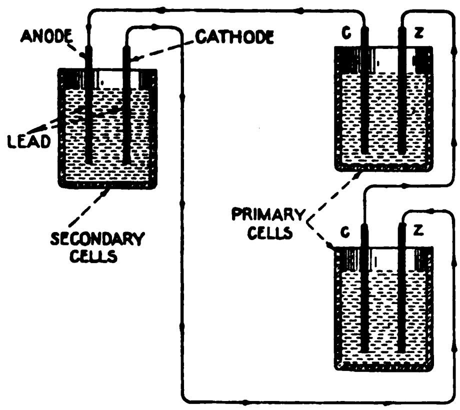


Figure 11

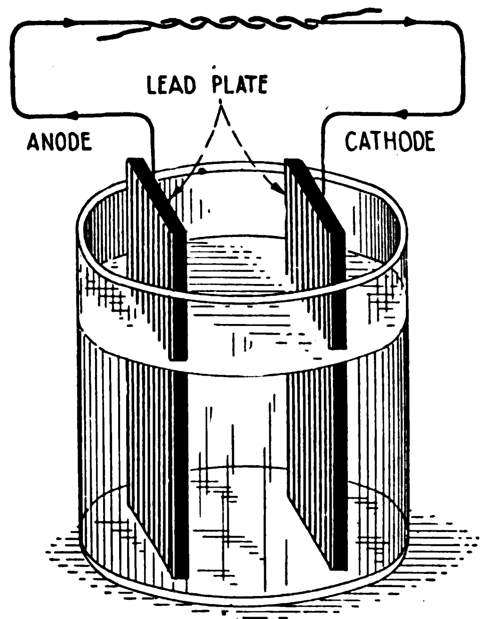


Figure 12

OBJECT OF THE DIAGRAM.

(Figure 11) To show the fundamental construction of a simple storage cell.
(Figure 12) To show the direction of the flow of current after the cell has been "charged."

PRINCIPLE.

When an electrical current from an outside source is made to flow from one lead plate to another through a dilute solution of sulphuric acid, an electro-chemical change is produced which gives these plates dis-similar properties.

The plate connected to the positive pole of the primary cells receives a brown coating of peroxide of lead.

The opposite plate becomes spongy or porous.

DESCRIPTION OF A SIMPLE STORAGE CELL.

Two lead plates are immersed in a 16% to 20% solution of sulphuric acid and their terminals connected to the positive and negative poles of a primary battery.

A storage cell may have several plates connected in parallel and its capacity for furnishing current thereby increased.

Modern storage cells are **charged** by direct current dynamos.

SPECIAL REMARKS.

(1) Electricity is not stored up in a storage cell, but the current supplied to the cell during the charging process produces an **electrochemical change** which gives the plates dis-similar properties, and so long as this change is evident, there will be a difference of potential at the terminals, and therefore, an electromotive force.

(2) The plate connected to the positive pole of a dynamo or battery of primary cells is called the **anode** and the opposite plate the **cathode.**

(3) When the anode is joined to the cathode by a wire (as shown) the current will flow from the anode to the cathode outside the cell and from the cathode to the anode inside the cell.

(4) A storage cell will continue to supply current until the lead peroxide is partly used up, and during the process of discharge, the plates will gradually return to the state they were in before the charging process took place.

(Storage cells will be described in detail further on, particularly in the chapters devoted to emergency apparatus and auxiliary radio transmitters.)

QUES.—How can the electric circuit of a battery, such as shown in Figure 3 be closed?

ANS.—The circuit is closed by connecting together the wires leading from the terminals of the copper and zinc plates.

QUES.—What is meant by an external circuit?

ANS.—An external circuit is the path the current takes from plate to plate outside the cell.

QUES.—How may the strength of the current in the external circuit be regulated?

ANS.—By means of a variable resistance coil, i. e., a coil made of wire having a high specific resistance such as German silver.

QUES.—What determines the rate of current flow of a primary cell?

ANS.—The size of the plates, their proximity, and the resistance of the liquid; also the resistance of the external circuit.

QUES.—What is the unit of electromotive force?

ANS.—The volt.

QUES.—What is the unit of current strength?

ANS.—The ampere.

QUES.—What is the unit of resistance?

ANS.—The ohm.

QUES.—What is the unit of current quantity?

ANS.—The coulomb.

QUES.—What is the unit of electric power?

ANS.—The watt. (1 watt=1 volt×1 ampere; 746 watts=1 horsepower.)

QUES.—What is the current output of the average primary cell such as commercial types of dry cells?

ANS.—The current output varies from 15 to 50 amperes.

QUES.—What is the electromotive force of the average primary and secondary cell?

ANS.—The electromotive force of primary cells varies from 0.6 to 2.1 volts. The E. M. F. of the Edison Storage Cell is 1.2 volts and of the lead plate storage cells from 2.1 to 2.6 volts.

QUES.—What is the physical standard for the volt, the ampere and the ohm?

ANS.—The standard for the volt is the E. M. F. of the Weston Cadmium cell which has an electromotive force of 1.018 volts at a temperature of 20 degrees Centigrade.

The physical standard for the ampere is designated as follows: It is found that if a silver and copper electrode is dipped in a neutral solution of silver nitrate (consisting of 15 parts by weight of silver nitrate and 18 parts of water) a steady current of one ampere flowing from the silver to the platinum plate will deposit .001118 grams of silver on the platinum per second.

The international ohm is the resistance offered to the flow of an unvarying electric current by a column of mercury 106.3 centimeters long, weighing 14.4531 grams, at a temperature of 32 degrees Fahrenheit.

QUES.—How may the total E. M. F. of a given battery in chemical cells be increased?

ANS.—By joining them in series.

QUES.—What does a series connection consist of?

ANS.—In joining the positive terminal of one cell to the negative terminal of the next cell and so on throughout the series. By this connection the total E. M. F. is that of one cell multiplied by the number of cells in the circuit (provided their E. M. F.'s are equal.)

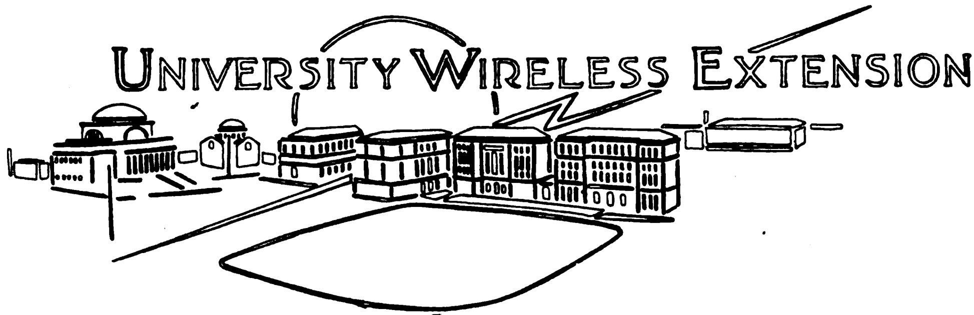
QUES.—How may the current output of a number of cells be increased?

ANS.—By arranging the cells in parallel.

QUES.—What does a parallel connection consist of?

ANS.—The connecting together of all positive terminals and of all negative terminals. By this connection, the current output is that of one cell multiplied by the number of cells.

(*To be Continued*)



Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE VII

ONE of the circuits devised in 1914 by Mr. Franklin of Marconi's Wireless Telegraph Company of England is shown in Figure 74.* It will be noticed that the plate oscillating circuit is tuned by means of the condenser, *C'* and that one of its inductances, *L"*, is coupled to the grid circuit inductance, *L'*. The grid circuit, *L L' C*, is also tuned. Energetic oscillations can thus be obtained. It will be noticed further that there is included in the circuit between filament and grid the battery, *B'*. The purpose of this battery is to enable choosing such normal grid potential as shall give a desired plate current through the bulb, and desired output with high efficiency. Indeed, it is necessary with most bulbs to keep the grid at a negative potential, since, if the grid becomes positive, current begins to flow from the grid to the filament with consequent absorption of energy in the grid circuit. The amplifying action of the tube and its efficiency as a sustained current generator are then impaired.

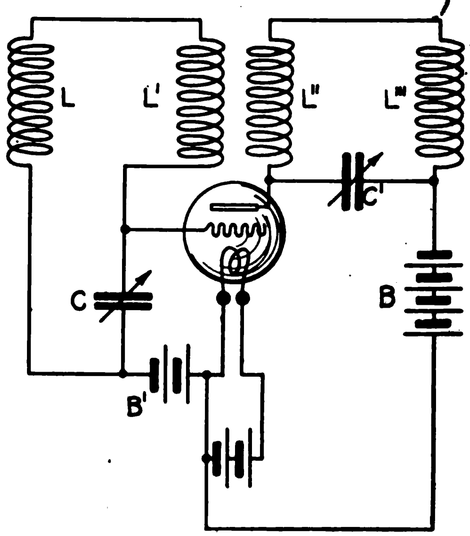


Figure 74—Marconi Company-Franklin Circuit, 1914

In Figure 75 is shown a simplified diagram of another form of transmitting circuit used by the English Marconi Company in its ship radiophone transmitters. The details of the wiring diagram will be given under "Control Systems." It need only be mentioned that the alternating current energy is withdrawn from the oscillator at L_1.

Dr. de Forest has carried on extensive experiments with vacuum tube oscillators. One of the earliest and simplest circuits is his "ultraudion" circuit, shown in Figure 76. It is normally used in receiving, though it is naturally available also

* British patent, No. 13,248, of 1914.

for generation of greater power. As shown, the telephone T and battery B in the plate circuit are shunted by the "a bridging condenser" C''. Connected between the plate and grid is the oscillating circuit, L C, one side of which is directly connected to the plate, and the other to the grid by the small condenser, C'. This condenser is usually shunted by a leakage resistance (not shown in the figure) which prevents the accumulation of an excessive negative charge on the grid and consequent limitation of the plate current.

Dr. de Forest explains the action as

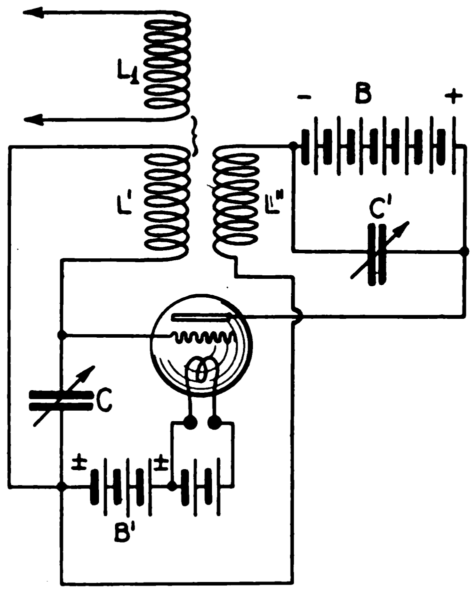


Figure 75—English Marconi Company oscillating circuit; modified form

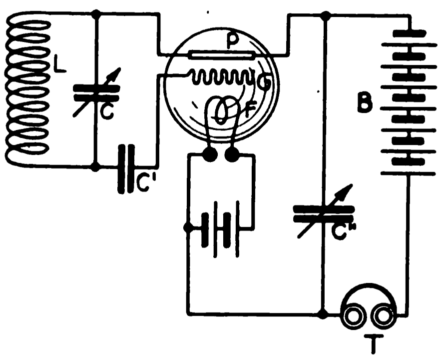


Figure 76—de Forest ultraudion circuit

follows: "There is only one oscillating circuit. This circuit is such that a sudden change of potential impressed on the plate produces in turn a change in the potential impressed on the grid of such a character as to produce, in its turn, an opposite change of value of potential on the plate, etc. Thus the to-and-fro action is reciprocal and self-sustaining." In thus explaining the action of the device, Dr. de Forest takes sharp issue with Mr. Armstrong, who claims that the circuit is "regenerative" in the sense that there is an inductive-capacity coupling between the plate and grid circuits, which latter circuits are claimed by Mr. Armstrong to be existent and clearly defined.

A later oscillating circuit (1915), due to de Forest, is shown in Figure 77. It will be seen that this circuit differs from the normal ultraudion in that there is a coupling added between the grid and plate circuits. This coupling is L and L'' and is presumably intended to reinforce the production of oscillations and produced greater outputs in consequence. The coil, L'', is referred to as a "tickler" coil.

Though detailed wiring diagrams of the arrangement shown in Figure 78 are not available, it is of some interest. It shows a complete de Forest radiophone transmitter and receiver. At the left is shown the bulb-mounting panel. Dr. de Forest has given the name of "oscillion" to the bulb shown in the

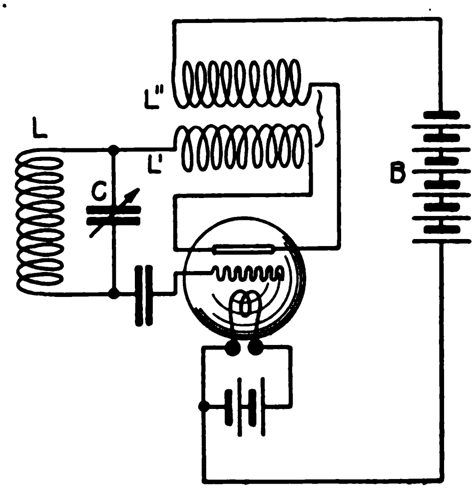


Figure 77—de Forest oscillating circuit, 1915

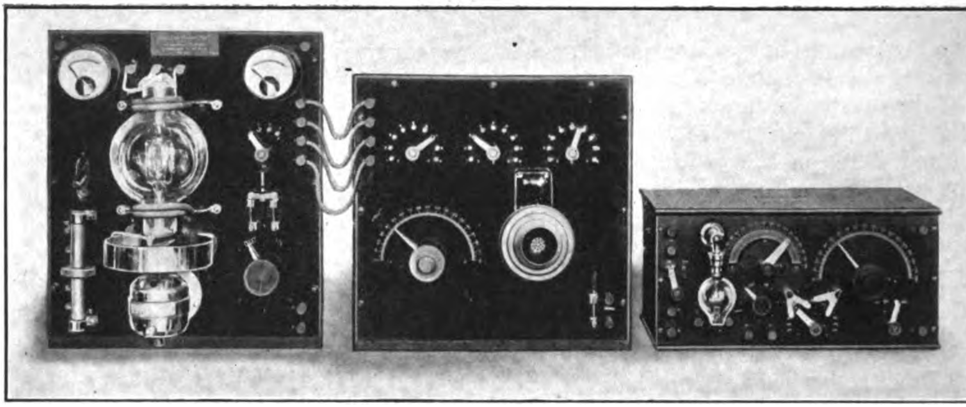


Figure 78—de Forest "oscillion" radiophone transmitter (and receiving set)

figure. This bulb has a tungsten "W" filament, a grid of tungsten wire wound on a glass support, and two nickel plates. As seen from the figure, the bulb is air-cooled by means of the small fan placed underneath it. The two instruments mounted on top of the panel are respectively indicators of the filament amperage and plate circuit current of the oscillion. The switch at the left hand side turns the plate current of the tube on and off. The filament current control-rheostat handle is shown in the lower right hand corner of this panel. In the middle box are mounted the various portions of the oscillating circuits and microphone control apparatus. The microphone transmitter is visible on the front. The equipment to the right of the figure is a fairly normal audion receiving set.

The question of considerable outputs from vacuum tube oscillators has led to the consideration of methods of heat-resistant tube construction. An attempt in this direction is shown in Figure 79 and is due to de Forest. The two metal vessels, 6 and 7, are so arranged that the space between them is filled by a heat-conducting fluid, *e. g.,* mercury or certain oils. This fluid acts at the same time as a means of sealing the inner vessel and of preventing air leakage. The grid, filament, and plate structure are mounted inside the inner vessel in the usual manner. The inner vessel is corrugated in the region, 20, so as to provide plenty of heat conducting surface where this is most needed.

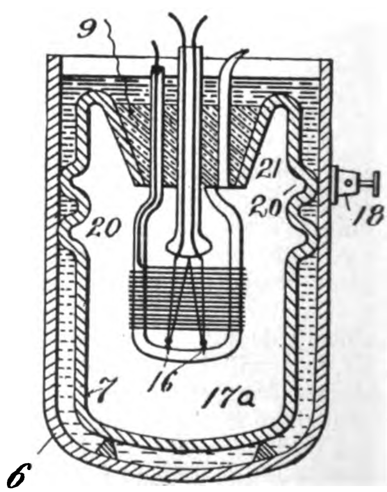


Figure 79—de Forest high-power tube construction

The General Electric Company has developed a number of types of extremely high vacuum tubes and the circuits necessary for their use. One of the simplest of these, and one having marked advantages, is shown in Figure 80. Here both plate circuit $L'' C'' G$ and grid circuit $L' C'$ are tuned and coupled to each other. The output circuit is connected to the inductance, L, coupled as shown. A unique feature of the circuit is that the same generator, G, is used both for lighting the filament through the auxiliary regulating resistance, R, and for supplying the plate circuit directly. It is thus possible to connect such an arrangement directly to a single source of direct current and to start the oscillation by merely closing a single switch. Such automatic action is a desideratum in radiophone equipment.

The actual appearance of the General Electric pliotron or three-electrode tube is indicated in Figures 81, 82 and 83. The first of these figures shows the mode of mounting the filament and grid member of a pliotron. The "W" filament is suitably anchored and supported. The grid itself is wound on a tungsten frame. Figure 82 represents a later type of filament and grid support. This type has increased rigidity and is more heat resistant. In addition, the insulation has been improved, particularly with a view to resisting the extremely high temperatures attained within the bulbs when in operation. The appearance of one of the complete bulbs is clearly shown in Figure 83. The massive tungsten plates are seen to be properly supported outside the filament grid structure, and from the opposite end of the tube. Tubes of this sort can stand thousands, and even tens of thousands, of volts between plate and filament without showing any blue glow due to gas present in the tube. The output of even a comparatively small tube of the type shown in Figure 83 runs into hundreds of watts at plate voltages of about one thousand volts. Such tubes and the circuits associated with them will be further considered under a later heading, wherein complete radiophone sets of the General Electric Company are shown.

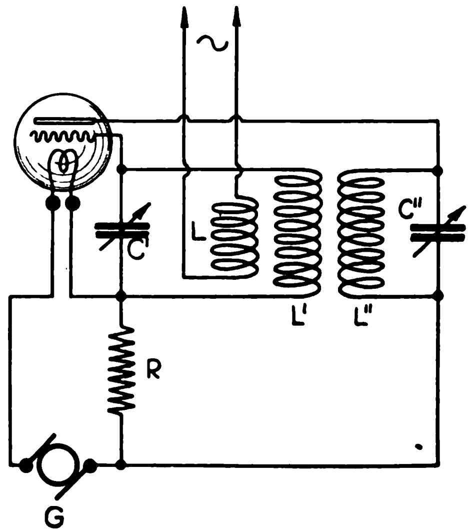


Figure 80—*General Electric Company oscillating circuit*

We consider next certain phases of the work of the Western Electric Company. A circuit used for the production of oscillations by that company and due to Mr. Edwin Colpitts in 1915 is shown in Figure 84. The plate circuit is fed from the battery, *B*, which is in series with the choke coil or inductance, L_1. Consequently the plate voltage does not remain constant. The tuned plate oscillating circuit is L' C', this being inductively coupled to the tuned grid

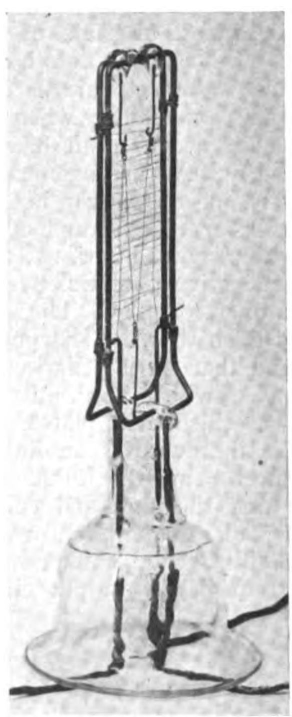


Figure 81—*Filament and grid element of pliotron*

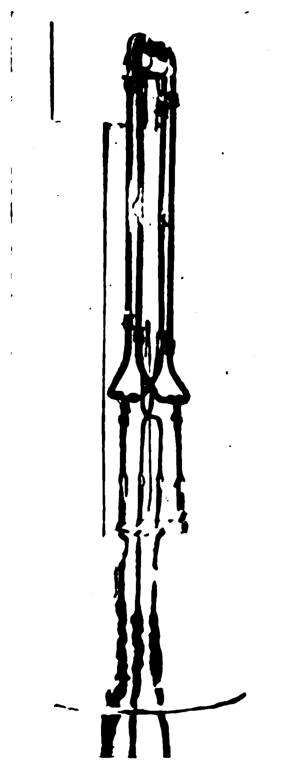


Figure 82—*Filament and grid element of pliotron*

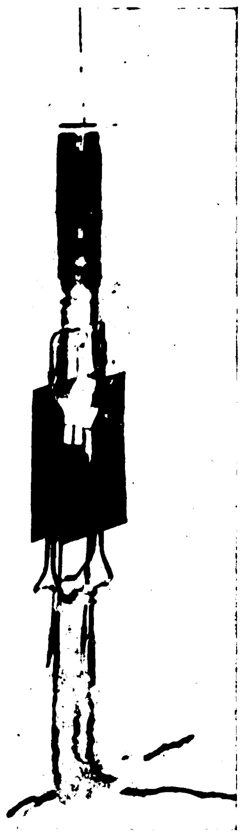


Figure 83—General Electric Company pliotron

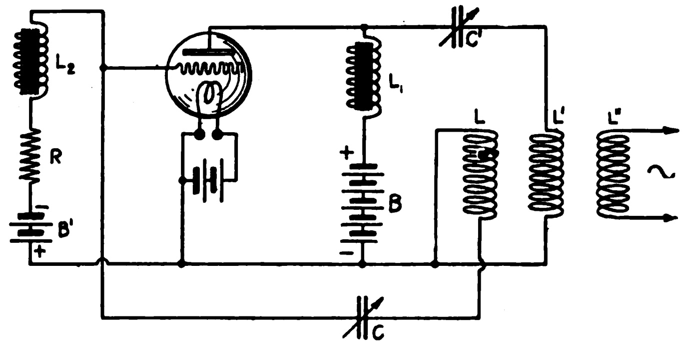


Figure 84—Western Electric Company—Colpitts oscillating circuit

circuit, *L. C.* The grid is maintained at a negative potential by means of the battery, *B'*, the oscillations impressed on the grid being prevented from passing through the battery, *B'*, by means of the inductance, L_2. The output of the bulb is drawn from the coil, *L''*, which is inductively coupled to the inductance in the plate circuit.

A line of development which the Western Electric Company, among others, has pursued in connection with the obtaining of considerable outputs has been the amplification of the output of a single oscillator by a bank or banks of vacuum tube amplifiers, these individual amplifiers being placed in groups in parallel. While apparatus of this type tends to become bulky and clumsy when a very considerable number of bulbs are used, it has considerable electrical flexibility. An arrangement of this sort due to Mr. R. Heising is shown in Figure 85. Herein the oscillator *A*, is coupled inductively to the combined grid circuit of a number of amplifying bulbs, *A'*, *A'*. The grids of these bulbs are maintained at a suitable negative potential by the battery, *B'*. The circuit, *L C*, is tuned to the oscillator frequency. The resistance, *R* (which is non-inductive), is shunted across *C* so that the sharpness of resonance of the combined circuit is adjustable and that its impedance at a definite frequency shall have a sharply defined value. As will be seen, all the grids of the amplifiers, *A'*, are connected in parallel, as are also their plates. A common plate battery, *B*, feeds all of them. In series therewith is an inductance which is coupled to the circuit, *L' R' C'*, this latter being the input circuit of the second bank of amplifiers, *A"*, *A"*. In this way the amplified voltages which are produced in the plate circuit of the first bank of amplifiers are brought to the grids of the second bank of amplifiers. This second bank of amplifiers is intended for increasing the alternating current in the output circuit, whereas the first bank

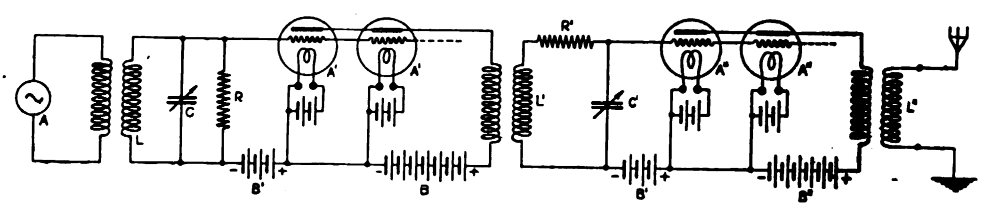


Figure 85—Western Electric Company-Heising oscillator—amplifier arrangement

was intended primarily for a voltage increase. The resistance, R' is inserted in the grid input circuit of the second bank of amplifiers to render the operation more stable. The plate circuit of all the amplifiers, A'', are fed from the common battery, B'', and an inductance in this plate circuit is coupled to the antenna tuning coil, L''. By this means the amplified currents are set up in the antenna or final output circuit. This system will be further considered under another heading in connection with the radiophone work of the Western Electric Company.

The construction of vacuum bulbs for large outputs has engaged the attention of the engineers of this company as well. A well-defined trend of their development has been the attempt to secure very effective control by placing the filament and grid very close together. In fact, actual contact (though with an insulator, such as nickelous oxide, between) has been considered. The arrangements developed for this purpose will be considered in greater detail in connection with receiving apparatus. For transmitting work Mr. A. Nicolson has developed the type of bulb shown in Figure 86. A glass tube, *A*, of cylindrical form, is sealed inside another cylindrical glass tube, *B*, and the space between is exhausted through the seal *C*.

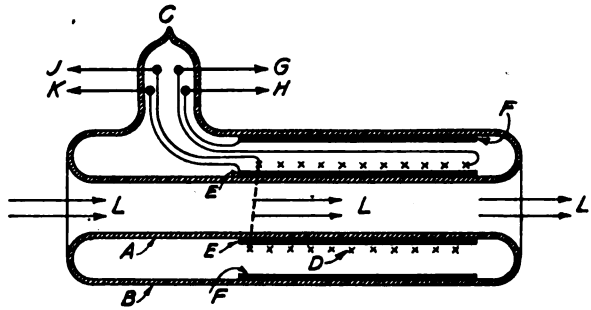


Figure 86—Western Electric Company—Nicolson high-power bulb

Prior to the exhaustion, the filament, grid, and plate members are inserted or slid into the space between the inner and outer tubes. The filament is a twisted platinum strip coated with nickelous oxide and wound around the metal cylinder *E*, which is the grid. The filament, *D*, is represented by the two lines of crosses along the length of the cylindrical grid. The filament terminals are brought out of the tube through the leads, *J* and *G*. It will be noticed that the grid is ***internal*** to the filament in this particular tube, a comparatively rare construction. The grid lead out of the tube is *K*. The plate is the outer cylinder, *F*, and its connection to the outside of the tube is *H*. The plate is inserted into the tube at the same time as the grid and filament, that is, before exhaustion. Cooling of the tube is accomplished by passing a liquid or gas through the central orifice as indicated by the arrows, *L*. The exterior portions of the tube are similarly cooled, and this is claimed to enable the tube to operate continuously with heavy plate currents.

Through the courtesy of the General Electric Company and Dr. Albert W. Hull, we are enabled to present to our readers a more recent development in vacuum tube amplifiers and oscillators, namely the "dynatron." This device depends on a principle hitherto not used in this connection, namely secondary emission. This phenomenon is as follows: When a stream of rapidly moving negative electrons falls on a metal plate, if the velocity of the stream is not very great, no unusual effect will be noticed. If the velocity is somewhat increased each electron impinging on the plate will liberate from the molecule which it strikes one slowly moving electron. As the velocity of the impinging or "primary" electron stream is increased, at each collision, two electrons will be liberated from the plate, and the number of "secondary" electrons liberated by each primary electron on impact may be as many as twenty for very high primary electron velocities.

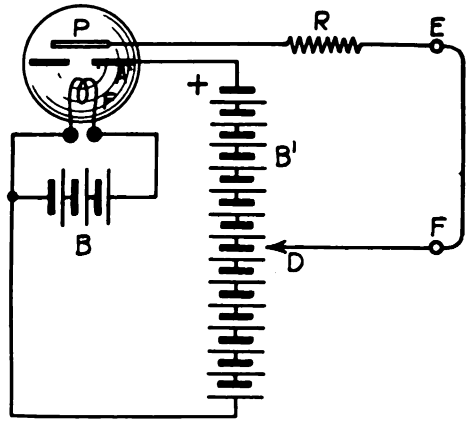


Figure 87—General Electric Company—Hull dynatron amplifier circuit

Let us now consider the arrangement of circuits shown in Figure 87. The bulb shown is a dynatron, containing an incandescent filament, *F*, an ***anode***, *A* (which is a perforated plate), and the plate, *P*. It is at once to be noted that the anode, *A* is ***not a grid***, being maintained at a ***fixed*** and high ***positive*** potential and not serving as an ***input*** member of the system. Unless this is kept in mind, the action of the device can not be understood. The filament is maintained incandescent by the battery, *B*. Between the filament and the anode, *A*, is connected the battery, *B'*, with its positive end connected to *A*. So far the device will act just as does an ordinary hot cathode rectifier, *e. g.*, a kenotron, with the exception that a great number of electrons moving from the filament, *F*, to the anode, *A*, will pass through the hole or holes in the anode and strike the plate. So long as the velocity of the electrons striking the plate, *P*, is not high the curve connecting applied voltage (between the plate. *P*, and the filament, *F*) and the current flowing in the plate circuit (*e. g.*, between points *E* and *F*) will be similar to that for a kenotron. Suppose for the present the resistance, *R*, in the plate circuit to be zero. As long, then, as the tap, *D*, is so placed that the plate is not very positive, we get the usually characteristic indicated by the portion *OA* of the curve of Figure 88, which, as stated, resembles the normal current-voltage curve of a kenotron rectifier.

As we approach the point, *A*, of the curve, however (by raising the voltage of the plate by moving the tap. *D*, up the battery, *B'*), the electrons striking the plate begin to have higher velocities and secondary emission occurs. In consequence the electrons released by the secondary emission are produced in increasing quantities. Since the anode is *more positive* than the plate, these electrons will be attracted to the anode and there absorbed. As for the plate, it begins to lose by secondary emission an appreciable portion of the current which strikes it so that the net current in the plate circuit (*DFERP*) becomes smaller and smaller as the plate voltage is increased. This is shown in the portion, *AB*, of the curve of Figure 88, which shows that the current in the plate circuit is *diminishing* for *increasing* plate voltage. At *B* the plate loses as many electrons as strike it, and the net current is zero. From *B* to *C*, as the voltage of the plate is further increased, each electron that strikes the plate liberates more than one electron so that the plate on the whole *loses* electrons and the plate current is actually reversed and negative. At *C* the

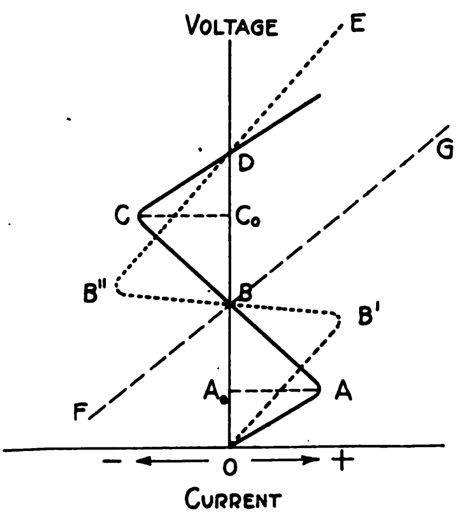


Figure 88—Dynatron voltage amplifier characteristics

limit of re-emission is reached, and thereafter the plate current rises along the curve, *CDE,* as the voltage is increased. We have, in the range, *ABC,* of the applied plate voltage a most curious effect, namely that an increase of voltage causes an increase of current ***in the wrong direction.*** That is, between voltages A_0 and C_0 the plate-to-filament circuit of the dynatron acts as a true "negative resistance" which, so far from opposing the flow of current, actually assists it. It acts, therefore, in a manner very roughly analogous to the electrical (though not to the physical) behavior of the Poulsen arc and is capable of being an amplifier or oscillator. The arc, however, has a negative resistance characteristic only for ***increasing*** current, but acts as an open circuit for ***decreasing*** current. The dynatron has a stable negative resistance in either case. Furthermore, the dynatron has no hysteresis or lag, but responds instantaneously, because it does not depend on gas ionization, as does the arc.

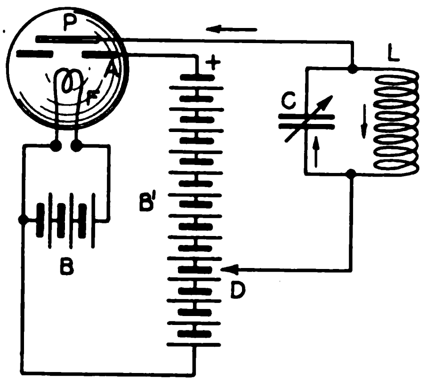


Figure 89a—Dynatron oscillator

To make the device a strong amplifier, we insert a resistance, *R,* in the plate circuit, which resistance has a positive value nearly equal to the negative resistance of the dynatron plate circuit. The current-voltage curve of such a resistance will be parallel to the line *FG* in Figure 88, where *FG* slopes to the right nearly as much as *AC* to the left. The plate circuit characteristic of the dynatron will then become the curve, *OB'B"E,* which is dotted in the figure. It will be seen that a very small change in voltage in the neighborhood of the value, *B,* will cause a very great change in the current in the circuit from *B'* to *B"*. The small exciting voltage would be inserted into the plate circuit, for example between the points *E* and *F*.

Since the dynatron is a negative resistance, it is essentially an unstable device and will, if an oscillating circuit is included in the plate circuit, produce in that oscillating circuit sustained alternating currents. The circuit diagram, therefore, is shown in Figure 89a, which is quite similar to Figure 87, except that the oscillating circuit, *LC,* is added in the plate circuit. The directions of current while the capacity, *C,* is discharging are shown by the small arrows, and it will be seen that the capacity discharges partly through the inductance, *L,* and partly through the plate circuit of the bulb.

Using the dynatron as an amplifier, voltage amplifications of as much as 1,000-fold have been obtained, and 100-fold amplifications are very readily available. Used as an oscillator, the dynatron has shown itself capable so far of producing all frequencies between less than one cycle per second and 20,000,000 cycles per second (corresponding to a wave-length of 15 meters). The output of a single bulb has been as much as 100 watts.

A still more recent device, also due to Dr. Hull, is the pliodynatron, a combination of the pliotron and the dynatron. This device has a true grid as well as the anode and plate electrodes and is an interesting four-electrode device. The grid, as usual, is an electrostatic control member, and, if the conditions are properly chosen, enables the stable control of the oscillating energy in the circuit, *LC.* That is, the variation of the grid potential (as determined by the battery, *B"*, or otherwise) will cause variations in the oscillation output of the bulb. This feature will be further considered under "Modulation Control for Radio Telephony." The wiring of a pliodynatron is clearly indicated in Figure 89b.

The actual appearance of the dynatron is illustrated in Figure 90a and of the pliodynatron in figure 90b. It will be noted that the anodes are naturally much heavier than the grids of pliotrons, which must, of course, be the case, since its function is quite a different one and since it must carry very considerable currents in its own circuit and be subjected to very energetic electron bombardment.

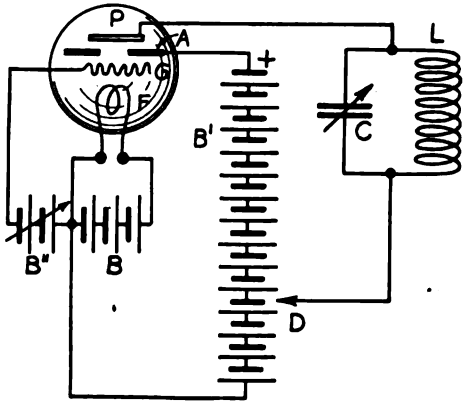


Figure 89b—General Electric Company-Hull pliodynatron controlled oscillator

(d) Alternators of Radio Frequency.—As we have repeatedly seen, the first necessity in radio telephony is a steady stream of alternating current of radio frequency, available for modulation into speech form. We have treated in succession the arc, radio frequent spark and vacuum tube generators of such currents (or first approximations to such currents). It would seem, at first sight, as if we had neglected deliberately an apparently far more natural and simple means of securing such currents and one well known to ordinary commercial electrical engineering. We refer, of course, to the normal alternator.

As a matter of fact, we have deferred the study of the radio frequency alternator because of the real difficulties in the generation of such very high frequency alternating currents directly. This can be seen if we consider the pitch or distance between adjacent armature windings for a 100,000-cycle alternator. If we assume the diameter of the rotor to be 2.0 feet (60 cm.) and a normal speed of rotation of 2,500 revolutions per minute, we find that the pole pitch has the extraordinarily small value of 0.016 inch (0.04 cm.), which is entirely impracticable when one considers that wire and insulation must all be crowded into the winding slot. In addition, there would have to be 4,800 poles.

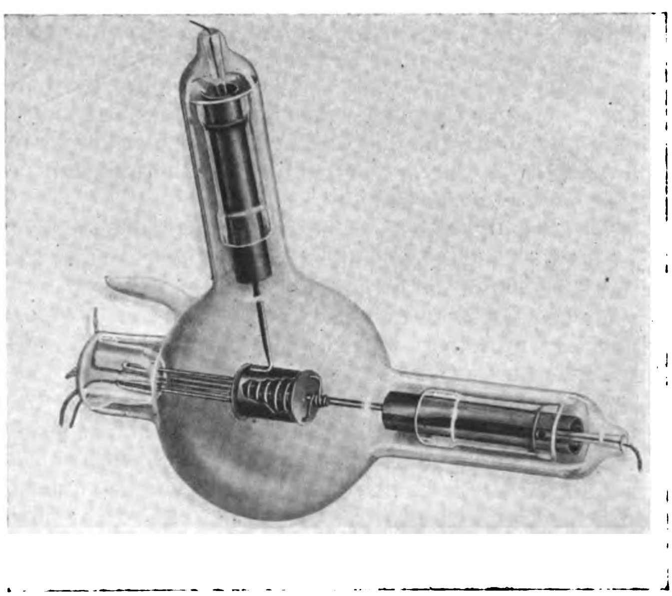


Figure 90a—General Electric Company-Hull dynatron, showing internal structure

It becomes necessary, then, if we persist in the process of direct generation of the current, to have a higher speed of rotation, since the pole number must obviously be reduced. Suppose we choose the extremely high speed of rotation of 20,000 revolutions per

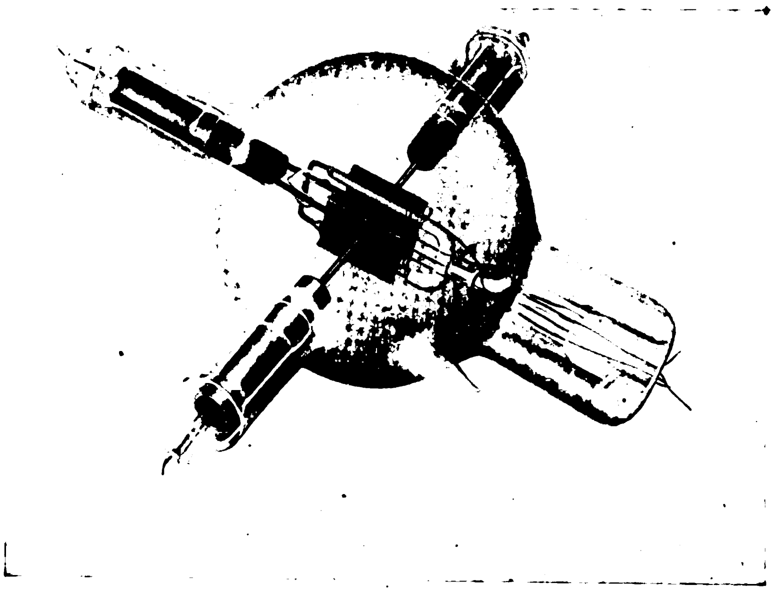


Figure 90b—General Electric Company-Hull pliodynatron controlled oscillator

minute. We shall need then 600 poles, and the width of winding becomes 0.12 inch (0.30 cm.) approximately. So close a winding can be accomplished if great care is exercised in the choice of wire insulation and in the milling out of the slots. The requirement of a speed of rotation of 20.000 revolutions per second makes a solid steel rotor and an alternator of the inductor type essential; and this is indeed the case for the radio frequency alternators of the present, which (with the exception of the Goldschmidt type, which must have a wound armature for electrical reasons) are all of the inductor type.

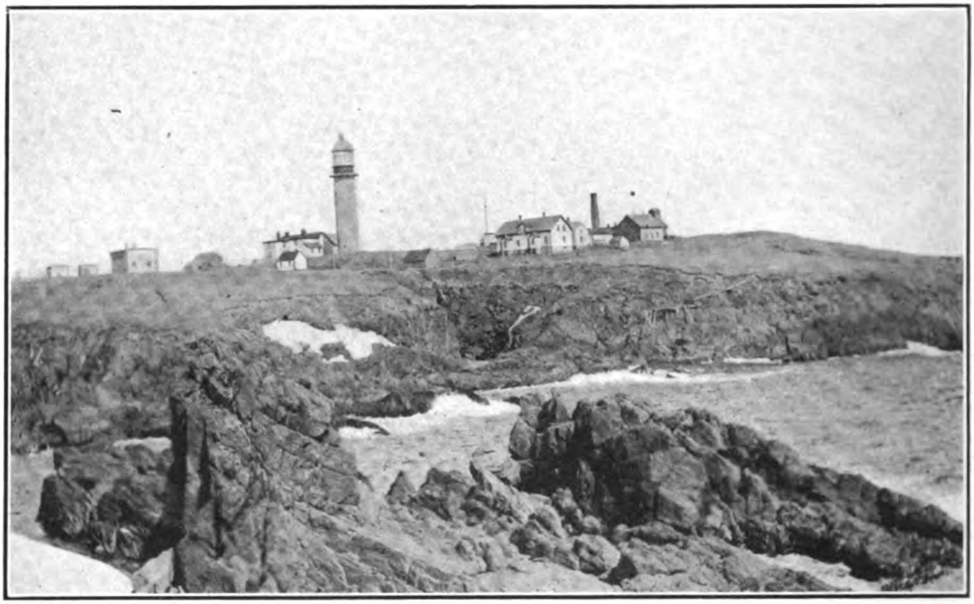
We shall see that there are thus at least three general lines of endeavor in connection with the generation of radio frequent currents by alternators. These are, firstly, the multiplication of frequency within the machine (Goldschmidt type); secondly, the multiplication of frequency outside the machine (*e. g.*, Arco alternator of the Telefunken Company, with frequency changers), and, thirdly, the direct generation in the machine of the frequency used (Alexanderson alternator of the General Electric Company). It is interesting to note that a solution of the problem of producing currents of frequencies of the order of 50,000 cycles per second (and wave-lengths of 6,000 meters) turns out to be possible for considerable output powers (100 kilowatts or more) by all three methods. The details of these methods will be next considered.

This is the seventh article of a series on "Radio Telephony," by Dr. Goldsmith. In article VIII, in the August issue, he takes up the subject of the details of methods employed in generating radio frequent currents in alternators. The Goldschmidt alternator and those used by the Telefunken Company are described.

Professional Operators

Our Northern Ally's Stations

By Frank C. Perkins



The old Cape Race station, with a mast just discernible in the background. A new station has taken the place of the one shown

Editor's note—Not only because of the close relationships established with our northern neighbor in wartime, is this article of interest to wireless men. The prominent part Canada has played in the history of the art on this continent makes the present status of that colony's wireless system of importance. It will be recalled that in the early days of commercial working Cape Race and Sable Island stations were the means of establishing first touch with this continent for inward bound steamers, and from another Canadian station, Glace Bay, the first trans-Atlantic communication was established with Clifden, Ireland. Mr. Perkins' article gives an informative survey of the work accomplished by Marconi interests both in the Lake District and on the coast.

THE accompanying photographs show the electrical equipment of typical Canadian Great Lakes Wireless Telegraph Stations, as operated by the Marconi Wireless Telegraph Company of Canada, Ltd. Apart from the trans-Atlantic station at Glace Bay, N. S., which communicates with the English Marconi Company's plant at Clifden, Ireland, the outstanding feature of wireless in the Dominion is the chain of intercommunicating stations—the longest in the world—extending from Port Arthur at the head of Lake Superior down through the Great Lakes along the River and Gulf of St. Lawrence to far-off Labrador. Along the Atlantic Coast of New Brunswick, Nova Scotia and Newfoundland, stations are located, and one of the busiest stations in the entire group is located at Sable Island, "the graveyard of the Atlantic," about 200 miles from Halifax.

Stations on the Great Lakes at Port Arthur Soo, Toberymory, Midland, and Sarnie, Port Burwell, Toronto, and Kingston make up the chain. The stations on the River and Gulf include those at Montreal, Three Rivers, Quebec, Gross Isle, Father Point, Eame Point, Heath Point, Harrington, Grindstone Island, Cape Bear, Pictou, Point Amour and Clarke City.

It is of interest to note that the Newfoundland and Labrador wireless stations have been established at Battle Harbor, Venison Island, American Tickel and Domino; also at Grady, Indian Harbor, Holton, Cape Harrison, Makkovik, Fogo and Pointe Riche. The Atlantic stations of long range include those at Cape Race, Cape Ray, Belle Isle and Camperdown (Halifax). Stations are also located at Cape Sable, Partridge Island (St. John), Sable Island and North Sydney.

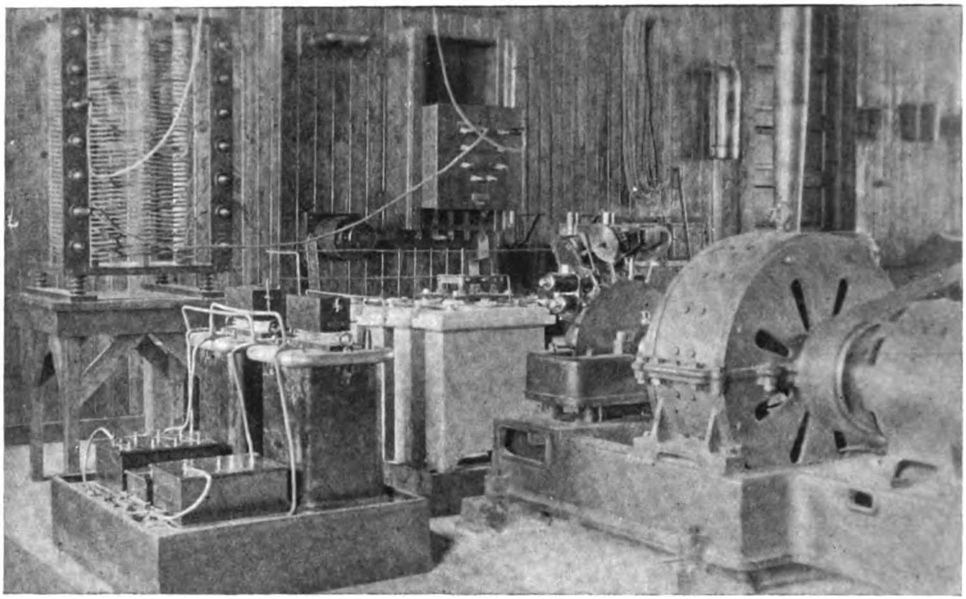
The Great Lakes stations have electric generators of 5½ K. W. power, driven by 8 h. p. horizontal gasoline engines of the Fairbanks-Morse type, and wooden masts 185 feet high. The range of the stations is from 250 to 300 miles. The river, Gulf and Atlantic stations, with the exception of that at Cape Race, have 2 K. W. generators, driven by 4 h. p. gasoline engines, Sixty-cycle dynamos are employed. The masts are 180 feet in height and the station has a range of from 200 to 300 miles. The Cape Race 5 K. W. station has duplicate sets driven by a 10 h. p. engine. There are two masts of steel 250 feet in height. The range of this station is 600 miles. The Newfoundland and Labrador stations use 2 h. p. gasoline engines with D. C. dynamos, and accumulator battery sets. Each station has a range of fifty miles.

In view of the fact that wireless telegraphy in Canada is only thirteen years old, the remarkable advance which it has made discourages any attempts to determine the limits of its application. Its value as an aid to shipping has been proven a hundred times. A striking instance of the value of the Great Lakes system occurred during the great storm of November, 1913. Many vessels with their crews were lost, but not a single ship equipped with Marconi apparatus met with disaster, due to the fact that each vessel received notification of the approaching storm by means of the stations that stand sentinel on the shores of the Great Lakes.

It is pointed out that the repeated instances of the saving of life and property by these ship and shore stations have created a strong sentiment among owners of ships of the Canadian Mercantile Marine that no vessel engaged in coastwise or ocean trade is fully protected unless it is equipped with wireless, and the establishment of radio stations on vessels exempt by law from compulsory equipment is now being viewed with favor.

Cape Race projects far into the Atlantic and the station at this point transmits messages from New York and Montreal to vessels in mid-Atlantic. Almost all advices regarding casualties to ships on the trans-Atlantic routes have their origin at Cape Race. Although the normal range of the station is 600 miles, instances of messages handled at far greater distances have been repeatedly recorded. Messages are received from points more than 1,000 miles away and signals from the Cape have been heard

One of the stations making up the Canadian wireless chain is located at Toberymory Bay



The generating plant at Le Pas

on the other side of the Atlantic and as far south as Gibraltar. The power of the station is 5½ K. W.

The Labrador stations are best known because of the services which they render to the Newfoundland fishing fleets and to vessels en route to Hudson Bay. Wireless telegraphy offers the only practical means of communication between Labrador points, as land lines may be put out of commission by storms and blizzards. Trappers in Labrador obtain freightage for their catch, and the Newfoundland Fishing Fleet is kept in touch with the markets of St. John's and other ports by wireless. As many as 30,000 fishermen visit the Labrador waters in one season and the value of the catch exceeds $1,000,000.

The seal fishing fleet had a forcible illustration of the value of wireless in a disaster which occurred in 1914. On April 2nd of that year the crews of some of the vessels of the Newfoundland Fleet were caught during a blizzard on the ice floes three or four miles from the ships. The steamship Bellaventure, equipped with wireless, first received the news and at once steamed to the scene. With aid from other vessels which had received her radio signals, she was instrumental in saving hundreds of lives. Following this incident, the Newfoundland Government legislation made wireless telegraphy compulsory on all vessels engaged in the sealing industry.

The establishment of stations at Le Pas, Man., the connecting point of the Hudson Bay Railway with the Government Railway system, and Port Nelson on St. James Bay, a terminus of the Hudson Bay Railway, marked an important step in the opening of the new outlet to the sea, the need of which had been felt so long by the Canadian West. In establishing these stations the Government showed that it fully realized the great advantage to be derived from wireless.

The object of the Hudson Bay Railway, it is asserted, is to give the grain growers of the Northwest means of cheap communication between the Interior and Europe via Hudson Bay and the Atlantic. Wireless has played an important part in the construction of the railway. Primarily it has served as an intermediary for the ordering and forwarding of material and labor from the base to the scene of operations. The town of Port Nelson, which was formerly cut off from communication with Ottawa for nine months in the year, is now in constant touch with the Capital and by means of wireless the constructional work has been greatly facilitated. The stations are of 10 K. W. power, each station having a range over land of 500 miles.

It is of interest to note that at Port Nelson, which, it is anticipated, will become a summer port of importance, the plant comprises an additional installation to communicate with vessels trading to that point. These stations, according to plans, will form the commencement of the wireless chain linking up the far Hudson's Bay with Northern Ontario and Quebec and the Government stations on the Labrador. Sites for the new stations on the Hudson Bay route have already been chosen, and preliminary work on the foundations has been accomplished.

The Glace Bay and Louisburg trans-Atlantic duplex high-power stations are of great importance. Early in 1902, Marconi began the erection of the high-power station in Cape Breton. For a considerable period experiments have been conducted at various points on the Atlantic, none of which gave the results desired, and Glace Bay was finally decided upon as a suitable site for these tests. In the autumn messages were exchanged for the first time between Poldhu, Cornwall, and Glace Bay, and trans-Atlantic wireless telegraphy became an accomplished fact. In the Spring of the following year, 1903, the transmission of news messages from New York to the London Times was attempted, and for a time such messages were correctly received and published. A breakdown in the insulation of the apparatus at Glace Bay made it necessary, however, to suspend the service until it could be maintained in both directions under all ordinary conditions. To attain this end it was decided to erect a long distance new station in Ireland, and a larger and more modern station was erected at Glace Bay. In 1908, the opening of permanent commercial service was inaugurated. From that date developments in the trans-Atlantic service have been rapid. Various improvements have been made in stations, including the installation of apparatus for the automatic transmission and reception of messages, with the aid of which traffic can be handled at a rate as high as 150 words a minute. Duplex stations have been erected on both sides of the Atlantic, enabling the simultaneous dispatch and receipt of traffic.

"JACK" BINNS ENLISTS

"Jack Binns," wireless hero of the steamship Republic, was among the first of the British subjects to register at the British Recruiting Mission, 280 Broadway, New York City, when it opened. Anxious to add to his fame by exploits in the air, he enrolled for the Royal Flying Corps.

Binns was the wireless operator aboard the Republic when she was rammed by the Florida off Nantucket January 23, 1909. His persistent calls for help brought the Baltic to the rescue, and those on the rammed vessel were saved.

Since that time Binns has made his home in New York and has been a member of the reportorial staff of the New York American. The day the United States declared war on Germany he took out his first papers for American citizenship. Three years ago he married an American girl.

How the Pearl Shell Stood Up Under the Test

Some Observations on the First Voyage of a Steamship Across War-Swept Seas

By LEO GOLDBLATT

A corner of a French village visited by the author

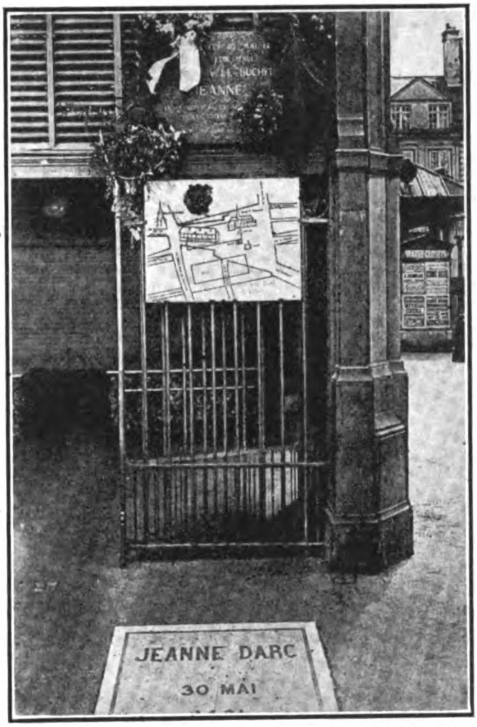
WHILE many readers of THE WIRELESS AGE are professional operators and world-wide travelers, there are others who have never been outside the waters included in the territory of the United States. And there are a number, it is likely, who have never seen salt water.

Persons who are strangers to the briny deep, or who know very little regarding vessels, inevitably say, when meeting a ship operator, "Tell us some of your experiences."

He who sails the sea learns early the art of spinning yarns, and the adventures which he relates seldom fail to thrill (or chill) the blood of the auditor, provoking in some a spirit of take-a-chance, and drawing from others a brief but heart-felt, " I think I'll stick to land."

These tales, often exaggerated and distorted, are seldom told in proper sequence, and when a date is assigned to each, the period between them is so great as to give an impression that circumstances worth recording occur but once in four or five years. As a matter of fact, incidents which would appear strange and interesting to a landsman are of common occurrence on the sea. However, the wireless operator, as a rule, considers them too commonplace to mention.

As I have recorded in this narrative the events during a seven weeks' voyage on a ship making her maiden trip, a description of the vessel will be of interest. The Pearl Shell, about which the events in my recital center, is a steel oil tanker almost 500 feet long and carries approximately 70,000 barrels of oil (kerosene, gasoline, benzine, etc.) in bulk. She is equipped to burn as fuel either coal or crude oil.



In Rouen you will be shown the memorial to Joan of Arc, who, as history relates, was tortured to death as a witch

To the accompaniment of salutes from factory whistles, sirens from ships large and small, the cheers of crowds lining the banks of the Christiana River, and the clicking of cameras, the Pearl Shell left the shipyards at Wilmington, Delaware, on the afternoon of November 1st, 1916, for her first "dip" in the ocean, bound for Bayonne, N. J., to load a cargo for ports unknown. The voyage from Wilmington to Bayonne was also a trial trip. Representatives of both the ship owners and shipbuilders were aboard. After the vessel had successfully undergone the numerous tests necessary to determine whether she agreed with contract specifications, the steamship company's representatives expressed themselves as satisfied, and the ship was formally handed over by the builders.

At Bayonne, the loading was quickly accomplished, and we steamed away from the dock and anchored in New York harbor to await orders.

The latest election returns were known aboard ship before many persons ashore heard them, as WHB (the New York Herald) sent them out every half hour. In the intervals, some unknown had attached a phonograph to a wireless telephone. Several members of the crew were invited into our wireless room, where they were able to hear band music, marches and patriotic songs as clearly as if they were sitting in the same room where the phonograph was located. At times the phonograph was disconnected, and a person with a deep bass voice announced the election returns.

The Pearl Shell weighed anchor on November 8th, and we headed toward the rising sun, bound for Bordeaux, France. We ran into a strong northerly gale on the second day out. It attained hurricane force at times, raising formidable seas. This weather we were compelled to combat during the greater part of the voyage.

One night we picked up a message from VCE (Cape Race, New Foundland) warning all ships that "German armored submarines may be met with anywhere in the Atlantic. Keep a good lookout and show no unnecessary lights."

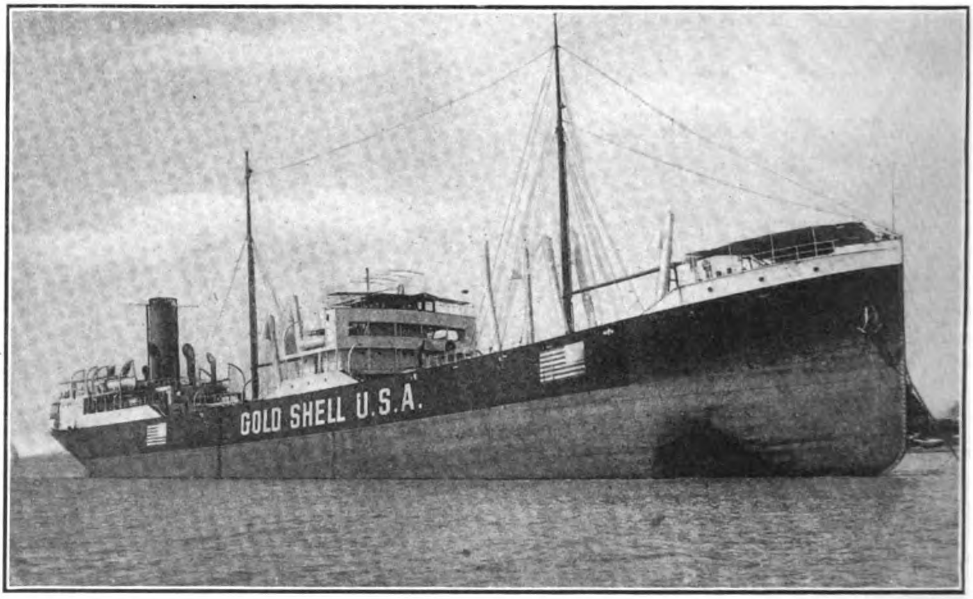
Even after the hoarse rumblings of Cape Cod had died out in the distance, the musical notes of the 100 K.W. set at NAA (Arlington) kept us supplied with news of the day. Once within range ot MPD (Poldhu, England) we had war news sufficient to satiate the longings of those most eager for information; and the latest British official and French bulletins were faithfully repeated.

All of the Allied nations had something to report. Even Serbia and busy little Belgium had time to send word that the enemy had been routed. FL (Eiffel Tower, Paris) was short and to the point: "We are winning." From KAV (Norddeich, Germany) came a high pitched musical spark announcing to the world that "the land of the Kaiser is still on top and intends to stay there."

Before entering the war zone various precautions were taken. The life boats were provisioned and swung over the ship's side, ready to be lowered at a moment's notice, while drills were held so that each man might know his proper station and duty in case of necessity. Extra lookout men were posted, and at night all the port holes were darkened to prevent any lights from being seen.

Word was received several days before the French coast was sighted that an unknown vessel, believed to be the American schooner Manga Reva, had been damaged by the storm then raging, and was in urgent need of assistance. The American steamer Nebraskan was only fifty miles from the position given, and her captain sent word that he was proceeding to assist her at full speed.

The Pearl Shell picked up the coast of France on November 23rd, having made the crossing in fourteen days. We hugged the coast a short time and at length came to the Gironde River, which we ascended as far as Blaye, thirty-five miles below Bordeaux. It was just off the mouth of the Gironde that the Gold Shell, a sister ship of the Pearl Shell, struck a mine four months previous to our arrival.



The Gold Shell, a sister ship of the Pearl Shell. The former vessel struck a mine just off the mouth of the Gironde River

Blaye, a typical French village, with a population in peace times of about 20,000, is in the heart of the wine district, and for miles around carefully-kept vineyards can be seen. In these days of high prices of footwear it is interesting to note that persons in the humbler walks of life in Blaye wear wooden shoes.

Sunday is "fair" day, which is devoted to recreation. In an open space near a small wooded park, tents and stalls are put up in which are displayed such varied articles as candy, cheap jewelry, hats, second-hand clothing, shoes, scrap iron, farm implements, and colored post-cards. The village had neither footlight nor motion picture theater.

All the work on the farms and in the town is performed by old men, women and children. Only a few were able-bodied men and all of these were soldiers. A number of Austrians and Germans, sent back from the front as prisoners, do various kinds of hard labor under guard. Most of those I saw ranged in age from twenty to twenty-eight years.

Before entering the Gironde our aerial had been taken down, as a result of orders from French naval authorities. After we left Blaye behind and were outside the three-mile limit the aerial was again raised. The WTY (Standard Oil Barge No. 93) was heard sending SOS signals on November 29th. Her calls were picked up by GLD (Land's End, England), which promptly informed the patrol boats ZAAW and YZK, ordering them to the tanker's assistance. We were too far away at the time to render aid.

The following day it was found that our steward, a Japanese, was missing. He had last been seen the previous evening, while the ship was about ten miles off shore. It was believed he fell overboard, but the circumstances of his death are still shrouded in mystery.

The Pearl Shell anchored in Cherbourg harbor on December 1st to await orders. It was there we met one of the mysteries of the sea. While proceeding up the harbor to an anchorage, we steamed close to an anchored steamer whose entire forecastle head was blown off, as if by an internal explosion. We learned later that she had been picked up off the coast by fishermen about a week before, carrying a full cargo of crude oil. Not a living person was found aboard, but in the remains of the shattered forecastle were the bodies of eleven men. Several were wedged in portholes. They had, it is believed, attempted unsuccessfully to escape. The vessel's amidship house and after-quarters were not damaged and all of the lifeboats were in place. The fate of the remainder of the crew and their reasons for leaving the vessel, is still an unsolved riddle.

Our next port of call was Rouen, which is about sixty miles from the front and the same distance from Paris. A short distance below Rouen, along the banks of the Seine, up which we steamed, we passed several "prison camps" in which the French confine their prisoners of war. These prison camps consist of rows of long one-story barns, having windows similar to houses, with some form of arrangement within for sleeping. The entire "camp" is surrounded by a high barbed wire fence, along which patrol armed guards. The prisoners work in squads of six or eight, each squad being accompanied by a guard when working outside the prison limits.

On arriving at Rouen, we found, to our dismay, that none of the ship's crew could go ashore, by orders of the French military authorities. They cheerfully informed us that anyone caught ashore would either pay a fine of $1,000 or remain in jail until the conclusion of the war. In spite of the severity of the penalty, several members of our crew went ashore, and came back undetected. The next day the police came aboard, and all of the crew who could prove that they were American citizens were given passes permitting them to go ashore. Citizens of other neutral countries, a Dane and several Spaniards, were refused passes and told that if caught ashore they would be imprisoned.

Two detectives were stationed at the foot of the gangplank and they allowed no one to pass until a police pass was shown. An amusing incident occurred as a result of this espionage. One of our

Japanese messboys tried to get ashore, although for some reason, the French authorities would not give him a pass. He was stopped by a detective, and when no permit was shown the Japanese was ordered back to the ship. He demurred and to enforce his commands the officer drew a blackjack and threatened to use it. The Japanese went aboard the ship, obtained a huge butcher knife from the galley and again went ashore. The officer came over to chase him back, but on catching sight of the knife he fled with the messboy in hot pursuit. The Japanese was an excellent runner, but the Frenchman literally faded from view.

Rouen is famous as the place where Joan of Arc was tortured to death as a witch, a slab of marble marking the spot where she died. Another point of interest is the cathedral, which was begun about the year 1200. The Flying Bridge which spans the Seine, should not be overlooked by the visitor. A platform running on trolleys is suspended from the bridge and a fee of two cents is charged for passing over it.

Thousands of English "Tommies" are to be seen in Rouen. Canadians, Australians and New Zealanders are numerous, while an occasional Belgian or a group of coffee-colored East Indians may be met with. The turbans worn by the latter give them a picturesque appearance.

While we were at Rouen the military authorities received a report one night stating that Zeppelins had been seen flying in a direction which would take them over the town. Huge searchlights were immediately put into operation, and the powerful beams of light searched every corner of the heavens, but the airships could not be seen.

Our departure from Rouen was without incident, but while crossing the English Channel we passed the wrecks of six vessels which had been sunk by mines and submarines. About a hundred mine-sweepers and patrol boats on the lookout for mines or under-sea boats, were sighted.

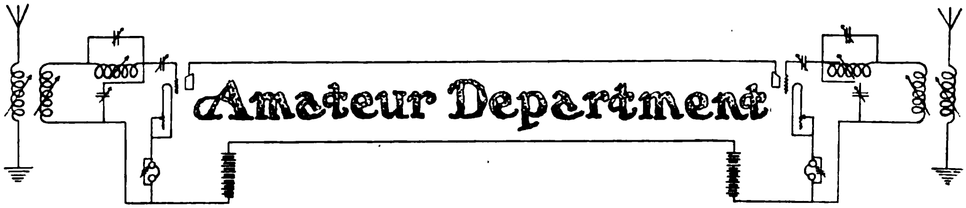
Submarines are very active in the vicinity of Brixham. A ship which left soon after we arrived there was torpedoed within ten miles of the harbor, as were several fishing smacks. This resulted in orders from the British government for all fishing boats to stay in port, while a number of mine-sweepers armed with small guns patrolled the surrounding waters in the hope of bagging the submarine. As the population of Brixham is in the main engaged in the fish trade, an idle day hits it hard.

We lay two days at Brixham, coaling up, and on December 10th we said "good-bye" to the shores of England, and headed westward, bound for the land which all of us were now calling "God's country." Our course took us through waters in which several ships, one an American craft, had been sunk or shelled only a few days before, but fortune favored us, and we passed the scene of destruction unscathed.

Wireless communication throughout the voyage was excellent. On the return trip, press was received nightly from Poldhu and later from Arlington, while time for the chronometers was regularly received from Paris and Arlington. On four nights time was received from Paris and a few hours later from Arlington. Paris was copied at a distance of more than 2,300 miles through static.

Stormy weather handicapped us all the way back. At one time, with the engines going at full speed, we made about a mile an hour. Another vessel, caught in the same blow, had a 100-ton deckload of coal washed away, and was so battered by the heavy seas that it was necessary to steam to the nearest port for repairs. Her captain described the weather as "terrific."

But the Pearl Shell proved that she was seaworthy by riding the storm without bringing peril to the ship's company, and arrived at Philadelphia none the worse for her battle with wind and wave. She had undergone the severest of tests and emerged with credit. And we who had kept company with her during the ordeal agreed that we would trust ourselves to her in any and all circumstances.



Announcement

THE EDITOR has decided to extend the scope of this department to include general electrical experimental apparatus as well as radio telegraph equipment.

Readers who have made exceptional and unusual experimental apparatus for use in the workshop or in the home are invited to send in a complete and brief description of its construction and working, accompanied by clear drawings. Articles from amateur electricians and wireless operators who have developed devices of particular merit both in and outside of the radio telegraph field will be particularly acceptable.

In preparing such articles, it is suggested that contributors state fully:

The object of the device;
Prominent or unusual features of utility of your construction;
A detailed description of the construction;
Results obtained by actual use.

Such contributions will be paid for at a rate depending upon their merit. Prizes will be given for the better class of articles, and those which are used outside of this department will be paid for.

In addition to the articles covering experimental electrical apparatus in general, the editor will welcome articles of timely interest to the amateur field at large, such as criticisms and comments on Government legislation, unusual experiences during previous years of experimental work and suggestions for establishing amateur communications on a more scientific basis.

Experimenters who owned wireless stations in the early days—say, about the year 1904—should be able to write highly interesting articles on early experiences and attempts at communication with the type of apparatus in use at that time.

All contributions designed for the amateur field should be addressed to the Editor of the Amateur Department, The Wireless Age, 42 Broad Street, New York City.

The Monthly Service Bulletin
of the
NATIONAL AMATEUR WIRELESS ASSOCIATION

Founded to promote the best interests of radio communication among wireless amateurs in America

NEVER have the members of the N. A. W. A. been afforded a better opportunity to advance their knowledge of technical wireless telegraphy than during the present crisis. The enforced closing of stations should not decrease interest in experimental work, for it is obviously the duty of all amateurs to prepare themselves technically and in key manipulation so as to serve the Government in one of the signaling divisions of the Army or Navy.

Amateur experimenters do not give sufficient attention to acquiring skill as telegraphers. They frequently adopt a haphazard mode of forming the telegraph characters, many in fact, believing that ability to carry on an abbreviated conversation with the neighboring stations is the ultimate goal.

Those who enlist in the Signal Corps will eventually be required to become first class telegraphers. Morse code must be sent and received at a fair rate and clean, clear, legible copy made when receiving at speeds up to twenty-five words per minute. Technical knowledge is of great importance, but a good signalman must be able to get off "the business" at high speed.

Since preference will be given to the technical man who can handle important field orders speedily and legibly every amateur who hopes to serve in the U. S. Army Signal Corps or as a Naval operator, must therefore (1) practice style in penmanship; (2) acquire skill as a first grade operator.

There is only one way to obtain such skill, and that is by practice—continuous practice day after day with an amateur friend who has attained the required degree of proficiency.

Many members of the Association not subject to conscription—unless, of course, they serve the country in some other way at home—will have plenty of leisure time. This presents to them an excellent opportunity to re-equip their stations or rebuild certain parts of the apparatus which do not come up to the final mark of efficiency.

For example, there may be a leaky high voltage condenser which should be rebuilt.

Perhaps a greater degree of efficiency can be obtained by re-designing the high voltage transformer.

The rotary spark gap may require attention; its disc may be "wobbly" or the insulation faulty. Some of the amateur disc dischargers which have passed our observation, even when used with ¼ K. W. transmitting sets, were fitted with electrodes of a size as large as the Marconi Company uses on 5 K. W. and 10 K. W. transmitters.

Attention might be turned to simplifying the receiving apparatus. Time might be conveniently employed, for instance, in building a universal receiving set, fitted with properly located "end turn" switches and regenerative features.

Experimenters would do well to direct their efforts toward design of receiving apparatus, scientifically making use of one of the well known formulae for calculating the inductance and capacity of an oscillation circuit. Even if the calculations fall somewhat short of the mark, the final results are bound to be more accurate than those obtained by mere guesswork. In many an amateur station may be found a receiving set which has an ultimate range of 5,000 to 6,000 meters, but which is used for reception at the wave-length of 200 meters. The end turn losses, of course, are in such tuners exorbitant, and in consequence, without re-design the apparatus is way below the required degree of efficiency.

An important matter upon which scientific data is lacking is the design of a regenerative circuit for the reception of signals at short wave-lengths. Most every amateur has his private "hook-up," and the result is that the beginner who has had no experience in the design of these sets is somewhat confused in building a set to meet his particular requirements. More queries have, in fact, been received at headquarters upon this one point than on any other technical matter bearing upon receiving apparatus.

Members of the Association who have had experience with the regenerative receiver are invited to send full details of construction, showing the exact number of turns in use in the inductance coils of all circuits, the capacity of the condensers and the general operating characteristics of the set, as a whole. From time to time, such information will be given full publicity in this department, with full credit to the contributor.

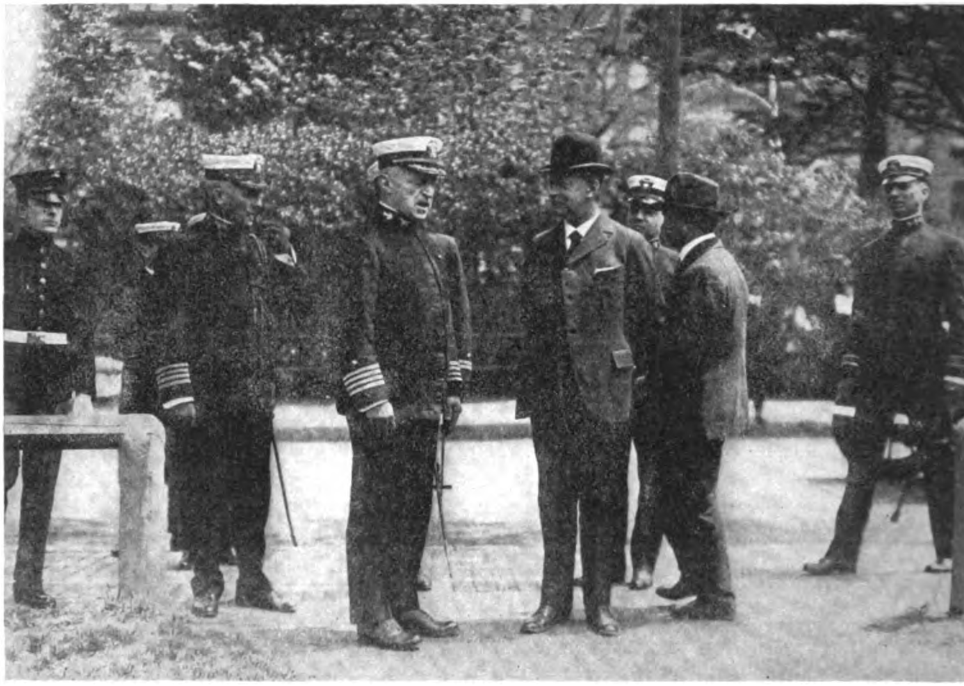
Another matter which comes in for attention in connection with the design of receiving sets is the use of multi-layered windings. Many of our members now employ a receiving tuner of small physical dimensions, which, through the use of multi-layered windings, will respond to wave lengths in the vicinity of 10,000 meters. Some report better results obtained with such a winding than with the more commonly used single layer windings. Data on this important point will also be welcomed and will be published from time to time.

There have been doubts expressed among amateurs as to whether or not they will be able to obtain vacuum valves in the future. No definite advice can be given at this time, but there is little doubt that such apparatus will again be placed on the market. Although a final decision has been handed down by the courts, a complete settlement between the parties concerned has not been concluded.

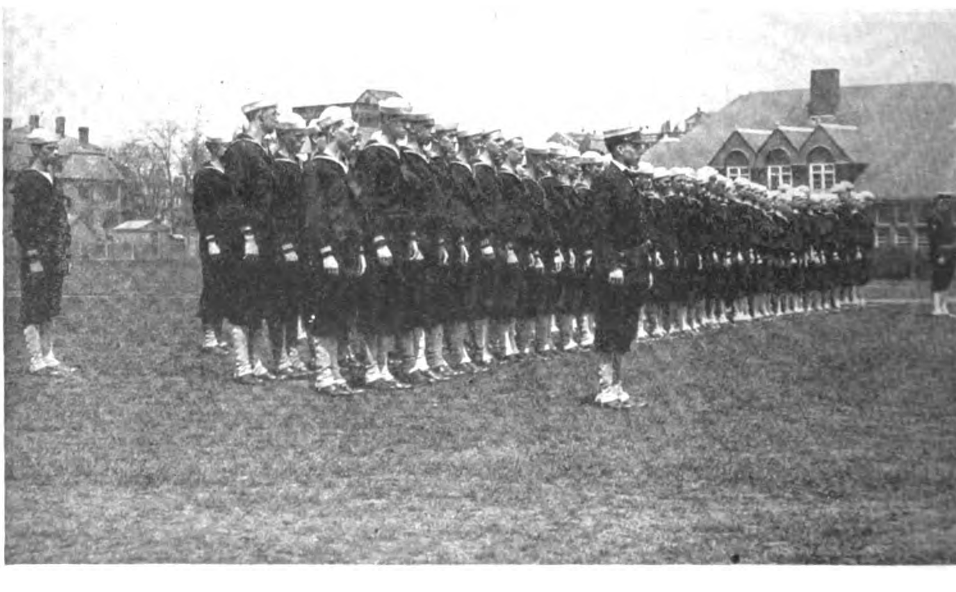
It appears that certain experimenters believe the magnetic detector to be so highly insensitive that it is of no value for their work. As a matter of fact, the magnetic detector is very sensitive for wave-lengths around 3,000 meters. Stations located at a considerable distance from Arlington have received the time signals with little difficulty with receiving tuners of proper design. The advantage which the magnetic detector possesses is that it requires practically no attention except to the mechanism which keeps the iron band in rotation.

Complete descriptions of this detector which should enable any experimenter to duplicate its construction, have been published in THE WIRELESS AGE and included in the third revised edition of the book, "How to Conduct a Radio Club."

(*Concluded on page 786*)



Commandant Rush of the Charleston Navy Yard and his staff recently made a tour of inspection at Harvard University, visiting the Pierce and Crust laboratories where students are engaged in studying wireless. In the photograph above are shown in the foreground, from left to right, Commandant Rush, President Lowell of Harvard and Professor Pierce, who is in charge of the electrical department at Harvard. Below are pictured the members of the Harvard Radio School, lined up for inspection



What Women Can Do and Are Doing

Progress of the Hunter College Students

The following statement has been made by the Wireless Section of the National League for Woman's Service:

THE members of the Wireless Class For Women at Hunter College, New York City, under the auspices of the National League for Woman's Service are making excellent progress. More than 100 pupils are studying the art.

L. R. Krumm, technical lecturer ot the class, has received his commission as captain in the Signal Corps of the United States Army and Otto Redfern, code instructor, has received his commission as lieutenant in the Navy. Both Captain Krumm and Lieutenant Redfern are now stationed in the New York Navy Yard, but will continue their work with the wireless classes until their duties make it impossible for them to do so.

One of the possibilities open to the members of the class was pointed out by Professor Michael I. Pupin, of the National Advisory Board. He suggested that the students showing marked ability should be encouraged to fit themselves to be instructors in radio telegraphy. It is well within the bounds of possibility that the present corps of instructors throughout the United States will be considerably depleted, in which event women may qualify as teachers of wireless and take the places of men needed at the front.

"What use will they make of the art after they have mastered it?" is a remark frequently made regarding this new activity of women. We know almost nothing of what women among our Allies are doing, but occasionally we hear of inspiring service which those in England and France are performing. What we have to do is to be ready. Suppose in six months we are called upon to provide a number of radio operators in order that the wireless men may be released from their regular posts and go to the front. We shall be ready. In a year we shall have hundreds of operators. What the women have to look forward to is a chance for service. It may not materialize within the next year, but the signs of the times give us absolute assurance that when we are ready we shall be wanted.

There is no doubt in the minds of those who know what is really going on in the circles having to do with the preparations for actual warfare, that the woman power of the United States will be called on in ways that now seem out of consideration altogether.

In an interview which Mrs. Herbert Sumner Owen, chairman of the National Committee of the National League for Woman's Service, had recently in Washington with two of the men who stand high in the councils of the Navy Department, she was told that there were five electrical schools under the control and authority of the navy. "I will promise you in the name of the National League 500 radio operators six months from the day that the navy co-operate with me," she said. There was a possibility at the time that an electrical school in one of the navy yards would be thrown open to a class of 100 women. There has since been an influx of men into the various navy schools, particularly the one which was in question, and had there been no opposition, it would have been impossible for women to have received training in this navy yard. A reporter who heard Mrs. Owen's assertion probably misunderstood her, for a statement that she had undertaken to present the Navy

Mrs. J. C. Sheehan, an active figure among the women who took up wireless to aid the nation

Department with 500 radio operators in six months was published. While all of the members of the class at Hunter cannot expect to be graduated as full-fledged operators in six months, there is little doubt that a large percentage of their number will complete the course within that time.

Another misapprehension, due to published reports, should be corrected. Miss Helen Campbell was understood by a reporter to say that any girl of alert intelligence could become a radio operator in three months. Miss Campbell was surprised when she read the statement.

"I had had three years of actual service in telegraphy as preparation," she said, "and it took me six weeks to prepare myself to take the emergency license. I shall not go up for my commercial license before the end of six months."

It must be remembered that the girls in the wireless class are receiving instruction only at the evening sessions. The larger proportion of them are self-supporting and attend the wireless class after a hard day's work. They display admirable spirit and enthusiasm.

One of the students is a girl who is earning $6 a week. She lives at home, but is compelled to defray all her personal expenses except those for board and lodging out of her pay. When she made application to join the class Mrs. Owen attempted to dissuade her. She works from eight o'clock in the morning until five o'clock at night and is barely of the age required for admission to the class. However, she begged with tears in her eyes to be allowed to carry out her ambition.

"I have read everything I can get my hands on in the libraries," she said. "A boy I know got me an old buzzer and I have done what I can to learn the code, but I cannot go on any longer by myself. Please let me come into the class. I'd rather go without everything else and pay my fee to come in."

It goes without saying that the applicant's plea for admission was successful. "I take off my hat to that child," said Mrs. Owen. "She is the type of girl that we are coming in touch with through this new activity. We ought to have some scholarships, and when I get time I am going to go out and beg for a reserve fund so that girls like her can have the chance that they want so much."

David Sarnoff of the Marconi Wireless Telegraph Company of America, in conversation with Mrs. Owen, recently, said: "How many girls in your classes do you suppose would volunteer for service on coast-wise steamers? It would be practically safe, and if we could put women on those steamers we could set free for navy service the men detailed on these craft."

"I had never imagined that this was the sort of call that might come to my girls," said Mrs. Owen. "However, I don't believe Mr. Sarnoff realized how amazed I was, for I managed to respond that I believed my girls would volunteer for any service that the United States might ask of them."

That night, when the classes were gathering, Mrs. Owen told the pupils what Mr. Sarnoff had said.

"Now don't answer hurriedly the question I am going to ask you," she said, "think over soberly what it means and then tell me how many of you are ready to volunteer for such a service."

Every girl present signified her willingness to go wherever the United States might call her.

Miss Helen Campbell, the only one of the class who now has a license making her eligible for this service, was advised by Professor Hill to prepare herself to instruct students. She was absent when Mrs. Owen spoke to the classes, but when informed of what Mr. Sarnoff had said, she replied: "I will volunteer today if they want me."

Besides the coastwise steamers going through the canal and up the Pacific coast and along the Central and South American coasts and Mexico, there are the river steamers, sound steamers and craft of the short lines all about our home waters on which girls might serve as operators.

Although the Navy Department has not taken up Mrs. Owen's promise to provide operators, the appeals for aid and instruction are pouring in in such numbers that perhaps the 500 operators may be ready by the time the Navy Department is ready to co-operate in the plan. There are four divisions of the wireless classes at Hunter College, with approximately twenty-five women in each division. Each division has its commandant who calls the class to order, calls the roll, leads in the salute to the flag, receives the excuses and explanations of tardiness, jogs the memories of the delinquents as to fees, and is, in general, responsible for her particular division.

Miss Rebecca Parker, who is commandant of the first division, is soft-voiced and gentle, with a firm will. She is attached to Grace Church, where she accomplished excellent work last summer in the fight against infantile paralysis.

Mrs. Eila Haggin is the commandant of the second class. Mrs. Haggin is a woman of leisure and is detailed on special work at the Marconi School of

Instruction, New York, in the morning. She spends the evening with her class at Hunter. Mrs. Henry M. Warner is the commandant of the afternoon class, which is made up of women of leisure. Miss Helen Hemphill, commandant, is employed as translator in the engineer's library of the Western Electric Company.

The committee of the National League for Woman's Service in Atlanta, Ga., has started a preparatory class on the lines blocked out by the National Advisory Board and has sent its most promising pupil, Mrs. J. C. Sheehan, to New York City to take advantage of a scholarship, one of three that has been put at Mrs. Owen's disposal. Mrs. Sheehan had worked up her speed to ten words a minute, but had had no opportunity for technical or laboratory training. She is detailed for special training at the Marconi School during the morning and afternoon sessions and is at Hunter for the evening session. She shows marked ability. Mrs. Sheehan took up radio telegraphy purely from a patriotic motive. Naturally it appealed to her, but it is because of her desire to fit herself for real service in the national emergency that she is giving up her whole time to this work. It is to be borne in mind that six hours' concentrated mental effort a day through the hot summer months is no holiday proposition, even though our beloved New York may be, as it has been described, a delightful summer resort.

A close connection between the ramifications of the wireless divisions of the National League for Woman's Service, is being established and a coherent scheme has been instituted. The outline of the plan follows:

In collaboration with the Marconi School of Instruction, an Extension Wireless Course is being arranged for. Each wireless chairman will receive registrations for her particular group. These groups will engage instructors. Each member of the group will subscribe to The Wireless Age, which contains each month an article by Elmer E. Bucher. The instructors of the various groups will use these articles of Mr. Bucher as a structure round which to build the class. The individual members of the class will be enabled to purchase the necessary outfit for $7.50, plus expressage or postage. This preliminary training will carry the members of the class to the point where it can be decided whether they intend to finish the training and take their commercial licenses. The Marconi Schools in San Francisco and in New York and the National League's Wireless Class for Women at Hunter College will be open to members of these various classes throughout the United States.

It is probable that the establishment of these preparatory classes will give an opportunity to all those who desire this training to prove themselves; in fact, it will winnow out the "real stuff" of which radio operators must be made. The fact that the art is not an easy one cannot be too strongly emphasized. But is there any real achievement that is soft and easy? Radio telegraphy is now in its infancy, it stimulates the imagination, opens up vistas of fascination and has such unlimited possibilities for the inquiring mind as to make it well worth the price that must be paid in hard work and in the achieving of success in this particular sphere of activity.

Apparatus which was the accepted model a year ago is being "scrapped" today. Pupin's experience shows what lies in the grasp of the young minds which take up the consideration of this most wonderful of problems. The immigrant boy of several years ago is the man whose "coils" have made impossibilities accomplished facts. To you, girls, who have this door open to you, congratulation is a poor and weak word. Those of you who pass the tests have a fairyland of the intellect opening to you. There is no reason why you should not achieve. There is no reason why we should not have a great woman radio engineer. The privilege is put into your hands. It remains now for you to prove that you are worth the opportunity which is given you.

Intensive Course in Wireless Planned

In response to numerous applications, it has been decided by the National Advisory Board of the National League for Woman's Service to offer to the women of the United States an intensive course in wireless telegraphy to be held in Hunter College, Lexington Avenue, between Sixty-eighth and Sixty-ninth Streets, New York City. This course will be of three months' duration, beginning July 9th. Arrangements have been made to hold sessions of six hours a day, five days a week.

This course is designed for students and teachers who are ambitious to take up this branch of national service. "We believe," says a statement issued by Mrs. Herbert Sumner Owen, chairman of the National Advisory Board, "they can prepare for the test required by the United States Government, before granting a commercial license, in three months' time.

"It is not desirable to take this intensive course unless it is a necessity as it entails concentrated study of the most severe type."

Anyone desiring to apply for this course must register with the National League for Woman's Service in her community and send to Hunter College application for membership in this class.

The fee for the course will be $35. Text books $0.75.

The course has been approved by Professor Michael I. Pupin, Dr. Alfred N. Goldsmith, Edward J. Nally, Gano Dunn, Professor Lewis D. Hill and John Stone Stone.

COLLEGE OF CITY OF NEW YORK STATION OPEN

After an inspection by naval officers of the radio laboratories of the College of the City of New York, a recommendation was made to the War Department that an exception be made to the order of President Wilson that all non-official wireless stations be shut down during the war. The authorities have allowed the use of the entire radio equipment for experiment and instruction.

PENNSYLVANIA STATE COLLEGE GIRLS ORGANIZE

Seventy girl students at the Pennsylvania State College have organized a reserve unit of wireless telegraph operators. They expect to offer their services to the Government after they become efficient with the codes and apparatus.

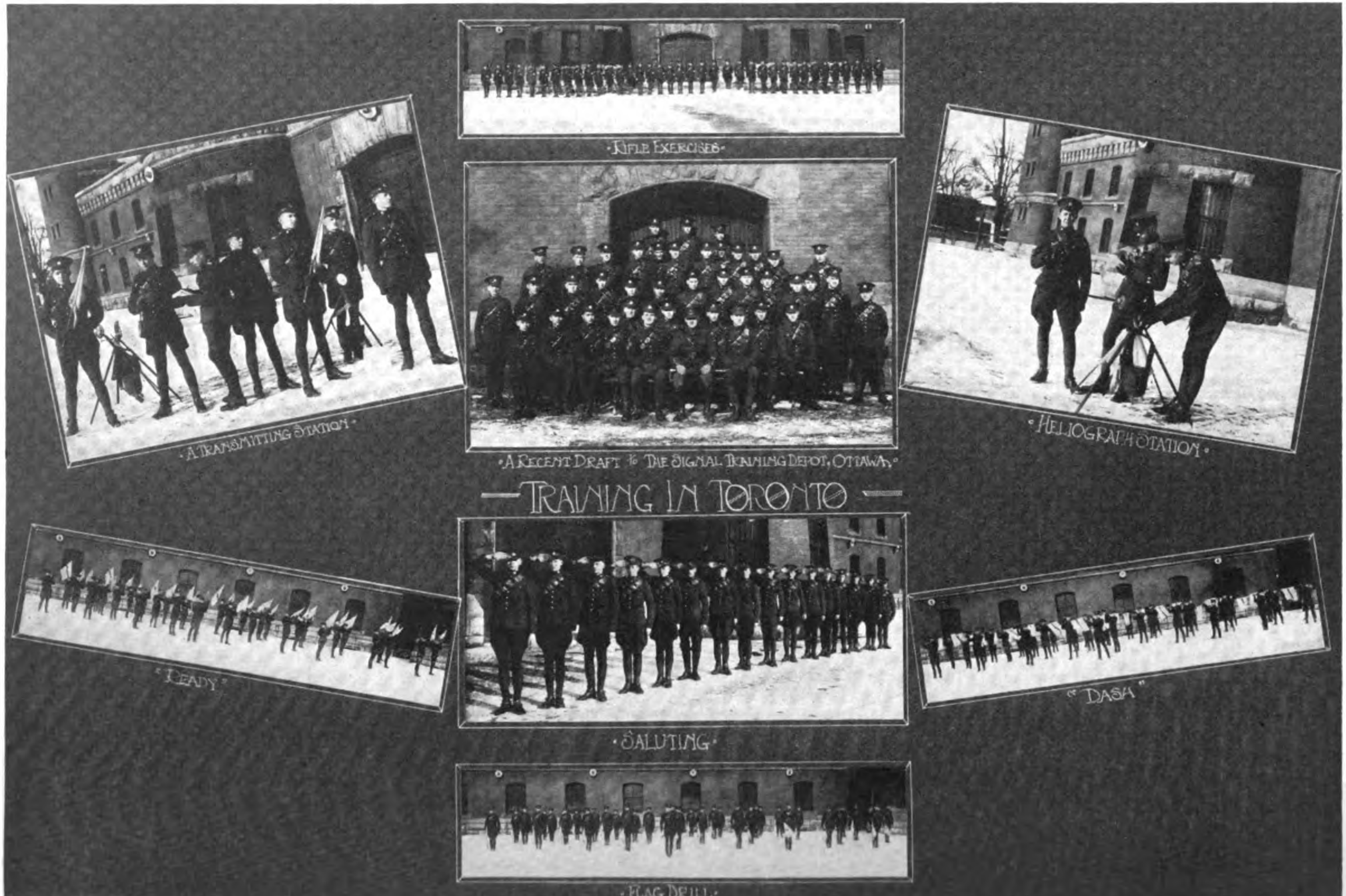
Practical work with instruments and lectures are given regularly to the class of co-eds by F. R. Amthor, a student, who is versed in military communication. Twenty-five other young women are learning flag signaling under the semaphore or two-flag code.

With more than 300 of the men students already out of college for patriotic service under arms and on farms, the girls said they would not be outdone. Immediately they formed Red Cross units, took lessons in first-aid work and established the class in wireless.

BOSTON YOUNG WOMEN REPORT FOR DUTY

Miss Charlotte Bayliss and Miss Edith Sigourney, who are among the first young women to pass the examination for enrollment in the Naval Reserves in Boston, have reported for duty as wireless operators. Both young women have been active in charitable work in Boston.

Clark College in Worcester, Mass., has petitioned War Department officials for permission to establish a class in wireless at the college.



The wireless men of Canada have found a field for their activities in the signal corps of that colony. In these photographs the members of a signaling company are pictured at drill

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

Suggestions for Improving the Design of Receiving Apparatus

This article was prepared to convey suggestions regarding the methods followed in the design of receiving tuners and associated apparatus.

On the panels of some receiving sets are too many binding posts and name plates. Not only do the posts detract from the appearance of the set, but they are sometimes placed in the most inaccessible places.

There is on the market a set for receiving undamped signals, on which the binding posts are located at least eighteen inches from the base. Imagine this set wired up in a station! The whole beauty of the cabinet design is destroyed by the wires running that distance up the side of the apparatus.

If the only defense that can be put forward for this construction is the high insulating qualities of the panel on which the posts are mounted, why not use inexpensive bushings and employ cheaper posts at the back of the set? A simple connection employing a machine screw and a washer will serve the purpose as well, if not better.

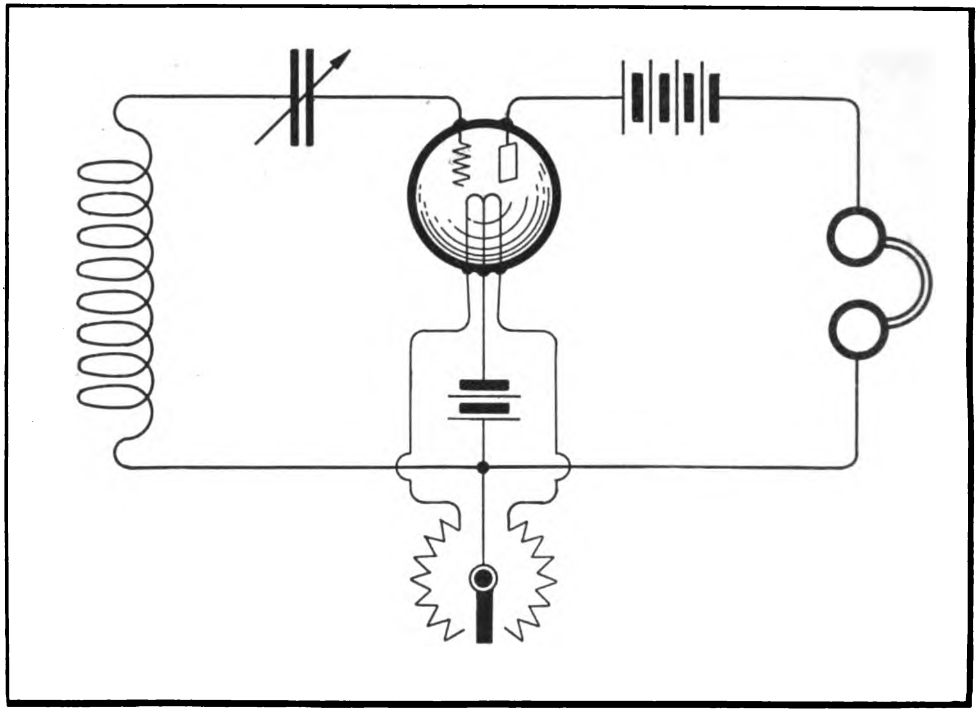
Going to the other extreme and selecting a cheap set, there is a little cabinet set less than a foot each way on the panel and less than four fingers thick. This has six large binding posts and four name plates on the tiny panel.

These name plates are intended to indicate where to make connections. A blueprint will give more information at less cost and simplify the construction. Another set, alike as to size of panel, but twice as thick, has eight binding posts and seven name plates on the panel.

Then, again, there are variable condensers which have binding posts on the top. They are not in themselves very objectionable, except that they necessitate unsightly wiring. I suggest a simple method of connection that is not so noticeable.

The arrangement of the controls on a cabinet set has important bearing on its appearance. In the construction of some sets the switches and other knobs are placed without regard to appearance and symmetry. On the other hand, unnecessary switches are employed to effect the appearance of a well balanced panel. This does not improve the set. One coupler I have in mind has twice as many contacts as are required on one switch for the reason referred to; in fact, each of the two switches has twenty-five contacts. Imagine the end turn losses and capacity losses in all those leads! The same effect, perhaps closer tuning, could be obtained by using a variometer for fine tuning, and tapping off the remainder of the primary in units equal to the maximum value of the variometer.

The carrying out of my suggestions, of course, would make for simplicity, and this is the keynote of successful results. Turning to the small "Tron" panels, it will be noted that a small two-point switch is used to select one of two filaments. This is not necessary by any means and too often unbalances the whole design. A circuit that eliminates this switch is shown in the accompanying drawing. It is only necessary that the resistance wire on the rheostat be cut at the center and a small piece of fibre be



Drawing, First Prize Article

inserted in the cut. The open end of the winding is connected to the filaments. The switch lever is normally in the small fibre block; moving it one way or the other will cut in either filament gradually. It is thus impossible to suddenly throw the current into the filament with resistance nearly all cut out and burn it out.

Examine the more complicated amplifying "Tron" panels. They are usually a motley collection of switches and variables. Name plates, letters and figures are distributed with a lavish hand and all to the detriment of the appearance of the set.

Manufacturers are beginning to realize that variometers are superior to condensers for fine tuning, particularly with the regenerative circuits now in vogue. This is a sign of further development in receiving apparatus.

Another matter of importance is the arrangement of the wiring of a receiving cabinet so it may be changed easily and quickly. The writer has just designed an amplifying "Tron" cabinet that meets these requirements. All the instruments have leads brought up to a panel mounted two inches below the level of the top of the cabinet. The set contains three variables, two "Tron" tubes, two sets of high voltage batteries with allied potentiometers, two rheostats and two telephone keys. A separate lead is brought up from each of these and connected to a spring binding post. The top of the cabinet is held in place with hinges and, when closed, covers the panel with all the binding posts.

With this set any desired hookup can be tried out. All that is necessary to effect a change is to raise the top, and, by means of short lengths of copper wire, connect the proper posts together.

In conclusion I make the following recommendations: Employ less variable condensers, more variometers, fewer switches, and place them symmetrically, find a less conspicuous place for the binding posts and arrange the set so the connections may be changed and the station wired up in accordance with the latest advances in the art.

T. W. Benson, *Pennsylvania.*

SECOND PRIZE, FIVE DOLLARS

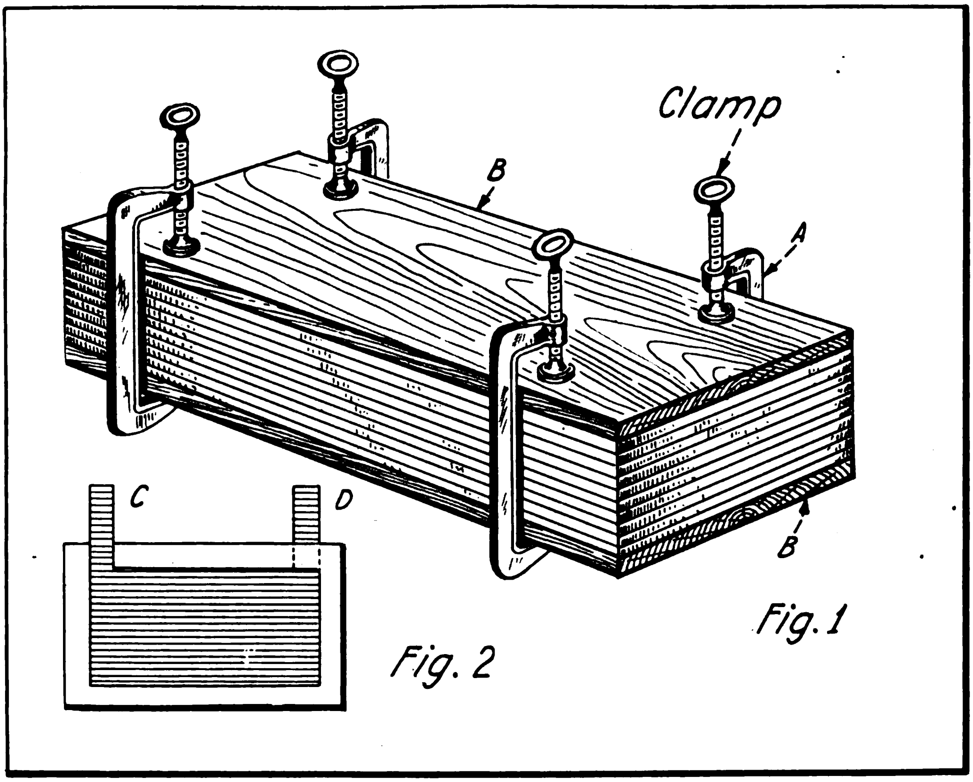
A 1 K. W. Oil-Immersed High Voltage Condenser

The condenser described in this article has the correct capacity for a 1 K. W. transformer. The glass plates can be secured from a photographer and should be 10 inches by 8 inches, and one-eighth of an inch in thickness.

Thirty-five of these plates will be required. They should be covered with tinfoil on both sides, each sheet measuring 8 inches by 6 inches. The glass is coated with the tinfoil in the following manner: First heat the plate of glass and rub the surface with a piece of bees wax. When the wax melts, cover each side of the glass with the tinfoil. While the glass is still warm, stick the terminal, C (Figure 2) on one side of the glass and the terminal, D (Figure 2) on the opposite side of the glass. These are cut from tinfoil, measuring 1 inch by 4 inches, and they are attached to the glass by means of melted wax.

Thirty-three plates should be covered in this manner, the other two being used for the top and bottom plates. Coating both sides of the glass makes two thicknesses of tinfoil between each plate.

This having been completed, cut out two pieces of wood of the same dimensions as the plates of glass, except that the wood should be about one-fourth of an inch thick. Secure four clamps (A, Figure 1), such as are used to hold the corners of curtain stretchers.



Drawings, Second Prize Article

On one side of the pieces of wood (B, Figure 1) lay the glass plate having no tinfoil on it. Then place the other thirty-three plates on this and cover them with a plain piece of glass and finally with the wood. Arrange the plates during assembly so that the terminals come out on alternate sides. For instance, terminal C, Figure 2, comes from the top plate, while terminal D, Figure 2, comes from the next plate.

When all plates are assembled, the clamps should be attached at each corner, as in Figure 1, and the condenser heated until the wax begins to melt. Then the clamps should be tightened and the wax allowed to harden.

The condenser is now ready to be placed in the oil. The dimensions for the tank are not given, but it should be large enough to admit the condenser with ease. The cover of the tank should be of some insulating material so that the terminals may be brought out to binding posts. Finally the tank should be filled with insulating or transformer oil until the plates are completely submerged.

W. Bradshaw, *Connecticut.*

THIRD PRIZE, THREE DOLLARS

Description of an Aerial Mast of Unique Construction

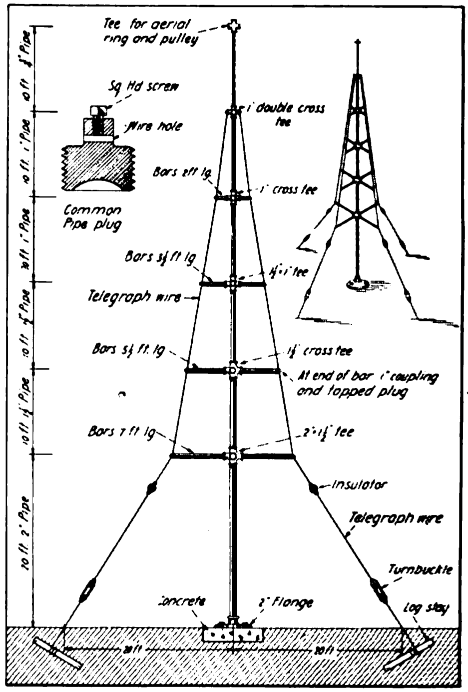
This article contains a description of an aerial mast which I designed. My mast is 70 feet in height, made of specified lengths of pipe, ranging from 2 inches at the base to ¾ of an inch at the mast top. It is supported by four strands of telegraph wire, which in turn are fastened by log stays as shown in the accompanying drawing.

The chief difficulty found was that the supporting wires gradually became slack. This fault I entirely eliminated by a tapped plug scheme for tightening and fastening the wire to the cross bars. This tapped plug is of simple design as shown in the lower left hand detail. The base is made from a pipe plug and a hole drilled to take the wire. Perpendicular to this hole is a tap in which is placed a screw for fastening the wire permanently when it is once pulled tight.

If double cross ties, such as shown in the drawing, cannot be obtained easily, it would be possible to use two cross ties connected by a nipple. Then one set of bars would be slightly above the others.

The obvious simplicity of the mast does not call for further explanation on my part, and I trust that my drawing will show at least the general principle of design.

George H. P. Gannon, *Massachusetts.*



Drawing, Third Prize Article

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

How to Make a Highly Polished Black Panel

The following should be of interest to amateurs who desire a highly polished black panel and do not wish to spend the amount of cash necessary for hard rubber or bakelite:

Take a piece of some soft porous wood, such as cypress, cut it to the desired size, drill all holes that are needed, then cut down the rising of the grain with a piece of pumice stone and some water. Pour two quarts of boiling water over one ounce of powdered extract of logwood and when the solution is effected, add one drachm of yellow chromate of potash and stir the solution well.

Apply two or three coats of this to the wood until a deep black is produced. The panel is then polished by the use of powdered tripoli and boiled linseed oil.

This wood is then put in a solution of equal parts of gem salt, rock alum, white vinegar, chalk and Peebles' powder. Mix these together well and put the wood in after the ebullition is over. The latter solution will petrify the wood making it hard like rock.

Panels made in this way, while slightly inferior to hard rubber in respect to insulation qualities, will never warp or twist, and will have a bright, shiny black face.

If the amateur will follow my directions closely, he will have a panel that will be a credit to his station and will represent a decided saving in cash.

If a cherry colored panel instead of the solid black is desired, use the following solution: Three quarts of rain water and four ounces of anotto boiled in a copper kettle until the anotto is dissolved. Put in a piece of potash about the size of a walnut and boil for about half an hour longer. This gives a bright cherry color.

V. C. McILVAINE, *Florida.*

HONORARY MENTION

Antimony Silicon Detectors and Their Advantages

A great many amateurs have trouble keeping the adjustment of silicon detectors. To a great extent this may be remedied by using as a contact, in place of the customary point or wire, a wedge-shaped piece of antimony. The edge should be as sharp as possible and only a small part should be in contact with the silicon. The use of this mineral allows a greater pressure on the silicon without making the signals inaudible. The signals may not be as strong in some cases as by using a light contact (as a point), but the keeping of adjustment must be taken into consideration.

A. C. STANSFIELD, *New York.*

HONORARY MENTION

Supposed Wireless Telephone Conversations and an Actual Experience

Speaking of wireless telephone conversations which so many amateurs have heard, particularly around the zones where such transmitters are in operation, I am firmly of the opinion that in a number of cases these supposed conversations are the result of an elastic imagination working jointly with a few solid facts.

It is often noticed that the average amateur is so greatly interested when he operates his apparatus, in fact, he is so fascinated at hearing far-off stations, that his imagination carries him beyond all bounds, and while in this state it is likely that he will hear almost anything.

Others may have been fooled as I was. One night about six months ago, just after adjusting my vacuum valve to its best degree of sensitiveness and getting results not to be compared with previous detectors in use, I put my telephones on to pick up anything within range. After turning the switches here and there and adjusting the apparatus for a few minutes, I came upon a distinct voice saying, "Hello, Hello; who is this?" Then I heard nothing further that night.

I was of course of the firm belief that I had heard a wireless telephone conversation, and I thought possibly that the signals emanated from the telephone transmitter at Arlington. But when I heard a similar conversation a couple of nights later, I began to retrench and wonder.

Two or three days later I traced out my connections thoroughly and found that the wireless apparatus was connected to earth by the same ground wire attached to the house telephone and which, by the way, was a party line. Therefore, what I had really heard was a part of an actual wireless telephone conversation.

It may be that some amateurs have been fooled in the same way that I was, and I advise them to trace down their connections and make sure that they have an individual earth connection.

J. F. MILLER, *Illinois.*

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

C. T. H., Barto, Pa., inquires:

Ques.—(1) I am attaching to this communication two circuit diagrams for the charging of a 6-volt 40-ampere hour storage battery and desire to know which one is correct. In the first diagram five lights are connected in parallel and the entire bank in series with the cell, and in the second diagram five lights are connected in series with one another and with the cells.

Ans.—(1) The parallel connection of lamps is the correct one. Each lamp will pass approximately ½ ampere and therefore five in parallel will permit about 2½ amperes to flow on charge. If this is the normal charging rate of the particular cell it will effect the purpose, but it is usual to pass about 5 amperes through a 40-ampere hour storage cell during the charging period.

* * *

A. E., Sargent, Neb., inquires:

Ques.—(1) I am addressing this letter to your "Queries Answered" Department because I want reliable information. I should like to know first if portable wireless stations are as effective as stationary.

Ans.—(1) Portable stations generally cannot cover the range of the fixed stations because usually the earth connection is not as efficient and the antenna is of small dimensions. Modern military portable transmitting sets are very powerful and have been used for communication up to 400 miles.

Ques.—(2) Can undamped waves be received by small receiving sets?

Ans.—(2) We do not understand what you mean by small receiving sets. The majority of high-power stations using undamped waves transmit at very long wave-lengths in excess of 6,000 meters, and consequently a rather large receiving tuner is required. A special detector is required for the reception of undamped oscillations, such as the tikker, the slipping contact detector or the vacuum valve used as a beat receiver and amplifier.

Your third query is not clearly understood. Just what you mean by tuned or untuned amateur stations is not clear. It is necessary that all types of transmitting apparatus in use by amateurs be accurately tuned to a definite wave-length and to resonance with the local oscillation circuit.

Ques.—(4) If I can pass the Government license wireless examinations what are the opportunities and the salary to be expected?

Ans.—(4) You would receive, provided your qualifications were in accordance with their requirements, immediate employment in the ship service of the Marconi Wireless Telegraph Company of America.

Ques.—(5) Is the demand for wireless telegraph operators great?

Ans.—(5) There is a large demand for the services of properly qualified telegraphists and you would have no difficulty in obtaining employment within a few days after sending in your application.

Now that amateur stations have been closed by Government order, there is no necessity for answering your last query.

* * *

W. G., Oak Park, Ill.:

The glass plates of a condenser should be free from lead and at least ⅛th of an inch in thickness. For amateur use, a plate, 8 inches by 10 inches, covered with tinfoil, 6 inches by 8 inches, makes the condenser unit easy to assemble and one which will not take an inordinate amount of space.

The average ½ K. W. transformer will require about twelve such plates connected in parallel, but if a series parallel connection is required, you will need forty-eight plates, twenty-four connected in parallel on each bank, and the two banks finally connected in series.

All types of oscillation transformers are equally efficient provided they are of the correct dimensions and have sufficient conductivity to carry the current without losses. The flat spiral pancake type is probably more convenient because it permits the sliding contact to be fastened on a control handle which can be revolved inch by inch over the inductance and thus permits a very fine adjustment to be obtained in the quickest possible manner.

The November, 1916, issue of The Wireless Age gives complete information

(*Continued on page 778*)

EARNING A NAVAL NICK-NAME

By L. E. Fetter

IT was thrust upon me—I didn't really earn it. The reason was this:

I was sent to the U. S. S. Marietta soon after leaving the Navy electrical school.

One day when the mail steamer was due I sat listening in for her report, and after she had called I told her to go ahead. I judged from the signals that she was miles away, yet she came in strong the first time. All I got was "To the Capt."

The only information the steamer could have for us, I reasoned, would be to announce the prospective delivery of mail. I knew the last stop was Livingston, which was fifty miles away, about three hours' sail; she would probably call as soon as she left there. So I wrote out the following:

"To the Capt., U. S. S. Marietta. Have mail for you. Will arrive about five P. M. (Signed) Bluefields."

It was about two o'clock when I sent this in to the captain. An orderly sought me out fifteen minutes afterward and said that the skipper wanted me. I surmised that he wanted to send a message, but he said: "Fetter, if you get a spud from the locker over there you can toss it aboard the Bluefields."

I looked over the side and saw the Bluefields not a hundred feet away. I'd forgotten to close the aerial switch which was fastened to the deck above and worked by pulling a couple of cords. It was in when I got the call; I pulled it out to answer (it worked on the transmitting side when out and on the receiving set when in, an old style now), and, in my haste, forgot to pull it in again. The only reason for hearing the Bluefields operator at all, the second time was that he either came in strong enough to jump the open switch or I picked him up through the grounded ship's line.

QUERIES ANSWERED

(*Continued from page 776*)

concerning dimensions of aerials suitable for transmission at wave-lengths of about 200 meters. You are advised to obtain a copy of the November issue and note carefully the article by A. S. Blattermann.

* * *

T. E., Troy, Mo., inquires:

Ques.—(1) Please advise me how to construct a 1 K. W. oil-immersed condenser out of 5 inches by 7 inches photographic negative?

Ans.—(1) These plates are rather small but will work efficiently provided you have a sufficient number. They should be covered with tinfoil, 4 inches by 6 inches, and each will then have a capacity of approximately .00033 microfarad.

You will require 300 plates connected in parallel for an approximate value of .01 microfarad.

* * *

S. X. M., Stockholm, Me., inquires:

Ques.—(1) While I have noticed in your magazine many articles telling of the great success obtained by many amateurs who have covered several hundred miles with crystal receiving sets, etc., I have never heard a word about the man of failure like myself. You will note, as per the sketch enclosed, that my equipment consists of the usual apparatus connected to an antenna 150 feet in length, 72 feet in height at one end and 67 feet at the other with a lead-in 35 feet in length.

I have tried the wiring diagrams shown in several of your publications, but so far although I have listened for several hours at a time, I have had no success. I feel quite sure that there must be something wrong with the apparatus, although I cannot understand why I do not receive signals.

Ans.—(1) We have noted carefully the diagram and your error is easy to locate. You have the fixed or stopping condenser in series with the variable condenser and in shunt to the variable you have a crystal detector and head telephone; in other words, you have short-circuited the secondary variable condenser by the head telephone and therefore have destroyed the efficiency of the set because the receiving detector is practically cut out of the circuit.

Connect your fixed stopping condenser between one terminal of the variable condenser and one terminal of the crystal detector. Put the telephone in shunt to the stopping condenser, C-2, and you will have an efficient working set. You are, of course, aware that all amateur stations must be closed until further notice.

* * *

L. S. H., Pennsylvania, inquires:

Ques.—(1) Will you please describe how to make a small tubular fixed condenser for a receiving set?

Ans.—(1) We see no advantage in constructing a condenser of this particular shape. Ordinarily the fixed or stopping condenser has capacity of approximately .005 microfarad although it may vary from .0005 to .05 microfarad. The usual procedure is to take a number of sheets of tinfoil, about 2½ by 2½ inches, and separate them by extremely thin sheets of paraffin paper, and after a number of such sheets have been filled up, to compress the entire unit between two blocks of wood and immerse it in paraffin. Connections of course, are brought out from alternate sheets throughout the sides of the condenser frame and connected to binding posts which are mounted on the wooden block.

* * *

F. C. C., Winfield, Kans.:

There is no difference in the construction of a receiving tuner for a short wave regenerative receiver and one used for ordinary purposes. The regenerative loose coupler can have the dimensions of the variometer described in the book, "How to Conduct a Radio Club." The regenerative tuner for a certain range of wave-lengths will have the same dimensions as when used with a vacuum valve detector and the ordinary circuit. A regenerative circuit was shown in a previous issue of the Bulletin of the National Amateur Wireless Association.

* * *

W. S., Daconia, Okla.:

Now that the ban has been placed on amateur stations, you will not be able to erect the contemplated aerial.

In the book, "Practical Wireless Telegraphy" on sale by the Wireless Press, Inc., you will find a detailed diagram showing the construction of a modern Marconi aerial and you would do well to duplicate the particular type shown in so far as possible.

In commercial radio service silicon bronze wire (7 strands of No. 21) is almost universally employed. Occasionally aerials have been erected made of a special copper coated steel wire which combines the conductivity of copper with the tensile strength of steel.

You would do well in erecting an aerial to be sure that the dimensions are correct for the transmission and reception of waves of 200 meters. Complete dimensions of aerials for operation at this wavelength were printed in the November, 1916, issue of The Wireless Age.

* * *

E. C. S. T. J., Dayton, Ohio.:

If you desire to build a receiving tuner responsive to wave-lengths up to 6,000 meters, we advise you to secure a copy of the fourth revised edition of the book, "How to Conduct a Radio Club" and construct a tuner after the dimensions given therein.

P. H. L., Fort Wayne, Neb.:
We have no data at hand for calculating the inductance of multi-layer coils such as may be used in the wing and grid circuits of the vacuum valve. It is customary to wind these coils on concentric tubes, adjacent windings being spaced about 1/4th of an inch. If you will mount these coils so that they can be telescoped, one within the other, you will have a variable inductance of considerable range. Multi-layered coils are of particular value for tuners operating on long waves although many tuners are in use wherein multi-layered coils are used for the reception of short wave-lengths, not over 600 meters.

* * *

L. N., Bay City, Mich.:
A complete course in radio engineering is given periodically at the College of the City of New York and also a special course at Columbia University, New York City. Full information concerning the entrance requirements can be obtained from the dean of either college.

Graduates of technical schools will be given an engineering course at the Marconi Company's factory at Aldene, N. J. If the applicant possesses the proper credentials he is assigned to the manufacturing department on a salary which is periodically increased over a space of three years.

The Marconi Wireless Telegraph Company of America will give you employment during the summer months in the Great Lakes Division if you desire such an appointment.

* * *

B. C., Tampa, Fla.:
In order to construct the variable high voltage condenser you propose it will be necessary to separate the adjacent plates, even though oil-immersed, by sheets of glass or by a good grade of micanite. A condenser of this type is feasible but not essential. The average radio transmitter, with the exception of one to be operated over a large range of wave-length adjustment, operates most efficiently with a condenser of fixed capacity across the secondary winding. For experimental laboratory work a high voltage condenser of variable capacity is of considerable value.

The formula for calculating the capacity of a variable condenser appeared in the April issue of The Wireless Age.

Your last query is answered in an article by A. S. Blattermann in the November, 1916, issue of The Wireless Age.

* * *

Howard D., Brooklyn, N. Y., inquires:
Ques.—(1) Please note the circuit diagram accompanying this inquiry. I should like to have the dimensions of all coils for this regenerative receiving tuner responsive to waves up to 3,000 meters.

Ans.—(1) The secondary winding of a receiving tuner may be 5 inches in length, 3½ inches in diameter, wound closely with No. 32 S. S. C. wire. The primary winding may be 4 inches in diameter, 6 inches in length, wound closely with No. 24 S. S. C. wire. The loading coil, L-3, may be 3 inches in diameter, 5 inches in length, wound closely with No. 32 S. S. C. wire. Similar dimensions will hold good for the coil, L-4. The condenser, C-1, need not have at its maximum value capacity in excess of .0001 microfarad, while the condenser, C-3, should have a maximum value of about .001 microfarad. The condenser, C-2, is one of extremely small capacity and is not absolutely necessary in all cases.

* * *

J. E., Milwaukee, Wis.:
We have no details of the aeroplane set which you mention, nor the connections of the receiving apparatus which is supposed to have given good results.

* * *

H. H., Brooklyn, N. Y.:
The diagram of connections you have attached to your inquiry are feasible, but we do not see where you will derive any particular advantage in breaking the circuit by means of a tikker at the point mentioned. Ordinarily, the tikker is placed in series with the telephone condenser. In fact, there is no necessity for interposing a crystal rectifier in the circuit. The apparatus will respond to undamped waves without a rectifier although it is often noted that the presence of the rectifier smooths out the note. The apparatus you have shown will respond to undamped wave stations in the United States, but not to stations located in foreign countries for the reason that it is not sensitive enough for the purpose. You, of course, understand that all amateur stations will remain closed for the period of the war.

* * *

H. P. W., Lansing, Mich.:
The book, "How to Conduct a Radio Club" contains complete diagrams of the vacuum valve connected in various ways. Copies of this book can be secured from The Wireless Press, Inc., 42 Broad Street, New York City.

* * *

F. E. P., Port au Prince, Haiti:
The allowable flux density of 500-cycle transformers is from 10,000 to 15,000 lines of force per square inch. The primary of a 3 K. W. transformer may be wound with No. 8 S. S. C. wire and the secondary with No. 26.

The irregularity in the note of your quenched spark transmitter can probably be eliminated by careful adjustment of the generator voltage when the point of resonance between the primary and secondary circuits of the oscillation transformer has been reached.

After a quenched spark set has been tuned to resonance, it is necessary to carefully adjust the generator voltage to get

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SHORT WAVE REGENERATIVE RECEIVER $32.50

This short wave regenerative receiver is recommended for long distance relay work on wave lengths approximating 180 to 450 meters. It is possible, however, to receive wave lengths up to nearly 1,000 meters sufficiently with reduced amplification.

The circuit used is the Armstrong regenerative type with constants accurately calculated for the wave lengths referred to above when employed in conjunction with any of the audion detectors described in our Manual of Wireless Telegraphy.

With this set it is possible to receive undamped and damped waves. A blue print of connections with detailed instructions for setting up and operating this receiver is supplied with each instrument. Both tube and round type audion detectors can be used successfully with it.

Our 248 Page Pocket Catalog N 28 on request.
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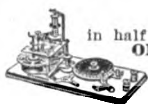

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HOBOKEN, N. J.

a clear spark tone and this may be the difficulty in your particular case. The 200-mile range which you have obtained with your ¼ K. W. is very good indeed and about all to be expected with an apparatus of this power input.

* * *

E. M. T., St. Joseph. Ark.:

The best way to keep up your code practice during the period of the war is to purchase an automatic transmitter such as the omnigraph and connect it to a small buzzer practice set, or you might install a small buzzer and key and have a friend who is familiar with the telegraph code send to you daily. In this way you would soon be enabled to pass the Government license examination and would be able to secure a position with a Commercial Company, the Army or the Navy.

* * *

A. B. S., New Orleans, La., inquires:

Ques.—(1) I have been an operator in the Marconi service and should like to know the use of the protective choke coil on the Marconi 107-a tuner.

Ans.—(1) It is a coil of high self-inductance which is shunted around the short wave condenser and the primary winding of the receiving transformer. Its function is to prevent the accumulation of extra high potentials on the di-electric of the Marconi disc variable condenser.

It is not connected in the circuit of the tuners of the American Marconi Company.

Ques.—(2) How is the Marconi magnetic detector connected at the "stand-by" side?

Ans.—(2) When the change-over switch is thrown to the stand-by position the detector is disconnected from the secondary circuit and placed in series with the antenna. Tuning is then effected by variation of the aerial tuning inductance or the short wave condenser.

On the "tuned" side of the switch the magnetic detector is connected in series with the closed oscillation circuit.

An intermediate oscillation circuit is placed between the antenna and the local detector circuit.

Ques.—(3) What is the receiving range of the Marconi direction finder?

Ans.—(3) Its range is only limited by the size of the aerial and the sensitiveness of the receiving detector. Recent tests made by the Marconi Wireless Telegraph Company of America indicate that the looped aerials of the direction finder can be used for the reception of signals over extremely long distances.

* * *

A. D. R., New York City, inquires:

Ques.—(1) How can a commercial wireless operator be assured that his transmitting set is working at the maximum degree of efficiency?

Ans.—(1) This is easily determined by the data given on the tuning cards which are posted in the wireless cabin. These cards show the number of primary and secondary turns in use at the oscillation transformer for all wave-lengths, and also the amount of antenna current to be expected under normal operating conditions.

If these adjustments are thoroughly duplicated and the reading of the ammeter is below normal, it is evident that some part of the apparatus is not functioning properly.

A commercial operator should first check up the antenna current, noting at the same time the reading of the primary wattmeter. The normal power consumption of the set should not be exceeded in any case. When the transmitting set is properly tuned is evidenced by an aerial ammeter, and the next thing in the order of the adjustment is to determine the note of the spark. If the note is not clear the range of the apparatus will be considerably reduced because receiving telephones are generally more sensitive to a certain critical spark frequency. The tone of the note can be regulated by the generator field rheostat or by cutting in and out gaps in the case of the series or multiple plate discharger.

The rotary gaps are adjusted for a clear note by means of an adjusting handle attached to the muffling drum which shifts the position of the stationary electrodes in respect to the disc electrodes.

* * *

A. N. D., New York City, inquires:

Ques.—(1) Will you please state some causes for the sparking of the brushes of a motor generator?

Ans.—(1) We presume that reference is made to the motor brushes. Some of the causes of sparking are as follows: (1) The commutator may be worn in ridges causing an uneven surface for the brush contact; (2) There may be a loose connection between the armature coil and the commutator bar; (3) There may be a high or low commutator bar which causes poor contact with the brush each time that this particular section passes underneath; (4) The brushes may be in very light contact with the commutator; in other words, they are not set with sufficient pressure; (5) The brushes are not set at the neutral point and they should be shifted back and forth until the correct point is found; (6) There may be an open coil in the armature, which, if it exists, will cause very severe sparking; (7) There may be a collection of dirt and grease in the commutator which prevents good contact at the brushes.

There are still other causes, but in general the foregoing will cover the troubles encountered by the wireless operator.

* * *

H. M. T., Seattle, Wash.:

The Marconi direction finder is a very accurate instrument and gives the line of direction of a given station, but does not indicate

whether the signals come from the north, for instance, or from the south. In the case of a ship there need be no argument on this point if the reception is at a land station, as it is generally known on which side of the vessel the land station is situated.

* * *

A. Z. B., Washington, D. C., inquires:

Ques.—(1) I frequently run across the terms "skin effect" in connection with wireless apparatus and am not quite sure that I actually understand its application.

Ans.—(1) The skin effect in a conductor is a tendency of alternating current to avoid the central portions of solid conductors and to flow on or near to the surface. This effect is more pronounced as the frequency is increased and when the frequency becomes of the order of several thousand cycles per second, a hollow conductor is just as effective as a solid conductor.

* * *

A. B. L., Brooklyn, N. Y., inquires:

Ques.—(1) What is meant by an "earth" arrester of the transmitting set?

Ans.—(1) It is a particular type of series spark gap used by the Marconi Company in connection with its transmitting and receiving sets. It consists of a brass plate gap, the length of the gap being exceedingly small, and connected in series with the earth lead of the transmitting system. The antenna and earth connections of a receiving transformer are connected directly across the gap and when the transmitter ceases operation. The receiving set is connected directly in series with the aerial for receiving purposes.

Connecting the receiving tuner in this way requires a rigid oscillation detector such as the Fleming oscillation valve or the Marconi magnetic detector. Sensitive crystal detectors would not stand the induced potentials that would be set up in the receiving circuits.

Ques.—(2) How is the correct direction for the flow of the local battery current through a carborundum crystal determined?

Ans.—(2) It is best determined by actual experiment. The connections from the battery to the potentiometer are reversed until the best signals are obtained. It is well in making this test to cut down the strength of the incoming signals until they are rather weak, for it is often observed that the adjustment of the local battery that will give loud signals from a near-by station is not the correct adjustment for a far distant transmitter. This is more or less true of all types of oscillation detectors in which a local battery current flows.

* * *

C. V. H., Kinsley, Kans., inquires:

Ques.—(1) What is the wave-length of an aerial consisting of a single wire 550 feet in length, 64 feet in height at one end and 68 feet at the other? The lead-in is 70 feet in length. I believe that this aerial has a wave-length of more than 200 meters. Amateur stations have been heard on it. Why?

Ans.—(1) The natural wave-length of the antenna under consideration is about 890 meters which is several times the value it should be for the efficient reception of 200 meters. Amateur stations can be heard on this aerial, but the effect is one of forced oscillations. If a transmitting station is located close to a receiving station and radiates a considerable amount of energy, oscillations will be forced into the receiving aerial even if the receiving apparatus is out of resonance with the emitted wave from the transmitter. This may be the condition that prevails at your station.

Ques.—(2) What effect do galena and other minerals have on electro-magnetic waves which causes them to be audible in the receiving telephones?

Ans.—(2) Mineral detectors are rectifiers possessing the peculiar property of changing a high frequency current into a series of direct current pulses. The alternating currents of radio frequency which flow in the secondary circuits of the receiving apparatus could not operate the telephones direct because the mechanical time period of the diaphragm of the receiver will not permit it to vibrate at such a rapid rate per second of time. Therefore it becomes necessary to convert the high frequency current into an audio-frequency current to which the receiving telephones will readily respond.

In the case of a spark transmitter the entire action may be summed up as follows: For each spark of the transmitting apparatus a train of high frequency electrical oscillations, from twenty-five to 100 in number, passes up and down the aerial system. Corresponding displacement currents are set up in the immediate region of the antenna system and travel through space at the speed of light—300,000,000 meters a second. At the receiving apparatus the train of oscillations comprising each individual spark at the transmitter is rectified into a single series of decaying direct current pulses which cause a single movement of the telephone diaphragm for a single spark of the transmitter. In other words, a complete train of oscillations has an integral effect on the diaphragm, creating a single sound.

Ques.—(3) Why are the minerals sensitive only in certain parts?

Ans.—(3) The cause of this phenomenon has never been determined. In fact it is not definitely known just why crystals possess the property of rectification. The most complete answer to this query can be found in the book, "Principles of Wireless Telegraphy," by G. W. Pierce. Investigations concerning the actions of the various crystalline detectors are fully described in certain experiments and the effects on the oscillograph are observed.

R. H. L., Rutland, Vt., asks:

Ques.—(1) Would a rotary spark gap operated on a spark coil in synchronism with the gap by means of a mechanical interrupter (on the same shaft as the gap wheel) be termed "efficient" by a radio inspector?

Ans.—(1) We cannot possibly see why there should be any objection to this construction, provided the decrement of the spark gap circuit is not too great. Of course the United States authorities are chiefly interested in the decrement of the emitted wave rather than that of the spark gap circuit and we do not believe they are particularly anxious in regard to the efficiency of an amateur set.

* * *

A. C., Bangor, Me.:

The freak results obtained with your receiving tuner are undoubtedly due to the end turns, i. e., your tuner is too large for the range of wave-lengths you desire to receive. When your receiving transformer is adjusted to the shorter range of wave-length, it is quite probable that the end turns have a natural period of oscillation somewhat near to that of the incoming signal, and hence a considerable amount of the energy of the oscillations is absorbed. This will tend to damp out the oscillations and will give the effects you have observed, namely, amateur stations can be heard regardless of the adjustment of the tuner.

THE N. A. W. A. SERVICE BULLETIN

(*Concluded from page 763*)

It is proposed to begin a country-wide campaign to enlarge the membership of the N. A. W. A. and to further its interest in every way possible.

A State Director of Communications will be appointed in each state who will look after the interests of the Association. The one to be selected to carry out this important work will, of course, be a well known amateur who possesses a first grade equipment and whose ability as a telegraphist is generally recognized.

Form letters will be sent out at a later date which all members are to fill out in detail. These will enable us to obtain highly important data for carrying out the plans of the campaign.

Long distance relay tests appear to appeal to the amateur experimenter both for utility and interest, and it is therefore proposed to organize several standard relay routes across the United States, designed not only to interest experimental workers in general, but to serve as an emergency communication means in case of disaster such as that of several years ago in the flooded Ohio districts.

That amateur stations can be of great assistance in emergency has been fully proven. Several instances can be cited where amateurs have maintained the only means of communication when telegraph and telephone have failed.

Through the columns of this department members of the Association are requested to express themselves freely on Government legislation. Those who have stations which might be of benefit to the Government in the present crisis and others which possess equipment peculiarly located for carrying out such work efficiently should send in full details to Association headquarters. These data will be kept on file, so when they are required we shall be able to present to the Government authorities a complete list of such stations.

Communications are invited from all amateurs on subjects pertaining to the advancement of the Association. Constructive criticism will be particularly welcomed and communications which are considered of importance to the field in general will be published in this department.

It is the purpose of the Association to further the interest of the amateur:

(1) By informing him of the latest developments in respect to the technical application of wireless telegraphy;

(2) By informing him of proposed legislation pro and con to his interests;

(3) By guiding his experimental work along more scientific lines of investigation;

(4) By protecting him from nefarious and unprincipled manufacturers;

(5) By showing him what is true and what is false in the published reports of the day.

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August, 1917

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THE ACTIVITIES OF ALIEN ENEMIES

THE arrest of Professor Jonathan Zenneck by order of the Department of Justice is an event of the month that holds significance beyond its surface indications. Nothing made public thus far has disclosed any definite German spy activities attributed directly to this scientist whose name has become a by-word in the radio art, but it is strongly intimated that the Government looks upon him as one of the most dangerous German subjects in this country. His internment at Ellis Island for the duration of the war is a proper measure.

It is difficult—and no one knows it better than the writer—for the American mind to cut off instanter from the fraternal spirit which scientific investigation fosters among men of all races and nationalities. Yet that this must be done answers itself in the fact that we are at war; undeniably active already in the greatest conflict the world has ever known; and our personal liking or affection for a kindred scientific worker must not be permitted to cloud our sense of duty in silencing the activities of enemy aliens. It is certain that communication of some sort is established between Germany and her agents in this country; it is a reasonable certainty also that radio figures in the communication scheme. Professor Zenneck, being one of our enemy's most skilled wireless experts, must have restricted the freedom hitherto allowed him.

One cannot forget the lesson of Germany's publication of our torpedo flotilla's arrival four days in advance of its appearance in foreign waters, despite the fact that the vessels sailed under sealed orders and not a line concerning their departure was published in any American journal. When our enemy's agents can penetrate the innermost portals of the Navy Department, secure information presumably known to but the two high officials concerned, and then transmit the details right under our very noses, so to speak, it is time for us to wake up.

Who can doubt that at this very instant German agents in this country are receiving instructions from Nauen or Hanover by wireless? It is a simple and safe task to establish a receiving station of the portable type most anywhere in this nation. The Secret Service is well nigh helpless in locating plants of this character, for their detection is more a matter of skillful engineering than sleuthing of the conventional type. The day is not far distant when the Government will realize the tremendous value of amateur skill in this connection.

Meanwhile the nation must, we expect, resign itself to waiting for the catastrophe which will rouse the officials to action. While the lay public rests in fancied security now that all wireless plants are shut down, the wireless men know that hundreds of American experimenters could, if they so willed, operate for a considerable period without detection. Loyally, they have obeyed the law, and will still continue to obey. But the ease with which the enemy alien can keep in touch with German wireless across the water is common knowledge and a matter for grave concern.

The secrecy which surrounds events since our entrance into the war prohibits illustrating this point by specific instances. But an incident of the days of our neutrality will serve.

It will be remembered that when the submarine Bremen arrived in New London, moorings for the vessel had been prepared in advance by German agents. Presumably, Germany was then, as now, without communication with this country, other than the Sayville wireless. Yet neither Government nor commercial stations had intercepted any message relating to the submarine's arrival. Secret stations, working on unusual wave-lengths, apparently had no difficulty, however, in keeping in touch with enemy equipments outside this country; and that these stations are inoperative now is a proposition that even the most guillible cannot credit.

Thus we return to a consideration of the Zenneck arrest. This type of expert is an undeniable menace to the safety of our merchant vessels and troop ships when given unrestricted freedom. His prominence as a radio scientist made certain his apprehension, but little seems to have been done with the many lesser lights whose familiarity with the methods of superimposing a number of oscillation circuits one upon the other gives German agents on these shores unlimited opportunities for secret communication.

The use of advanced amateurs for detection of these men seems inevitable. Some suspects have already been informally reported and action taken, but the radio field still awaits establishment by the Government of a comprehensive plan. A board capable of creating a system of spy station detection can be quickly assembled from competent experts in the experimental field, and it is to be hoped that the Government will not postpone the execution of this obviously necessary measure until our transports are reached through a death-dealing message.

Meanwhile, every radio man must realize his duty to report any definite suspicions he may entertain. We have reached the point where apparent friendships must not prejudice our judgment. For instance, though a large measure of Professor Zenneck's popularity may be deserved, he is the expert who for a time was in charge of Sayville and he has served in the German army. It is said also that before coming to this country he participated in the German drive through Belgium and later by falsifying his passports gained admission to the United States. His scientific standing is of the highest; he has been professor of physics in Danzig and has the D. Sc. degree from the University of Tübingen, besides being the author of several standard works on electricity and magnetism and wireless telegraphy. It is therefore obvious that no good end is served by allowing him liberty under which he very readily could direct a well organized group of less skilled men resident in this country to serve Germany's ends.

Americans with unbounded faith in German acquaintances who have through naturalization declared themselves loyal to the United States will do well to consider the possible operation of the infamous Delbrück law passed by Germany in 1913. Under this law Germans who have been naturalized in foreign countries, or their descendants, are still considered to be German subjects provided they register with local German Consuls. Could anything be devised which puts a higher premium upon dishonor than this? Can we doubt that possibly thousands have taken out their papers and so registered? One such case known to the Secret Service concerns a reservist in the German army, who, having taken out his first papers, openly boasts that it was done for business purposes. He says that he still considers himself a German subject while posing as an American.

This type of information, particularly if the one concerned is a skilled wireless man, often results in the apprehension of a menace to the safety of American fighting forces going abroad. Until the Government realizes the value of a system of espionage for spy wireless stations and lays out a plan for utilizing amateurs in their detection, the experimental field can be of service by separating sentiment from loyalty in their associations with possible enemies and not hesitating to report to the police any well-founded suspicions.

JACK BINNS' PARTING MESSAGE

JUST before leaving New York to join the British Royal Flying Corps, Jack Binns, the famous C. Q. D. operator of Republic fame, told the English recruiting officers that he knew that Germany was preparing for war against Great Britain years ago, because from April, 1905, to July of 1908 he had been a wireless operator on German ships. He told them that the wireless apparatus on the German ships was controlled by a Belgian concern, and that there were ten English, two Italian, one Belgian, one Icelander, and a number of Danish wireless men employed on German ships. In 1908 at the time of the Morocco crisis, Binns said, the Germans asked the Belgian concern to discharge the British, Italian, and Belgian operators, stating that in the event of war between Great Britain and Germany the British operators would refuse to tell the German Captains when war was declared, if they received the information at sea, and that consequently the German ships would be captured by British warships.

In this incident is once again illustrated how the mailed hand of the Hun has been ready to strike for years. Can it be doubted that the same thoroughgoing consideration has been given to the eventual engagement in war with the United States? America must awake; eternal vigilance is the price of safety.

THE NEW FACTOR IN WARFARE

BOUNDLESS opportunities are daily revealed for the wireless man whose knowledge of electricity and magnetism is of the practical order. Electricity, child of peace, has been adopted by war as its own especial ward. Without electricity this war could never have reached the proportions which it has; perhaps could never have been fought at all. Every Big Bertha is fired by an electric spark. Every order from headquarters reaches the trenches, not by courier as in days of old, but by telephone. The wireless crackles a staccato accompaniment to every sailing of ship and submarine. The torpedo itself is propelled by electric motors.

Invention has been stimulated almost hysterically by the demands of war. Armies on the march or in the field have now a hundred conveniences which were not known last year. There is a radio telephone and telegraph equipment, for instance, which can be attached to a motorcycle. Current for this compact field set is supplied to the telephone or telegraph by a high voltage direct current generator connected directly to an independent motorcycle engine connected with the side car. For the equipment is contained in a small metal side car attached to the cycle.

The wireless equipment comprises a completely independent unit, which can easily be detached and pushed by hand or loaded on a wagon and transported over rough ground. An extra wheel is provided which can be attached to either hub of the side car or to the front or rear of the motorcycle. The antenna is supported by a light-weight metal mast of tubular construction. The telescopic form of it makes it possible to collapse the mast and to strap it out of the way on the car's side.

It is said that the French are using a detector so small that it can be carried in the soldier's breast pocket. To use it, a knife is planted in a tree and the wire attached by metal clip to this "antenna," another clip and stake serving for the ground wire. The entire receiver weighs but thirteen ounces, and yet, in spite of its size, it is meticulously made and is a most accurate apparatus.

For long distances, for instance, to the extreme borders of France, one clip is joined to a telephone line which serves as an antenna, and the other goes to gas or water pipes for the ground. But at a smaller distance there can be a wider choice for antennæ: a kitchen stove, a balcony, a metal bed or the like, or even a bicycle or an automobile. The operator may use his own body for the ground by attaching the metal clip to his finger, while the other clip goes to the telephone wire.

We have termed these things "stunts" up to now; perhaps we have considered them both foolish and useless forms of pastime. Yet, on good authority, it is reported that these former toys are carrying on important work.

ALLEGIANCE AS VIEWED BY A WORLD-CITIZEN

THE Italian Mission had been formally received at the City Hall in New York. The ceremonies were ended for the day. "The cordiality of our reception," said Mr. Marconi, "was most marked. It has been very different from the reception given to me here twenty years ago this month, when I first came with my poor wireless inventions."

In these few phrases lie a world of encouragement for inventors the world over. Cold, callous, self-centered and satisfied New York turning out by the tens of thousands to cheer the inventor of wireless made a spectacle never to be forgotten. At every turn Marconi was met with wild and enthusiastic acclaim and, most significant of all, his popularity did not rest alone on gratitude for his humanitarian invention—everywhere was manifest recognition that he stands for the true adjustment of nationality and world-relationship.

The straightforward simplicity of character which has endeared him to men of all nationalities was made evident in his every official act while the guest of Americans. The inventor has long been looked upon as a citizen of the world, Italian by circumstance of birth, but somehow belonging to all nations. It required a slight readjustment of habitual thought to recognize him as the official representative of Italy, but it was obvious that by being a good citizen of Italy he was best serving America. At a public school in the poorer section of the city—a school which has honored him by adopting his name—he spoke in Italian to those of a quarter occupied largely by those who were originally his countrymen. Here his sincerity of purpose to make these schoolboys good Americans was eloquently revealed.

"You boys represent the future of this great country," he said, "and it is the vitality, enthusiasm and patriotism that you show which give to your elders who are now engaged in actual war increased courage to carry on their work. Nothing could please me more than to see children who are preparing to become citizens of the great ally of Italy at such time. We are living in stern times and we must do all in our power to prepare not only to end this terrible struggle victoriously, but also to prepare for the new conditions which are bound to arise when peace finally comes.

"Our countrymen are giving their heart's blood, not for themselves, but to obtain a better world for you. I therefore exhort you to remember that this struggle is for democracy, liberty and mankind."

How different is this spirit from that shown by the scientific men of our enemy country! Propaganda designed to demolish America's traditions and continuous efforts to make naturalized citizenship but a blind to cover allegiance to their fatherland is Germany's contribution for years antedating the war. It is cause for general thankfulness that fate selected as the benefactor of humanity, Marconi—a Man.

—THE EDITOR.

Multiplying Wireless by Magic

How the Call of the Nation for Vast Quantities of New Sets for the Army and the Navy Expanded the Marconi Factory

By JOHN WALKER HARRINGTON

THE magic flutes of today are the wireless sets. With them men fend themselves from harm in peace and outwit their foes in war. A modern magician gave them to us that we might sing across the liquid leagues and span the continents with voices which are silent melodies save to those whose ears are attuned to the hidden minstrelsy.

When war came, the United States Government took from the Marconi Wireless Telegraph Company of America all those magic flutes, both large and small, and said, "Make for the Army and Navy a thousand or so more." How the Company's plant in Aldene, New Jersey, was to put through this rush order was a problem which required considerable planning. To make appliances in a leisurely way for one's own use is one thing, but to manufacture them commercially is another. It would have been impossible to have risen to this great national need, had not the Company called to its aid that which works so many wonders in this world—the wizardy of efficiency.

There was no time to be lost. The erection of additions to the factory; the perfection of new machines and new jigs and models; the training of artisans to a new and highly specialized calling—all had to be carried on at once. "Business as unusual" from May 1st until now has been the slogan at the Aldene plant.

Cartloads of brick, piles of lumber, barricades of cement bags, appeared overnight. Carpenters, masons, machinists, engineers, electricians, arrived from all parts of the compass. On the first of May there was a lawn and on the second something that looked like a shell crater. The foundations of the big one-story extensions were spun rather than dug and built, and the brick walls were reared on them by workmen who turned night into day. The progress photographs of the addition could be built into a movie and sped up into a two-reel production. No construction contract was ever carried through on quicker schedules than was the one which gave the needed room to Aldene. The buildings which have been added cover 40,000 feet more of ground space. They are of the saw-tooth type on top, which gives them the appearance of a series of studios such as are let out to artists and sculptors. They are dedicated to the art which in these days is so all important—that of swift communication. Now that everything is done, those who watched the bewildering swiftness of the operations wonder how such order was brought out of all this hectic haste. It is an apt illustration of what men can do when they have to.

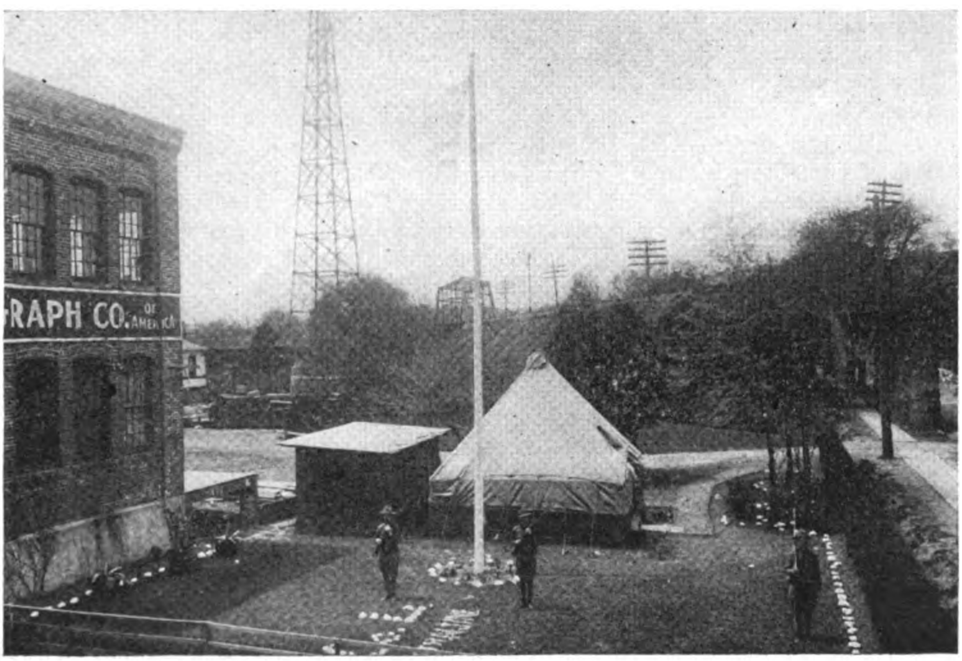
Some of the seasoned old lathe hands, recruited from all parts of the country, were jarred a little when they started. To see a group of carpenters nailing down a floor as though they were mad hatters rather than respectable craftsmen; then to see another frenzied crew slide a lathe upon the freshly-planed surface, while others were rigging up belts, caused those aristocrats of labor to rub their eyes in a bewildered kind of way.

"All right, there's your lathe, man, get to work," roared the superintendent in their ears, for there has not been any silence on tap at the Marconi factory for months, and before they realized what they were about they themselves were seized with the spirit of rush.

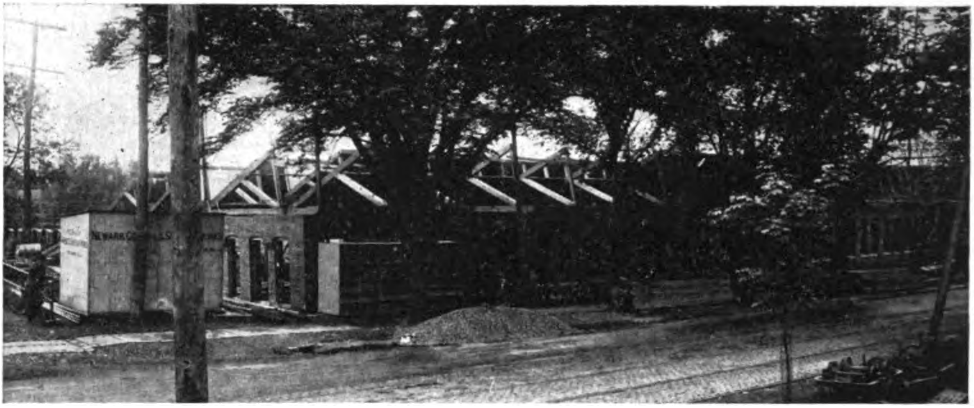
The installation of instruments of precision, such as required for the making of the thousands of parts which enter into a wireless set, be it little or big, requires meticulous care. The marvel of it all is that these appliances which are used in such delicate operations seemed to be veritably thrown into position and yet they are as right as trivets.

One of the reasons for this is that the United States brand of workman is one of the ablest and most adaptable human beings under the sun. He is as fit to do a thousand things well as is his prototype of the machinery world, the great American lathe. The men at Aldene are putting into their daily tasks the zeal of patriots. There are more than 700 of them working in two shifts in the new plant. Some were once making gauges and caliphers; others were adepts in fashioning automobiles or sewing machines; many were making brass work or working over hard rubber. There is no better example of the way in which a group of ingenious Americans can be drilled in difficult and highly specialized trades than is shown at the benches at Aldene.

First of all, there had to come into being certain jigs and templets and many other appliances such as only skilled die makers and tool experts can fashion from the designs of the engineers. The Marconi Company had for years been making apparatus for its own use both on land and sea. The Federal authori-



The Aldene plant of the Marconi Company where, on the first of May, there was a lawn, a few piles of lumber and soldiers on guard, harbingers of the reconstruction to meet a national emergency



A view of the work dedicated to the art of swift communication; note on the left the depth of the partially roofed building, extending beyond the third telegraph pole

ties wanted apparatus adapted to different wave-lengths than those sets in ordinary commercial use and that meant all kinds of changes. There had to be sets for aeroplanes, for destroyers, for submarines, for battleships and for colliers, all of which had to have their own patterns and jigs before a single one could be turned out from the works. The way these skilled workers, brought into the "Valley" from all parts of the United States, go about interpreting a blue print as though Marconi, and Hertz and Sir Oliver Lodge were everything in their lives, was a sight which made one think of automatic efficiency. And mind you, they were doing all this while carpenters were sawing and ripping along side, while masons were rattling their trowels in the next unit, and roofers were hammering and stamping overhead, as though trying to show that each and every one of them was the most important in putting wireless sets together.

Probably there is not a reader of THE WIRELESS AGE who has not seen radio apparatus both stripped and mounted in ebon panels hurling its shocks into the ether, but few who have not watched wireless sets being machined and assembled can realize what an intricate task it is to build them. Of the thousands of parts, tiny and big, which go into the make-up of the sets, scarcely any can be bought in the open market. Screws and nuts, and bolts and all the bits of copper and aluminum and iron and steel and wire which enter into the composition are all made according to the Government standards, and the process of standardization itself was one which might have taken months had there been time to wait. Brass and silver and bakelite-dilecto enter into the making of these magic flutes of earth and sea with which brave men may be called to fight or warned of the coming of the foe.

The steps in the making of the wireless sets are numerous and intricate. Practically everything which comes in at the receiving end of the great plant is raw material. This makes its way through many operations into a delicately adjusted instrument which can make the earth a whispering gallery at the touch of a brazen key. Everything looks pretty much alike at the start. The tyro cannot distinguish whether all the material piled so high in the storeroom or being shoved in from the freight cars on the siding is going to come out as commercial ½ K. W. sets or the great twenty kilowatters which can jar the ether into vibrations from Sandy Hook to Lands End. The operations are literally legion and by the time a 5 K. W. apparatus has emerged at the discharging end of the factory from four to six months will have elapsed. All the time, however, there is so much action that the metals which are the makings of the sets have hardly time to get cool from the constant handling of hundreds of toilers carried on all day and almost around the clock.

Some of the types of wireless sets which are being developed at Aldene are, to the visitor, unlike anything which has ever been fashioned before. That is evident in the dexterous manipulation of strange tools which are everywhere seen in the plant and in the array of weird jigs which are being carried about the long rows of benches and lathes.

Here is a skilled artificer bending steel angle bars into the frame for a new type of aeroplane set, surely one of the most compact contrivances which ever saw the light of invention. Other types for the submarine chaser, the destroyer and the submarine are being sent through the works at top speed. Side by side with the small set may loom a black paneled contrivance which before long may be talking from the wireless cabin of a dreadnaught

In order to manufacture all these varieties it was necessary to convert many of the standard machines to unaccustomed uses. The turning out of copper plates on the lathe, for instance, where iron castings or such materials were machined, is a very difficult job but it is being admirably and effectively done at the Aldene plant. End to end, there are sixteen machines on which are being turned the finely-threaded screws which are used in the precise adjustments of tuning the wireless to wave-lengths of other instruments. Turret lathes just placed in commission are performing their ingenious tasks so deftly that they seem even to ignore the guidance of the skillful hands which direct them.

Everywhere are bundles of rods of brass, sheets of aluminum, and foil of copper, emerging from machines as parts of the instruments which are to make vibrant the air above the warfare of the seas. Into every piece there is put the conscientious work of a spirit which transcends the machine. Wonderful as is the mechanical ingenuity here displayed, there is nothing of the automaton in the way in which these able artificers go about their toil, as the processes grow step by step more complicated.

There is the same alert enthusiasm shown by the girls and women who are winding the miles and miles of fine wire for the coils, for there is about them just such an unconscious air of consecration that one observes on the faces of the women who are learning the technique of the Red Cross nurse. Side by side are girls just out of school and gray-haired mothers who are doing their bit in this factory while husbands or sons are enlisted in the service of the country.

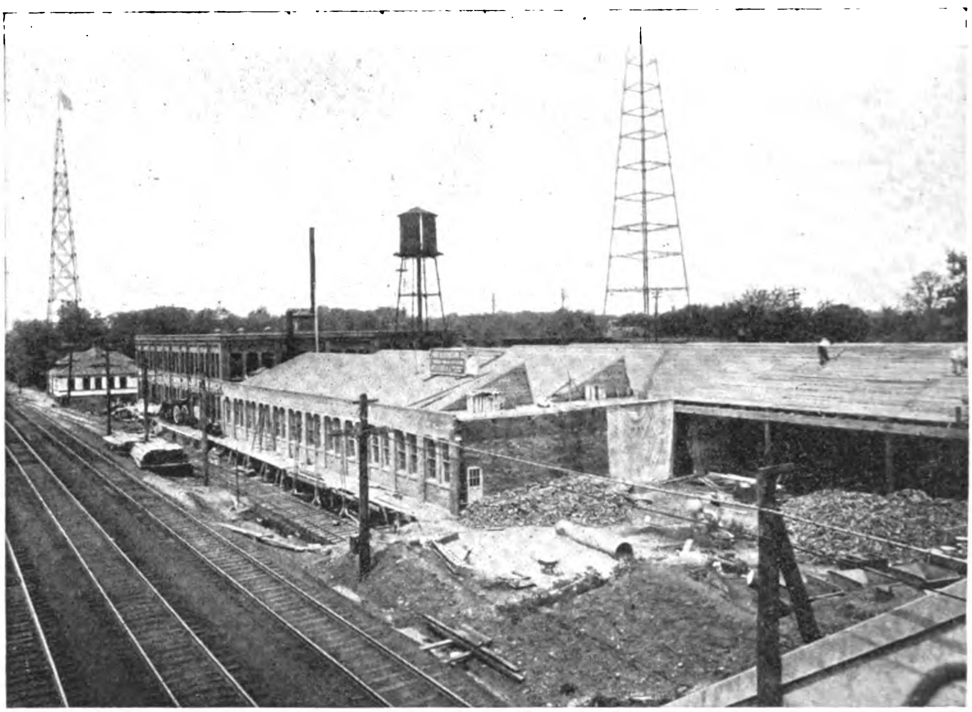
The expansion of the manufacture of wireless sets has brought into play all manner of factory efficiency methods. They apply especially to the great stockrooms where in hundreds of separate compartments are piled the different sections of the various sets. Motor-generators, transformers, starters, gap switches, aerial indicators, rheostats, are waiting in their stations, ready to go out into the world of adventure.

Owing to the highly developed system in the assembling room, the widely separated fractions are joined with a rapidity which is startling to the uninitiated.

When the sets are finally articulated they are taken to the testing room, where they are tried under what are practically service conditions which have been ingeniously simulated. "Birds may be singing in the trees" from which the wooden ships are to be built to carry food for France, but the wireless sets which are to be on board of some of those craft are already giving voice to their lays at this factory. If Rembrandt were back again on earth, he would like nothing better than to paint the lights and the shadows which play about a youth in one corner of the testing room bending intently over the new appliance which is being practiced to in its notes as though it were some sable-hued bird trying to attune its unaccustomed throat to a mighty lilt.

The plotting room, from which has been directed so much of the plant strategy, is a one-story wooden building from which the engineering force was in transit when I visited the works a few days since. The engineers are now quartered in the remodeled part of the factory which was the old building. The men who have done so much to meet the sudden emergency which confronted them are of that keen witted, capable breed which are coming these days from American schools of technology and also from the drafting rooms of the great manufacturing plants. Among them I noticed one who only a few months ago had been a wireless operator, but by intensive study had fitted himself for one of the best positions in the employ of the company. He is among the able staff which, through its adaptation of shop practice to the demands of these days of stress, has made possible such an achievement of human resourcefulness and skill as one sees everywhere about him in this plant.

The laboratory and the drafting rooms seem to be a busy plant in themselves. Indeed they might have well suited the purposes of Guglielmo Marconi in the early days of wireless.



Cartloads of brick, piles of lumber, barricades of cement bags, appeared overnight at Aldene and were as quickly absorbed into buildings, which, in seven weeks, covered 40,000 feet more of ground space.

One of the strongest features of the development of the factory is that despite the drive for efficiency, nothing has been neglected which makes for the well-being and the comfort of every employee, be he engineer, a winder of coils or a clipper of copper.

There are commodious quarters for the men with plenty of locker space and suitable washing facilities, and there is also a well appointed rest room for the women and girls. Everything which can make for the best environment of the worker is at hand.

The soul of the task reigns in this realm of the busy machines where a spirit of work for work's sake seems to prevail and the results obtained speak convincingly of the power of individual co-operation,

Under Fire With an Amateur On the Silver Shell

The Sinking of a German Submarine by an American Ship as Seen From the latter Vessel's Wireless Cabin

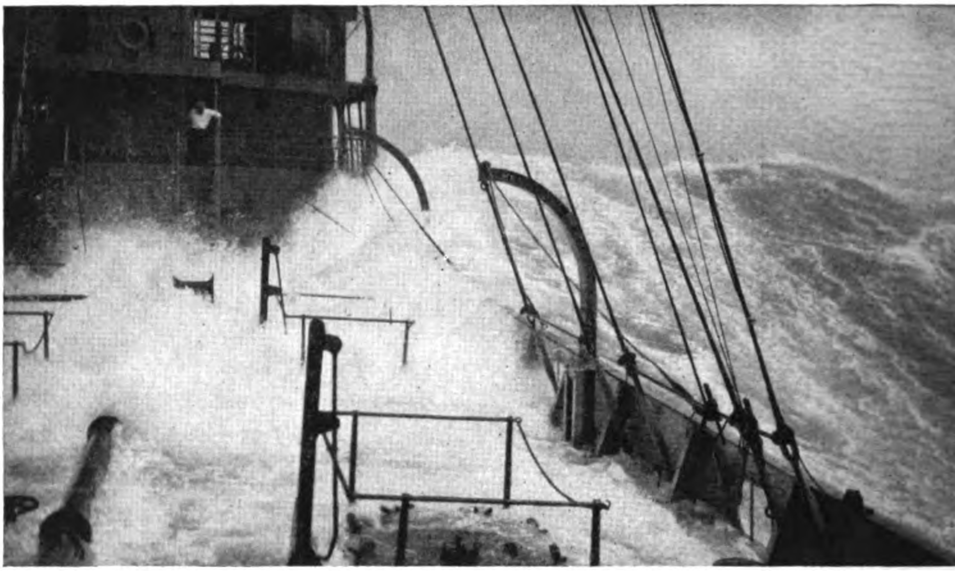
By HAROLD T. MAPES.

EDITOR'S NOTE.—In this recital of an amateur wireless operator who obtained an assignment in the radio cabin of a ship that sank a German submarine by which she was attacked, is contained a vivid picture of sea warfare. The author is a mining engineer and assistant general manager of a mining company in Mexico. Having obtained a Government first-grade commercial operator's license, he sought a place in the commercial field with the aim of gaining experience, and was assigned as first Marconi operator on the American oil tank steamship Silver Shell. What he saw from the radio cabin while the vessel was engaged with the undersea craft is graphically related in the following article:

Harold T. Mapes, the author of this article

AS I sat in the wireless cabin of the Silver Shell, sending out frantic calls for protection against the German submarine which was bombarding us even as she steamed closer to the stern of her prospective victim, my position might be likened somewhat to that of the blackfaced man at the Coney Island amusement places who exposes himself as a target for the missiles hurled by visitors.

On a tanker, it should be explained, the boiler, engines and wireless cabin, forming the vital parts of the ship, are in the stern. So I had, as it were, a



For three days the Silver Shell was tossed about on turbulent waters

grand stand seat, rather too close to the bullseye to be comfortable. Add to this description of my position the fact that the Silver Shell was laden with more than a million gallons of gasolene, which was almost sure to explode when the first shell hits its mark, and you can comprehend without difficulty the perils with which I was surrounded.

But I had embarked on the Silver Shell for experience and experience I got.

During the earlier stage of the vessel's voyage from New York to Marseilles, France, our port of destination, we weathered a storm of no mean force, being tossed about on turbulent waters for three days. A short time afterward we passed within 100 feet of a submarine that was on the surface of the water, going through the process of having her storage batteries charged for the next day's run. It was three o'clock in the morning, in mid-Atlantic, when she was sighted. So close did the Silver Shell pass to the craft that she could be plainly seen from the deck and the throb of her engines was heard after she had been swallowed up in the darkness. Her lookouts were asleep evidently, for she made no attempt to attack us and she had passed out of sight before the after-guns of the Silver Shell could be trained on her.

Although every one on the tanker realized fully the danger of traveling through the war zone, the proximity of the submarine made us more alert to avoid peril. The fact that the crew of a submarine, on a dark night, can see a large steamship with considerable less difficulty than those on the latter would have in locating the U-boat had been thoroughly impressed on the minds of all on the Silver Shell. Still more forcibly was the destroying-power of the submarine brought to our attention when the Silver Shell passed the wreck of a wooden ship. She floated bottom up, the large wound in her side providing grim evidence of the torpedo's ravages. Tossed about by the waves nearby were a few life preservers and a lifeboat. All of which bears out my statement that the Mediterranean is a mecca for U-boats. Twelve out of the sixteen submarines reported to me by wireless were found in the Mediterranean.

Our next and more thrilling encounter with a submarine occurred when a day and half more of steaming would have brought us to Marseilles. It was early in the afternoon of May 30th when she was sighted. She was then off our starboard bow and the alarm blast was sounded immediately.

The course of the Silver Shell was changed to the west, lifeboats were made ready for lowering into the water and the ship's company buckled lifebelts about their waists. We had just thrown the bundles containing our valuables into the boats when the submarine, which was one of the largest type of U-boats, being about 300 feet in length, gave unmistakable notice that she was an enemy craft by firing a shell. The latter exploded about 100 yards away from the American vessel. Almost before we had time to realize our situation another shell was fired. It just missed the wireless cabin, finding a resting-place in the water 100 yards away from the ship.

Meanwhile the Silver Shell's men had been preparing to defend themselves.

Seated, from left to right, are shown L. D. Higgins, third assistant engineer of the Silver Shell, Operator Mapes and G. S. Adams, first assistant engineer. Standing are the members of the gun crew which did such effective work

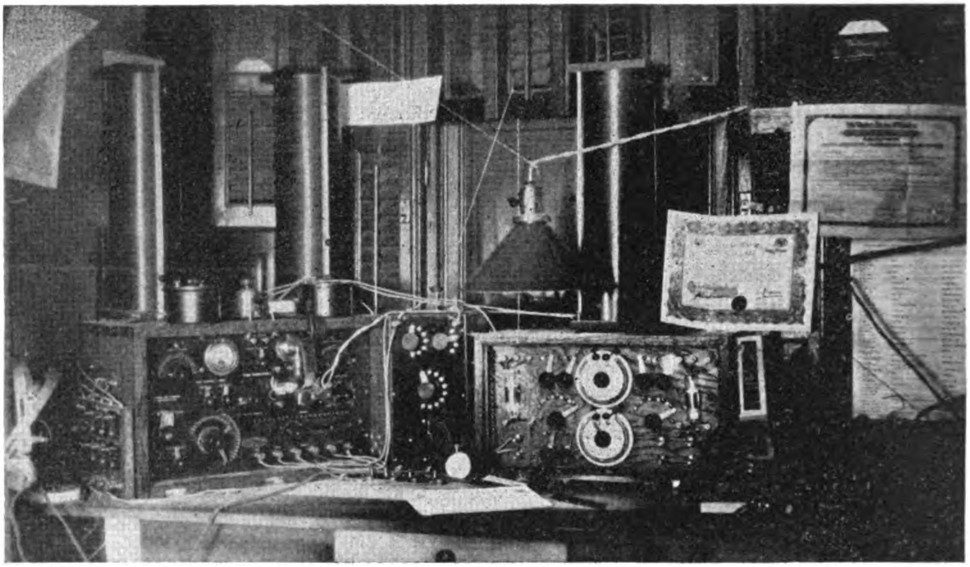
They opened fire on the Germans with our four-inch after gun, but the first seven shots missed their target by about 1,000 yards. This fault was soon remedied by Chief Petty Officer Clark who knocked out the extreme elevation pin, which gave the gun about forty degrees. The improvement in marksmanship was at once evident. On all sides of the submarine the shells from our vessel dropped, giving preliminary notice of what our fire was to accomplish later.

But we did not have the fighting all our own way by any means, for the Germans had two five-inch guns as compared to our four-inch ones and at the beginning of the engagement were outshooting us. Their shells passed in alarming proximity to our heads and burst on both sides and at the bow and the stern of the ship. I recall that one shell bounded over the wireless cabin, just missing that structure by a couple of feet.

There was no lack of activity in the radio room while we were being shelled. Even while I was flashing the S O S, giving our position, course and rate of speed, Second Operator Douglas was adjusting my life preserver.

Listening in for the response to my appeals for aid was not without its problems. Our after-gun was only twenty-five feet away from the wireless cabin and every time it was fired the concussion knocked the radio apparatus out of adjustment. Then, too, the roar of the gun and the bursting of the German shells were deafening.

Algiers was the first to answer my call. The handicaps in receiving were so great, however, that it was necessary to ask for a repetition of the message several times. To add to my difficulties a Spanish ship interfered by repeatedly asking in Spanish: "What ship is that asking for help?" She did not sign off



A view of the amateur set operated by Mr. Mapes

and the circumstances made the incident appear like deliberate interference. However, I finally succeeded in receiving the Algiers message which was as follows: "Help thirty-five miles northwest gunboat FQ." Getting into communication with gunboat FQ, I received this response: "Coming as fast as possible."

This was reassuring news, indeed, for from my position in the cabin I could see the submarine steaming along in our wake like a hound after a hare. She was astern of us about 3,000 yards, the head seas washing over her deck as she breasted the waves and compelling the members of her gun crew to stand waist-deep in the water. They would fire between the intervals of the boat's plunges through the waves. From the Silver Shell could be seen the flash of their guns. Then would follow an interval of about ten seconds before those on the tanker could determine whether the shot would hit its mark. The emotions which filled the men on the American tanker during these periods were not the most comfortable, I can assure you. As for myself, I sat with strained nerves, at the head phones, listening for word that might be of value.

The Silver Shell was speeding through the water at the rate of fourteen knots an hour although she had never made more than eleven before. The safety valves were screwed down and the engineers and firemen were bending every effort to get all possible speed out of her. Their position was by no means enviable as a shell was likely to strike the boilers and cause an explosion.

Under a high pressure of steam the U-boat was gaining on us and finally she reached a point about 2,300 yards away. She was using a shrapnel to sweep our decks; the shells continued to burst on all sides of us and it seemed that some of them must take disastrous effect. Then, as suddenly as she had begun the attack on us, she was vanquished. For one of our shots struck her just aft of her conning tower, inflicting a wound which caused her bow to rise high in the air. Immediately she began to sink, stern first, with her crew still on deck.

It was a dramatic finish of a dramatic fight, for she would, it is likely, have cleared our decks in fifteen minutes and then turned her fire on our lifeboats in the event that we tried to escape in them.

The Germans did not abandon their attempts to sink the Pearl Shell, following the sending to the bottom of the submarine. Soon after the engagement was ended I received the following message: "If possible steer south, I will meet you in an hour." This message, which came in very weak, was a decoy communication sent out by another submarine to lure us into her path. We had already been instructed to disrègard messages sent by ships that were not authorized, or confirmed by a Government land station. It was impossible for me to confirm the "steer south" message.

Gunboat FQ asked me for the Silver Shell's new position at five minutes after seven o'clock that evening. This I wirelessed, as well as details concerning the sinking of the submarine. She flashed back, "Good work!" and at eleven o'clock had approached so close to us that the two vessels were able to exchange messages by Morse lamp signals.

Or arrival at Marseilles the next afternoon had in a measure the significance of an important event, for the Silver Shell was the first American ship to enter that port since the United States had declared war with Germany. The uniforms of the bluejackets, of course, attracted considerable attention and the fact that we would probably receive prize money from the French Government for sinking the U-boat added to the interest displayed in the Americans.

The engagement with the submarine lasted more than an hour and a half, but fortunately no one on the Silver Shell was seriously injured. As I look back on the engagement now that it is ended I can even see a humorous side to some of the incidents. For instance, the bos'n, who had donned his three suits of clothes when preparations were made to take to the lifeboats, did not neglect to take a pinch of snuff and express his feelings with considerable force every time a shot was fired from the submarine. He was an active figure in the fighting as were also Petty Officer Clark, who showed excellent judgment in handling the guns and gunners, and Captain J. Charlton. Despite the fact that Captain Charlton was suffering from rheumatism, he remained on the bridge to navigate the ship. G. S. Adams, J. J. Prescott and L. D. Higgins, respectively first, second and third assistant engineers, also deserve mention for their efforts in speeding up the Silver Shell at a time when speed was sorely needed.

And that is the story of how an amateur got an insight into the life of a commercial operator at sea. When this article appears in The Wireless Age I shall be on by way to Mexico to resume my mining work, but the memories of my voyage on the Silver Shell will remain with me for years to come.

CIVIL SERVICE EXAMINATIONS

The United States Civil Service Commission announces open competitive examinations for auditing clerk (radio) and bookkeeper and accountant (radio), for men only, on July 25th. Five vacancies in the position of auditing clerk at entrance salaries ranging from $1,000 to $1,400 a year; one vacancy in the position of bookkeeper and accountant at $1,500 a year; two vacancies in the position of assistant bookkeeper and accountant at $1,000 a year, all in the office of Naval Communication Service, Washington, D. C., and future vacancies requiring similar qualifications, will be filled from these examinations, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion.

DAVID SARNOFF WEDS

David Sarnoff, commercial manager of the Marconi Wireless Telegraph Company of America, and secretary of the Institute of Radio Engineers, was married to Miss Lizette Hermant of New York City, in the Broadway Central Hotel, New York, at six o'clock in the evening of July 4th. The Rev. S. Privin, the bridegroom's grandfather, performed the ceremony.

Radio Science

STATIC ELIMINATION WITH UNDAMPED WAVES

THE pressing problem in long distance wireless telegraphy and telephony is the prevention of static or impulsive currents which may be induced in a receiving telephone either by atmospheric discharges or earth disturbances.

In collaboration, H. D. Arnold and H. W. Nichols, have evolved a method whereby a transient atmospheric discharge may be eliminated when the receiving apparatus is adjusted to an undamped or sustained oscillation transmitter.

The proposed method of obtaining selectivity by the use of a number of resonant circuits in series between the antenna and oscillation detector, while thoroughly efficient, gives rise, on account of the number of coupling coils in use, to considerable energy losses. Beyond this, a static discharge striking the antenna system produces a loud response in the receiver even though the circuits are sharply resonant.

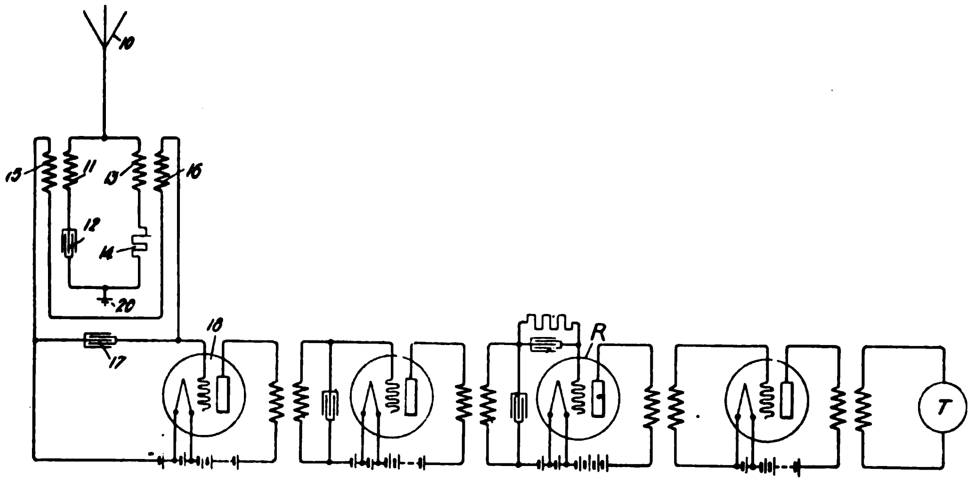


Fig. 1—Arnold-Nichols circuit for static elimination

The fundamental principle of the apparatus is as follows: Under the impressed electromotive force of an impulsive disturbance, the initial rush of current in a receiving circuit is inversely proportional to its inductance, but the final current during the flow of undamped or sustained oscillations is dependent solely upon the resistance of the circuit. Following out this principle, if two parallel circuits have impressed upon them an electric impulse, the initial rush of current in each will be inversely proportional to the inductances, and if the inductances are made equal, they may be connected in a circuit to annul each other's effects. This will be the case even though the resistance and capacity in the two parallel circuits are widely different.

If, however, the impressed electromotive force on the two parallel circuits has a sustained oscillatory character, the current which will finally be built up will depend upon all the constants of the circuit, and in the case of a tuned circuit, it will depend upon the resistance, being inversely proportional thereto.

If the one circuit is tuned to the frequency of the received electromotive force and has a low resistance while the other circuit has equal inductance but a higher resistance, the current flow in the first will be much larger than in the second. In order to obtain discrimination between impulsive electromotive forces and sustained oscillations, it is therefore necessary to give one circuit a large damping constant. This is most easily accomplished by increasing the resistance or decreasing the inductance. By using a third circuit inductively connected to both of the primary circuits, the effect of an impulsive current may be neutralized, but the effect of the sustained oscillations will be transferred to the detector circuit.

Like all devices of this kind where discrimination between two incoming signals is obtained, there will be some loss of energy, and in general, it is necessary to amplify the desired oscillations, after which they may be detected. In other words, however large the loss of energy may be in the initial weeding out circuit this can be properly compensated for by amplifying the desired signal through a number of three electrode vacuum valves or thermionic amplifiers connected in cascade.

One method of applying this principle is shown in Figure 1 where it will be noted that two branch circuits 11 and 12, 13 and 14 are connected in parallel between the antenna and the earth. In the right hand branch the resistance 14 is large in order that the damping constant $\frac{R}{L}$ of that branch shall be large compared to that of the left hand branch. Coils 11 and 13 are inductively coupled to coils 15 and 16, which are connected in series and the final terminals to the grid and filament of a vacuum valve. As is usual in circuits of this kind, a source of electromotive force, 22, is connected in series with the grid to maintain a strongly negative potential with respect to the heated filament. It will further be noted that a number of valves are connected in cascade, transformers being employed in the local circuit of the one circuit to the next one, and so on throughout the series. These circuits may be tuned or untuned at the discretion of the experimenter.

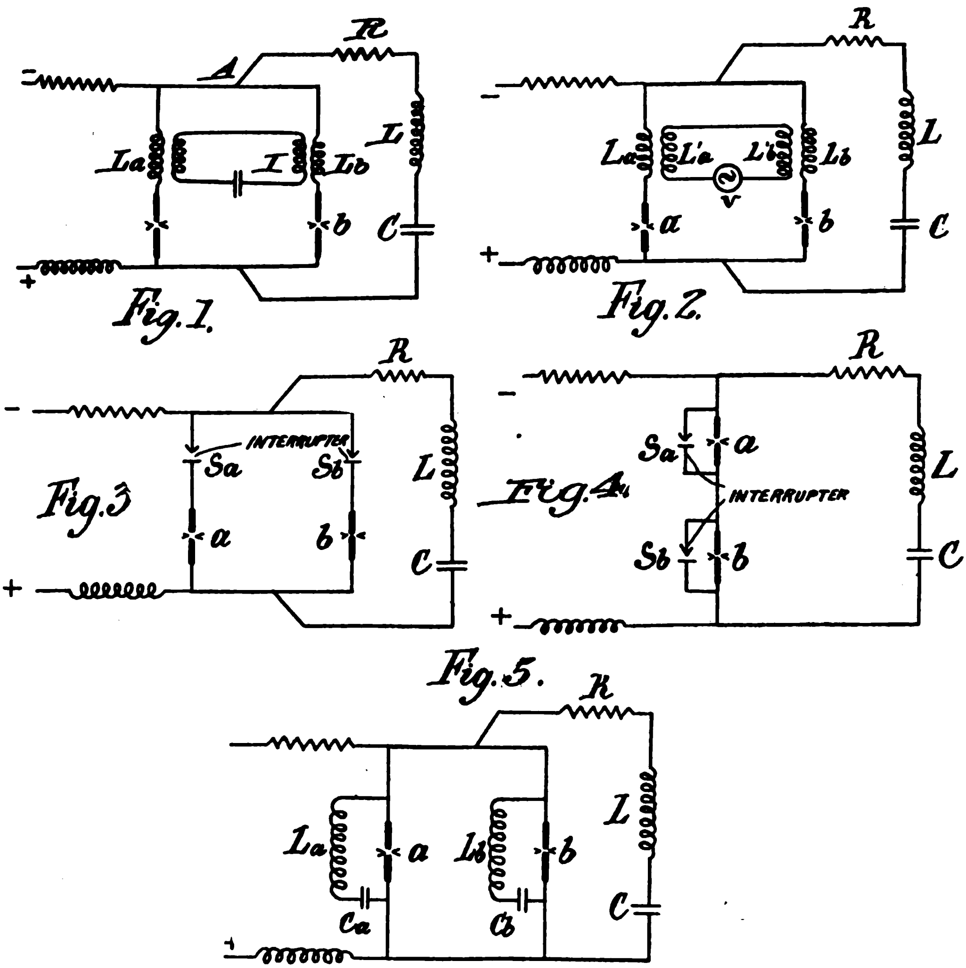
The action of the apparatus in Figure 1 is as follows: If sustained waves of desired frequency are impressed upon the antenna of the receiving station, the current in the tuned branch 11 and 12 is large, while that in the branch 13 and 14 is very small. Energy is therefore transferred to the circuit 15, 17 and 16 and from there on to the oscillation detector, but if static or impulsive disturbances are impressed upon the antenna, the current in the two branches will neutralize each other's effects in circuits 15, 17 and 16.

In practice, inductances 11 and 13 are made approximately equal in order that the currents will be equal, but this is by no means necessary, for any difference in the inductance of 11 and 13 can be compensated for by changing the coupling or inductive relation between 11 and 15 or 13 and 16.

HIGH FREQUENCIES FROM DIRECT CURRENT ARCS

Circuits through which extremely high frequencies can be obtained from the direct current arc are accredited to P. O. Pedersen of Frederiksberg, Denmark. Heretofore the maximum frequency obtainable from arc systems has been limited, owing to the difficulty of cooling the anode, a limitation which Mr. Pedersen seeks to overcome by providing a number of arcs which are so arranged that the current impulses pass through the arcs alternately. For example, if three arcs are employed only each third current impulse passes through a single arc, and this arc remains inactive for two entire periods, allowing the gap sufficient time to cool. If the shiftings are promptly timed this will not affect the period of the alternating currents which pass through the circuit containing the inductance L and the condenser C. This contribution to the art is important in that it provides a sufficiently long time for each arc to cool and deionize, no special methods for cooling the arc being needed. Another interesting feature is that the discharge loses the character of an arc, since so long a time elapses between the passage of single current impulses through one of the discharge spaces, the discharges therefore becoming in effect a series of non-oscillating sparks.

In Figure 1, between the cathode and the feed conductor are inserted inductance coils L-a and L-b, which are inductively coupled to a third circuit I, containing two coils and a condenser in series. The condenser C, the induc-



Pederson circuits for obtaining high frequencies from the direct current arc

tance L and rheostat R constitute an oscillation circuit. The period of circuit I is twice the period of R, L, C. If a current impulse passes through the discharge space A, a free oscillation is induced in circuit I, but a period later the oscillations in this circuit will again counteract through the inductance L-a, so that a current impulse again passes the discharge space A, but at the same time it will permit the passage of a current impulse through the discharge space B. It is important that the damping of the circuit I be as small as possible.

A somewhat different arrangement is shown in Figure 2, where an alternating current from a generator V is passed through the coils L*a* and L*b* and the period of the alternating current is twice that of the circuit R, L, C. Each second discharge passes through the discharge space A, and then through the discharge space B. If the period of the alternating current is four times that of R, L, C, two discharges will pass through the discharge space A and thereafter two discharges from the discharge space B, and so on.

Figures 3 and 4 show the apparatus employing interrupters which alternatively close and interrupt the connection between the cathodes and the source of direct current. The contact period of the interrupters should be in the neighborhood of the period of the oscillation circuit or some sub-multiple or multiple thereof. By proper design of these circuits the interrupters S-a and S-b will work without sparking, and if at the same time the sparking distances are chosen so that the potential between the electrodes during the passage of the current is small, while the ignition tension is relatively high, a very high efficiency is obtained, practically all the energy of the direct current being transformed into radio-frequency oscillations.

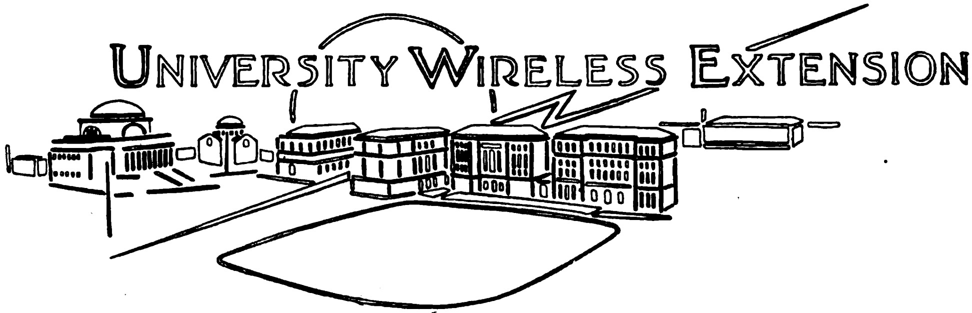
Figure 4 shows the interrupters and arcs connected in series, and in Figure 5 the arcs are in parallel, shunted by the circuits L-a, C-a and L-b C-b. The discharges of this circuit are incurred by the sudden high tension currents being alternatively induced in the inductances L-a and L-b, which cause sparks to jump through the discharge space A and the discharge space B, respectively. The sparks follow each other with an interval of nT where T as usual indicates the natural period of the oscillation circuit.

Items of Varying Interest

The peroxide of lead detector consists of a pressed pellet of peroxide of lead placed between a blunt lead point and a platinum plate. The pressure of the lead point is varied by an adjustable spring tension. The device is in reality an electrolytic cell and when it is connected in series with the local battery and head telephones, it exerts a back pressure upon the voltage of the cell. If these two E. M. F.'s nearly balance and the detector is connected directly in series with the antenna circuit, the incoming signal will destroy the balance of the opposing E. M. F.'s and cause an audio-frequent current to flow through the head telephone. This variation of current has been found to be of sufficient amplitude in many cases to operate a recording instrument direct without the use of an intermediate relay.

One of the earliest efforts toward establishing a commercial service on the American continent was undertaken by the United States Army between Nome and St. Michaels, Alaska, across Norton Sound, a distance of 107 miles. These stations were put into successful operation as early as August, 1903.

A synthetic crystal rectifier may be prepared as follows: Take one part by weight of powdered sulphur and four parts of finely divided lead, both of which should be chemically pure to secure the maximum sensibility. Mix these elements thoroughly and place them in a test tube, but, in order to allow for expansion, do not fill more than half of the tube. Hold the tip of the tube in the flame of a Bunsen burner or an alcohol lamp. The mixture will soon become incandescent and as soon as this comes about, remove the tube from the flame and allow the incandescence to spread through the mass. Keep the open end of the tube away from the flames in order that the gases generated may not ignite, although no serious harm will result from their doing so. Allow the tube to cool, then break it away from the crystaline mass inside. Break this into convenient pieces and mount in a crystal cup or in some other approved fashion..



Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE VIII

PRIOR to the consideration in detail of the Goldschmidt radio frequency alternator and internal frequency changer, we desire to establish a principle of interest in connection therewith. This principle can be rendered clear from a simple analogy. Imagine a circular platform of moderate dimensions rotating once per minute, somewhat in the fashion of the carousels used in amusement resorts. Suppose, further, that the attendant elects to walk back and forth along a *diameter* of the rotating platform while it is in motion, and that he makes one to-and-fro trip in one minute, that is, in the same length of time as that required for one complete rotation of the platform. It is required to find his path as viewed from an external stationary point, or, otherwise stated, with reference to the fixed ground under the platform.

Figure 91 shows a series of successive positions of the diametral line along which he walks, each position being 45 degrees further advanced than the preceding (that is, one-eighth revolution). The dotted line with the reference dotted arrow at one end indicates this diameter which, as will be seen, has reversed its direction in the half-revolution between positions 1 and 5. The position of the man on the diametral line is indicated in each case by the cross. It will be seen that the man never succeeds in getting to the left of the center of the platform because, as position 3 is passed, he comes to the reversed end of the diametral line, that is, the end away from the arrow.

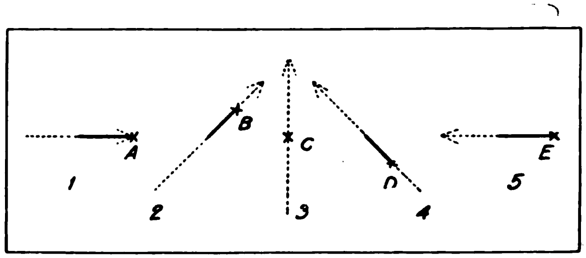


Figure 91—To-and-fro motion on rotating platform with equal periods of oscillation and rotation

The important point is that the path of the man relative to the ground (that is, the curve *ABCDE*) is a closed curve, and that he has returned to his original position in a *half-revolution* of the platform. In other words, relative to the ground, he moves in a closed curve at twice the speed or double the frequency that the platform rotates.

We establish then the principle that an oscillatory movement of frequency *n* taking place on a system rotating with frequency *n* is equivalent relative to fixed external points to an oscillation of half the amplitude or width of swing and of *double* frequency. The mathematical proof of this principle for simple harmonic (sinusoidal) vibrations is of the utmost simplicity, but need not here be given.

The diagrammatic wiring plan of the Goldschmidt alternator is given in Figure 92. The following description is based on an earlier explanation of this device by the Author. In the figure, the battery, *B*, supplies the direct current whereby the stator winding, *S*, becomes the field magnet of the alternator. *L* is a large inductance intended to prevent the flow of alternating currents through the battery circuit. In the field of the stator, *S*, is a rotor, *R*, which is short-circuited (that is, tuned to resonance) for the fundamental frequency produced when the rotor is revolved. The tuning of the rotor circuit is accomplished by means of the capacities, C_3 and C_4, and the inductance, L_2. It is to be noted that *R* and C_3 alone would be in resonance to the fundamental frequency, as also would L_2 and C_4. The complete circuit, *R* C_3 L_2 C_4, therefore contains approximately twice the inductance and half the capacity of either *R* C_3 or L_2 C_4. Its period, therefore, is the same as that of either of these, and even if L_2 C_4 were to be short-circuited, the rotor would still be resonant to the fundamental frequency. This permits shunting the condenser, C_5, across the circuit, L_2-C_4, without disturbing the tuning.

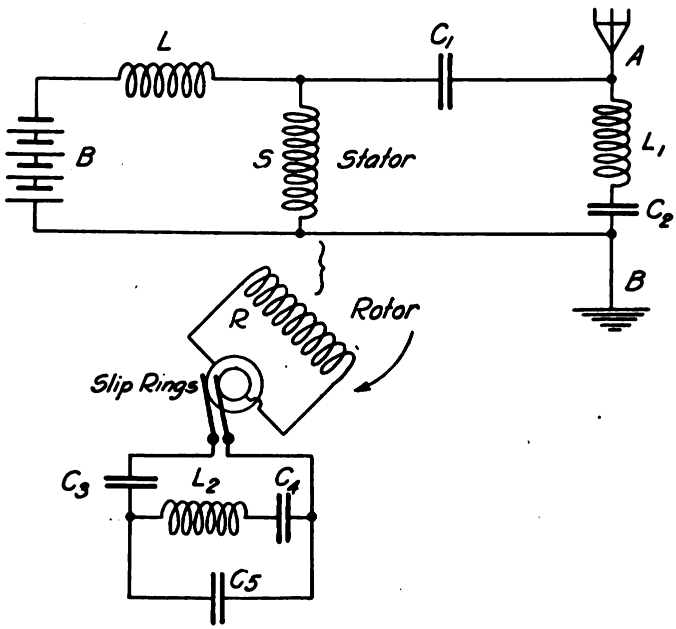


Figure 92—Winding of Goldschmidt alternator

A perfectly similar arrangement is adopted for the stator by the use of the circuit, *S* C_1 L_1 C_2, except that the circuit in question is tuned to *twice* the fundamental frequency. It will be seen that as the rotor revolves in the field of the stator, powerful currents of the fundamental frequency will flow through it. The great magnitude of these currents is due to the fact that the rotor is itself part of a circuit resonant to the fundamental frequency. If we consider the field of the rotor, we see that it is a field produced by an alternating current of fundamental frequency *n* itself rotating with a frequency, *n*. Therefore, by the principle established at the beginning of this discussion, we may regard it as containing a component field of constant magnitude, but rotating with a doubled frequency, 2*n*, relative to the stator. A further study of the phenomena would show that there was also present a constant field rotating with velocity 0. The rotor fields will therefore induce in the stator electromotive forces of twice the fundamental frequency (and zero frequency); and since a circuit resonant to the double frequency is provided, powerful currents of that frequency will flow through the stator. These alternating currents in the stator will induce in the rotor electromotive forces of frequencies, *n*, (from the steady field) and 3*n* (from the field of the current of frequency 2*n*). By means of the condenser, C_5, a path resonant to the frequency, 3*n* is provided in the rotor. By properly choosing the constants of the rotor circuits, the current of frequency *n* just mentioned can be made nearly to neutralise the current of frequency *n* first mentioned. The reason for this is that these currents can be brought to nearly complete opposition in phase and equal amplitude. There will be left then in the rotor a powerful current of triple frequency. Its field may be regarded by a process of reasoning quite similar to that originally employed as equivalent to two constant and equal rotating fields, revolving in opposite directions, with speeds of rotation corresponding to 2*n* and 4*n*. There will, therefore, be induced in the stator currents of frequency 2*n* and 4*n*. Of these, the current of frequency 2*n* will nearly completely neutralise the current of frequency 2*n* mentioned previously if the stator constants are properly chosen. The outstanding current of frequency 4*n* is shown in the figure as flowing into the capacity and inductance formed by the antenna, *A*, and the ground, *B*. We have, therefore, by "internal reflection" of energy, quadrupled the original frequency of the machine before using it for antenna excitation.

In the actual Goldschmidt installations (at Tuckerton, New Jersey, and Eilvese, Germany,) the motor drive of the alternator is accomplished by a 220-volt, direct current, 250-horse power motor having a speed of 4,000 R. P. M. For constant speed, a special form of sending key is used. This is shown in Figure 93. This key automatically inserts (by opening the back stop circuit) the resistance, *R′*, in the motor field circuit just before the load is thrown on by closing the exciter circuit of the alternator (by the front contact of the key). In this way the motor tends to speed up just as load is thrown on, and the speed actually remains constant. In addition, the inertia of the heavy armature helps greatly.

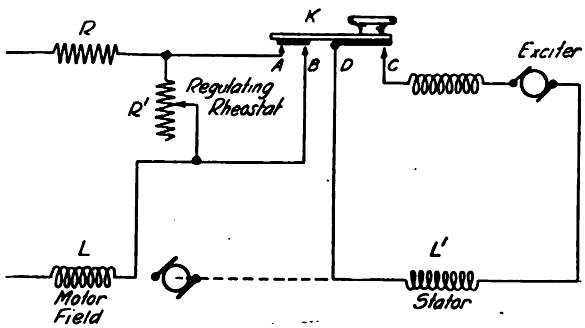


Figure 93—Goldschmidt alternator speed constancy system

The alternator itself is a 360-pole machine having a pole pitch or distance between windings of 7.5 mm. (0.3 inch), the slots in which the insulation and wire are placed being circular and of cross sectional diameter of 5 mm. (0.2 inch). The rotor diameter is, therefore, about 90 cm. (3 feet) and the rotor weighs about 5 tons (4,500 kg.). The direct current power required for field excitation is about 5 per cent. the rated output of the machine.

The winding of the machine is one conductor per pole, being a simple wave winding indicated in Figure 94. *AB* and *CD* are typical separate sections of the winding so arranged that they may be connected in series or parallel, depending on the electrical requirements. There are twenty-four such sections on the total circumference. Both rotor and stator are wound in the same way. The wire itself is very finely stranded, and made of No. 40 Brown and Sharpe gauge individual enamelled wires suitably twisted. The iron in the machine is very

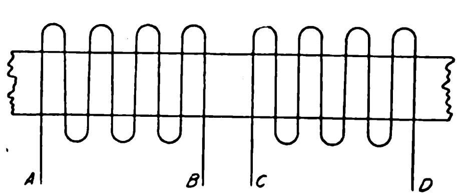


Figure 94—Position of rotor or stator winding of Goldschmidt alternator (developed)

finely laminated, the sheets being only 0.05 mm. (0.002 inch) thick, insulated by paper between, 0.03 mm. (0.001 inch) thick. The rotor is more than one-third paper, which is a most unusual proportion. Such construction is particularly noteworthy in view of the high speed of peripheral rotation, namely 200 meters (600 feet) per second. The design of the brushes bearing on the rotor slip rings and the connection to these brushes required careful consideration, especially in view of the danger of burning the slip rings of any brush that was connected to an output circuit of greater or less impedance than the remainder. In this connection, it must be mentioned that there were really more than one pair of slip ring connections to the rotor since a number of the rotor sections were placed in parallel outside the machine.

Some difficulty was experienced in preventing the currents which were generated from escaping to ground through the capacity (in air) between the conducting wires and the ground. In addition, there was always the danger that this air capacity would, in conjunction with one or more of the machine windings, produce a circuit resonant to one of the frequencies generated whereupon dangerously high voltages and currents would have arisen, and the output have disappeared.

The accuracy of construction of such machines is extreme. Since the air gap clearance between rotor and stator is 0.8 mm. (about 0.03 inch), very accurate centering of the rotor was necessary. In addition, very strict parallelism of the armature and stator slots was required, a deviation from parallelism of one part in a thousand causing a fifth of the output of the machine to disappear!

One of the Goldschmidt alternators in use at Eilvese (Hanover, Germany,) is shown in Figure 95. The machine is to the right, the driving motor to the left.

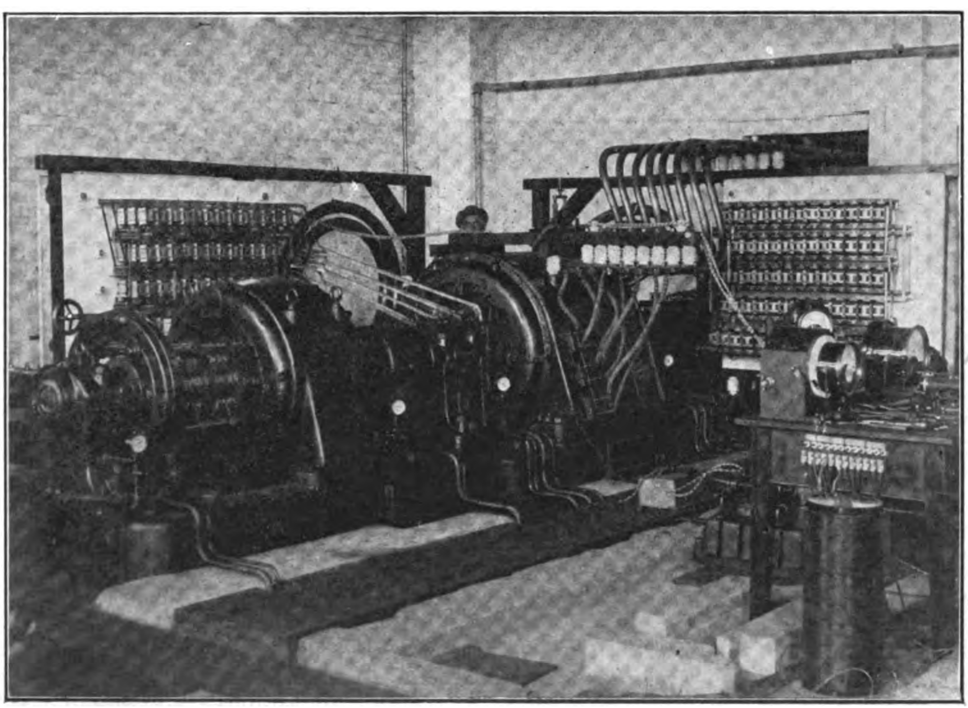


Figure 95—Goldschmidt alternator, motor, and reflection circuits at Eilvese, Germany

The large brush surface chosen for the high-speed driving motor is obvious. The condenser banks for tuning the various rotor and stator circuits are mounted on the walls, and are typical mica condensers. Some idea of the difficulty of leading the radio frequency currents into and out of the machine may be gained from the leads which are visible. The ingenious fashion in which the difficulties have been overcome is worthy of comment.

At the present time (January, 1917) two such alternators are being used in parallel when necessary, and put 275 amperes into the Eilvese antenna. Rapid telegraphy has been accomplished by their use at a rate of 200 letters per minute.

As has been previously stated, the second method of securing considerable amounts of sustained energy at radio frequencies when using alternators is that wherein an alternator of moderately high frequency is employed and the frequency is multiplied by external frequency changers and not, as in the Goldschmidt machine, by reflection of the energy in the machine itself. Most of the external frequency changers employed at the present time, particularly for considerable energy, are based on the properties of iron. Before explaining them in detail, it is desirable to quote from a paper by the Author on the subject of "Radio Frequency Changers."

In Figure 96 is shown a typical "B-H" curve for iron. This is the curve which shows the connection between the magnetising force (e. g., expressed in ampere-turns or product of current flowing through the magnetising winding by the number of turns of winding) and resulting magnetisation or magnetic flux through the iron core (referred to as the "induction"). "Let us suppose that the magnetisation of the iron has been brought to the point, *x*. If now, by means of a superposed alternating magnetising force, (such as may be produced by having around the iron core an auxiliary winding through which flows alternating current), equal increments and decrements be added to the magnetising force, the magnetic induction will increase during the positive half of the cycle by the small amount, *ef*. On the other hand, during the negative half of the cycle, the induction will diminish by the considerably larger amount, *xd*. The explanation of this phenomenon is found in the well-known magnetic saturation qualities of iron, whence it results that for high magnetising forces the iron becomes saturated and the bend or "knee" of the curve which is shown at *x* results. It will be seen, then, that though a sine-wave alternating current may be flowing through the auxiliary winding, the variation in the magnetic flux through the iron core will not be sinusoidal but distorted, the upper halves of the curve being flattened. Such a deformation of the flux variation always occurs when nearly saturated iron cores are used under the conditions mentioned. However, such a deformation of a sine curve always leads to the production of upper harmonics (i. e., high frequencies in a secondary circuit wound around the same iron core), and it is upon this principle that the entire series of frequency changers employing iron is based."

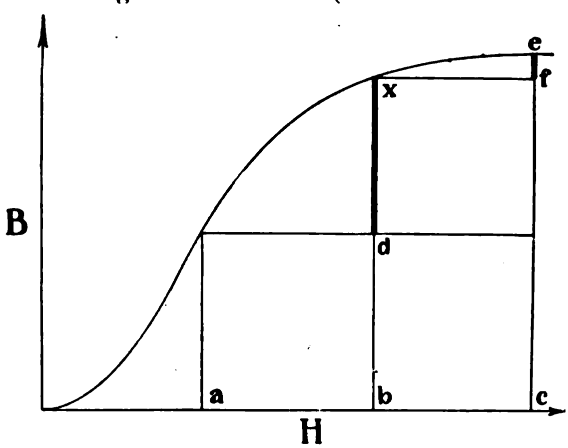


Figure 96—Magnetising force and magnetic induction curve for iron

An application of the principle just stated was shown by Epstein in 1902 (German patent 149,761) and has since been worked out and amplified in detail by Joly in 1910 and Vallauri in 1911. It is now extensively employed in various forms by the Telefunken Company under the patents of Count von Arco and Dr. A. Meissner. The circuit arrangement in a simple form is shown in Figure 97. As will be seen, an alternating current source, *A*, sends its current through the primaries, P_1 and P_2, of each of two transformers having iron cores. These primaries may be connected in series or in parallel according to the secondary voltage and primary current which may be desired. They are wound oppositely relative to each other. A direct current source, *B*, e. g., a storage battery or small direct current generator, supplies the two auxiliary coils, M_1 and M_2, which coils are also wound on the same transformer cores. The direct current coils are wound oppositely. The secondaries of the two transformers, S_1 and S_2, are wound in the same direction, and connected as indicated in the figure.

The operation of the device is in the main as follows: The direct current flowing through M_1 and M_2 is so chosen that the iron is brought to the knee of the magnetisation curve, i. e., the point, *x*, in Figure 96. In consequence, during half the alternating current cycle, each of the transformers has a flattened addition to its iron magnetisation due to the iron saturation, while during the other half of the cycle it has a peaked diminution in its iron magnetisation due to the rapid drop of the iron curve below the point, *x*.

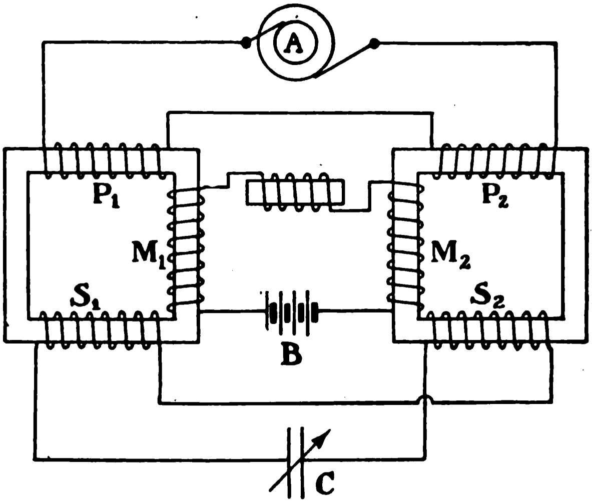


Figure 97—Telefunken Company frequency doubler

This effect is shown graphically in Figure 98. In curve *a* of the figure, the fine horizontal line represents the constant magnetisation produced by the direct current which flows continuously. The curved line shows the actual magnetisation which results when the alternating current also flows in the winding, P_1. It will be seen that during the positive half of the alternating current cycle, there is only a small increase in the iron magnetisation, whereas during the negative half cycle, there is a large diminution in the iron magnetisation. It will further be noticed that the direct current coils and the alternating current coils on the two transformers are wound so that during the positive half cycle they assist each other on

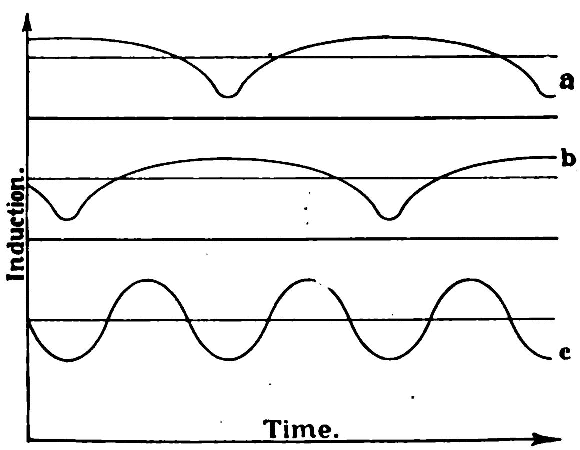


Figure 98—Iron magnetisation curves for frequency doublers

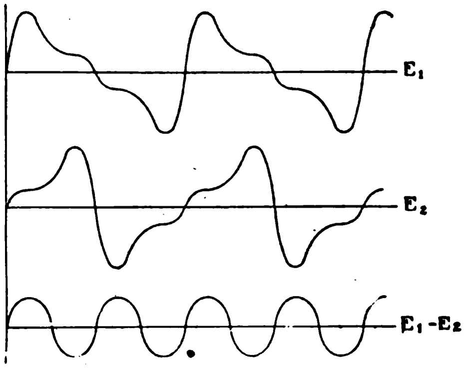


Figure 99—Induced voltages in secondarys of Telefunken Company frequency doubler

one transformer and that they simultaneously oppose each other on the other transformer. From this it follows that the induction in the second transformer is given by curve *b*, which lags practically a half cycle behind curve *a*. The resulting total magnetisation is given by curve *c* and is seen to contain a double frequency. Oscillograms of the voltages induced at the secondary terminals of each of the transformers are represented in Figure 99. The voltage at the terminal of one of the transformers is given by the curve E_1; that at the terminals of the secondary of the other transformer by E_2, and there is also shown the resultant voltage, namely E_1-E_2. The voltage curves are easily explicable on the ground that the voltage magnitude is proportional to the rate of change of the primary current so that it is only at times when the primary current is changing from the flat portion to the peaked portion that the large secondary voltages are induced. The resultant voltage is seen to be of double frequency."

Of course, the phenomena shown are for the frequency doubler with no load on the secondary, and these are to some degree modified when the double frequency energy is withdrawn. However, by secondary tuning and appropriate design, the same results as outlined can be obtained. A more detailed diagram, showing something of the actual practce with the frequency doublers, is given in Figure 100. It will be noted that the primary circuit of the alternator *A* is tuned by the inductances L_1, P_1, and P_2 and by the condensers C_1 and C_2. It will also be seen that there is a choke coil L_2 inserted in the direct current magnetising circuit of the frequency changers to prevent injuriously large radio frequency currents from being induced in this circuit.

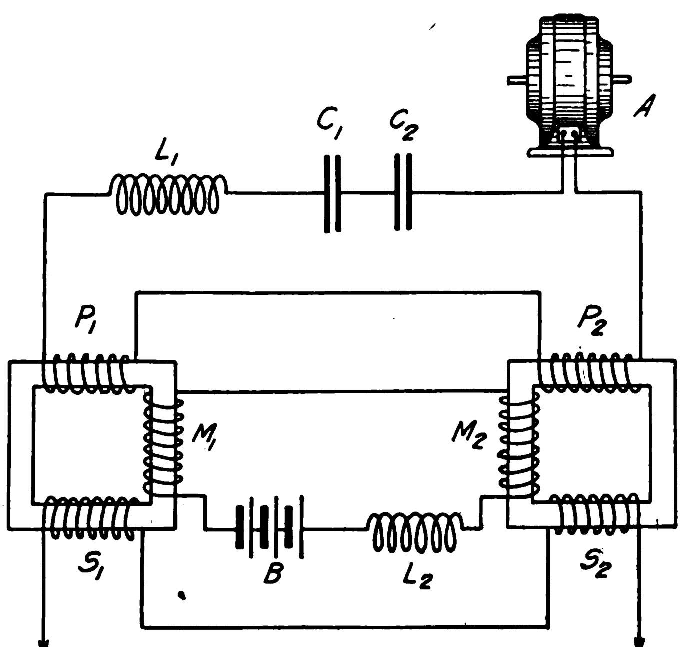


Figure 100—Frequency doublers used in actual practice

It can further be shown, both theoretically and practically, that if the secondaries of the frequency changer, S_1 and S_2 are connected assisting instead of opposing each other, there will be produced in the secondary circuit an electromotive force of *triple* frequency. Thus the same equipment can be readily used either as a doubler or a tripler.

A clear idea of the interior construction of the Telefunken radio frequency alternators can be obtained from Figure 101. The left hand portion of the figure gives a vertical cross section of half of the machine. Here *A* is the shaft to which the driving motor or engine is attached either directly or through appropriate gearing. *R* is the inductor or rotor, a rotating mass of steel, on the outer surface of which are cut a great number of grooves parallel to *A* thus producing the longitudinal teeth and slots indicated in cross section at *R* in the right hand portion of the figure. The constant direct current passing through the field winding, *F*, (which is an ordinary circular coil or ring of square cross section) produces a field the lines of force of which take the path indicated by the dashed line, *P*. It will be seen that this path is suitably interlinked with the coil, *F*, and passes through the yoke, *Y*, the stator slot supports *W*, and the rotor, *R*. The armature, which is in two portions, one on each side of the field coil consists of to-and-fro windings in longitudinal slots parallel to those of the rotor. The portions of the armature can be placed in series or parallel in accordance with the characteristics of the circuit to which the machine is connected. The mode of winding the armature is indicated at *W* in the right hand portion of the figure. It is evident that as the rotor revolves, the field passing through the armature turns, *W* pulsates back and forth with a frequency corresponding to the product of the number of rotor slots and the rotor revolutions per second. The advantage of this (inductor) type of machine as compared to those with wound armatures is that the rotating portion consists of a solid steel mass and is consequently much more sturdy than a normal armature carrying wire windings on a laminated support.

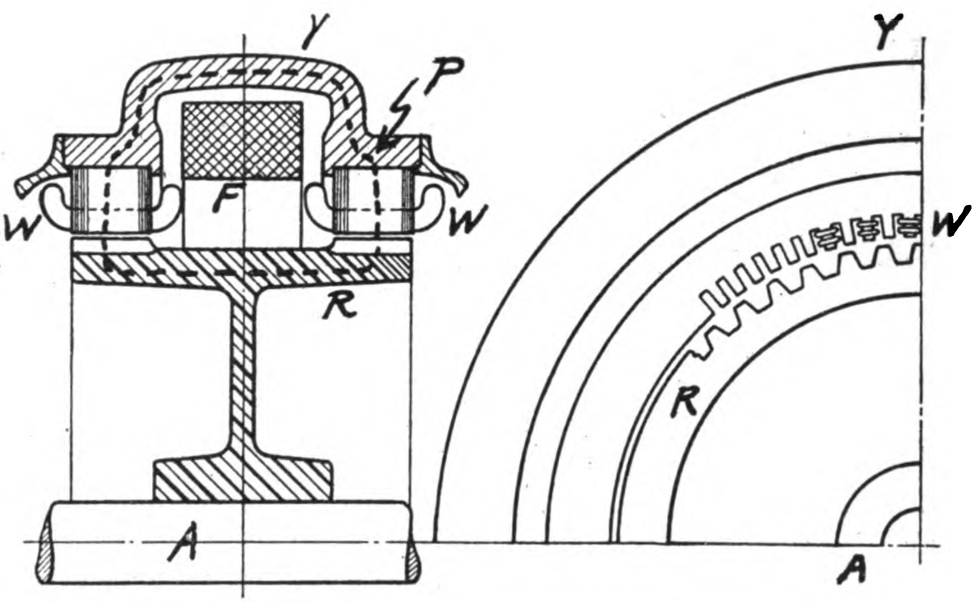


Figure 101—*General arrangement of Telefunken radio frequency alternator*

The appearance of a small (10 K. W.) machine of this type is indicated in Figure 102. The motor is mounted at the front of the base plate and the alternator at the rear. The housing between them contains the multiplying gear.

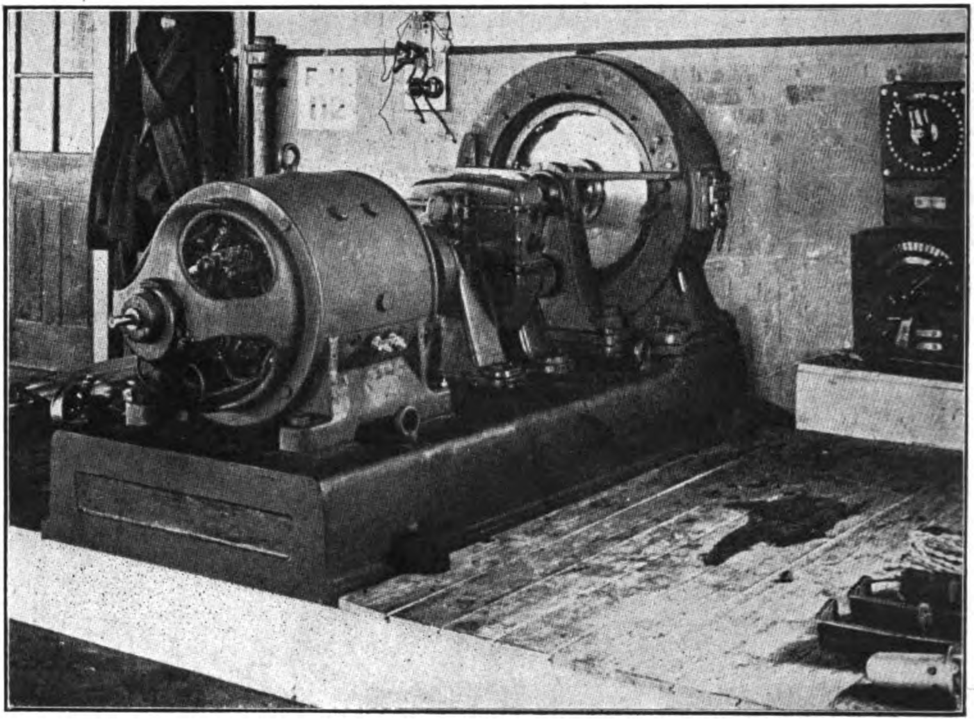


Figure 102—*Telefunken Company* 10 *K. W.* 10,000 *cycle alternator*

The motor starter, and the speed controlling rheostat are mounted on the wall at the rear. The machine shown produced 10,000 cycles per second directly. Its use in radio telephony, together with the other portions of a frequency changer set of which it was a part, will be described under "Control Systems."

This is the eighth article of a series on "Radio Telephony" by Dr. Goldsmith. In Article IX, continuing the consideration of generating radio frequent currents by alternators, an interesting and important form of alternator, largely developed by E. F. W. Alexanderson, is taken up.

MARCONI CALLS FOR AMATEURS

An exclusive interview with Guglielmo Marconi will appear in the September issue of THE WIRELESS AGE. It will contain a special message from the inventor to wireless men, telling of their place in the war.

Signal Officers' Training Course

A Wartime Instruction Series for Advanced Amateurs Preparing for U. S. Army Service

THIRD ARTICLE

By MAJOR J. ANDREW WHITE

Chief Signal Officer, Junior American Guard

WIRELESS men training for army war service show a natural impatience to begin study of the tactical employment of technical apparatus with which they are already familiar in great or lesser degree. That this seeking for knowledge is premature is best explained in the words of Brigadier General George O. Squier, Chief Signal Officer of the United States Army: "History shows that wars are usualy won by new devices. Frederick the Great was the first to employ the principle of drill, and won his battles by that agency. Until this time armies had been formless crowds of men which could not be quickly handled and manoeuvred. Frederick the Great was the first drill master. He saw the possibilities in having men trained to march and halt and wheel and countermarch and so on, automatically like a great machine, in response to a word of command. He made an army a co-ordinate, coherent thing, capable of quickly responding to meet every emergency as the emergency was seen and understood by a man in supreme command. And his success was based on that.

"This now seems a very simple, matter-of-course thing, but it was unheard of before Frederick the Great introduced it into warfare as his new contribution."

It is now recognized that the principle of drill—the marching, halting, wheeling and turning in unison—is the first essential for mastery by soldiers. So, while it is true, as General Squier says, that "wars are usually won by new devices," and wireless experimenters of America may yet develop a new agency in scientific practice, familiarity with military principles must be gained before the experimenter is of value as a Signal Corps member.

In the preceding article, an outline of the recruit instruction was included in the form of extracts from the book, "Military Signal Corps Manual." From the same source the following extracts are made, carrying the drill instruction one step further: the School of the Squad, the smallest military unit, consisting of eight men—seven privates and a corporal.

THE SQUAD

As soon as the recruits are sufficiently instructed for the purpose, they are formed into squads of convenient size in order to teach them the principles of the alignments, taking intervals, and the marchings.

For this instruction, the recruits are formed in double rank. The files on the right and left of the squad are always complete; if there be an incomplete file, it will be the second from the left. The rear-rank men cover their file leaders accurately at 1 yard distance.

In the case of a small number of recruits, they may be formed in single rank. The movements described for the double rank formation apply equally well to the single rank, omitting the explanations for the rear-rank men.

TO FORM THE SQUAD

To form the squad, the instructor designates a recruit as the front-rank man of the right file and indicates to him where the right of the squad is to rest; he then places himself about 3 yards in front of where the center is to be formed, and commands: FALL IN.

How the squad is formed is illustrated in this photograph, showing the rear rank with proper distance. The position illustrates the action immediately after the command "Fall in"

The men form on the designated recruit, in two ranks facing to the front, as nearly as practicable in order of height from right to left.

The rear rank forms with distance of 40 inches.

The instructor then commands: COUNT OFF.

At this command, all except the right file execute *eyes right,* and beginning on the right, the men in each rank count *one, two, three, four;* each man turns his head and eyes to the front as he counts.

The squad executes *the rests;* resumes *the attention; marks time;* and executes *the facings,* the *setting-up exercises, the step,* and *the halt,* and is dismissed by the same commands and means as explained for the recruit in the preceding article.

ALIGNMENTS

The alignments are first taught by requiring the recruits to align themselves upon two files established as a base.

Being at a halt, the instructor causes the first two files on the flank toward which the alignment is to be made to move forward a few paces, and establishes them as a base; he then commands: 1. Right (left), 2. DRESS, 3. FRONT.

At the command DRESS, all men place the left hand upon the hip (whether dressing to the right or left); each man, except the base file, when on or near the new line executes *eyes right,* and, taking steps of 2 or 3 inches, places himself so that his right arm rests lightly against the arm of the man on his right, and so that his eyes and shoulders are in line with those of the men on his right; the rear rank men cover in file.

The instructor verifies the alignment of both ranks from the right flank and orders up or back such men as may be in rear, or in advance, of the line; only the men designated move.

At the command *front*, given when the ranks are aligned, each man turns his head and eyes to the front and drops his left hand by his side.

In the first drills the basis of the alignment is established on, or parallel to, the front of the squad; afterwards, in oblique directions.

Whenever the position of the base file or files necessitates a considerable movement by the squad, such movement is executed by marching to the front or oblique, to the flank or backward, as the case may be, without other command.

To preserve the alignment when marching: GUIDE RIGHT (LEFT).

The men preserve their intervals from the side of the guide, yielding to pressure from that side and resisting pressure from the opposite direction; they recover intervals, if lost, by gradually opening out or closing in; they recover alignment by slightly lengthening or shortening the step; the rear-rank men cover their file leaders at 40 inches.

In double rank, the front-rank man on the right, or designated flank, conducts the march; when marching faced to the flank, the leading man of the front rank is the guide.

TO TAKE INTERVALS

Being in line at a halt: 1. Take interval. 2. To the right (left). 3. MARCH. 4. Squad. 5. HALT.

At the first command, the rear rank steps back 4 steps and halt; at the command MARCH, all face to the right and the leading man of each rank steps off; the other men step off in succession so as to follow the preceding man at 4 paces, rear-rank men marching abreast of their file leaders.

At the command HALT, given when all have their intervals, all halt and face to the front.

TO ASSEMBLE

1. Assemble, to the right (left). 2. MARCH.

The front-rank man on the right stands fast, the rear-rank man on the right closes to 40 inches. The other men face to the right, close by the shortest line, and face to the front.

MARCHINGS

During the marchings the guide conducts the march, preserving with great care the direction, length, and cadence of the step and selecting points on which to march.

TO MARCH TO THE FRONT

Being at a halt: 1. Forward. 2. MARCH.

The men step off and march straight to the front.

If in line, the rear-rank men follow their file leaders accurately. The instructor sees that the ranks preserve the alignment and the intervals toward the side of the guide. The men yield to pressure from that side and resist pressure from the opposite side; by slightly shortening or lengthening the step they gradually recover the alignment, and by slightly opening out or closing in they gradually recover the interval, if lost; while habitually keeping the head to the front, they may occasionally glance toward the side of the guide to assure themselves of the alignment and interval, but the head is turned as little as possible for this purpose.

If in flank column, the men of the leading file step off at full step; the leading rear-rank man marches abreast of his file leader at 26 inches interval. The other files march at the half step, each taking the full step when at 1 yard distance.

Being in march: 1. To the rear. 2. MARCH.

At the command *march*, given as the right foot strikes the ground, advance and plant the left foot; turn to the right about on the balls of both feet and immediately step off with the left foot.

In marching in double time, turn to the right about, taking four steps in place, keeping the cadence, and then step off with the left foot.

If at a halt, the squad may be faced about and then moved forward, as explained in the preceding paragraph; or, without facing about, it may be marched a short distance to the rear by the command; 1. Backward. 2. MARCH.

Whenever the squad in line is faced about or marched to the rear, all men in the front rank not covered step into the new front rank.

TO MARCH BY THE FLANK

Being in line; 1. By the right (left) flank. 2. MARCH.

At the command *march*, given as the right foot strikes the ground, advance and plant the left foot, then face to the right in marching and step off in the new direction with the right foot. The march is continued as described in the preceding paragraph, "March to the Front."

The formation obtained by marching by the flank from line is called a *flank column*.

If at a halt, the squad may be marched by the flank by first facing it in the desired direction and then moving it forward, as explained.

When the march by the flank is executed from flank column while at 1 yard distance, the files close in gradually toward the guide until they have the prescribed interval.

Whenever the flank column is halted while marching at 1 yard distance, the leading file halts at the command; the others close to facing distance before halting.

To close up in flank column without halting: 1. Close. 2. MARCH.

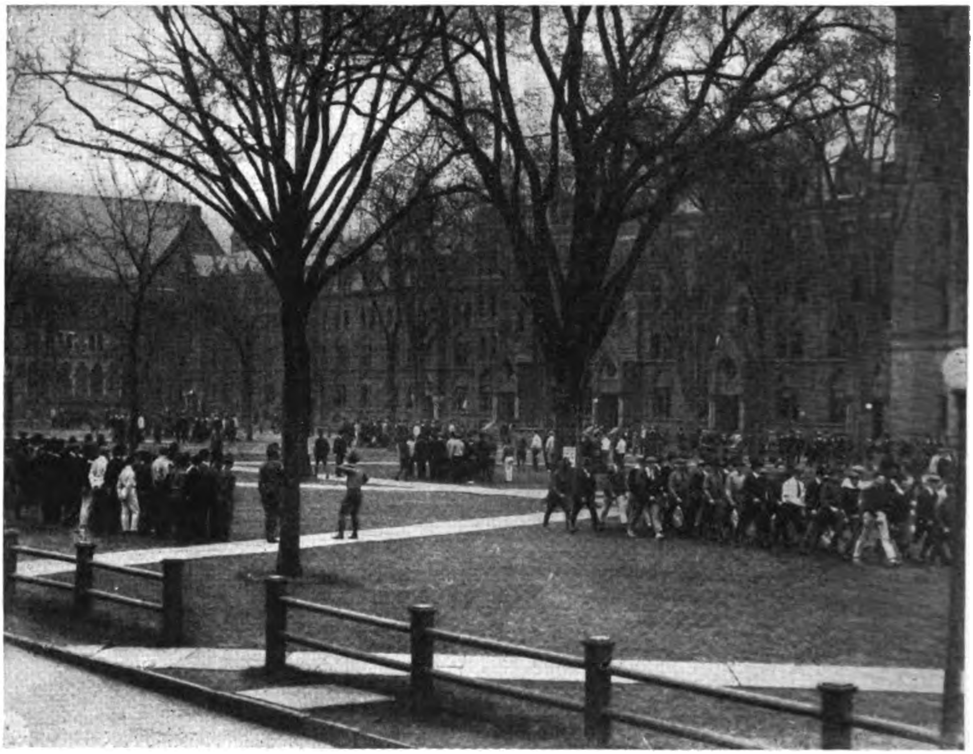
The leading file takes the half step; the other files close to facing distance and take the half step; all the files having closed to facing distance, the column is halted or marched by the flank as previously explained.

To halt the flank column without closing up: 1. In place. 2. HALT.

TO MARCH OBLIQUELY

For the instruction of recruits, the squad being correctly aligned, the instructor causes the squad to face half right or half left, points out to the men their relative positions, and explains that these are to be maintained in the oblique march.

1. Right (left) oblique. 2. MARCH.



A view of Yale campus, showing the students, not yet in uniform, receiving elementary instruction in close-order drill

Each man steps off in a direction 45 degrees to the right of his former front. He preserves his relative position, keeping his shoulders parallel to those of the guide, and so regulates his step as to keep the ranks parallel to their original direction.

If the command HALT be given while marching obliquely, the men halt faced to the original front.

To resume the original direction: 1. Forward. 2. MARCH. 3. Guide (right or left).

At *half step* or *mark time*, while obliquing, the oblique march is resumed by the commands: 1. Oblique. 2. MARCH.

TO CHANGE DIRECTION IN FLANK COLUMN

1. Column right (left). 2. MARCH.

The movement is executed by each rank successively and on the same ground. At the second command, the pivot man of the front-rank faces to the right in marching and takes the half step; the other men of the rank oblique to the right until opposite their places in line, then execute a second right-oblique and take the half step on arriving abreast of the pivot man. All glance toward the marching flank while at half step and take the full step without command as the last man arrives on the line.

Wireless Instruction for Military Preparedness

A Practical Course for Radio Operators

ARTICLE IV

By Elmer E. Bucher

Instructing Engineer, Marconi School of Instruction

EDITOR'S NOTE.—This is the fourth installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

THE ELECTRICAL UNITS

(1) We have stated the unit of **electromotive force** to be the **volt, the unit of current strength,** the **ampere** and the **unit of resistance,** the **ohm.**

(2) The student should understand that a **difference of potential** in an electrical circuit causes **electromotive force** and electromotive force will cause the flow of an **electric current** provided the proper conducting **path** is afforded.

(3) The distinction between the unit of current quantity and of current strength should be clear. The quantity of electricity flowing in a given circuit is expressed by the unit termed the **coulomb,** which is analogous in hydraulic systems to the term, the gallon. The strength of an electrical current should be described as the **rate of the flow of electricity** through a circuit per second of time, and this rate is expressed by the unit, the **ampere,** the physical standard for which has already been mentioned.

(4) We may define the **coulomb** as that amount of electricity which would pass in one second through a given circuit in which the strength of the current is one ampere.

(5) If a current of one ampere flows every three seconds, the quantity of electricity delivered is three coulombs, or if three amperes of current flow for one second the quantity is also three coulombs.

(6) From this it is clear that the quantity of electricity flowing in any circuit in coulombs is equal to the current strength in amperes multiplied by the time it flows in seconds or——

$$Q = I \times T;$$

where Q = the quantity of current in coulombs;
I = the current in amperes;
T = the time in seconds.

(7) Hence, in a circuit carrying 15 amperes of current for ten minutes, the quantity of electricity flowing equals $10 \times 60 \times 15 = 9{,}000$ coulombs. In such a circuit, current flows at the rate of 15 amperes per second, but the quantity of current flowing for ten minutes equals 9,000 coulombs.

(8) As it is more convenient in electrical practice to measure the strength of the current in amperes than to compute the total quantity of electricity flowing, we express the rate at which it flows, i. e., employ the unit, the ampere.

(9) In electrical equations the ampere is represented by the letter I. Instruments for measuring the strength of current in electrical circuits are called **ampere meters** or **ammeters.**

ELECTRICAL RESISTANCE

(1) **Resistance** in electrical circuits is that property of bodies which oppose the flow of electric current, the spent energy being manifested in the form of heat.

(2) All substances are found to resist the passage of electricity, but the resistance of metals is the least.

(3) **Silver** is found to be the **best conductor** and offers less resistance than copper; in fact, the ability of silver to conduct electricity is taken as the base from which the **specific resistance** of other metals is computed. German silver, for example, has a relative resistance of 13.92 and silver 1; hence a cubic inch of German silver, for instance, has a little more than thirteen times the specific resistance of a cubic inch of pure silver. Lead may also be classed among the poorer conductors of electric currents.

(4) Since resistance opposes the flow of an electrical current, it reduces the energy of the current. A resistance coil of variable value may be employed in any circuit to regulate the flow of current. Such a resistance unit is termed a **rheostat.**

(5) The resistance of metals is effected by temperature. The majority of metals increase their electrical resistance with increase of temperature, but certain substances decrease their resistance under rise of temperature, an example being carbon filaments and certain electrolytic conductors, such as battery solutions.

(6) The resistance of a conductor is always constant if its temperature remains constant, irrespective of the strength of current flowing through it. If the conductor offers unit resistance to a current of one ampere, it offers the same resistance to a current of 20 amperes, provided the temperature does not change appreciably.

(7) The **unit of resistance** is called the **ohm,** the physical standard for the ohm has been previously noted.

OHM'S LAW

(1) There is a distinct relation between electromotive force, current strength and the resistance of an electrical circuit. This is disclosed by **Ohm's law,** which states that the strength of the current in amperes in any given circuit is directly proportional to the E. M. F. and inversely proportional to the resistance.

This may be written—

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

where I = the current in amperes;
E = the electromotive force in volts;
R = the resistance in ohms.

(2) This law shows that an electrical circuit in which the condition of the circuit does not change during the flow of the current, i. e., the circuit remains of constant resistance, the current flow in amperes will increase directly in proportion to the E. M. F. Hence if an E. M. F. of 10 volts is applied to any circuit, the resistance of which is 5 ohms, the current strength in amperes will be——

$$I = \frac{10}{5} = 2 \text{ amperes}$$

and if the E. M. F. were increased to 20 volts then

$$I = \frac{20}{5} = 4 \text{ amperes.}$$

This formula may be transposed to read:

$$E = I \times R \text{ or}$$
$$R = \frac{E}{I}$$

(3) Thus if we know any two of the quantities involved in this expression, the third can be readily determined. For example, if an electrical circuit had resistance of 10 ohms and the current as measured by an ammeter is found to be 11 amperes, then the electromotive force applied to this circuit must have been——

$$11 \times 10 = 110 \text{ volts.}$$

ELECTRICAL POWER

(1) The relation between electrical and mechanical power is determined by the unit, the **watt,** and the watt is the unit to express the **rate of doing work** per unit of time. The energy expended in an electrical circuit is expressed by the unit, **the joule,** and the joule occupies the same relation to the watt as the coulomb to the ampere.

(2) In an electrical circuit, the electrical energy expended in the form of heat in joules is expressed:

$$J = I^2 \times R \times T;$$

where I = the current in amperes;
R = the resistance in ohms;
T = the time the current flows.

(3) It should be thoroughly understood that the **joule per second** is called the **watt** and the watt is **the unit of electrical power.**

(4) The **power** in watts in a given circuit in which direct current is flowing is equal to the result obtained **by multiplying the current in amperes by the electromotive force in volts** or

$$W = I \times E.$$

Hence if a current of 10 amperes flows in a circuit to which is applied an E. M. F. of 100 volts, the power of the current = 10 × 100 = 1,000 watts and since 1,000 watts = 1 K. W. (abbreviation for kilowatt), the power of the current is said to be 1 K. W.

(5) **One mechanical horsepower** is the work done at a rate equal to raising 550 lbs. per second through a distance of one foot against the force of gravity.

(6) It can also be shown that 746 watts = 1 mechanical horsepower, hence 1,000 watts = approximately 1 1-3 horsepower.

GROUPING OF ELECTRICAL CELLS

(1) The grouping of electrical cells in various ways effects the current and pressure available for a given external circuit. The following diagrams will illustrate the point:

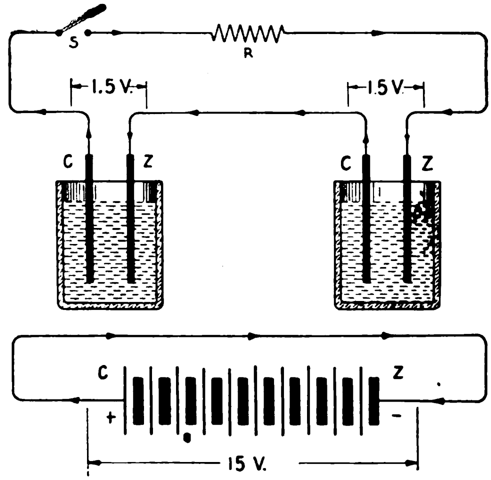


Figure 13

OBJECT OF THE DIAGRAM

To show how electrochemical cells are connected in series.

PRINCIPLE

If a number of electrochemical cells are connected in series, the electromotive force is increased and the resultant E. M. F. is the sum of the individual E. M. F.'s.

DESCRIPTION OF THE APPARATUS

In the upper diagram of Figure 13, two cells are connected in series, the zinc terminal of one cell being joined to the carbon terminal of the next cell. In the lower part of the diagram 10 cells connected in series are shown as they would be represented in electrical diagrams.

SPECIAL REMARKS

(1) If the E. M. F. of all cells is identical, the final E. M. F. will be that of one cell multiplied by the number of cells in the group.

(2) The strength of the current will not exceed that of a single cell and due to the internal resistance of all cells, it will be somewhat less.

(3) A series connection is employed when the resistance of the external circuit is large compared to the internal resistance of the cells.

QUES.—What is the total E. M. F. of 10 *average dry cells connected in series?*

ANS.—The average voltage per cell = 1.5 volts. Hence the voltage of 10 cells in series = 10 × 1.5 = 15 volts.

QUES.—What is the total E. M. F. of 10 *lead plate storage cells connected in series?*

ANS.—The E. M. F. of the average lead plate cell is 2.1 volts. Hence 10 cells in series would have an E. M. F. of 10 × 2.1 = 21 volts.

QUES.—If the resistance, R, in the upper part of the diagram (Figure 13) *has resistance of* 6 *ohms and the E. M. F. of the two cells is* 3 *volts, what current will flow (ignoring the internal resistance of the cells)?*

ANS.—According to Ohm's law, $I = \frac{E}{R}$ **hence, the current in amperes** $= \frac{2}{6} = 0.33$ **amperes.**

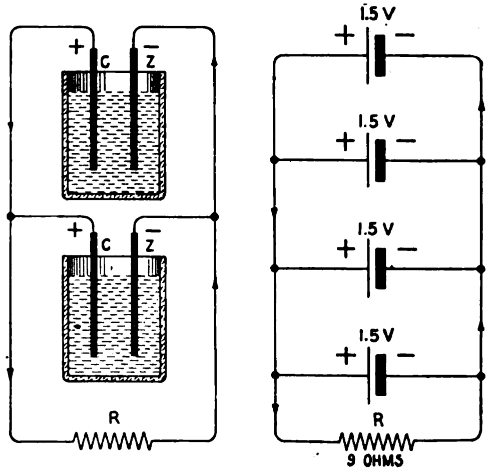


Figure 14

OBJECT OF THE DIAGRAM

To show how electrochemical cells are connected in parallel.

PRINCIPLE

The total E. M. F. of a bank of cells connected in parallel is that of a single cell provided the E. M. F.'s of all are equal, but the current output is that available from one cell multiplied by the number of cells in the group.

DESCRIPTION OF THE APPARATUS

In the left hand part of the diagram (Figure 14) two electrochemical cells are connected in parallel, and the positive and negative terminals joined together through the resistance, R.

In the right hand part of the diagram four electrochemical cells are connected in parallel and their positive and negative terminals are joined together through the resistance R. This diagram shows electrical cells in parallel as they would be represented in wiring diagrams.

SPECIAL REMARKS

(1) Electric cells should be joined in parallel when the resistance of the external circuit is small in comparison with the internal resistance of the cell.

QUES.—If the four cells in the right hand part of Figure 14 have, individually, normal current output of 15 amperes, what would be the current available at the negative and positive terminals of the group?

ANS.—The four cells in parallel would furnish current of 4 × 15 or 60 amperes.

QUES.—If in the right hand part of Figure 14, the resistance R has 9 ohms and the E. M. F. of the bank is 1.5 volts, what value of current will flow?

ANS.—Current $= \frac{1.5}{9} =$ **0.166 amperes.**

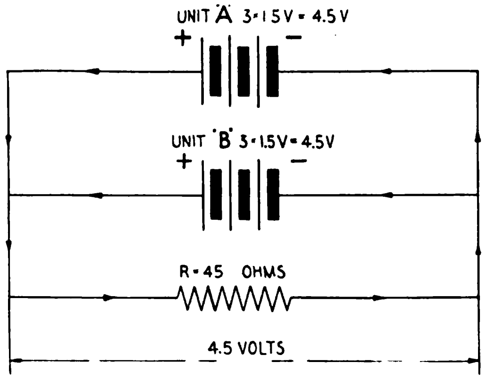


Figure 15

OBJECT OF THE DIAGRAM

To show a series parallel connection of electrochemical cells.

PRINCIPLE

Cells may be grouped in series and several units connected in parallel in order to increase the supply of current.

DESCRIPTION OF THE APPARATUS

In the diagram (Figure 15) two battery groups, A and B, consisting of three cells connected in series, are connected in parallel and their positive and negative terminals joined through the resistance, R, of 45 ohms. By this connection, the E. M. F. at the terminals is that of either group A or B, but the current supply is that available from the two groups.

SPECIAL REMARKS

(1) In connecting groups of cells in parallel, as shown in Figure 15, care must be taken to have like E. M. F.'s in each group, otherwise the weaker cells will absorb current from the stronger cells.

QUES.—If the current output of each cell of Figure 15 is 15 amperes, what will be the current available at the terminals of the external circuit?

ANS.—Unit A would have a current output of approximately 15 amperes, likewise unit B, hence the two units connected in parallel would produce a curr.nt of approximately 30 amperes.

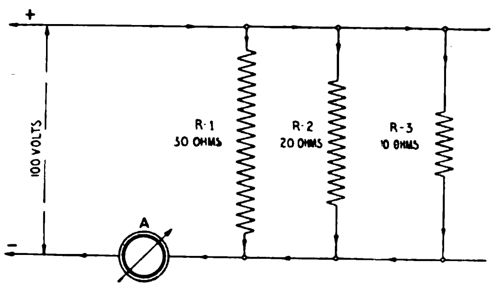


Figure 16

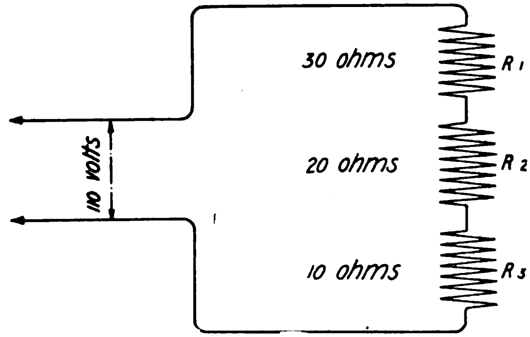


Figure 17

OBJECT OF THE DIAGRAM

To show an electrical circuit of several branches.

To show the effect of connecting several resistance coils in series or in parallel.

PRINCIPLE

The joint resistance of several unequal resistances connected in parallel will be less than that of the smaller resistance.

The joint resistance of several equal branches in parallel will be that of the resistance of the one branch divided by the number of branches.

The joint resistance of several resistances in series is equal to their sum.

DESCRIPTION OF THE CIRCUIT

In Figure 16 three resistance coils, R-1, R-2 and R-3 of 30, 20 and 10 ohms resistance respectively, are connected in shunt to a power line to which is applied an E. M. F. of 100 volts.

Three paths are thus afforded for the flow of current.

In Figure 17 three resistance coils are connected in series.

SPECIAL REMARKS

(1) The joint resistance of several resistances connected in parallel is found as follows:

$$R = \frac{1}{\frac{1}{R\text{-}1} + \frac{1}{R\text{-}2} + \frac{1}{R\text{-}3}}$$

Example:—In the circuit of Figure 15, the joint resistance of the three elements

$$= \frac{1}{\frac{1}{30} + \frac{1}{20} + \frac{1}{10}} = \frac{1}{\frac{11}{60}} = 5.4 \text{ ohms.}$$

(2) When a number of resistances are connected in series, their joint resistance is the sum of several resistances taken separately.

Example:—In the circuit of Figure 16, the total resistance of the three coils = R-1 + R-2 + R-3 or 30 + 20 + 10 = 60 ohms.

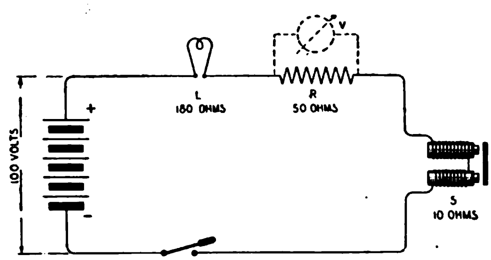


Figure 18

OBJECT OF THE DIAGRAM

To show a complete electrical circuit with a number of electrical devices connected in series.

PRINCIPLE

Irrespective of the resistance of each element in Figure 18, the current flow through each is the same.

DESCRIPTION OF THE APPARATUS

An incandescent lamp L of 180 ohms, a resistance coil, R, of 50 ohms and a telegraph sounder of 10 ohms are connected in series and in series with a battery of 100 volts.

SPECIAL REMARKS

(1) The total resistance of the external circuit is 180 + 50 + 10 = 240 ohms.

(2) According to Ohm's law $I = \frac{E}{R}$; then the flow of current (through the circuit) must equal $\frac{100}{240} = 0.41$ amperes.

DEFINITION OF PRACTICAL ELECTRICAL UNITS

The practical units of electrical measurements may be defined as follows:

(1) The practical unit of **electromotive force** is the **volt,** and by definition the volt is that E. M. F. required to maintain the flow of current of one ampere through a resistance of one ohm.

(2) The practical unit of **current strength** is the **ampere,** and it is that strength of current maintained by an E. M. F. of one volt through a resistance of one ohm.

(3) The **ohm** is the **unit of resistance** and is such resistance of conductor or circuit that permits the passage of a current of one ampere under an E. M. F. of one volt.

(4) The unit of **current quantity** is the **coulomb** which is the quantity of electricity flowing in a circuit when one ampere passes a given point during one second of time.

(5) The **watt** is the unit of **electrical power** and is equal to **one joule per second.** It is the power of a current of one ampere flowing under electric pressure of one volt.

(6) In connection with these units, the prefixes kilo, micro and milli are employed, meaning respectively 1,000 times, $\frac{1}{1,000,000}$ of, and $\frac{1}{1,000}$ of. Thus a kilo-volt=1,000 volts; a micro-ampere = $\frac{1}{1,000,000}$ ampere; and a milli-volt = $\frac{1}{1,000}$ of a volt.

QUES.—What voltage is to be expected from the average primary cell?

ANS.—It varies according to the type of construction from 0.6 to 1.75 volts.

QUES.—What is the current output of the average open circuit primary cell?

ANS.—From 5 to 30 amperes.

QUES.—What is the voltage of the average lead plate storage cell?

ANS.—From 2.08 to 2.6 volts.

QUES.—What voltage is generally used in the lighting circuits of house wiring?

ANS.—110 volts.

QUES.—What voltage is generally used on the trolley wires of the street car service?

ANS.—550 volts.

QUES.—In what branches of electrical work are extremely high voltages used?

ANS.—Voltages up to 200,000 volts are employed for the transmission of power over great distances and up to 50,000 volts for exciting the condenser circuit of a wireless telegraph transmitter.

QUES.—How is the safe current carrying capacity of a copper wire determined?

ANS.—A complete table of the current carrying capacity of various sized wires in the B. & S. gauge, is contained in the instructions issued by the National Board of Electrical Inspectors, and also in the Underwriters booklet, copies of which can be obtained in any city in the United States.

QUES.—What precaution must be taken in the installation of a power circuit?

ANS.—Care should be taken that such installations conform thoroughly with the Underwriters Rules in each city. The circuits must be insulated and in the majority of cases low voltage circuits are installed in armored cable, lead covered copper conductor or in iron conduit. Circuits carrying current at a pressure of several thousand volts must have special insulation in order to prevent breakdown.

(To be continued)

How to Become An Aviator

The First Article of a Series for Wireless Men in the Service of the U. S. Government Giving the Elements of Aeroplane Design, Power, Equipment and Military Tactics

By HENRY WOODHOUSE

Author of "Text Book of Naval Aeronautics"

UNTIL the beginning of the war we marveled at a small aeroplane radio set transmitting one mile per pound weight, but the progress made in the past two years has been extensive and at present we get three miles per pound weight.

The wireless equipped aeroplane was, at the outbreak of the war, something of a novelty; today it is an accepted factor in both military and naval aeronautics and aviator-operators are in ever increasing demand. An indication of the place occupied by the wireless operators of aircraft is disclosed in the four general rules recently defined by a British authority:

(1) See before starting that the wireless instrument is properly adjusted to send strong signals.

(2) Don't send when turning; always send when the nose of the machine is towards the receiving station.

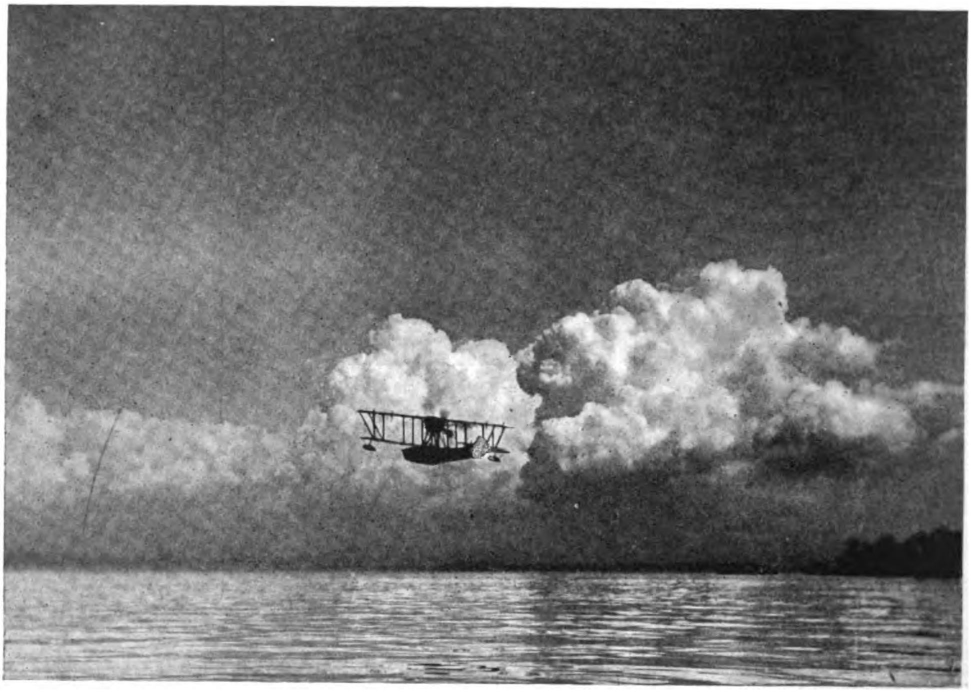
(3) Don't send too near the receiving station; a minimum distance of from 2,000 to 3,000 yards gives better results.

(4) Don't send jerkily; send evenly and remember that slow, bad sending is quite as undesirable as quick, bad sending. In sending slowly, don't stop in the middle of a word, a set of code letters, figures or coordinates.

These practical suggestions are of value, of course, only to the qualified aviator; they are given here, however, to point out to readers of THE WIRELESS AGE the definite place in aeronautics assigned to the wireless operator and to acquaint the field with the fact that many wireless men will be needed and developed when the new national program of military aviation is completed. It may be well to note also that the greatest percentage of flying men are former civilians. General W. S. Brancker, R.A., Director of the British Air Organization, has stated officially in an explanation of civilian training that the British practice is to place the candidate through a course in the cadets' school, after which "he goes through a course in the care of engines and rigging, is given some ideas of the theory of flight, and is taught wireless signaling and receiving."

This article will consider some aspects of our naval requirements, in which connection it is interesting to know that under the heading "Advanced Flying," the United States Navy requires instruction in the Flying School to include "sending and receiving radio messages in the air."

The practical application of this instruction may be instanced in the present war. Spotting the fall of shots was one of the first recognized uses for naval aeroplanes. The employment of aeroplanes for this purpose greatly extended

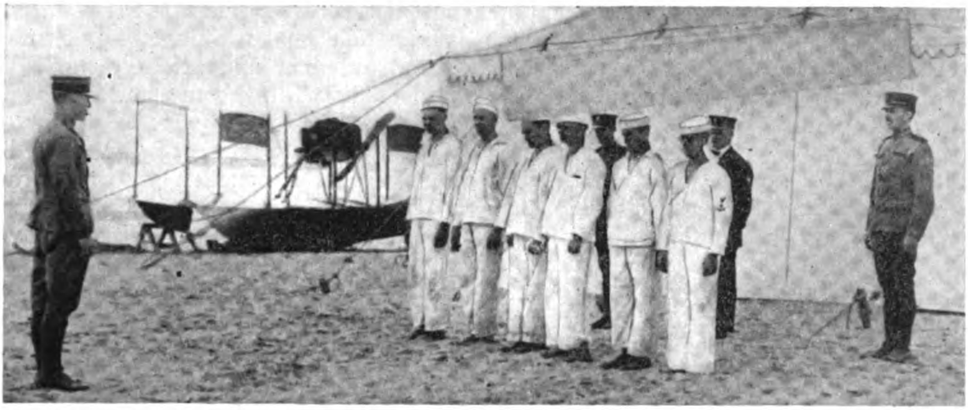


It was a seaplane of a type similar to the one here illustrated which directed by wireless the fire of the British monitors which destroyed the German cruiser Konigsberg

the range of vision of ships and became invaluable in long range, indirect, high-angle firing. The following extract from the "Text Book of Naval Aeronautics" deals with an important test of the seaplane's value in spotting gunfire. "At first this work was hampered by the lack of efficient wireless sets to be carried on seaplanes, to make it possible to the aviators to communicate with the man behind the gun. The weight of wireless sets up to 1914 was between three and five pounds per mile of transmission, which was almost prohibitive, as the seaplanes at the time had a small margin of carrying capacity. By 1916, weight of sets was cut down to one pound per mile of transmission, and the margin of carrying capacity was increased through general improvements in the construction of seaplanes.

"The first actual tests of seaplanes to spot the fall of shots took place in July, 1915, when British seaplanes were used to direct the guns of monitors to attack the German cruiser Konigsberg, which was hidden up the Rufigi River, in East Africa. The writer is fortunate in being able to present herewith the first complete report of this historic event.

"The wrecking of the German by two British monitors, one of the most remarkable events of the war, was made possible by seaplanes. Following is a letter written home by an English naval officer, which describes the aid rendered by the two aeroplanes, and shows how closely the gunners of the sea, as well as the gunners of the land, have been working as a team with the air scouts. The action described was the attack by monitors upon the German cruiser Konigsberg. It may be remembered she took refuge up the river on the east coast of Central Africa and was a menace to British interests. She was found after many months up the river where she was hidden from the monitors by palm trees.



A squad of naval aviators undergoing instruction which will insure them active service within six months

A typical aeronautical school, where instruction begins with shopwork and includes lectures, flying lessons, elementary and advanced, and aircraft station administration

Aeroplanes were procured after many weeks, and action started. The officer of the monitor Savern writes:

"We went on higher up the river, and finally anchored. Two shells fell within eight feet of the side and drenched the quarterdeck. It was a very critical time. If she hit us we were probably finished.

"We had no sooner anchored than the aeroplane signaled she was ready to spot. Our first four salvos, at about one minute intervals, were all signaled as, 'Did not observe fall of shot.' We came down 400, then another 400 and more to the left. The next was spotted at 200 yards over and about 200 to the right. The next 150 short and 100 to the left. At the seventh salvo we hit with one and were just over with the other. We hit eight times in the next twelve shots. It was frightfully exciting. The Konigsberg was now firing salvos of three only. The aeroplanes signaled all hits were forward, so we came a little left to get her amidships. The aeroplane suddenly signaled, 'Am hit; coming down;

send a boat.' As they fell they continued to signal our shots, we, of course, kept on firing. The aeroplane fell in the water about 150 yards from the Mersey; one man was thrown clear, but the other had a struggle to get free. Finally both got away and were swimming for ten minutes before the Mersey's motor boat reached them—beating ours by a short head. They were uninjured and as merry as crickets."

From this incident the prospective operator-aviator may gain some understanding of the importance of the radio man in the air service. While it is purposed in this series to outline the duties and knowledge of aircraft required in both branches of military service, this article will consider only the aeronautics of the Navy and state something of the qualifications and training. Later, descriptions of the apparatus will be included and practical suggestions given for supplementary study for those who expect to qualify for the flying service in the Signal Corps of the Army.

The regulations governing the classes for the Air Service of the United States Navy place the maximum period of courses of instruction at two years for officers and eighteen months for enlisted men. Under the present war conditions the maximum training period will not be over six months. Many aviators will be trained in considerably less time and there is no question that wireless operators will be given special consideration when applying for the aviation service, appropriations for which will be more than one billion dollars this year. Officers detailed for aeronautic duty are classed as student naval aviators, naval aviators, naval air pilots, aeroplane and dirigible, and military aviators. Enlisted men are classed as student airmen, airmen, quartermasters, aeroplane and dirigible, and aeronautic machinists.

Upon arriving at the aeronautic training station students supply themselves with the volumes prescribed by the commandant for text book study. The course of instruction begins with shopwork, and includes lectures, flying lessons, elementary and advanced flying and aircraft station administration. As far as possible, the shopwork is practical, students doing actual disassembly, reassembly, installation and adjustment of all parts of each type of machinery at the station. The same applies to the various types of aerodynamic instruments, following which weekly lectures are given to stimulate original thought and development. Meanwhile flying lessons are begun and continued until the student airman is qualified for high altitude and rough weather flying, to make spirals and steer an air course by compass.

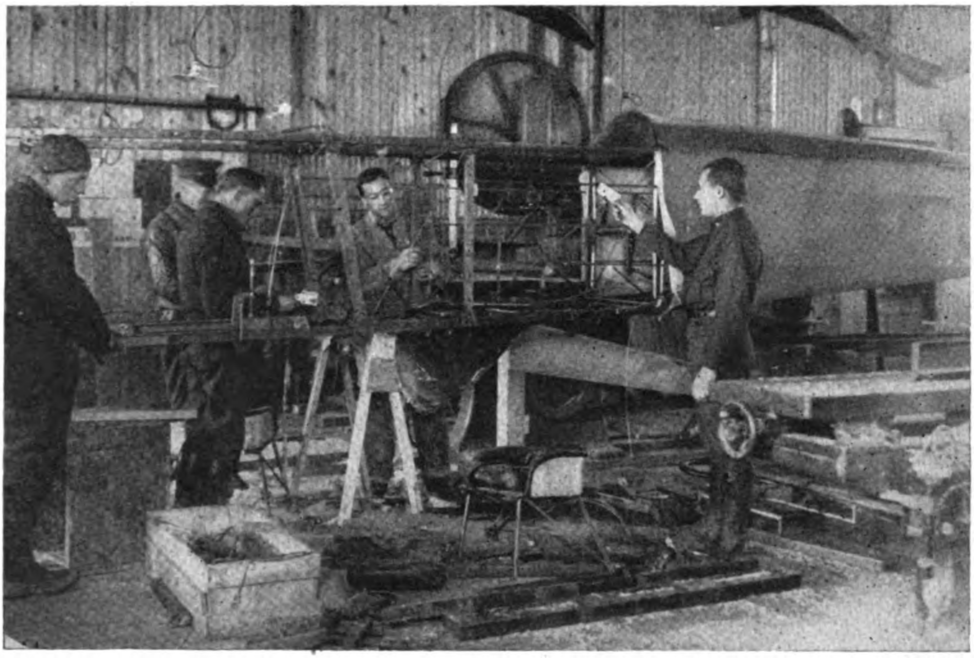
When sufficiently advanced in the shop course, the student has an aeroplane assigned to him for care, preservation and keeping its logs and records. His instruction in advanced flying then begins, under the supervision of the officer in charge of the Flying School. By actual experience he learns then to start from a catapult, to land in deep-sea waves, drop bombs, fly in formation and send and receive radio messages in the air.

While qualifying as an advanced flyer, the student is appointed a sub-inspector of machinery and aeroplane work and assistant planning superintendent. Monthly written examinations are held during the entire period, students being rated in adaptability, bearing and conduct, flying, practical knowledge and written examination. A rating equal to 62½ per cent is required in all subjects, any average below this mark being reported to the department and the student may be recommended for detachment.

To become a naval aviator the student must demonstrate ability to climb to an altitude of 6,000 feet and glide with motor idling to a normal landing within 200 feet of a designated mark; horizontal flights must be resumed twice during the descent at altitudes above 1,000 feet. Under the same landing conditions, a spiral glide must then be made from an altitude of 3,000 feet, with the motor stopped. Landings must also be made in waves at least three feet high, without damage to any part of the aeroplane. Flying in 20-mile winds or better over a prescribed course, demonstrating flying ability in very bad weather, and starting a flight from a catapult, after personally making all adjustments, are the remaining tests.

Scouting, taking sights while flying, solution of scouting problems and controlling the fire of the guns of an aeroplane must be mastered by those who, having qualified as aviators, seek the rating Navy Air Pilot.

It is obvious that these matters cannot be covered in a practical manner in



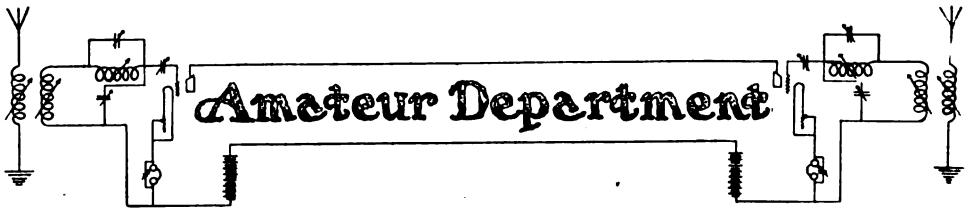
The Government requires its student aviators to do practical shopwork, actual disassembly, reassembly, installation and adjustment of all parts being part of the instruction

a series of magazine articles. A substantial amount of instruction can be included, however, and the series, of which this is the first article, will be of considerable value to wireless men who are specializing in naval communication and studying for commissions in the Signal Corps. Used in conjunction with the other two instructional courses appearing in this magazine, it is expected that valuable highly trained specialists will be made available for Uncle Sam's fighting forces from among the thousands of men engaged in the experimental field of radio.

FOR MEN WITH RADIO EXPERIENCE

Uncle Sam offers any American citizen from 18 to 35 years, with radio experience, an opportunity to see the world. Class 2 of the Naval Reserve is open for enrollment.

As this is for the period of the war, the opportunity should appeal strongly to the imagination of men of spirit who wish adventure, ever changing scenes, new countries and people. In addition to clothing outfit he is furnished excellent food and the pay is good.



Taking U. S. Government License Examinations

Hints to Candidates for Wireless Operators' Certificates

BEFORE taking the Government examination for a wireless operator's certificate, the examinee will do well to heed the following suggestions:

In complying with the request for a diagram of a standard radio transmitting and receiving set he should not fail to include the motor-generator and the motor starter. He should bear in mind that two types of hand starters are employed on Marconi commercial sets, namely, the Cutler Hammer and the General Electric Company's starter.

There is a slight difference between these two types in their construction: in the Cutler Hammer starter the release magnet is connected in series with the shunt field winding of the motor, whereas in the General Electric Company's starter, the release magnet is shunted across the D. C. line and has a small resistance coil connected in series.

In drawing the diagrams of the motor-generator, properly located field rheostats should be inserted in both the motor and generator field circuits. If the examinee elects to show the circuits of an automatic starter, he should draw one of the three types in use in the Marconi system.

The ½ K. W. 120-cycle panel transmitter is fitted with a single step starter, the ½ K. W. 500-cycle set with a two-step automatic starter and the 2 K. W. 500-cycle set with the Industrial Controller Company's multi-point automatic starter. The circuits for this last-named starter are completely shown in the book, "How to Pass U. S. License Examinations." It will be observed from the diagram in that volume that the starter not only performs this function, but assisted by an overload relay switch, it acts as a circuit breaker as well. In addition, it is fitted with a special set of contacts so that when the motor-generator D. C. line is opened, a resistance is thrown in shunt to the motor armature, thus giving a powerful braking action on the machine and bringing it to a quick stop.

In answering all questions pertaining to storage batteries or to auxiliary emergency apparatus, the student sitting for examination should bear in mind that two types of emergency transmitters are in use. On many ships the 2 K. W. 500-cycle set is operated by a 60-cell battery, but if such a battery is not in use, the auxiliary set will comprise a 10-inch induction coil set operated by a small battery varying in capacity from 16 to 30 volts. In the event that this emergency set is used, the induction coil is employed in place of the high voltage alternating current transformer, and its secondary winding is connected to the high potential condenser of the standard power set. With this type of apparatus, the length of the spark gap, of course, must be shortened and other adjustments made commensurate with the reduced power of the coil.

In drawing diagrams of both the transmitting and receiving apparatus, the student should aim for clearness and should adopt a standard method such as is shown in many textbooks; that is to say, he

(Continued on page 845)

Announcement

THE EDITOR has decided to extend the scope of this department to include general electrical experimental apparatus as well as radio telegraph equipment.

Readers who have made exceptional and unusual experimental apparatus for use in the workshop or in the home are invited to send in a complete and brief description of its construction and working, accompanied by clear drawings. Articles from amateur electricians and wireless operators who have developed devices of particular merit both in and outside of the radio telegraph field will be particularly acceptable.

In preparing such articles, it is suggested that contributors state fully:

The object of the device;
Prominent or unusual features of utility of your construction;
A detailed description of the construction;
Results obtained by actual use.

Such contributions will be paid for at a rate depending upon their merit. Prizes will be given for the better class of articles, and those which are used outside of this department will be paid for.

In addition to the articles covering experimental electrical apparatus in general, the editor will welcome articles of timely interest to the amateur field at large, such as criticisms and comments on Government legislation, unusual experiences during previous years of experimental work and suggestions for establishing amateur communications on a more scientific basis.

Experimenters who owned wireless stations in the early days—say, about the year 1904—should be able to write highly interesting articles on early experiences and attempts at communication with the type of apparatus in use at that time.

All contributions designed for the amateur field should be addressed to the Editor of the Amateur Department, The Wireless Age, 42 Broad Street, New York City.

BOOK REVIEW

Timely Book on Wireless Now Ready for Distribution

PRACTICAL WIRELESS TELEGRAPHY—By Elmer E. Bucher. Cloth Bound; 6¼ x 9½ inches; first edition; 322 pages; 323 illustrations. Wireless Press, Inc., 42 Broad Street, New York City. Price $1.50 Net.

The majority of books on wireless telegraphy have heretofore either been devoted to an historical resume of the art or to intensely theoretical explanations of high frequency phenomena. The greater part of the apparatus described is out of date, and hence the student seeking knowledge of modern commercial apparatus can obtain it only by attending wireless schools. A pressing need at present is a series of consecutive lessons in radio which will lead the beginner to a final understanding of commercial wireless telegraph apparatus.

This volume is not only one of the most comprehensive books that has appeared in the field, but it contains a wealth of subject matter which either has not been published previously, or has not been co-ordinated and placed in its proper relation to other parts of a complete wireless telegraph instruction system. The manner in which the text is prepared is particularly advantageous to the elementary student. The author describes and explains in detail the modern types of wireless telegraph apparatus up to the year 1917, beginning with the elementary principles of electricity and magnetism. The fundamentals are presented in a way that will permit the beginner to understand without difficulty the working of all types of wireless apparatus.

Three chapters are devoted entirely to elementary basic electrical principles. The motor-generator, the dynamotor and rotary converter are treated concisely and in detail. The nickel-iron and lead plate storage batteries, now supplied for emergency purposes with all commercial radio equipments are the subject of an entire chapter, a description of the apparatus associated with the charging of batteries and complete instructions for their care being published.

The radio transmitter is treated both in theory and in practice. The book contains complete diagrams, photographs and descriptions of modern commercial marine transmitters and instructions for the adjustment and operation of the apparatus. Receiving apparatus is treated in like manner, descriptions and working instructions being given for all types of up-to-date receiving sets, including the two and three-electrode valves.

A full chapter is devoted to practical radio measurements, showing in detail how to tune a transmitter and receiving set, how to measure inductance and capacity of radio telegraphic circuits, how to determine the strength of incoming signals and the method of plotting resonance curves. A complete explanation of ships' tuning records, Government tuning cards and everything pertaining to the adjustment of a wireless telegraph transmitter and receiver is published.

The emergency transmitters and auxiliary power apparatus of modern ship wireless sets are thoroughly described and illustrated. Descriptions in detail and principle of the Marconi direction finder are given and modern undamped wave transmitters and receivers are comprehensively told of.

The student, for the first time in the history of the art, is given a wide-embracing account of Marconi trans-oceanic stations. This includes their fundamental working principles, the details of the apparatus and the general plan of the great globe-girdling scheme of the Marconi system.

A series of questions appearing in the Appendix will appeal both to instructor and student. These questions relate to the text of the book and were written with the design of not only aiding the reader to obtain a Government license certificate, but to give him information regarding the apparatus for use in everyday practice.

The book is carefully arranged, each particular phase of the art being treated in separate chapters. Numerous formulae, tables and curves are given.

The Monthly Service Bulletin
of the
NATIONAL AMATEUR WIRELESS ASSOCIATION

Founded to promote the best interests of radio communication among wireless amateurs in America

Headquarters, 42 Broad St., New York

A DIRECTION FINDER OF SIMPLE CONSTRUCTION

SOME amateur experimenters believe that the direction finder is an apparatus complicated and mysterious, requiring such precise construction as to be beyond their skill in assembling. That the Marconi direction finder is an instrument of precision is a fact, but nevertheless it is possible for the experimenter to construct a simple direction-finding apparatus that will give a fair degree of accuracy.

Readers desiring a detailed description and account of the theory and of the series of experiments that led to the invention of the Marconi direction finder should refer to the article on this subject which appeared in the 1913 issue of The Year Book of Wireless Telegraphy. In that article they will find a most interesting discussion by C. E. Prince. The modern Marconi instrument is treated in detail in the textbook, "Practical Wireless Telegraphy."

Briefly, the fundamental principle of the Marconi direction finder is this: Experimental trials have thoroughly proven that a triangular looped aerial will receive with the greatest intensity when its plane points in the direction of an advancing wireless wave. When its plane is perpendicular to the incoming wave, the loop will receive no induction, that is to say, both sides of the loop are acted upon equally and there will be no response in the receiving apparatus connected thereto. At any intermediate position between the two points above mentioned, the loop will be acted upon inductively and the strength of the current (induced in the loop) will be proportional to the cosine of the angle between the advancing wave and the antenna.

In the Marconi direction finder, two stationary looped aerials are employed which, through the medium of the two primary windings, act inductively upon a receiving detector circuit, the secondary winding of which is made of a ball that can be rotated on its axis. By turning this ball the general direction of a given transmitter can be found by apparatus located within the station.

A simple direction finder for amateur use, however, can be constructed in which but one aerial is employed, provided the antenna is so arranged that it can be turned in a complete circle of 360 degrees. It will not always be convenient to erect an antenna of this particular style and shape required for this device, but many experimental stations

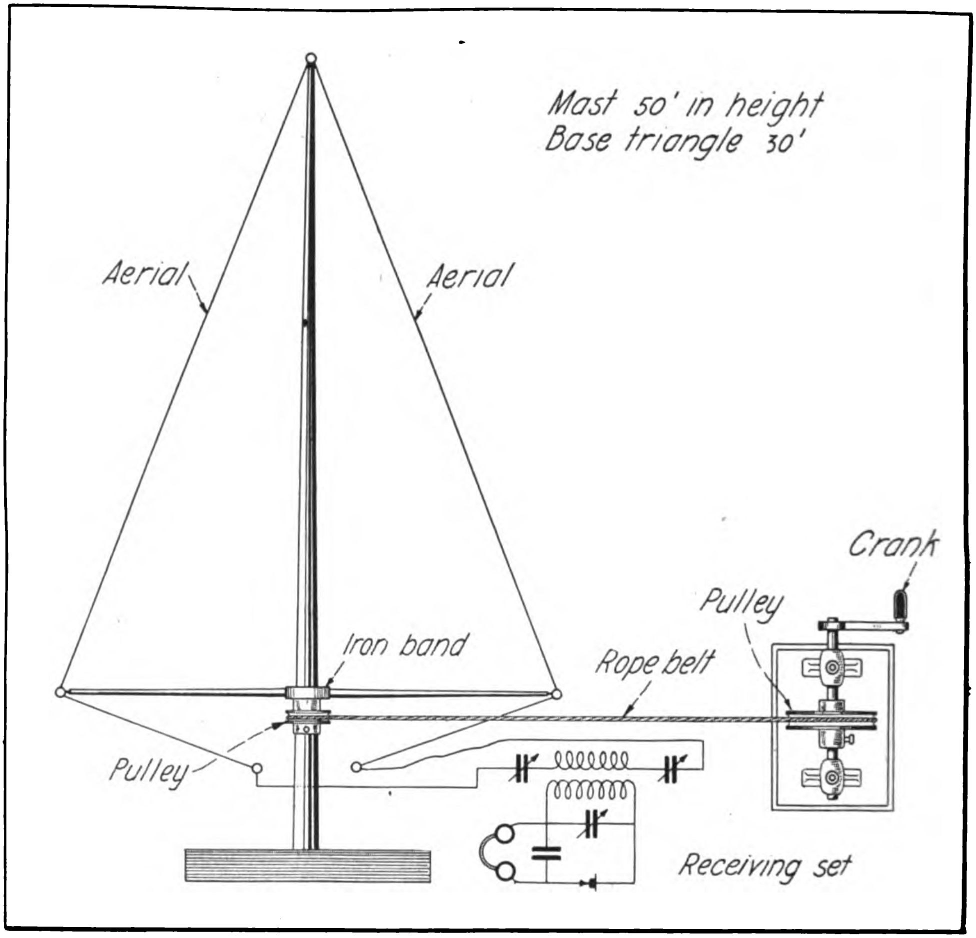


Figure 1.—Drawing showing design of direction finder

are so located that there will be no difficulty in erecting the proper structure.

The general design of the antenna is shown in Figure 1. It will be observed that the antenna has the form of an isosceles triangle, the apex of which is attached to the top of a 50-foot mast. About 10 feet from the earth, spreaders extend out from 15 to 16 feet on either side of the base, the two sides of the loop being bowed out and the lead-ins connected to the primary of a receiving tuner.

In order to find the direction of a station, it will be necessary to turn this aerial through a complete circle, and a variety of ways of doing it will suggest themselves to the experimenter. One method is shown in Figure 1, where a pulley is attached to the iron band at the base of the mast and extended within the station house to a smaller pulley to which is attached a crank. A rope belt, which is given a complete turn around the loop of the base of the mast, and also is attached to the pulley within the station house, is employed. It is necessary that the outriggers at the bottom of the mast should be attached to an iron band which fits loosely, permitting the entire antenna to be turned freely. It is also suggested that a cast iron socket be attached at the top of the mast, with a hole bored in it, to receive an iron peg with an eye through which the antenna can be threaded.

By interposing an inductance coil at the base and two variable condensers at either side, the capacity of which can be varied simultaneously by one control handle, the loop can be accurately tuned to a distant transmitting station. It will receive the maximum induction when it points in the general direction of a passing wave train.

By turning the entire antenna from one position to another, the maximum strength of signals will be obtained when the plane of the antenna points in the direction of the passing wave. The correct position is assured when the loudest possible signals are obtained in the receiving telephone.

Assume, for example, that the loudest signals are obtained from a given station when the loop points directly east and west; this will not indicate whether the passing wave is radiated from the east or from the west, but if the station, for example, is located near the ocean and signals are received at the wave-length of 200 meters, it is obvious that the station being received is located inland, unless by chance the ship should employ a wave-length of 200 meters, which is not at all probable.

Experimenters should see that the local detector circuit is coupled to the antenna inductance, and, in practice, should select the degree of coupling which will give the loudest possible signals. Beyond this to determine the direction of a given transmitting station, it is only necessary to turn the aerial on its axis. The accuracy of this direction finder will be rather surprising; in many cases a station may be located within two degrees of accuracy.

This apparatus will not only act as a direction finder, but it will permit the receiving operator to "screen out" a considerable amount of interference because, as previously remarked, any wave which advances in a direction perpendicular to the plane of the antenna will act equally on both sides and produce no current flow; in other words, the signal will not be heard.

If a sensitive receiving apparatus, such as the three electrode valve, is employed with a looped aerial of this kind, it will give nearly as strong signals as the ordinary aerial; in fact, by the use of looped aerials of enlarged dimensions signals have been received across the Atlantic ocean.

In a later issue we may describe the construction of a direction finder employing two-looped aerials which remain stationary, the direction of a given transmitting station being found by simply turning a handle attached to a receiving set within the station.

The United States Army and Navy Departments still require the services of several thousand radio operators to carry on war operations. Members of the National Amateur Wireless Association who are at least eighteen years of age and who have had several months of amateur experience, particularly those who possess first or second grade commercial licenses, should apply to the nearest recruiting office for further particulars. The N. A. W. A. should be well represented in all departments because its membership contains the most highly trained group of amateur wireless telegraphers in the United States.

Those who are not proficient enough in the telegraph code to average ten words a minute should either join a telegraph school or arrange a buzzer test outfit by which the necessary instruction can be obtained. There can be no doubt that the signalling divisions of the Army and Navy represent the most interesting and instructive fields for the patriotic young man desirous of serving his country.

Applicants who can qualify as high-speed telegraphers will naturally receive preference in appointments; hence, it behooves every member of the Association who desires to enter this field of the work to "brush up" in the telegraph code at once.

A reader writes: "The suggestions you put forth in a recent issue of The Wireless Age advising amateur operators to pay attention to their sending and to endeavor to acquire a more uniform method of forming the code characters have been noted. The points are so well taken that I wish to add my views on the matter.

"I have a criticism to offer. You have neglected to mention and segregate the various kinds of 'Morse mutilators' which we often hear. These do not exist in

Guglielmo Marconi receiving members of the Women's Division of the National Amateur Wireless Association at the Ritz-Carlton Hotel, New York City

the ranks of the amateurs alone, but may be found elsewhere. Take for example, the musical sender with the 'fife and snare drum habit,' the man who is troubled with a sort of fistic inertia; his sending sounds as if he were attempting to imitate some ragtime skit. He seems to forget that straightforward sending is not to be done to jig tunes. Then there is another type who forms his dots too briefly, but prolongs his dashes to such an extent that one receiving at the other end believes his key to be sticking. I cannot understand why all this extra effort is put in the dash. Why not save the power bill for the next dash? In other words, make the dashes of reasonable length and the dots of sufficient length so that they can be heard.

"There is still another type of sender coming within the scope of these remarks. This fellow, while transmitting to a far distant station, prolongs the code characters and slows down his speed. Evidently he believes that a slowly made radio signal will carry to a greater distance than one sent at the more normal speed of fifteen words a minute. Often we obtain the impression that such a sender is waiting for each word or call letter to reach its destination before sending out the next following.

"Finally, I might mention as undesirable the fellow who hammers the atmosphere unnecessarily about 200 times while he is merely adjusting the back stop of a telegraph key, never stopping to ascertain whether he is interfering with a neighboring station or not. This type of sender will keep on 'fuddling' with the key until he accidentally gets his fingers in the wrong place, whereupon the superfluous sending stops.

"The remedy in each and every case is obvious: Promiscuous sending should be abolished. Experimenters should make the characters as Professor Morse intended, clear and uniform and above all, they should keep quiet when they have nothing to say. They should not only aim to acquire speed, but should take care to form each dot and dash correctly and uniformly without unnecessary pauses."

One of the best methods of suppressing fatal amateur legislation is to inform your congressman of instances where amateur stations have supplanted existing means of communication and perhaps have been the means of saving human life. Tell him of the educational benefits derived in experimenting with the wireless apparatus and the fact that the services of the amateur have been of inestimable value to the War Department. Prove to him that the statements sent broadcast concerning interference on the part of amateurs are, in the majority of cases, without foundation, and that the 200-meter wave will in no way interfere with the working of a well-designed modern commercial station. Show him the possibilities of important inventions being made by experimenters whose activities are not curtailed by commercial demands and point out particularly that there are a few, if any instances, where an amateur station has done direct harm to the United States Government or to the operation of its stations.

TAKING LICENSE EXAMINATIONS

(*Continued from page* 838)

should use the symbols generally employed in wireless telegraph diagrams and should try to draw them in the simplest way possible, making sure in so far as possible, to keep all parts of the transmitting or receiving apparatus in the place where they actually belong in relation to other equipment.

It will be difficult to show the functions of an antenna change-over switch unless the operator has some knowledge of perspective drawing. If he is unable to make such a drawing, he should make a plan and elevation sketch, explaining briefly just how the various contacts function, and what office they perform in the different circuits. Particular care should be taken not to have an open circuit in any part of the wiring diagram, and above all, to avoid a haphazard method of drawing.

When giving a circuit diagram of the receiving apparatus, the student should remember that there are two methods in use of connecting the potentiometer in the local circuit of the carborundum crystal. In one circuit the potentiometer and head telephones are connected about the crystal and in another circuit about the fixed or stopping condenser. In the latter method, the current from the local battery circuit flows through the secondary winding of the tuning coil.

To turn to another phase of the examination—every student operator should strive to acquire skill in penmanship. It is a surprising fact that although many students have the ability to receive at a speed of from twenty to thirty words a minute, they cannot write legibly as fast as this. The result, oftentimes, is that when called upon to write at a speed equal to that of the reception of signals, their handwriting is so poor as to be undecipherable.

It should be kept in mind that a knowledge of the International Telegraph Regulations and the United States Navy Regulations is important. All students of wireless are expected to have an understanding of the more important rules, and particularly of the use of the "Q" signals by the use of which official conversation concerning traffic is carried on.

Careful attention to these matters will not only save the examining officials much trouble and labor, but will also tend to increase the efficiency of the radio operator; in short, it will offer more assurance of success in the examination.

The Marconi high-power stations at Glace Bay, Nova Scotia and Clifden, Ireland, have maintained for several years a twenty-four hour operating schedule for the transmission of trans-Atlantic traffic. A unique feature of these stations is the use of 15,000 volts direct current to charge the high voltage condenser, the source of current being 7,000 storage cells connected in series.

In place of the usual oil plate condenser, air condensers are employed which consist of a number of metallic sheets suspended on high voltage insulators, the di-electric being air at atmospheric pressure.

Both of these stations are arranged for duplex working, a transmitter and receiver on either side of the Atlantic being separated fifteen and thirty miles.

INCREASING THE RANGE OF SETS

I have read with interest the reports in The Wireless Age of the remarkable distances "covered" by amateurs of the West and the Middle West. It is generally believed by experimenters that small spark coils will not work well with an oscillation transformer, but I believe that if the average experimenter would take the trouble to construct one of the correct proportions and dimensions, the range of his apparatus would be noticeably increased.

For the maximum degree of efficiency it is quite necessary to tune the set by means of a hot wire ammeter and a wavemeter. If the experimenter does not possess the funds to purchase an aerial ammeter, he may make use of an ordinary 110-volt, 4, 8 or 16 candle-power lamp, connected in series with the aerial, with a fair degree of accuracy. Satisfactory constructional diagrams of both the hot wire ammeter and wavemeter, have appeared in previous issues of The Wireles Age and in the book "How to Conduct a Radio Club."

I tuned my transmitting set by means of a lamp such as mentioned, and, of course, did not thereby obtain the maximum efficiency but afterwards the set was tuned by means of a wavemeter constructed after the plan described in a previous article in The Wireless Age.

As a source of high potential I use one of the Duck Company's 2-inch spark coils operated by a 6-volt battery. With this transmitter, in time of peace, I can pick up IABO, South Meriden, Conn., about 18 miles distant from here, any hour of the day provided the owner of that station happens to be listening in. One day I was particularly surprised to hear that my signals had been picked up by the owners of IZZ, an amateur station located in Farmington, about thirty miles from here, but the signals were so weak that he could barely read me. This work was accomplished by using a coupling between the primary and secondary windings, separated by about 2½ inches.

The achievement of A. Petrie (station IEMP), located a couple of miles from my station is still more remarkable. He employs an oscillation transformer, a Manhattan 1-inch spark coil, condenser, stationary gap and a 4-volt battery, the entire set being tuned in the same manner as mine and the emitted wave being approximately 200 meters. With this small set his signals have been repeatedly copied by IABO, at a distance of about twenty miles. This, I believe, to be remarkable for a 1-inch spark coil operated from a 4-volt battery.

Florian J. Fox, *Connecticut.*

The United States Radio Regulations specify that the logarithmic decrement of the antenna oscillations in a spark transmitter must not exceed .2. This means that there must be at least twenty-four complete oscillations in the antenna circuit for each spark discharge at the gap. Modern spark dischargers, when properly adjusted, often give an antenna decrement of .03 per complete cycle which means that 150 complete oscillations take place for each spark discharge at the gap.

A properly adjusted spark gap is one which gives a clear spark discharge and does not permit the retransference of energy from the antenna circuits to the local spark gap circuit, once the antenna circuit is set into oscillation.

The decrement of a transmitter is measured by an instrument known as the decremeter which is simply a wave-meter with some sort of indicating instrument connected in series.

Ship's aerials in commercial radio service have either 4, 6 or 8 wires connected in parallel. It is found in the average case that four wires fulfil the requirements, but when the space for erection of the antenna is limited, eight wires are frequently employed in order to obtain the maximum possible capacity.

In the year 1873 James Maxwell presented a masterly treatise on electricity and magnetism and predicted the existence of electrical waves.

Marconi's first British patent for wireless telegraphy was filed June 2, 1906.

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

Reading Radio Signals With the Capillary Electrometer

I have found that the capillary electrometer originally described by Professor Lippman to be useful for reading radio signals by sight.

A description of the instrument follows: Referring to Figure 1, C is an ordinary soft glass tube, say one-fourth inch bore, and bent as shown. It is filled nearly to the top of the shorter limb with pure mercury. On top of this a

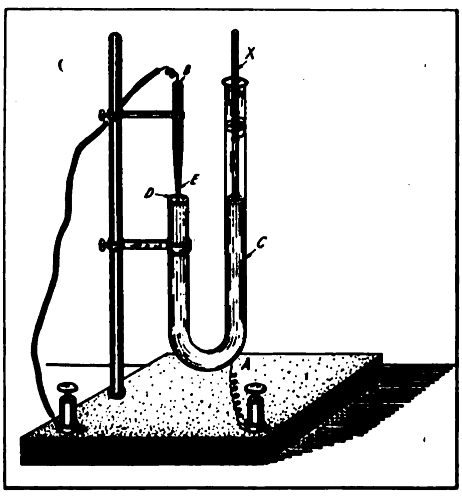


Figure 1, First Prize Article

small amount of twenty per cent. pure sulphuric acid is poured into D. Dipping into the acid is a small piece of capillary tubing drawn out to a very fine point at the lower end, E, and which is filled with clean mercury. It is necessary to construct several of these points of different lengths and degrees of fineness to find by trial the one which gives the best results with the particular instrument in use. In any case the point must be fine enough to prevent the mer-

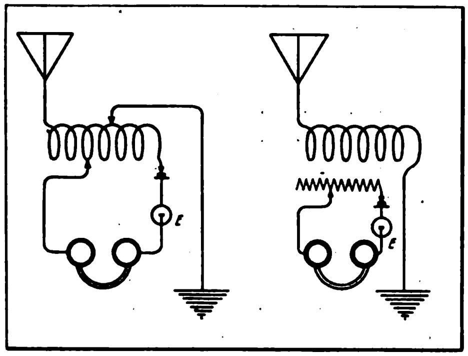


Figure 2, First Prize Article

cury running through by its own weight. The finer the tube is drawn out, the higher must be the column of mercury in the capillary tube. The inner bore should be about as fine as a human hair, but not too fine, otherwise the instrument will operate at a disadvantage.

X is a rod of ebonite or hard rubber which may be attached to the longer limb by a clip. It should be raised and lowered in the mercury until its level is properly adjusted.

To adjust the instrument for use, dip the point, E, into the sulphuric acid at D, and force the mercury out by blowing with the lips through the capillary. (*Don't Swallow.*) When the mercury is bubbling through the point in minute drops, stop blowing. It will then be drawn back for a short distance by capillary attraction and the sulphuric acid will follow up as it retracts.

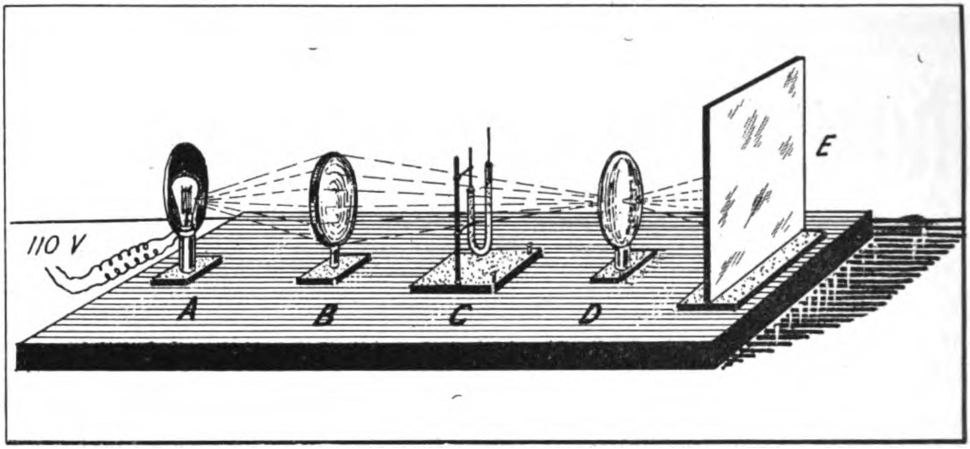


Figure 3, First Prize Article.

Connections brought to suitable terminals are made to the mercury at A and B with short pieces of platinum wire.

The vital point in connection with the operation of this device is that the most minute difference in potential set up between the two masses of mercury will, by affecting the surface tension, cause the fine point at the junction of the liquids at E to move perceptively up or down. The direction of motion will depend upon the direction of the flow of the current through the junction. So sensitive is the instrument that a motion is observed with the aid of a low power microscope even when the fingers are laid across the terminals.

If the electrometer be connected directly between the aerial and the earth, it will not be affected by wireless signals, but it is interesting to observe how it indicates varying electrostatic charges on the aerial wire. It is especally active during a thunderstorm and it is often possible by its use to predict within a few seconds when a flash of lightning will occur. As the potential rises on a charged cloud, perhaps many miles away, an opposite charge of increasing magnitude is indicated on the aerial and the little mercury column moves in sympathy a relatively long distance up and down. Then the flash occurs and the column falls back again with a jerk.

In order that the instrument may respond to wireless signals, the oscillating current must first be rectified; therefore a crystal detector is connected in series. The complete circuit is shown in Figure 2, where E is the electrometer. It is worth while to note that the telephones can be left in circuit with the electrometer and it is possible to read signals from the station in the ordinary way and at the same time to observe through a microscope or on a projected screen (which is preferable) the little column of mercury rising and falling in step with the audible spark signals.

It will be obvious that, after the column is once in proper adjustment the recording of signals is merely a matter of substituting an ordinary photo recording drum with suitable screening arrangements. Such an instrument, if made carefully, can be used in a variety of ways. For instance, by fitting a small electromagnet and a pencil, an excellent record of one's sending practice can be obtained. It can be also used to record earthquake shocks since the working parts of a seismograph are fairly simple to make. There are many other uses for the electrometer.

The general arrangement of the recording apparatus is shown in Figure 3. A is a powerful source of light (40-watt lamp), preferably with some sort of reflector; B a ground glass screen to distribute and diffuse the light; C the electrometer; D a double convex lens; E a plain white screen.

These parts are to be adjusted until the image of the electrometer tube is increased to four times its actual size. The image will be inverted. The connections at the electrometer must be reverse if necessary so that the image moves downward during the reception of a radio signal.

If the image be magnified about four times and the top of the column be marked by a dot of ink on the screen, when all is quiet, a downward movement of about one-fourth or one-third of an inch can be noticed from a distant station, while nearby commercial and powerful amateur stations cause the column to move one-half inch or more. The movement during the reception of very rapid signals was between one and three millimeters. This is ample for controlling a light spot. When the image is sharply focused, the screen is removed and the recording drum substituted.

Inasmuch as there are a great variety of simple recording drums open to the experimenter, that matter will not be discussed; in fact, the idea of substituting a recording drum is optional.

HERMAN EDWARD WERNER, *Ohio.*

SECOND PRIZE, FIVE DOLLARS

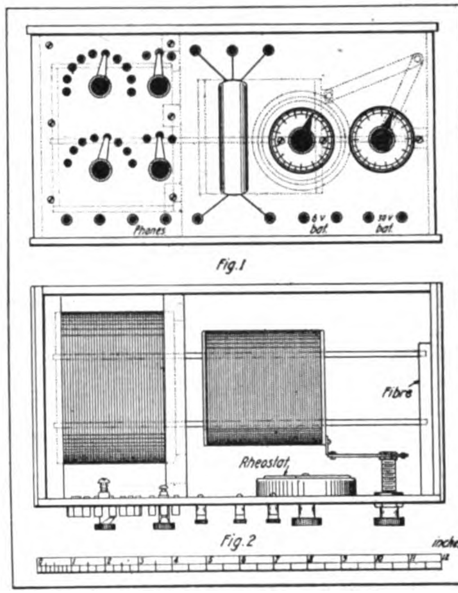
A Regenerative Receiving Set of Compact Design

One type of receiving apparatus which, above all else, held the attention of the amateur before the Government closed the amateur stations, is the regenerative tuner. While the amateur is for the time being, prevented from using wireless apparatus, there is nothing to hinder him from building new apparatus and have it ready for use when the Government restrictions are removed. With this thought in view, I shall describe a regenerative tuner which I have constructed and which gave excellent results on the 200-meter wave.

The cabinet shown in Figure 1, made of either maple or mahogany, is 12 inches in length and 6½ inches in width.

The primary winding of the inductively coupled tuning transformer is wound with eight turns of No. 22 D. C. C. wire. Taps are taken off every turn for the first ten turns and are brought out to a ten-point switch on the panel. A tap is then taken off every ten turns until eight taps are made. These, of course, are connected to an eight point switch.

The secondary has the same number of turns as the primary, but the winding is divided into three groups and three



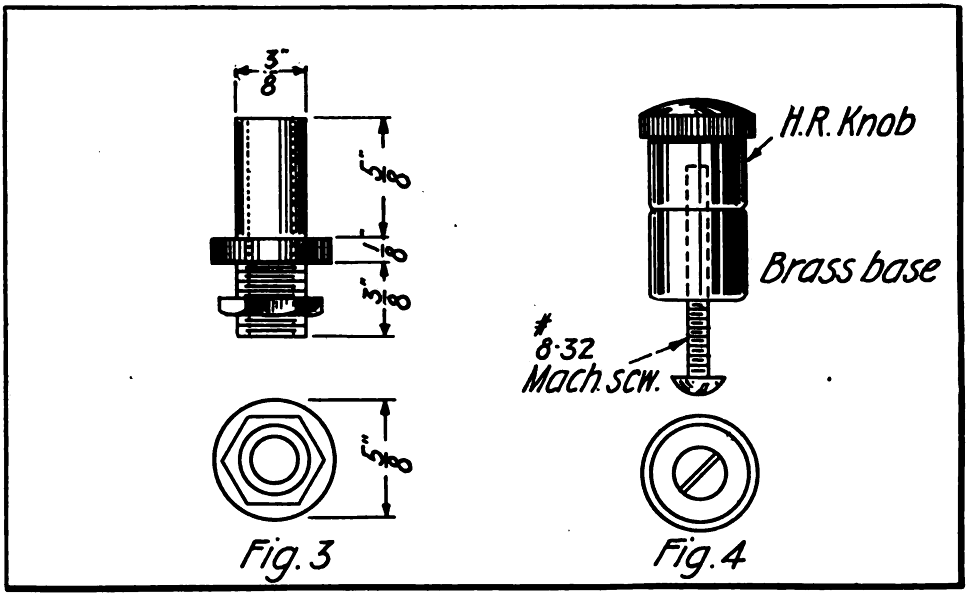
Drawings, Second Prize Article

taps are brought out through flexible cords to a three-point switch.

As will be noted from Figure 1, the secondary is moved in and out of the primary by a knob mounted on the front of the case by means of two brass strips constructed as shown to the right hand of the drawing. The longer of the two strips is 3 inches in length and the other 2½ inches in length. The 2½-inch strip is fastened solidly to a 3-16-inch brass rod which extends through the bushing shown in Figure 3 to the front of the panel upon which a knob and pointer are fastened.

The panel itself is of hard rubber or of bakelite. The scales for the various elements can be stamped on and filled in white, which gives them a very neat appearance.

The resistance for controlling the filament current of the vacuum valve is of the porcelain base type familiar to all amateurs. It is mounted directly on the



Drawings, Second Prize Article

panel. The high voltage batteries and control switches are mounted in a separate box and are connected to the binding posts shown in Figure 1. The variable condenser is screwed to the top of the cabinet and leads are brought down through to the panel.

Referring to the diagram of connections (Figure 5): A loading coil can be placed in series with the primary although it is not absolutely necessary. This coil can be made by winding 100 turns of No. 22 D. C. C. wire around a tube 6 inches in diameter, with the taps taken off every ten turns.

B, B, in the diagram are small stopping condensers made by covering both sides of a piece of mica, 2 inches by 1 inch, with tinfoil.

John B. Coleman, *Pennsylvania.*

THIRD PRIZE, THREE DOLLARS

A Multi-Contact Switch for Receiving Tuner Circuits

I have designed a multi-contact jack switch which may be put to a variety of uses in amateur receiving sets, particularly in changing the connections of a tuner for either the vacuum valve or a crystaline detector. I find that a switch of this type is inexpensive and can be constructed by anyone who possesses a small amount of skill and a large amount of patience.

I would advise the reader to follow my instructions thoroughly, as I have built several of these switches and have found, after trying several different designs, the construction shown to work the best.

The first part in the order of construction is the L arm or standard which supports the spring contact. As this arm is no part of the electrical circuit, it can be made of iron. It is also superior to brass because it is more rigid and in addition it can be heated to red heat and

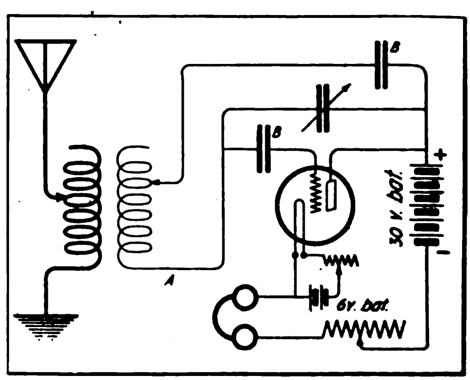


Figure 5, (diagram of connections) Second Prize Article

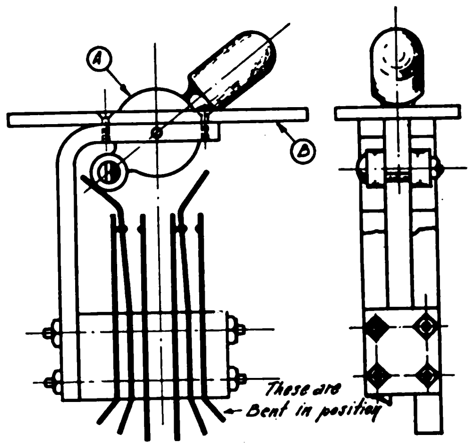


Figure 1, Third Prize Article

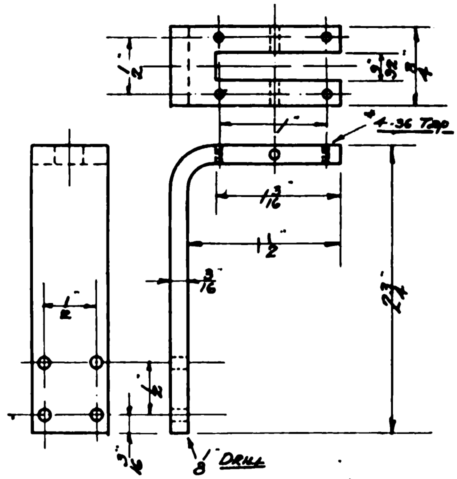


Figure 2, Third Prize Article

bent into position. If a piece of brass, for instance, were used, it would have to be bent cold and would be a much more difficult job. In addition, it will be found somewhat easier to tap the iron for the necessary machine screws.

After this part is constructed, the piece, A, can be made. It is constructed of brass and fitted with a hard rubber knob. It is mounted in position by means of a small pin or shaft so that it will rotate easily.

After this is completed, the hard rubber top can be made and a slot cut to take piece A so that the handle at the top can move freely from side to side.

In order to facilitate the easy moving of this switch, small roller bearings, made of fibre three-sixths of an inch in diameter and one-fourth inch in length are fitted on the lower end. These are mounted on a small stud or shaft which is then riveted over to prevent the rollers from becoming loose. Some may prefer to attach these rollers solid, but it should not be done, if possible, as the switch will work more easily if constructed in the way that I have described.

The springs should now be made and shaped according to the drawing. There are twelve in all. These are separated by pieces of fibre which can be made up of small thicknesses until the right position is obtained for each

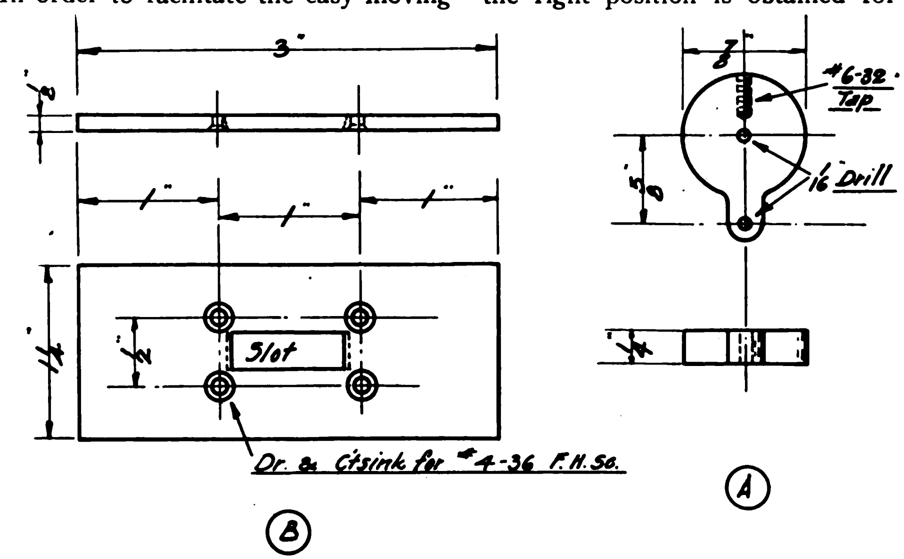


Figure 3, Third Prize Article

contact. In the building of these strips, it is best to drill one at a time and to use the holes in the standard for a template. The entire switch is then assembled and the spring bent in proper position as shown. To insulate these springs from the rods, the latter should be wound with a couple of layers of Empire cloth.

The knob shown for throwing the brass relay from right to left can either be made or purchased. It should be at least ½ inch in diameter, as this size brings the lever to a stop at the proper distance. I made my knobs of red fibre, which seem to present a good appearance in contrast with the hard rubber black top.

This switch can be mounted flush on the panel of a receiving set and will make a very neat appearance. By merely shifting the lever, any amount of connections or disconnections can be made according to the inside wiring. The details of construction of the switch are shown in Figures 2 and 3. The connections for this switch will be readily understood by the experimenter.

OMER E. COTE, *Rhode Island.*

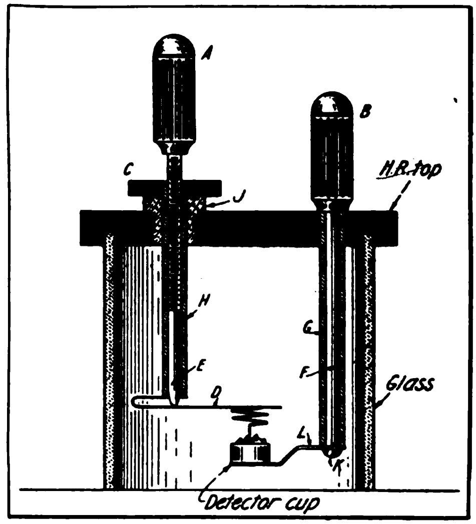
FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Dust-Proof Detector Which Overcomes Difficulties

To a considerable degree the accompanying drawing of a dust-proof detector I have used is self-explanatory. No dimensions are given as it can be constructed according to the materials at hand in the amateur workshop.

The crystal is mounted in a glass containing case which is an ordinary oil cup glass, such as used on gasoline engines. The top is made of hard rubber grooved to fit the glass. The brass bushing, J, should fit tightly or screw into the top; similarly the brass tube, G. The brass tube, H, should fit tightly enough to prevent it from turning in the bushing when the knob, A, is turned. A hard rubber knob, C, is fastened to the top of the tube.

A flat brass spring is soldered to the side of A and bent directly over the end of the tube. A spiral of No. 28 or No. 30 copper wire is soldered to the end of the spring to make contact with mineral in the detector cup. The cup is supported by spring L which is fastened to the end of rod F. This rod should not turn too

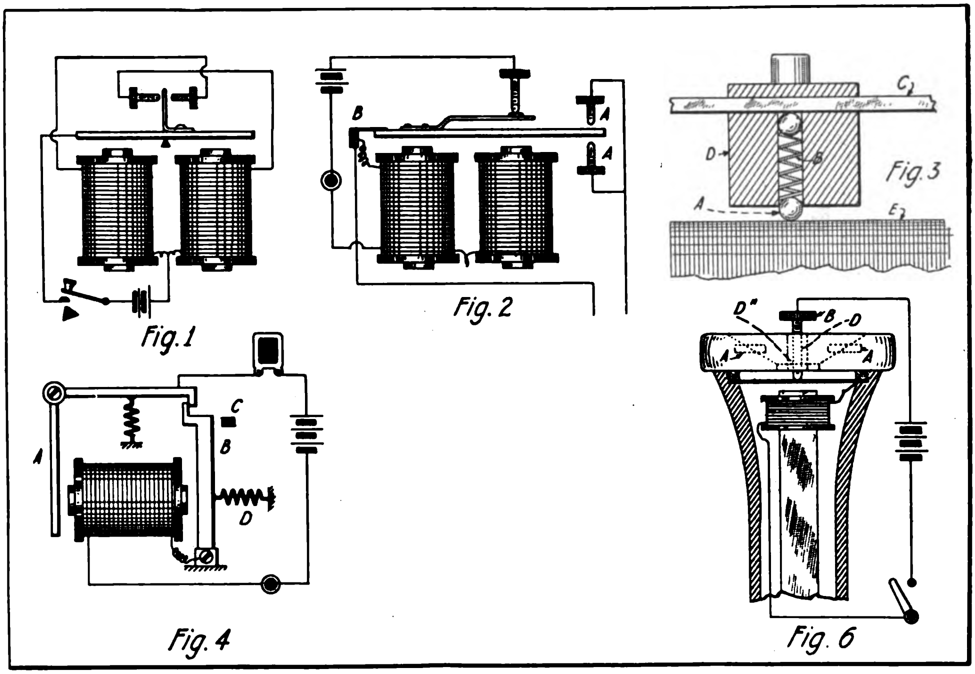


Drawing, Fourth Prize Article

freely in the tube, C, and it is adjusted by the knob, B. The hole in tube H should be small enough to be threaded with an 8-32 tap at the top for about a quarter of an inch. The remainder of the tube is drilled out with a No. 18 drill to clear an 8-32 screw. The spring, D, should be of such length as to permit the point at the end to reach the farthest point on the crystal when the cup is in the center. By alternately turning knobs A and B all points of the crystal can be reached and an extremely fine adjustment, which is hard to knock out, secured.

The detector is held firmly to the base by two one-eighth inch rods, threaded at each end and placed just inside of the glass tube. Up to the present my chief difficulty with the crystal detector has been not only a matter of the accumulation of dust on the crystal; the poor method of adjustment which the average holder afforded was disheartening. With the detector herein described, these difficulties have been wholly overcome, and besides it does away with the inverted crystal heretofore employed to prevent the accumulation of foreign matter.

ROY HOFFMAN, *Nebraska.*



Drawings, practical applicdtions of the electromagnet

HOW THE ELECTROMAGNET CAN BE PUT TO PRACTICAL USE

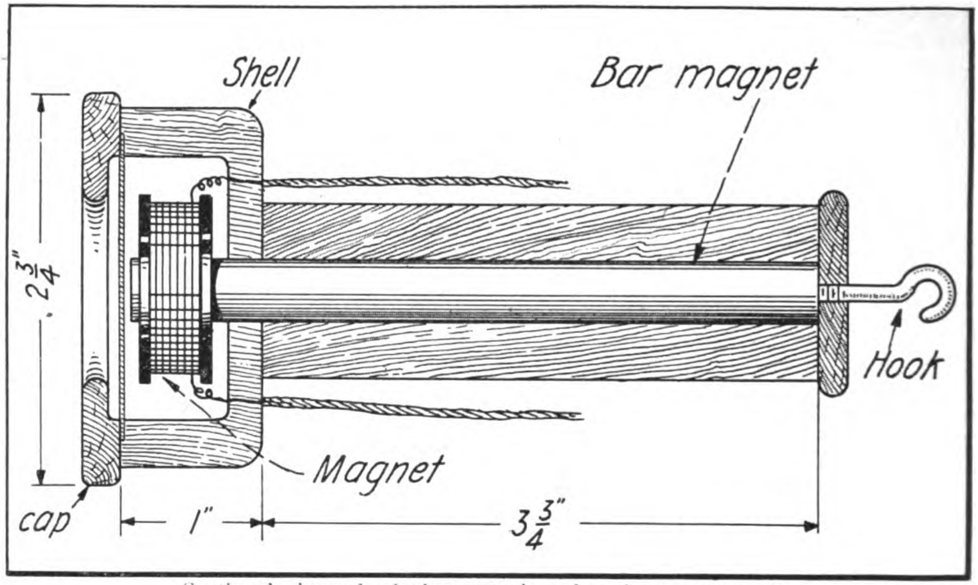
Before describing the various ways by which the electromagnet can be put to practical use in the experimental workshop, I should like to state that I have received my first copy of The Wireless Age and I am delighted with it. I like particularly the department "From and For Those Who Help Themselves" and best of all the "Queries Answered" department.

I have found that the simple electromagnet is one of the most important features of equipment about the average amateur station. The accompanying drawings show how it can be put to practical use.

Drawing No. 1 is a double action buzzer which is so simple that it needs no explanation. Drawing No. 2 shows how an electromagnet can be adapted for use as a tikker and thereby make audible undamped oscillations at any receiving station. If the spring on the vibrator is attached firmly to the soft iron armature, a very high rate of interruption will be secured, although if the spring is rigid a fairly high rate will be obtained with the ordinary construction. The circuit to be interrupted is of course, connected through the armature, B, and the opposite terminal of the circuit to either side of the stationary contact, K.

Drawing No. 3 shows a slider particularly suitable for fine wire tuners and giving the great advantage that it does not wear off the wire. In the drawing two ball bearings are shown at A; B is a spiral spring and D a copper tube built as shown. C is the slidder rod and E is the top of the tuner.

Drawing No. 4 shows a magnetic break arrangement which has to be set each time it is used. It is useful where only one surge of electricity is required to manipulate certain apparatus. When A is drawn towards the magnet, the lever, B, is released which spring D pulls back against C, thus breaking the circuit. This particular arrangement would have



Sectional view of telephone receiver for short amateur lines

better application on time clocks and similar apparatus.

When the D. P. D. T. switch is thrown over only one-half of the coil is in use, and the sliding contact can be progressively run over its turn, but if the switch is thrown to the opposite position the other half can be put into circuit and the tuning can be varied from this point on to the maximum value of inductance. This arrangement is especially adaptable to loading coils for the reception of long wave-lengths.

In drawing No. 6 is shown an arrangement whereby telephone receivers can be converted into a high frequency buzzer. At A are shown braces driven half way into the top of the receiver, and at B a contact screw which is held in place while the cavity is filled with plaster Paris and allowed to dry. The connections are made as shown. The buzzer is adjusted by screwing down the contact screw until contact is made with the platinum point mounted on the telephone diaphragm. I have found this to be a very efficient high frequency buzzer for testing the sensitiveness of wireless crystals.

Erwin F. Gray, *New York*.

AN INEXPENSIVE TELEPHONE RECEIVER

The telephone receiver of the type shown in the accompanying drawing is satisfactory for short amateur telephone lines, and although it may appear difficult in construction the exercise of a little time and patience will bring the desired results. A receiver of this type can be made from a piece of curtain pole 3¼th inches long and about 1⅛ inches in diameter. A hole ⅜ths of an inch in diameter is bored along the axis throughout the entire length. This is to hold the permanent magnet. The shell of the receiver is a cup-shaped piece of hard wood, 2½ inches in diameter and 1 inch in depth. It will have to be turned on a lathe. Its exact shape and dimension will be better understood by examining the drawing. The shell is attached to one end of the curtain pole with a good grade of glue.

The permanent magnet shown is a piece of hard steel, ⅜ths of an inch in diameter and 4⅝ths inches in length. The steel will have to be tempered or hardened before it will make a suitable magnet and this can best be done by a blacksmith who will heat the rod and plunge it into the water when at the right temperature.

One end of the steel bar is fitted with two thick fiber washers about ⅛th of an inch in diameter and spaced ¼th of an inch apart. The bobbin so formed is wound full of No. 36 B. & S. gauge single silk-covered magnet wire. The ends are passed through two small holes in fiber washers and then connected to a pair of heavier wires.

The wires are run through two holes in the end of the curtain pole, passing lengthwise from end to end, parallel to the hole bored to the receiver bar magnet.

The bar magnet is then pushed through the hole until the end of the rod on which the spool is fixed extends slightly below the level of the edges of the shell.

The two wires leading the magnet are run along the inside of the bar magnet and terminate. A suspension hook is attached to the receiver as shown. The diaphragm can be bought for ten cents. The magnet should fit into the hole very tightly so that it will not change its position, in fact, it should be fastened in place by set screws.

CLYDE R. BATTIN, *Ohio.*

A CARD INDEX OF AMATEUR STATIONS

Having an extra card index in my station which has been of inestimable value, it occurred to me that a similar one would facilitate the work of all experimenters, particularly those owning the more important amateur stations. The general plan I have put into use may be of interest to the readers of THE WIRELESS AGE.

Important or well known amateur stations were indexed, of course, according to station call, and then the location and distance from my station were jotted down. The balance of the card was used for other station information, such as could be gleaned from the magazines, and from acquaintance with the owners. Thus a sample card would be made up as follows:

9 ZF, Smith & Doig.
848 So. Emerson St., Denver, Colo.
Wave: 425800.
Power: 1 k. w. Hytone.
Description of set in May W. A.

In this way the amateur can become more familiar with the apparatus used by other experimenters, and he will have less trouble in choosing suitable instruments for his own set.

This same idea can also be applied to the information found in technical magazines on wireless subjects. I find it very helpful to jot down a note of every bit of valuable data I find in responsible publications, and then card index it. Then, at a later date, I can at once refer back to all the subject matter on a particular subject that I have in my magazines, which saves a lot of time and worry.

ARNO A. KLUGE, *Nebraska.*

The vacuum valve detector can be used to amplify the incoming signals of a radio station in a number of ways.

In the regenerative system, the amplification is effected by coupling the local telephone circuit to the grid circuit through the medium of a direct or inductive coupled oscillation transformer. Either the currents of audio or radio frequency can be amplified individually or by the use of an audio and radio frequency transformer, simultaneously.

In the cascade system of amplification, the strength of the incoming signals may be progressively increased by transferring them from bulb to bulb, and as in the regenerative system, either the currents of audio or radio frequency can thus be strengthened.

In the radio-frequency cascade amplifier, the local telephone circuit of the first valve is coupled to the grid circuit of the second valve, and so on throughout the series, the valves being coupled together through a conductively or inductively-coupled transformer. As many as six bulbs have thus been connected in cascade, but three bulbs only are ordinarily required. The radio-frequency amplifier permits a remarkable degree of selectivity in tuning out interfering stations.

Suggestions and Ideas for the Wireless Inventor

Timely Discussion on Unsolved Problems of the Art

DESPITE the scientific research that has been brought to bear upon the developing and perfecting of radio telegraph apparatus, there still remain certain unsolved problems which offer to the experimenter, with the time and facilities for carrying on such investigation, an unusual opportunity for original work. In fact, it may be said that the further development of radio telegraphy presents a practically unlimited field.

The all-important problem in commercial radio telegraphy is that of the total elimination of atmospheric electricity at the receiving station. The present methods of combating this interference consist in the use of a high-pitch spark note at the transmitter, the employment of abnormal power at the transmitter to give a strength of signals that can be heard above the roar of the atmospheric discharges and the use of special means at the receiving station.

The Marconi balanced valve receiver has helped largely to eliminate the crashing charges of static electricity in the telephone receivers, but the radio field still awaits the development of a device that will wholly eliminate this disturbing element. Another method of eliminating this interference is found in special adjustments of the three-element vacuum valve. If advantage is taken of the volt-ampere characteristic of this valve, then by manipulation on a certain critical point on the characteristic curve, the effect is to limit the production of sound in the local head telephone. This reduces the interference of crashing static discharges to a considerable degree, particularly when the "beat" method of reception is employed.

A direct advantage of a static eliminator would be that it would permit communication over extremely long distances with small amounts of power at the transmitter. To hasten the solution of the problem, a new principle must be discovered and, working under its guidance, an earnest student must construct some device which will permit only a uniform alternating current to pass through it, and will not be responsive to an irregularly pulsating aperiodic or alternating current. If this obstructor were placed in series with the antenna system, the heavy intermittent discharges of static would be eliminated. The requirements of the transmitter would be met by using a radio-frequency alternator or a battery of vacuum tube oscillators.

If the reader doubts the possibility of such a device, how will he account for the marvellous development in the application of the pure electron discharge for the production of radio-frequency currents (the conversion of D. C. into A. C.) for magnifying the incoming signals at the receiving station and the use of the electron bulb for the control of the antenna current? The possibility of the employment of these devices for such control was not even imagined or hinted at a few years ago. If the reader will reflect for a moment on the marvellous advances made in the past several years in the development of the vacuum valve, the probable evolution of an apparatus such as we mention will not seem so absurd after all.

The second problem which should draw the attention of all experimenters who have access to a fully equipped laboratory, is producing a vacuum valve oscillator which, in a single bulb, will convert direct current at a power of 2 K. W. into alternating current at a frequency of 500,000 cycles a second, i. e., invent a valve that will be useful for transmission of electric waves at the length of 600 meters. A transmitter of this type would, of course, require a complete change in present day ship station receivers, but if we take into account the selectivity obtainable by the use of undamped waves, the desirability

of this source of radio-frequency current will become apparent.

A device that remains to be perfected not only for use in radio telegraph work, but in other lines of electrical application as well, is the magnetic or hammer interrupter for induction coils. Years of thought and labor accompanied by the expenditure of large sums of money have so far failed to produce an efficient, continuously-operative interrupter that would handle, say, 1 K. W. of direct current.

If some inventor would devise a high-speed interrupter, one that would interrupt the primary circuit of an induction coil, let us say, at rates varying from 500 to 700 times a second and which would convert 2 K. W. of direct current into 15,000 volts alternating current, we would not only have a convenient means of attaining high voltage current, but also would be enabled to do away with the expensive motor-generator and accessory controlling devices which must now be installed on every vessel for use in connection with the wireless apparatus. This is a problem which can be undertaken by a radio amateur, a mechanic, or an electrician, even though he does not possess the most modern working equipment; money and fame await him who solves this vexed question.

Another way in which the time of the experimenter can be profitably utilized is in trying to discover some new basic principle whereby the waves of wireless telegraphy can be directed and confined to a definite zone. This is already possible by means of the Marconi directional flat top aerial or the Bellini-Tosi triangular aerial, either of which confines the greater part of the radiated energy to a definite direction; but what is wanted is a system that will confine the radiation to a very narrow zone. Such a system would prevent interference with other stations, even though several close to one another operated on the same wave-length.

The improvement of wireless receiving detectors offers an excellent opportunity for closer steps to electrical and mechanical perfection. Take, for instance, the magnetic detector. Although it leaves nothing to be desired from the standpoint of stability, it lacks sensitiveness on the lower range of wave-lengths. Assuming, however, that it had been made to nearly equal the vacuum valve detector in sensibility, the advantages of the device from a commercial standpoint would be so obvious as to require no further comment. Engineers generally assert that the magnetic detector will probably be further developed, but in so far as we are aware, no particular research along this line has been undertaken.

Another invention that will naturally follow the elimination of atmospheric or static electricity at the receiver will be improving the calling apparatus, i. e., the equipment of the local detector circuit at a receiving station, with a positive acting telegraph key relay that will actuate a bell and call the attention of the operator. Such a receiver would have particular value at an isolated wireless station conducting a limited service and on ships not having a constant watch. It would also be of use to lighthouses and lightships, in fact, in all cases where messages are transmitted intermittently.

Following the production of an apparatus of this kind would come the radio controlled torpedo, aeroplane, aero-bomb, etc. The aero-bomb would have particular application to modern warfare, because it could be directed to the enemy's line and so controlled as to discharge its cargo of bombs at the desired point. In fact, there are so many fields open for the use of radio controlled mechanisms, that this limited space will not permit their enumeration even by name alone.

Finally, it should be remembered that it is not always the highly trained scientific engineer who brings out the inventions most important and most beneficial to mankind. Numerous instances could be cited where inventions having great merit and wide commercial application have been evolved by men of limited technical knowledge. Many of the great inventions have been built upon foundations already constructed. The mere reading of the description of a device has frequently suggested an improvement and been made the basis of a greater invention.

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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

R. W. K., Norfolk, Va., inquires:

Ques.—(1) I note that when using a small copper wire as the opposing contact for a galena detector that the sensitive adjustment is frequently lost, and I have wondered whether this loss in sensitiveness could be prevented by the use of several fine copper wires connected in parallel, all of which are placed in contact at different points on the crystal.

Ans.—(1) We are inclined to believe that the single contact will give the best results.

Ques.—(2) I possess a non-synchronous rotary spark gap on which the electrodes are set 3-64ths of an inch apart. Is this separation too great? The voltage of the transformer is 40,000 volts.

Ans.—(2) The rotary spark gap apparently gives the best results with a minimum discharge gap, and if the construction of your rotary gap would permit the electrodes to be set within 1-100th of an inch without injury, this should be done

* * *

H. W., Rockford, Conn.:

The dimensions of the regenerative tuner shown in the June issue of The Wireless Age follow: The over-all length of the tuner, including the length of the rod upon which the coil slides, is 8¾ inches. The end pieces for supporting the rod are ¾ths of an inch in width and 3 inches in height. The wooden discs have an outside diameter of 4 inches, the diameter of the groove being 2½ inches. All three coils are in variable inductive relation. It is quite important in this circuit that there be a variable degree of coupling at the regenerative coupler. It should be obvious that in any inductively-coupled system the best results will be obtained by having the primary and secondary in variable inductive relation. This point requires no further discussion.

Each wooden core for the support of the windings is 1 inch in length and each groove is ⅛th of an inch in width.

* * *

J. A., San Juan, Porto Rico.:

If you will place the loading coil of your receiving set at a right angle to the primary and secondary windings of the receiving tuner. inductive effects between the two circuits will be reduced to a minimum.

It is not essential to wind either the primary or secondary coils of a receiving tuner with a single layer. Multi-layered windings give very good results, principally because they give a maximum amount of inductance with a minimum amount of resistance. If the coils of the receiving tuner are narrow, the multi-layered windings can be separated by a thin sheet of paper, but if the coils are rather long, say 3 inches or 4 inches, it may be of advantage to separate the various windings by an air space of at least one-fourth of an inch.

In the navy type of tuner using multipoint switches for variation of inductance, the wires leading to the studs on the switch are rigidly soldered in place. It is not difficult to take these taps from the winding; a hole is cut in the tube right at the point where the tap is to be taken, and the wire is doubled back upon itself and drawn through this hole until it reaches the stud on the switch. The connection is then soldered to the stud and the winding continued on. If the taps are taken in this manner, it will barely be noticed from the outside of the coil.

You need not fear loss in efficiency by the use of multi-layered coils, as they have proven satisfactory both for the reception of long and short waves.

* * *

G. S. V., Hurst, Ill.:

In order to satisfy yourself on the subject of radio range, you are directed to read the discussions in some of the more important textbooks on wireless telegraphy, for example, "Wireless Telegraphy," by J. Erskine Murray, or "Wireless Telegraphy and Telephony," by W. H. Eccles. The "Textbook on Wireless Telegraphy," by Rupert Stanley, discusses the subject more or less in detail. Various theories have been put forth to account for the increased range of transmission during the night hours, but they are more or less speculative.

You are referred specifically to pages 161, 162, 163, 164 and 165 of "Wireless Telegraphy and Telephony," by W. H. Eccles, a copy of which will probably be found on the book shelves of your local library.

If through a friend you can obtain a copy of the December, 1916, issue of the "Monthly Service Bulletin" of the National Amateur Wireless Association, you will find a complete circuit of the regenerative receiver applicable to the reception of waves at 200

meters. The dimensions of a loose coupler for this range of wave-lengths is given in the last chapter of the second edition of the book, "How to Conduct a Radio Club." The primary winding of a 200-meter coupler may be wound on a tube 3¾ inches in diameter by 2 inches in length, wound with eighty turns of No. 28 S. C. wire. The secondary winding may be 2¾ inches in diameter by 1½ inches in length, wound with sixty turns of No. 30 S. C. wire. The regenerative coupler may have the dimensions of the variometer shown in the book, "How to Conduct a Radio Club," and the inside winding of the variometer may, for example, be connected in series with the secondary winding of the receiving tuner and the outside winding in series with the local telephone circuit. This makes it an oscillation transformer.

* * *

F. G. H., Providence, R. I.:

You, of course, understand that during the period of the war, the use of transmitting or receiving apparatus is prohibited.

We have no distinct data on the life of the various vacuum valve filaments mentioned, but believe them to have about equal degrees of sensibility.

While an oak panel will do for mounting the elements of a receiving set if the panel is dry, bakelite or hard rubber is far superior, particularly if the apparatus is to be used in a damp climate.

You will not require a loading coil 40 inches in length to increase the wave length of your set to 10,000 meters. A coil 24 inches in length, wound with No. 26 S. S. C. wire, would fulfill your requirements. The secondary loading coil could be 30 inches in length, wound with No. 30 S. S. C. wire.

The book, "How to Conduct a Radio Club," describes fully the construction of a long distance receiving set.

* * *

W. O., Covington, La.:

You will find a complete answer to your query relative to the derivation of the formula, $\lambda = 59.6 \sqrt{LC}$, in the Appendix of "Practical Wireless Telegraphy," copies of which are now on sale.

* * *

H. W., Seattle, Wash.:

You are quite correct in your statement regarding the direction finder, namely, that it gives the line of direction and does not indicate, for instance, whether the signals emanate from the north or from the south. In the majority of cases, however, there can be no doubt on this point, as it is generally known in the case of the ship, for instance, which side of a vessel a given shore station lies. Take, for instance, the following example: If the direction finder was installed on the Jersey coast and radio signals were heard at the wave-length of 600 meters, and the direction finder indicated that the signals emanated from a point due east or west, and the line of direction over a period of one hour indicated an increasing angle from due east or west, the probabilities, 99 out of 100, are that the signals are radiated by a vessel at sea because the location of land stations in the United States is fully known. Beyond this a hostile station would be recognized by some peculiarity either in the operator's method of sending or in the tone of a spark. Operators in a given vicinity would easily detect a foreign sender.

If your direction finder will perform the functions you mention, it is a very valuable invention and one that would have universal application because it would remove the only ambiguity which the direction finder possesses.

The apparently mysteriously designed receiving set you mention is nothing more than a regenerative vacuum valve set wherein the local detector circuit is coupled back to the grid circuit. The local circuit can either be directly connected through the turns of the secondary winding or inductively-coupled.

The latter is probably the arrangement used in the apparatus you mention.

If one knows the capacity of the condenser and the effective inductance of the coil, and, furthermore, a scale of calibrations is furnished for the condenser over its entire range, the wave-meter can be calibrated by the following formula:

$$\lambda = 59.6 \times \sqrt{LC}$$

Where L = the inductance of the coil in centimeters.

C = the capacity of the variable condenser in microfarads.

The ordinary variable condenser will not give a progressive increase of wave-length in accordance with the condenser scale; consequently, you will have to make from eighteen to twenty-four calculations for a complete calibration.

* * *

G. H. K., Baltimore, Md., inquires:

Ques.—(1) Will you please explain what is meant by "corona" loss? I have often noticed this expression in electrical publications, particularly in reference to high voltages.

Ans.—(1) The term "corona" is applied to the glow which appears between two parallel conductors when subjected to a high voltage. When the voltage produces a visible discharge it is termed the visual voltage, but if the E. M. F. be gradually increased and the conductors are well separated, a glow takes place around it which is termed "corona." If the voltage still is increased, a brush discharge takes place and finally a spark discharge.

The energy dissipated by corona loss is often quite considerable. Such losses have been investigated experimentally by a number of noted scientists.

* * *

C. L. K., Chicago, Ill.:

We do not know the exact constituents of electrose except that it is a pulped vegetable fiber.

Hardfiber is cotton paper pulped in zinc chloride.

The diameter of 0000 B. & S. wire is .46 of an inch; No. 20 B & S. wire, .031 of an inch, and No. 36 B. & S. wire, .005 of an inch.

* * *

A. P. D., Portland, Ore., inquires:

Ques.—(1) What is the maximum value of capacity permissible for use across the secondary winding of a receiving tuner coupled in connection with a carborundum crystal rectifier?

Ans.—(1) We would arbitrarily place the upper limit .0005 microfarad for the maximum strength of signals, although larger values are frequently employed.

Ques.—(2) Where can I obtain a complete wiring diagram of the Marconi 107-A tuner?

Ans.—(2) A complete and detailed description of this tuner appears in the textbook, "Practical Wireless Telegraphy." It is a modified valve tuner, one which was formerly employed in connection with the Fleming oscillation valve, but has now been rearranged for use with the crystal rectifier.

* * *

A. R. K., Pensacola, Fla., inquires:

Ques.—(1) What is meant by note tuning? I frequently see the term employed in wireless literature.

Ans.—(1) Note tuning at the receiver is the adjustment of the telephone circuit for maximum response to a given spark frequency. It consists of tuning the local telephone circuit to the spark frequency of the transmitter. Various types of spark-frequency tuning circuits have been devised. The majority of them have an iron core inductance and a condenser in the telephone circuit which give this circuit a low natural frequency suitable to the spark of the transmitter.

Ques.—(2) What is the resistance of 1,000 feet of No. 36 wire in the Standard wire gauge?

Ans.—(2) 176.5 ohms.

Ques.—(3) What is the resistance of 1,000 feet of No. 36 wire in the B. & S. gauge?

Ans.—(3) About 420 ohms.

* * *

A. B. R., Atlantic City, N. J., inquires:

Ques.—(1) Please advise how the neutral position for the motor brushes is found on the motor generator sets of the Marconi Company.

Ans.—(1) The neutral position is found by experiment, or there may be marks on the rocker arm and on the frame showing the exact neutral position. In some types of motors the position of the brushes is fixed, but in other types their position can be altered by swinging a rocker arm upon which the brush holders are mounted.

In the event that the machine is not marked for the neutral position of the brushes, it may be experimentally found as follows: Place the handle of the starting box on the first contact and watch the brushes for sparking. If excessive sparking takes place immediately, shift the brushes until a minimum sparking is obtained. Then gradually pull the handle across the contact studs of the starter, slightly varying the position of the brushes until no sparking is obtained.

Ques.—(2) In several wiring diagrams of wireless apparatus which I have observed, I note the use of a telephone transformer in the local circuit of a receiving set which apparently has a step down ratio of turns. Why is such an instrument employed?

Ans.—(2) The telephone transformer is not employed where a pair of high resistance telephones are available. When the resistance of the receiving detector is much greater than that of the head telephone, high resistance windings are desirable, but if only a 150 to 500 ohm receiver is available, better signals will be received by a step down transformer.

The Baldwin telephone is completely described in the book, "Practical Wireless Telegraphy."

* * *

T. R. B., Toledo, Ohio:

The land stations of the United States are now under the supervision and control of the United States Navy, and to secure an appointment at one of these stations, you would be required to enlist for four years. Further particulars can be obtained from any naval recruiting office in the United States.

The Marconi Company requires the services of many ship operators to take care of the rapid extensions of its service, and you would have no difficulty in securing employment in the Eastern Division if you possess a first grade Government license certificate.

The article entitled, "Designing your own Transformer" appeared on page 193 of the December, 1915, issue of The Wireless Age. This is an excellent article and one which you would do well to study in detail.

We have not been advised that the Pupin static device has been perfected. In fact, we have no detailed information except that obtainable through the columns of the newspapers.

* * *

E. M. R., Detroit, Mich.:

The emergency apparatus on a trans-Atlantic vessel comprises either a 10-inch induction coil operated by a thirty-volt storage battery or a sixty-cell battery of sufficient capacity to run the motor generator direct.

* * *

A. B. L., St. Louis, Mo.:

In a paper presented by Dr. Alfred N. Goldsmith before the Institute of Radio Engineers, the subject of frequency changers is completely discussed, and you are referred to it for further information. In fact, the subject is so comprehensive that we cannot give space to a complete discussion of the principles upon which these devices operate.

The paper on the "Magnetic Amplifier for Radio Telephony" was presented before the Institute of Radio Engineers, February 2, 1916. It was reprinted in The Wireless Age in May 1916.

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D. V. A., Philadelphia, Pa.:

The bulletin you desire is entitled "Some Contact Rectifiers for Electric Current," issued by the Bureau of Standards. Ask for No. 94, Volume 5, issued in 1908.

Zincite and chalcopyrite in combination have been found to give good rectification; also zincite and bornite will work very well in combination as a radio receiver.

* * *

D. L. A., New Orleans, La.:

The Exide storage cells in the Marconi Service are rated from sixty to 224 ampere hours, and those of larger capacity are employed for lighting auxiliary lamps just as well as operating the motor generator.

It is customary to give the Exide cell an overcharge once per month. The pointer of the ampere hour meter is placed at point 50 followed by placing the cells on charge until the pointer of the ampere hour meter returns to zero. These switchboards are fitted with an underload circuit breaker which is automatically tripped when the pointer of the ampere hour meter returns to zero. Operating instructions for the care of these cells generally appear in the radio cabin. These cells are the property of the steamship company and not the Marconi Company. The radio operator is supposed to have sufficient knowledge of the charging panel so that he can take proper care of it. He should understand its manipulation either during charge or discharge.

* * *

A. B. G., Boston, Mass.:

Just how close the coupling of the oscillation transmitter can be, in order that the transmitter may radiate a pure wave, depends upon the action of the spark gap. If the gap is free from arcing, a rather close coupling can be employed, but if there is evidence of arcing, there will be a retransference of energy from the antenna circuit, and two waves will result. Whether or not two waves exist in the antenna system can be determined by means of a wave-meter placed in inductive relation to the earth lead.

* * *

D. R. B., Franklin, Pa.:

Faraday's discovery of electromagnetic induction was made in 1831. Quoting his own description, he said, "203 feet of copper wire in one length were coiled around a large block of wood: another 203 feet of similar wire were introposed as a spiral between the turns of the first coil, and metallic contact everywhere prevented by twine. One of these helices was connected with a galvanometer, and the other with a battery of 100 pairs of plates four inches square with double copper and well charged. When contact was made, there was a sudden and very slight effect at the galvanometer, and there was also a similar slight effect when the contact with the battery was broken."

Pierce's conclusions from the experiments he made with crystal rectifiers are fully set forth on pages 199 and 200 of the "Principles of Wireless Telegraphy," written by himself. Inasmuch as this is rather lengthy, we shall have to refer you to his textbook.

* * *

J. R. F., Howe, Ind.:

Contrary to your statement, the book, "How to Conduct a Radio Club," contains a complete circuit diagram for connecting one, two or three vacuum valves in cascade. The connections for the double vacuum valve amplifier given in that publication can be duplicated for a third vacuum valve.

In the book entitled "Practical Wireless Telegraphy," now on the press, complete circuits of all types of vacuum valve receivers are published, including those which amplify radio-frequencies as well as audio-frequencies.

* * *

A. D. S., Chicago, Ill., inquires:

Ques.—(1) What is the International keep out signal?

Ans.—(1) QRT, "stop sending," is generally used.

The signal, QRS, means "stand by, I will call you when required or needed."

* * *

O. A. P., Wallowa, Ore., inquires:

Ques.—(1) Can you advise me of a good method for polishing hard rubber for cabinet wireless receivers?

Ans.—(1) Tripoline wax rubbed on a buffing wheel will give a very neat polish.

Hard rubber can be brought to fine polish by first rubbing it with fine emery paper followed by another rubbing with fresh charcoal and oil.

* * *

C. E. M., Madison, Wis.:

It is doubtful whether the 1/6 K. W. transmitting set which you mention will permit transmission over distances of thirty to fifty miles unless the receiving station is equipped with a supersensitive receiving set such as a double vacuum valve amplifier. Ordinarily we would not expect a set of this power to transmit more than five or six miles, although under favorable conditions, increased range might be obtained.

* * *

R. B., Seattle, Wash.:

We have no information regarding the efficiency of the K. & C. wireless transmitting set.

The fading of signals which you mention is in some instances due to leakage at the transmitting apparatus, but in the majority of cases it is caused by conditions external to a transmitting or receiving station. It is generally believed that long distance transmission at night time on short wave-lengths is largely due to reflection and refraction of the advancing wave between the earth and the upper conducting shell above the earth's atmosphere, and since this conducting shell (from which the waves are reflected) varies in position from hour to hour, the signals vary in accordance at the receiving station. The actual cause of this phenomena has not yet been accounted for.

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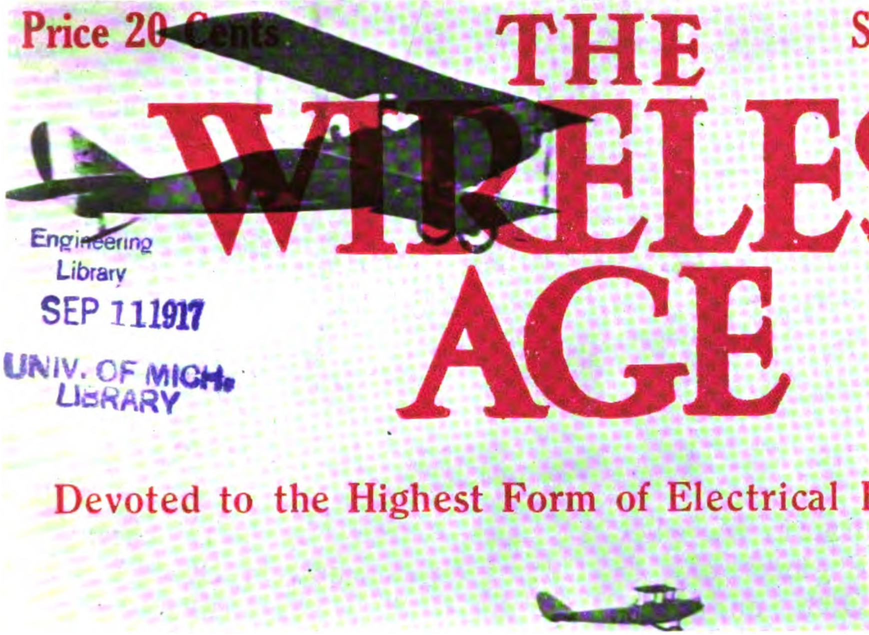

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MARCONI'S MESSAGE TO THE AMATEURS

WITH an entirely new light on the usage of wireless in the war, Mr. Marconi's utterances in this issue carry a tremendous inspiration to all wireless men. Their sphere of usefulness is not only made distinct, but tremendously important. And that there is room for all—nay, that all are ***needed*** —is made plain to the hundred thousand or more experimenters of this country. To illustrate the opportunities in the service, one need only refer to House Bill No. 5326, which provides for 75,000 officers and men for the air service. It is noted also that the recommendation of General Squier, Chief Signal Officer, U. S. A., and Vice-President, National Amateur Wireless Association, calls for 22,625 airplanes the first year! General Squier, upon whose shoulders rests the burden of supplying an air service for our soldiers, is a wireless man of note and close to the experimental field. No better man could have been chosen, from the amateur's point of view. Therefore, as it is his problem to fill up the Signal Corps ranks with competent and skilled men—a large proportion of whom are to be radio operators—so it is the duty of amateurs of ability to support him by coming forward for enlistment, irrespective of draft exemption and other considerations. THE WIRELESS AGE and the National Amateur Wireless Association will assist the experimental field in every way possible. More than ever, it rests with patriotic amateurs to prepare themselves for war service.

Marconi's message to the field clearly defines the duty of spotting artillery fire which devolves on the operator-aviator. How preparation for this reconnaissance work is being pursued in the United States is interesting. At the present writing there are some 1,200 student fliers hard at work in various educational institutions. They are studying to avoid many of the most serious mistakes made by foreign fliers in the early stages of the war.

One of the forms of laxity was in the adoption of a "popular" radio code instead of adhering rigidly to the technique of carefully devised symbols. A favorite signal, it is reported, for the concentration of artillery fire was F L H, literally an abbreviation of "Fire like hell." The home-made code of which this symbol is typical, was soon found to be more picturesque than practical and a code properly designed for effectiveness in attack and defense was quickly created to insure against error.

Fire control by wireless from aircraft is now considered an exact science. It is a matter of official record that in the battle of Messines Ridge so accurate was the information sent from an English air squadron that seventy-two German batteries were put out of action in the hours between dawn and six in the morning, when the attack began. It was due to this effectiveness in fire control that the English infantry stormed the slope and captured the key position with comparatively slight losses.

The young men of America who are being trained to transmit the radio messages while flying are now studying observation principles in an interesting manner. A birdseye view of a section of a typical battleground is represented in a picture spread on the ground, covering an area of about sixteen square feet and drawn from aviation photographs. The roads, rivers and houses, trenches and redoubts, appear as they would from a height of 7,000 feet above ground, at which altitude modern warfare aerial observation is secured. The student views this "landscape" from the top of a ladder, radio key in hand. The instructor manipulates a switch board and flashes numerous little electric lights distributed over the surface. Whereupon the embryo operator-aviator takes note of these imaginary explosions and ticks off appropriate fire control messages to supposed artillery.

WIRELESS IN TROPICAL EXPLORATION

ACCUSTOMED as the readers of THE WIRELESS AGE are to the strange experiences of wireless men, that of the radio operator who accompanied the scientific expedition of Dr. Alexander Hamilton Rice and his wife into the wilds of Rio Negro, South America, will command their deepest interest. Not content with making their way 2,100 miles up the Amazon River, a distance penetrated by few explorers, members of the party proceeded up the Rio Nego River to Santa Isabel and San Gabriel and would have pushed on still farther but for a freak of the inky stream the waters of which dropped steadily. This freak was directly contrary to the laws of nature for it took place during the month of February when, according to past observations, the river should have risen.

Although the journey of the adventurers through the jungle was marked by unusual incidents, the objects of the exploration were carried out. These included the testing of the practicability of wireless telegraphy in the wilds; study of the causes of certain tropical diseases; the fixing of certain latitudes and longitudes; the mapping of a large part of the Northwest Amazon basin, and the study of the constantly fluctuating channels of the Amazon and Rio Negro.

A noteworthy feature of the trip was the accomplishment of wireless communication with the outside world while the explorers were in remote parts of the jungle. Other adventurers had taken a day's journey into the wilds and found themselves entirely out of touch with civilization. But the members of Dr. Rice's party kept in communication with persons thousands of miles distant from the heart of the jungle.

Members of the Rice party steamed away from New York on November 15th, 1916, on the yacht Alberta, which was chartered by Dr. Rice from Frederick G. Bourne. A launch which was employed to explore the Rio Negro had been previously sent by steamship to Brazil. In addition to Dr. and Mrs. Rice, the party included Dr. W. C. Councilman of the Harvard Medical School; Dr. R. A. Lambert of the Columbia Medical School; W. H. Boyle, wireless operator; Dr. Ernest Howe, at one time attached to the United States Geological Survey; E. F. Church of the Coast and Geodetic Survey, and J. C. Couzon.

Accounts of the trip say that the Alberta steamed up the Amazon to Iquitos, a thousand miles farther than the point reached by Commodore Benedict on a previous exploring trip. Commander Todd is credited with having taken the gunboat Wilmington to Iquitos on one occasion and the British gunboat Pelorous also made the same journey.

The value of wireless was demonstrated at an early stage of the journey.

While the yacht was off Iquitos the radio operator picked up without difficulty signals sent from Arlington. They were sharp and clear, it is related, and doubtless afforded no small degree of comfort to the little band in the far away tropics.

Returning to Manaos in December, the explorers prepared for the topographical, hydrographical and geological work they had planned to accomplish in the Rio Negro. They also planned further testing of the portable wireless apparatus which was made especially for the journey.

The Rio Negro is quite true to its name, a black-water stream, and is unusually free from logs, drift wood and debris. In parts, however, there are rapids and cataracts which make navigation extremely dangerous. The explorers reached Santa Isabel, where they remained a week, and then proceeded on to Camamaos and later to San Gabriel. However, the falling of the waters in the Rio Negro made a change of plans necessary and the party started down stream, intending to reach the mouth of the Paduiri River and ascend it. But the low water again interfered and it was impossible to enter the mouth of the Paduiri. A large sand bank had formed at the mouth of the river and here the adventurers camped and took observations for longitude and latitude.

Then Dr. Rice and his companions descended the river along the north bank in an attempt to obtain an accurate map of this side of the river. After many mishaps they arrived late in March at Manaos.

At many points, wireless was successful in picking up the Arlington signals and Dr. Rice was struck by the fact that, save in one instance, all of the success in receiving was while the members of the party were on the south bank of the river. He was enthusiastic regarding the employment of radio, he declared on his return to the United States, and believes that the experiments made will be of great value to explorers in the future.

In this glimpse of the use of wireless and the wireless man in tropical exploration is found one of the impressive contrasts which from time to time meet the attention of those who follow the events connected with the art. It is interesting to note that while the nations of the world are devising means to further increase the effectiveness of wireless in warfare, its importance in other fields has not been lost sight of.

THE WAR ACTIVITIES OF WIRELESS MEN

ONE of the results of the world-war thus far has been to show the active part which wireless and wireless men have taken in the struggle. Hardly a week passes in which is not chronicled some deed of heroism on the part of a radio man, some achievement in which wireless did not largely figure. An instance in point was the attack by three Austrian cruisers on a line of British drifters employed in guarding anti-submarine nets in the Straits of Otranto.

On the Leonidas, one of the drifters, was a wireless operator who did not fail to live up to the standard of duty and courage set by his brothers among the Allies. The Leonidas was considerably damaged by the Austrian cruisers, but her radio man stuck to his post despite the efforts of the enemy to destroy the wireless apparatus. At the conclusion of the engagement he was found dead in his chair, having collapsed over the log in which he was writing at the moment of his death.

And even when the wireless man is not an active figure in world-stirring events he is a witness of them. An operator on a British vessel which recently arrived at an American port from Portugal, had an experience typical of those met with by men of the radio cabins. Standing in the rigging of his ship for nearly four hours, he saw the shelling of a defenceless town by a submarine, the rout of the U-boat by an American collier and eventually the submerging of the undersea craft.

The engagement took place in the harbor of St. Michaels, the Azores, early in the morning of July 4th. The submarine, which had two long-range guns, fired the first shot at the town at half-past three o'clock. This awakened the operator and others on his ship and even as they sought places of vantage to view the engagement a second shell exploded. Then followed a third explosion and the crew of the American collier, lying alongside, manned their guns and began firing.

From his place in the rigging the wireless man noted that the members of the collier's crew were free from excitement and worked their guns with remarkable speed. He saw the shells hurtling through the air and bursting, like sky rockets. He saw, as the dawn approached, the submarine retire out of range, driven to cover by the collier's fire. Then, when there was a lull in the shelling, the U-boat stole back to her former position, fired several shots and retired again. It was like a game of hide and seek.

This witness of the making of history had photographed on his mind an indelible picture, it is not every day that one has an opportunity to see a sea fight at close range, the privilege of being among the audience while an act of an international drama is staged. The seeker after adventure could not ask more.

NEW EMPLOYMENTS FOR THE ART

PEDESTRIANS in Broadway, in the heart of the New York theater district, have had their attention attracted for several weeks by a wireless station which flashed forth appeals for enlistment in the United States Signal Corps. "If you are a good enough wireless man to read this," ran the message, "why don't you enlist in the Signal Corps and help to can the Kaiser?"

The strength of this appeal is attested by the fact that in one day fifteen men heeded this summons and joined the Signal Corps. Thus was established another use to which wireless may be put. As the war progresses doubtless other new means of employment for the art will be found.

ELUDING SUBMARINES

IN the account of the chase of three speedy trans-Atlantic liners by submarines is found an illustration of how wireless enables vessels to elude the German undersea craft.

The liners were steaming abreast off the Irish coast, with a freighter in their wake, when the latter wirelessed a warning. The message said that she was being attacked by U-boats, one shot having already passed her bow. Those on the liners prepared to put on lifebelts, lifeboats were made ready for launching and orders were given for full steam ahead. The largest of the liners soon outdistanced the other two, but they learned by wireless afterward that the latter had eluded the submarines.

All of which leads to the conclusion that the Allies have reason to congratulate themselves on the fact that the far-reaching wireless is at hand as an effective means of protection against the enemy.

ANNUAL STATEMENT OF MARCONI'S WIRELESS TELEGRAPH COMPANY

THE annual statement of the Marconi's Wireless Telegraph Company, Limited, of London, shows that the net profit for 1916 amounted to £318,000. It was announced that at a general meeting of the Company to be held August 9th, the directors will recommend a final dividend of ten per cent. on the ordinary shares and five per cent. on the preference shares. This makes a payment for the year of fifteen per cent. on the ordinary shares and twelve per cent. on the preference shares.

The directors also recommend that the sum of £32,000 be placed in the general reserve and £380,000 carried forward in the profit and loss account.

The statement, which does not include the claim of the English Company against the British Government, is considered highly satisfactory under existing conditions.

THE REPORT OF THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY

AT the seventeenth ordinary general meeting of the Marconi International Marine Communication Company, Limited, held in London on July 4th, Godfrey C. Isaacs, the managing director, referring to the balance sheet, said that in the appropriation account, to the credit of profit and loss account, would be found the sum of £123,744, being the profit for the year plus the amount carried forward from last account after deduction of excess profits duty. The Company has already paid an interim dividend of five per cent., which amounted to £16,622 and it is now proposing to pay a final dividend of ten per cent., which will absorb a sum of £34,996. After placing £3,500 to reserve for payment of debentures, as is the yearly custom, and crediting the general reserve with £17,346, a sum of £51,279 is carried forward, which, of course, is subject to excess profits duty. The general reserve account has been increased from £17,639, at which it stood last year, to £47,653 10s., and to this figure was added £17,346 10s., bringing the reserve account up to £65,000.

The subsidies alone on June 30th, had increased to £431,713 per annum. Regarding this statement Mr. Isaacs remarked that " . . . you will appreciate the necessity of our summoning an extraordinary general meeting to ask you to approve of the Company's capital being increased by the creation of 250,000 new shares."

Before concluding his remarks, Mr. Isaacs related several examples of the bravery of Marconi operators. "Notwithstanding the great increase of risk and danger in the services which they perform," he said, "in no single instance has any one of them murmured, and in no case has any one failed in the critical moment to do a full and heroic duty."

FINED FOR BREAKING INTO STATION

Ellman B. Myers, who was indicted by the grand jury of Monmouth County, New Jersey, for breaking into the station of the Marconi Wireless Telegraph Company of America at Belmar and pleaded non vult, has been fined $500 and costs, amounting to about $40, and placed on probation for one year. The details of the case were printed in the June, 1917, issue of THE WIRELESS AGE.

A Visit From King Neptune in Mid-Pacific

What Happened When the Mythical Ruler of the Sea and His Retinue Came Aboard the Ecudor

Duckings in a Swimming Tank and Unwelcome Attentions From the Royal Barber—How the Monarch Was Received

By DAVID MANN TAYLOR

Marconi Operator

IN the days before steam, when sailing ships were prowling about the farthest corners of the Seven Seas, there was romance galore, as we have been assured by Captain Marryat, W. Clark Russell and other authors of their school. Richard Henry Dana and a few of his ultra-practical type, among whom are to be found several old-time whaling skippers of New England, stripped some of the romance from the voyages of wind-dependent ships by telling the truth about them. Nevertheless, we whose boyhood ambitions were fired by the stirring narratives of the first-mentioned writers, prefer to remember their romantic descriptions of life on the sea rather than the hardships and privations that fell to the lot of their heroes and heroines.

Sea-going nowadays is a business, for with the advent of steam the mariner is no longer compelled to rely entirely upon the vagaries of the ocean winds. In fact, voyages are now planned so minutely that the date and even the hour of the ship's arrival at her destination can be accurately determined before the vessel leaves port.

Fifty years of steam navigation have greatly altered sea travel and the old types of deep-water sailors and ships are rarely seen. There are some incidental features of ocean life, however, that have survived: Here and there, on overseas journeys to the antipodes and from America to Japan, many events crop out that make the voyager hark back to the days of the old square-riggers and their clouds of billowing canvas.

King Neptune's visit to a ship in the days of old was a noteworthy occurrence. The treatment of the victims was far from dignified, but a grotesque dignity marked the event notwithstanding.

King Neptune and his court taking leave with all the grotesque dignity which marks his equatorial visit

This article has principally to do with the visit which King Neptune made to the steamship Ecudor on May 19th, 1917, at half-past three o'clock in the afternoon. The vessel was crossing the 180th Meridian—the International date line in mid-Pacific—when the King and his consort, Queen Prosperine, with their retinues, boarded the ship, coming ceremoniously over the bows. Upon reaching the promenade deck, the King and Queen proceeded aft, meeting our commander, Captain R. Lobez, amidships, where greetings were exchanged. Escorted by the captain, the royal couple made their way to the throne room which had been erected upon one end of the large swimming tank on the after-deck. An address from the King to the passengers concerning his visit followed. It was interspersed with quaint nautical sayings by the Queen—in reality a sea-dog of the old school—one Captain C. E. Stewart.

At the conclusion of the address the culprits (those who had never crossed the line before) were arraigned before the King. With impressive manner the Court Herald announced that his royal master had learned that these malefactors had invaded Neptune's domains without permission. Now, he declared, they stood before his majesty to receive just punishment and later to be accepted as his loyal subjects.

The trial was brief, each culprit being found guilty with remarkable dispatch. He was then placed in charge of the Royal Doctor who, having taken his pulse, temperature and heart action, pronounced him prepared to go through the initiation. The Royal Barber was then called upon to take part in the ceremony. With a large paste brush in hand and a bucket of lather by his side, he thoroughly daubed the face of the victim, not neglecting to cover up his eyes, fill his ears and, if possible, his mouth. A large wooden razor was used for shaving and then the object of these attentions was thrown into the tank to be ducked.

There were seven culprits, five men and two women, but the King gallantly pardoned the latter. The remainder of the prospective victims, with the exception of one, pleaded guilty and accepted their sentences philosophically. The obdurate culprit demanded a sea lawyer. Considerable palavering followed, all of which was to no purpose—he was tipped backward into the tank.

This marked the conclusion of the ceremonies. The King was satisfied that in the future his laws would be respected and the new subjects were convinced that an entrance to Neptune's domains was not an event to be considered lightly. So, after the amateur photographers had been given an opportunity to snapshot the royal party, the visitors marched to the bows, where a farewell exchange of courtesies took place.

Then, with the same abruptness with which they had made their appearance, they nimbly vaulted the ship's rail and leaped into the sea, their leave-taking being marked by the splash of the waters in which the mythical ruler and his subjects dwelt.

WHEN MY SHIP WAS SUNK BY A TORPEDO

By Watson Sidney

ON March 18th the Aztec of the Oriental Navigation Company left New York for Havre, being the first armed American ship to leave an American port—after a sharp contest for this honor with the Manchuria and St. Louis.

At six o'clock in the morning of April 1st, one of the gunners on lookout sighted a submarine following the ship; she immediately submerged on sighting our guns, and we did not see anything more of her.

About 9:30 p. m. the Chief Engineer warned me that my port hole was showing light and I left the wireless cabin to take a look at it. As I stepped out on deck the wind was howling and rain and hail was falling. I kept close to the steel deck house for protection.

The chief gunner was standing at the rail, leaning over and searching the seas for signs of a possible submarine. I hailed him, asking if he had seen anything; he had not replied when a torpedo struck directly below where we were standing. The gunner immediately disappeared, and nothing more was seen or heard of him. Another man standing near had his head blown clean off. At the same instant I was struck by a piece of flying wreckage, which tore away the leg of my trousers and inflicted a gash fourteen inches in length in my left leg. The force of the explosion hurled me twenty-five feet along the deck.

I picked myself up and ran to the wireless cabin; there I found the apparatus completely wrecked and the water up to my knees. I then returned to the deck, and observed four sailors and three chinamen lowering a life boat. The rope fouled in the block and the ship's carpenter slashed at it. One end of the small boat dived down and was smashed to bits against the ship's side, spilling its seven occupants into the sea.

I went in search of the captain, to report the destruction of my apparatus, but failed to locate him in either the chart room or on the bridge. I returned to the deck and saw another boat lowered; it immediately rowed away from the ship. Nearby, I observed the captain talking with the naval lieutenant; he ordered me into the gunners' life boat, which was being lowered. As I jumped from the deck of the ship into the boat, followed by the captain and naval lieutenant, and left, the ship was settling fast. When we were about a hundred yards away we saw her slide beneath the surface of the sea, seven minutes after she was struck.

We had floundered around in the stormy sea for five hours when a French patrol boat, the Joan d'Arc, came in sight. We fired off our pistols, but they were not heard; and the lieutenant lighted a Coston distress signal which was observed.

The French officers took us aboard and gave us dry clothing and warm quarters.

The Aztec carried a crew of thirty-six men, of whom only six were rescued.

Signal Officers' Training Course

A Wartime Instruction Series for Advanced Amateurs Preparing for U. S. Army Service

FOURTH ARTICLE

By MAJOR J. ANDREW WHITE

Chief Signal Officer, Junior American Guard

IN Marconi's message to American amateurs, which appears elsewhere in this issue, the distinguished inventor and, now, war veteran, advises: "Begin at once some form of military training. Begin with essentials, and later take up the study of map reading and observation."

This message determines a slight deviation from the original schedule for this instructional series, designed to train aspirants for promotion in the U. S. Army Signal Corps. In the preceding articles what Mr. Marconi terms "essentials" have been covered; the student has been made familiar with the elementary instruction to make a citizen recruit a soldier, and the principles of drill which have been designed for uniformity, unity and agility of action. Since the purpose of this course is mainly for self-training and home study, it will not be amiss to devote this article to the recommended "study of map reading and observation."

It is not too early to introduce the subject here. I have tried the experiment within the past few weeks and found it practicable. Student soldiers-to-be of the Junior American Guard, encamped at Stony Point, N. Y., and familiar only with drill regulations and semaphore signaling, were given outpost work in a night attack and made a very successful reconnaissance. Then, applying their newly gained knowledge, they completed a military map of the terrain wherein the camp was located.

The type of map which is made for military needs is slightly different from those found in the ordinary atlas. At first glance it seems many times more complicated and appears to be very difficult of interpretation. Many candidates for officers' commissions become discouraged at this point and feel the subject so difficult of mastery that they mentally handicap themselves out of all proportion to the task. Map making and map reading is as simple as A-B-C if approached in the right spirit; every symbol and sketching method is based upon common sense visualization of the object it represents, and this minimizes the "memory trick" which many consider irksome.

It may be well to note here, before proceeding to the subject itself, that a knowledge of map reading is absolutely essential for a prospective officer in Signal Corps. It is obvious that communication lines cannot be laid without clear knowledge of the country, or terrain, in which the troops are operating. The shortest cut to mastery of the subject is *actual field work* and the student is urged to use the country about his home for practice, once the essentials have been grasped, as hereafter outlined.

Primarily, the function of the Signal Corps is the *speedy dissemination of military information.* Not only communication, but collection, of information is its function. Eyes and ears must be kept wide open at all times, if the signalman is to properly discharge his duty.

Signal Corps men must know *what* and *how* to observe. The book, "Military Signal Corps Manual," upon which this course is based, contains an abundance of material on this subject, a few extracts from which are given here.

Personal experience in the instruction of signal troops has demonstrated that mastery of map reading is best obtained by the student doing reconnaissance work—securing, himself, information of the country and sending back messages which can be easily understood.

In obtaining facts the following should be kept in mind:

Roads. Their direction, their nature (macadamized, corduroy, plank direct, etc.), their condition of repair, their grade, the nature of crossroads, and the points where they leave the main roads; their borders (woods, hedges, fences or ditches), the places at which they pass through defiles, cross heights or rivers, and where they intersect railroads, their breadth (whether suitable for column of fours or platoons, etc.)

Railroads. Their direction, gauge, the number of tracks, stations and junctions, their grade, the length and height of the cuts, embankments and tunnels.

Bridges. Their position, their width and length, their construction (trestle, girder, etc.), material (wood, brick, stone or iron), the roads and approaches on each bank.

Rivers and Other Streams. Their direction, width and depth, the rapidity of the current, liability to sudden rises and the highest and lowest points reached by the water, as indicated by drift wood, etc., fords, the nature of the banks, kinds, position and number of islands at suitable points of passage, heights in the vicinity and their command over the banks.

Woods. Their situation, extent and shape; whether clear or containing underbrush; the number and extent of "clearings" (open spaces); whether cut up by ravines or containing marshes, etc.; nature of roads passing through them.

Canals. Their direction, width and depth; condition of towpaths; locks and means of protecting or destroying them.

Telegraphs. Whether they follow railroads or common roads; stations, number of wires.

Villages. Their situation (on a height, in a valley or on a plain); nature of the surrounding country; construction of the houses, nature (straight or crooked) and width of streets; means of defense.

Defiles. Their direction; whether straight or crooked; whether heights on either side are accessible or inaccessible; nature of ground at each extremity; width (frontage of column that can pass through.)

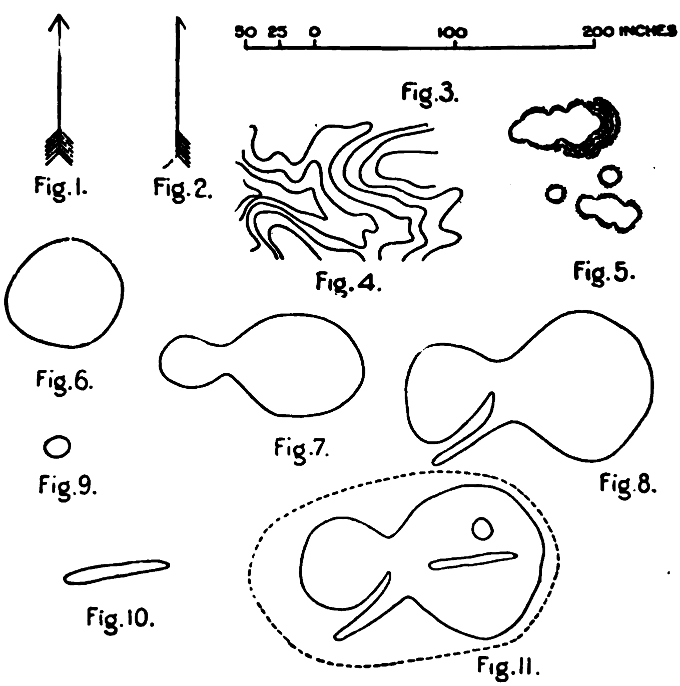
Ponds and Marshes. Means of crossing; defensive use that might be made of them as obstacles against enemy; whether the marshy grounds are practicable for any or all arms.

Springs and Rivulets. Nature of approaches; whether water is drinkable and abundant.

Valleys. Extent and nature; towns, villages, hamlets, streams, roads and paths therein; obstacles offered by or in the valley, to the movement of troops.

Heights. Whether slopes are easy or steep; whether good defensive positions are offered; whether plateau is wide or narrow; whether passages are easy or difficult; whether the ground is broken or smooth, wooded or clear.

The powers of observation are quickly trained by observing the facts of the landscape in view, in accordance with the foregoing, and making notes of



Elementary guides for the study of military map contours

the observation. Study of surroundings should be made by the watch, starting with a 10-minute observation from cover, and successively noting the facts obtained in 5 minutes, 3 minutes and 1 minute studies of terrain. Quick sketches, supplemented by marginal notes, are efficient aids in training for quick recording of observations.

When the student feels that he has mastered the art of *seeing* a landscape, rather than merely *looking* at it, the study of map reading may be begun.

Reproduced herewith is a portion of the military map which appears in "Military Signal Corps Manual," showing the vicinity of Fort Leavenworth, where the Army Signal Corps school is located. This may be used as a basis for elementary study.

The first question is: Where is north? On any map this can usually be told by an arrow (see Fig. 1) which will be found in one of the corners of the map, and which points to the true north—the north of the north star.

On some maps no arrow is to be found. The chances are a hundred to one that the north is at the top of the map, as it is on almost all printed maps. But you can only assure yourself of that fact by checking the map with the ground it represents. For instance, if you ascertain that the city of Philadelphia is due east of the city of Columbus, then the Philadelphia-Columbus line on the map is a due east-and-west line, and establishes at once all the other map directions.

Let it be understood that the map represents the ground as nearly as it can be represented on a flat piece of paper. If you are standing up facing the north, your right hand will be in the east, your left in the west, and your back to the south. It is the same with a map; if you look across it in the direction of the arrow—that is, towards its north—your right hand will be toward what is east on the map; your left hand to the west; the south will be at the bottom of the map.

There is another kind of an arrow that sometimes appears on a map. It is like the one in Figure 2, and points not to the true north, but to the magnetic north, which is the north of the compass. Though the compass needle, and therefore the arrow that represents it on the map, does not point exactly north, the deviation is, from a military point of view, slight, and appreciable error will rarely result through the use of the true north in the solution of any military problems.

Should you be curious to know the exact deviation, consult your local surveyor or any civil engineer.

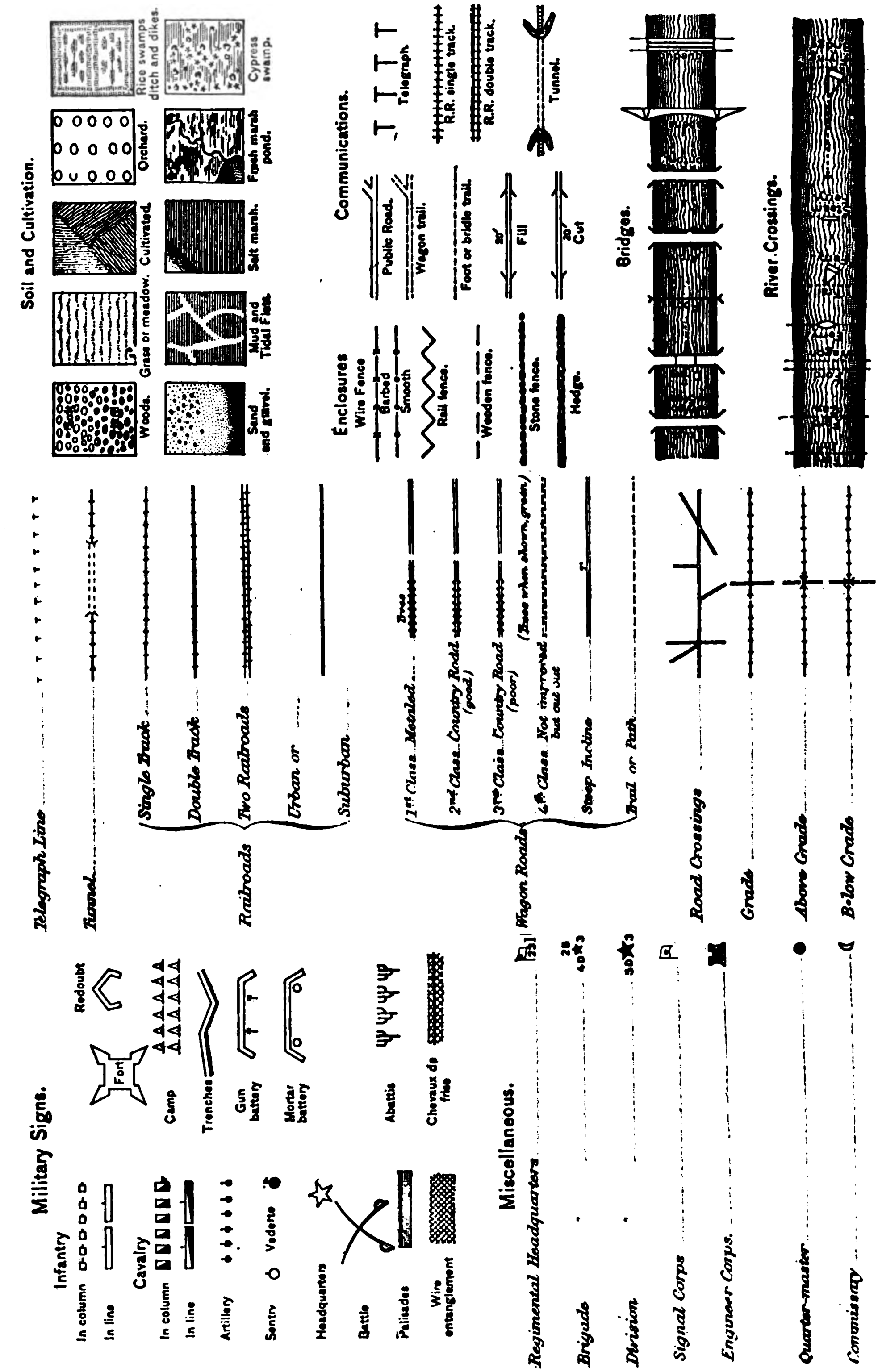
Both arrows may appear on your map. In that case disregard the magnetic arrow unless you are using the map in connection with a compass.

If a map is being used on the ground, the first thing to be done is to put the lines of the map parallel to the real outlines of the ground forms, and roads, fences, railroads, etc., that the map shows; for the making of a map is no more than the drawing on paper of lines parallel to and proportional in length to real directions and distances on the ground.

For instance, the road between two places runs due north and south. Then on the map a line representing the road will be parallel to the arrow showing the north and will be proportional in length to the real road. In this way a map is a picture, or, better, a bare outline sketch; and, as we can make out a picture, though it be upside down, or crooked on the wall, so we can use a map that is upside down or not parallel to the real ground forms. But it is easier to make out both the picture and the map if their lines are parallel to what they represent. So in using a map on the ground the lines are always placed parallel to the actual features they show. This is easy if the map has an arrow.

If the map has no arrow, you must locate some objects or features on the ground, and on the map, their representations. Draw on the map a line connecting any two of the features; place this line parallel to an imaginary line through the two actual features located, and your map will be correctly placed. Look to it that you do not reverse on the map the positions of the two objects or features, or your map will be exactly upside down.

When the map has been turned into the proper position—that is to say, "oriented"—the next thing is to locate on the map your position. If you are in the village of Easton and there is a place on the map labeled Easton, the answer is apparent. But if you are out in the country, at an unlabeled point that looks like any one of a dozen other similar points, the task is more complicated. In this latter case you must locate and identify, both on the map and on the ground, other points—hills, villages, peculiar bends in rivers, forests—any ground features that have some easily recognizable peculiarity and that you can see from your position.


Military Signs.
Infantry
In column
In line
Cavalry
In column
In line
Artillery
Sentry
Vedette
Headquarters
Battle
Palisades
Wire entanglement
Fort
Redoubt
Camp
Trenches
Gun battery
Mortar battery
Abattis
Chevaux de frise
Miscellaneous.
Regimental Headquarters
231
Brigade
28
40
3
Division
30
3
Signal Corps
Engineer Corps.
Quarter-master
Commissary
Telegraph Line
Tunnel
Railroads
Single Track
Double Track
Two Railroads
Urban or
Suburban
Wagon Roads
1st Class Metaled
Trees
2nd Class Country Road (good)
3rd Class Country Road (poor)
(Trees when shown, green)
4th Class Not improved but cut out
Steep Incline
Trail or Path
Road Crossings
Grade
Above Grade
Below Grade
Soil and Cultivation.
Woods.
Grass or meadow.
Cultivated.
Orchard.
Rice swamps ditch and dikes.
Sand and gravel.
Mud and Tidal Flats.
Salt marsh.
Fresh marsh pond.
Cypress swamp.
Enclosures
Wire Fence
Barbed
Smooth
Rail fence.
Wooden fence.
Stone fence.
Hedge.
Communications.
Public Road.
Wagon trail.
Foot or bridle trail.
20'
Fill
20'
Cut
Telegraph.
R.R. single track.
R.R. double track.
Tunnel.
Bridges.
River Crossings.

Suppose, for instance, you were near Leavenworth and wanted to locate your exact position, of which you are uncertain. You refer to the map, and, looking about, you see southwest from where you stand the United States Penitentiary; also, halfway between the south and the southeast—south-southeast a sailor would say—the reservoir (rectangle west of "O" in "Missouri"). Having oriented your map, draw on it a line from the map position of the reservoir toward its actual position on the ground. Similarly draw a line from the map position of penitentiary toward its actual position. Prolong the two lines until they intersect; the intersection of the lines will mark the place where you stand—south Merritt Hill.

After "What direction?" comes "How far?" To answer this, one must understand that the map distance between any two points shown bears a fixed and definite relation or proportion to the real distance between the two points.

For instance: We measure on a map and find the distance between two points to be 1 inch. Then we measure the real distance on the ground and find it to be 10,000 inches: hence the relation between the map distance and the real distance is 1 to 10,000 or 1-10,000. Now, if the map is properly drawn the same relation will hold good for all distances, and we can obtain any ground distance by multiplying by 10,000 the corresponding map distance.

This relation need not be 1-10,000, but may be anything from 1-100 that an architect might use in making a map or plan of a house up to one over a billion and a half, which is about the proportion between map and real distances in a pocket-atlas representation of the whole world on a 6-inch page. Map makers call this relation the "scale" of the map and put it down in a corner in one of three ways.

For the sake of an illustration, say the relation between map and ground distances is 1 to 100; that is, 1 inch on the map is equal to 100 on the ground. The scale may be written:

First. 1 inch equals 100.

Second. 1-100.

Third. As shown by figure 3.

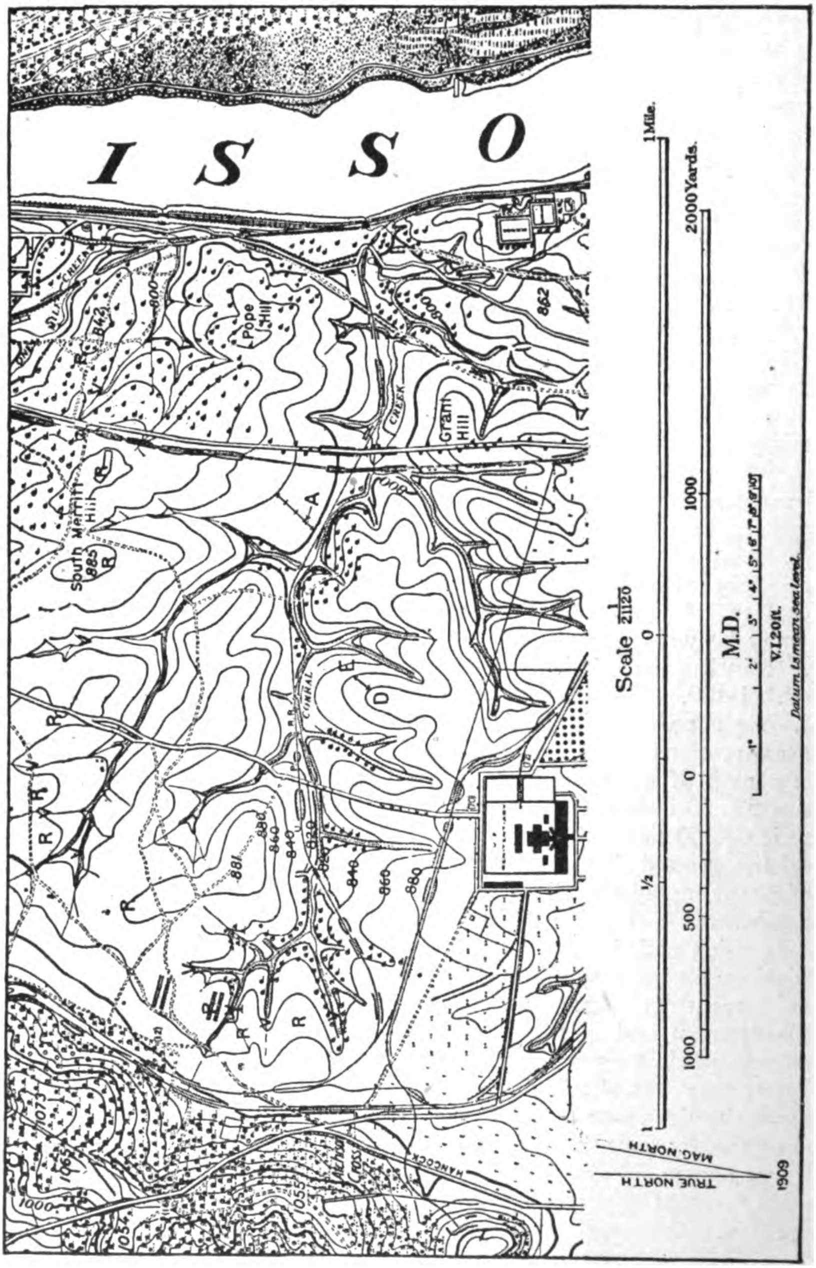
These expressions mean one and the same thing. A variation of the first method on a map of different scale might be: 1 inch equals 1 mile. Since a mile contains 63,360 inches, then the real distance between any two points shown on the map is 63,360 times the map distance.

To find the ground distance by the third kind of scale, copy it on the edge of a slip of paper, apply the slip directly to the map, and read off the distance; and so we answer the question, "How far?"

After direction and distance comes the interpretation of the signs, symbols, and abbreviations on the map. Those authorized are given, but there are a good many other conventional signs in common use. A key to them is published by the War Department and is called "Conventional Signs, United States Army." From these you read at once the natural and artificial features of the country shown on your map. It should be borne in mind that these conventional signs are not necessarily drawn to scale, as are the distances. They show the position and outline of the features, rather than the size. This, for the reason that many of the features shown, if drawn to scale, would be so small that one could not make them out except with a magnifying glass. If the exact dimensions are of any importance they will be written in figures on the map. For instance, bridges.

In addition to the conventional signs, we have CONTOURS to show the elevations, depressions, slope and shape of the ground. Abroad, HACHURES are much used, but they serve only to indicate elevation, and as compared to contours are of little value. Contours resemble the lines shown in Figure 4.

Hachures are shown in Figure 5, and may be found on any European map.



Military map of the vicinity of Fort Leavenworth, where the Signal Corps school is located

They simply show slopes and, when carefully drawn, show steeper slopes by heavier shading and gentler slopes by the fainter hachures. The crest of the mountain is within the hachures. (See Fig. 5.)

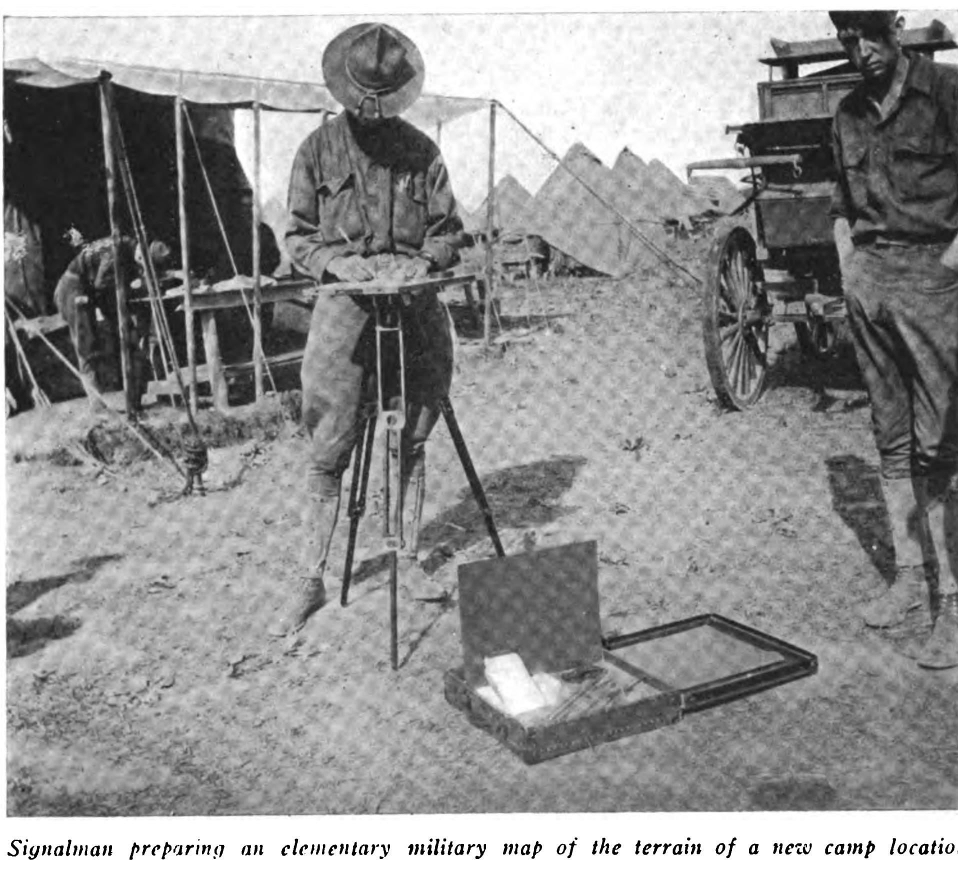
For examples of contours turn to the map and, starting at the United States Penitentiary, note the smooth, flowing, irregular curved lines marked 880, 860, 840, 860, etc.

The only other lines on the map that at all resemble contours are stream lines, like "Corral Creek," but the stream lines are readily distinguished from contours by the fact that they cross the contours squarely, while the contours run approximately parallel with each other. Note the stream line just to the west of South Merritt Hill.

The contours represent lines on the ground that are horizontal and whose meanderings follow the surface, just as the edge of a flood would follow the irregularities of the hills about it. Those lines that contours stand for are just as level as the water's edge of a lake but horizontally they wander back and forth to just as great a degree.

The line marked 880 at the penitentiary passes through on that particular piece of ground, every point that is 880 feet above sea level. Should the Missouri River rise in flood to 880 feet, the penitentiary would be on an island, the edge of which is marked by the 880 contour.

Contours show several things; among them the height of the ground they cross. Usually the contour has labeled on it in figures the height above some



Signalman preparing an elementary military map of the terrain of a new camp location starting point, called the DATUM PLANE—generally sea level. If, with a surveying instrument, you put in on a piece of ground a lot of stakes, each one of which is exactly the same height above sea level—that is, run a line of levels—then make a map showing the location of the stakes, a line drawn on the map through all the stake positions is a contour and shows the position of all points of that particular height.

On any given map all contours are equally spaced in a vertical direction, and the map shows the location of a great number of points at certain fixed levels. If you know the vertical interval between any two adjacent contours, you know the vertical interval for all the contours on that map, for these intervals on a given map are all the same.

With reference to a point through which no contour passes, we can only say the point in question is not higher than the next contour up the hill nor lower than the next one down the hill. For the purposes of any problem, it is usual to assume that the ground slopes evenly between the two adjacent contours, and that the vertical height of the point above the lower contour is proportional to its horizontal distance from the contour, as compared to the whole distance between the two contours. For instance, on the map, find the height of point A. The horizontal measurements are as shown on the map. The vertical distance between the contours is 20 feet, A is about one-quarter of the distance between the 800 and the 820 contours, and we assume its height to be one-quarter of 20 feet (5 feet) higher than 800 feet. So the height of A is 805 feet.

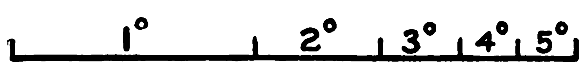
The vertical interval is usually indicated in the corner of the map by the letters "V. I." For instance, V. I.=20 feet.

On maps of very small pieces of ground, the V. I. is usually small—perhaps as small as 1 foot; on maps of large areas on a small scale it may be very great—even 1,000 feet.

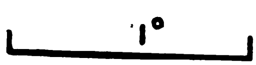
Contours also show SLOPES. It has already been explained that from any contour to the next one above it the ground rises a fixed number of feet, according to the vertical interval of that map. From the scale of distances on the map the horizontal distance between any two contours can be found. For example:

On the map, the horizontal distance between D and E is 90 yards, or 270 feet. The vertical distance is 20 feet the V. I. of the map. The slope then is 20/270=1/13.5=7½%=4½° in all of which different ways the slope can be expressed.

On a good many contoured maps a figure like this will be found in one of the corners:



On that particular map contours separated by the distance



on the vertical scale show a slope of 1°. A slope of 1° is a rise of 1 foot in 57. To use this scale of slopes copy it on the edge of a piece of paper just as you did the scale of distances and apply it directly to the map.

You will notice that where the contours lie closest the slope is steepest; where they are farthest apart the ground is most nearly flat.

It has already been set forth how contours show height and slope; in addition to this they show the shape of the ground, or GROUND FORMS. Each single contour shows the shape at its particular level of the hill or valley it outlines; for instance, the 880 contour about the penitentiary shows that the hill at that level has a shape somewhat like a horse's head. Similarly every contour on the map gives us the form of the ground at its particular level, and knowing these ground forms for many levels we can form a fair conception of what the whole surface is like.

A round contour like the letter O outlines a round ground feature; a long narrow one indicates a long narrow ground feature.

Different hills and depressions have different shapes. A good many of them have one shape at one level and another shape at another level, all of which information will be given you by the contours on the map.

One of the ways to see how contours show the shape of the ground is to pour half a bucket of water into a small depression in the ground. The water's edge will be exactly level and if the depression is approximately round, the water's edge will also be approximately round. The outline will look something like Figure 6.

Draw roughly on a piece of paper a figure of the same shape and you will have a contour showing the shape of the bit of ground where you poured your water.

Next with your heel gouge out on one edge of your little pond a small round bay. The water will rush in and the watermark on the soil will now be shaped something like Figure 7.

Alter your drawing accordingly, and the new contour will show the new ground shape.

Again do violence to the face of nature by digging with a stick a narrow inlet opening out of your miniature ocean, and the watermark will now look something like Figure 8.

Alter your drawing once more and your contour shows again the new ground form. Drop into your main pond a round clod and you will have a new watermark, like Figure 9, to add to your drawing. This new contour, of the same level with the one showing the limit of the depression, shows on the drawing the round island.

Drop in a second clod, this time long and narrow; the watermark will be like Figure 10, and the drawing of it, properly placed, will show another island of another shape. Your drawing now will look like Figure 11.

It shows a depression approximately round, off which open a round bay and a long narrow bay. There is also a round elevation and a long narrow one; a long, narrow ridge, jutting out between the two bays, and a short, broad one across the neck of the round bay.

Now flood your lake deeply enough to cover up the features you have introduced. The new water line, about as shown by the dotted line in Figure 11, shows the oblong shape of the depression at a higher level; the solid lines show the shape farther down; the horizontal distance between the two contours at different points shows where the bank is steep and where the slope is gentler.

Put together the information that each of these contours gives you, and you will see how contours show the shape of the ground. On the little map you have drawn you have introduced all the varieties of ground forms there are; therefore all the contour forms.

The contours on an ordinary map seem much more complicated, but this is due only to the number of them, their length, and many turns before they finally close on themselves. Or they may close off the paper. But trace each one out, and it will resolve itself into one of the forms shown in Figure 11.

"Send the Wireless Men Abroad Immediately"

"My Word to the Amateur of America is: Begin at Once Some Form of Military Training"

By GUGLIELMO MARCONI

Editorial Note: It is a well-known fact that Mr. Marconi has never written a line for publication. The article which follows is based on an exclusive interview which was given to the editor of this magazine in connection with his work as Acting President of the National Amateur Wireless Association, and is published as Mr. Marconi's official statement to the loyal wireless experimenters of the United States.

THE most striking feature of my observations since I have been on this official visit to the United States is the surprising ignorance of your wireless men concerning the conditions in the fighting zone abroad. It has required a readjustment of viewpoint for me to appreciate the fact that so much of the scientific development of the wireless art has been kept secret for military reasons; naturally the United States cannot know of things which to us have seemingly become elementary.

For example, it appears that American wireless men still look upon a portable set as a novelty; whereas, on the Western front, and particularly in the trenches, portable sets of all types have become indispensable. They vary in appearance from carefully designed equipments in neat containers to a key, coil and crudely manufactured accessories, strapped to a board. There has been no attempt at standardization—we have not had time.

A second impression, very general among Americans, is that wireless has not been a great factor in the war. In various quarters I have heard it said that you understood wireless was tried in the early months of the fighting and, being found impractical, was virtually abandoned so far as the army is concerned. Nothing could be further from the truth. To illustrate its great importance in modern warfare, I have only to say that with the exception of the first two or three months of the war, wireless has furnished the sole means of communication in the first line of trenches.

THE WIRELESS MAN HOLDS THE FIRST-LINE TRENCH

No longer are wire telephones and telegraphs used in the trenches bordering no man's land. We found it impossible to maintain these lines with the constant shelling by high explosives. When you go into a first-line trench today, you will find very little else occupying it but the wireless men. These trenches are not filled up with infantry at all times, as the popular conception has it. Unless an engagement is in progress, there will be found only a handful of fighting men with machine guns, distributed in small detachments about every 400 yards, and supported by the ever-present wireless man with his portable set. Through the continued and heavy shelling it is not possible to maintain many troops in these trenches, so until an advance of enemy infantry is observed, the wireless man and a few infantrymen to protect him are in sole possession. With the first observation of an infantry attack, the wireless man gets in action and sends back his call for troops from the supporting trenches. They pour in then through a traverse and the hand-to-hand engagement begins.

It can be readily seen from this that the Allies faced some serious problems in supplying the right sort of men for this duty, and, in fact, in supplying the armies with sufficient wireless men for their needs. We were far better equipped, however, than the Americans, because of the fact that the European nations had large standing armies with men well trained for their soldierly duties. It was better for us to take soldiers and train them as operators, and this we did. We had very little choice in the matter, however, because we had no great body of amateurs to call upon, as you have in this country. Your war problem, so far as wireless is concerned, is obviously directly opposite to ours —by our, I mean all the allied European nations. It appears to me the most logical, and the only practical thing to do here, since you have no great standing army, is to train your wireless operators as soldiers, which is a relatively short process when compared with the necessity which we faced of training soldiers technically. I do not know but that you are better off than we were, for this reason. It is certain, anyhow, that the United States can be a material factor in the war by sending us at the earliest possible date all its available wireless men.

What I have said may convey the impression that there is no such person as a wire operator at the front. On the contrary, there are a great many, as many I should say as there are wireless operators, but certainly not more. Their duties are a little different. They maintain the very important telephone and telegraph communications between the supporting trenches and the field bases, and keep in operation a network of connecting lines directly back of the fighting zone. There is a constant need for signalmen, and the American development of amateur experimenting having been so extensive, I look to the wireless men to make a great record in this war.

HOW AERIAL WIRES ARE STRUNG ALONG TRENCH TOPS

The trained signalmen of the United States Army are a fine, efficient lot, and they will do very effective service for us in France; but their numbers are so few they will have to be considerably augmented to occupy the space we provide in our tactical organizations. Furthermore, as with us before the war, the United States Army has done its field work on a maneuvre basis. They will have much to learn, and something to unlearn, just as we did. But used as a leaven for the host of civilian signalmen which can be quickly gathered together, they will be very valuable.

So pressing has been the need for operators, we have taught some of our men transmitting only, and assigned them to duties where a knowledge of receiving is not essential. It is, of course, obvious though, that a man who can both send and receive is far better equipped for duties where the lives of thousands of human beings are involved.

There seems to be a general misunderstanding in this country as to the use of aerials. I have heard it said that most American wireless men believe aerial wires are laid along the bottom of the trenches, and that masts have been dispensed with. This is not literally so. In the first line of trenches, the aerial wires are strung along a parapet just behind the barricade. Some of the aerial lines in the supporting trenches are raised a few feet above the ground. Still further back, where greater distances must be spanned, masts are used, but these are bamboo poles with a maximum height of twenty feet. We are not using the familiar sixty and eighty-foot sectional masts, which were part of all tractor wireless equipments before the outbreak of hostilities. And we use horizontal aerials, not so much to eliminate the size of the mark which draws artillery fire, as for convenience.

THE AIRCRAFT WIRELESS GOVERNS ALL ARTILLERY FIRE SPOTTING

Now in the consideration of wireless as applied to air service, I have a subject which caused me greater surprise than anything I have learned here as to American misconceptions of what has been done. The general supposition seems to have been that spotting of artillery fire has been accomplished through the use of various forms of visual signaling, such as flags and smoke bombs dropped from a 'plane. The truth of the matter is that our entire heavy artillery fire control is conducted by wireless from aircraft. At the very outset of the war, we had neither equipment, experience or personnel to accomplish this, so it was our custom to send up an observer with the airplane pilot who carefully drew a picture of the enemy battery emplacements, flew back to his own lines and dropped these drawings. This is no longer done. The observer now notes the results of his artillery fire and sends back by wireless such messages as "Too short." "Three to right." "Two to left," and so on.

The reconnaissance machines are protected by fighting 'planes which fly in squadrons over enemy lines, attacking every enemy machine they encounter, and thus allowing the observers to complete their work undisturbed. It is such an ordinary sight to see these airplanes at all hours of the day that their presence means nothing special to us. They are merely part of the great fighting machine which we have builded up. Their observations continue all day long and are of incalculable value. Many of the airplanes now in use show amazing development in power, speed and carrying capacity; we have quite a number of 'planes which carry as many as six or eight men armed with machine guns.

The wireless operator who makes the observations for fire control is provided with a map of the terrain blocked off into small squares. As he spots the fall of the shells, he sends back by wireless the number of the square and records a hit or gives directions for greater accuracy. While he is spotting he is continually subjected to tremendous shelling; white puffs of smoke break around the reconnaissance 'planes all day long, but it is surprisingly seldom that they are hit.

JUST WHY THE AMERICAN AMATEUR IS VALUABLE IN WAR

I do not know that I can say anything further than the generalities with which I have just dealt, because our technical development is a very carefully guarded secret. Quite amazing things have been done in the navy, as well as in the army, but I am not at liberty to disclose any of the details. I do wish to say this, however:

American wireless men are exceptionally well qualified to take an active part in important signaling work. Much valuable material will be found in the amateur ranks, as these young men are accustomed to transmission on short wave-lengths. A great deal of our communication is carried on with low power and wave-lengths in the neighborhood of 200 meters—the exact type of communication to which they are most accustomed.

We have not had the reserve of amateurs which the United States has to call upon. So the training of our soldiers for communication has been both rapid and continuous. For example, in Chelmsford, England, we have a school where seldom less than 400 men are studying at a time.

The demand for wireless operators is best illustrated by saying that at least half of the signalmen are wireless operators. The communication service is about equally divided between wire and wireless.

America is fortunate in having perfected its organization of the amateur field. The National Amateur Wireless Association, which has had my hearty support since its inception, has done valuable work in co-ordination and standardization of instructional methods. The younger men in the experimental field have a very definite place in the war scheme. The military laws of the allied nations did not permit using boys under eighteen, but I can see no reason why a boy of sixteen who has the necessary qualifications cannot be used; in fact, I think this will be done, if it is not already being done. Ability to communicate at a speed of twenty words per minute is adequate, for it is seldom that we have to use a greater speed than this, but while operation of this kind can be taught in a comparatively short time to any intelligent person, the amateur has a tremendous advantage in possessing the fundamental knowledge of wireless, which requires extended study. Extremely valuable also is his knowledge of all kinds, sizes, and types of low-power equipment.

MARCONI'S HOPE TO SEE YOU "OVER THERE"

My word to the amateurs of America is: Begin at once some form of military training. Begin with essentials, and later take up the study of map reading and observation; it will help wonderfully in increasing wartime efficiency and will be invaluable to those subject to draft.

I am not given to inspirational utterances as a rule, but I have been impressed and pleased with what I have learned of the work the amateurs are doing in the Junior American Guard. I had hoped to see them in an exhibition, but my engagements prevented this.

Perhaps it will not be long, however, before I will see many of them—over there.

Editor's Note.—This message to wireless men was given just before Mr. Marconi left America. His safe arrival in Paris on August 6th has since been announced.

Wireless Instruction for Military Service

A Practical Course for Radio Operators

ARTICLE V.

By Elmer E. Bucher

Instructing Engineer, Marconi School of Instruction

EDITOR'S NOTE.—This is the fifth installment of a condensed course in wireless telegraphy, especially prepared for training young men and women in the technical phases of radio in the shortest possible time. It is written particularly with the view of instructing prospective radio operators whose spirit of patriotism has inspired a desire to join signal branches of the United States reserve forces or the staff of a commercial wireless telegraph company, but who live at points far from wireless telegraph schools. The lessons to be published serially in this magazine are in fact a condensed version of the textbook, "Practical Wireless Telegraphy," and those students who have the opportunity and desire to go more fully into the subject will find the author's textbook a complete exposition of the wireless art in its most up-to-date phases. Where time will permit, its use in conjunction with this course is recommended.

The outstanding feature of the lessons will be the absence of cumbersome detail. Being intended to assist men to qualify for commercial positions in the shortest possible time consistent with a perfect understanding of the duties of operators, the course will contain only the essentials required to obtain a Government commercial first grade license certificate and knowledge of the practical operation of wireless telegraph apparatus.

To aid in an easy grasp of the lessons as they appear, numerous diagrams and drawings will illustrate the text, and, in so far as possible, the material pertaining to a particular diagram or illustration will be placed on the same page.

Because they will only contain the essential instructions for working modern wireless telegraph equipment, the lessons will be presented in such a way that the field telegraphist can use them in action as well as the student at home.

Beginning with the elements of electricity and magnetism, the course will continue through the construction and functioning of dynamos and motors, high voltage transformers into wireless telegraph equipment proper. Complete instruction will be given in the tuning of radio sets, adjustment of transmitting and receiving apparatus and elementary practical measurements.

This series began in the May, 1917, issue of THE WIRELESS AGE. Beginners should secure back copies, as the subject matter presented therein will aid them to grasp the explanations more readily. If possible, the series should be followed consecutively. The next issue will take up the fundamental principles of the dynamo and the motor.

THE MAGNETIC EFFECTS OF THE ELECTRICAL CURRENT

Electromagnetic Induction

ELECTROMAGNETIC PHENOMENA

Since the study of the magnetic effects of the electrical current constitutes an important phase of a student's elementary education, we shall review the more important phenomena of electromagnetism.

(1) As stated in a previous article, a compass needle, if suspended freely, will set itself in a certain definite direction; **it will lie parallel with the earth's magnetic field,** which is to say, the earth's magnetism exerts a force upon the needle and will hold it in this position.

(2) When the needle is in the position above mentioned, and a current-carrying conductor is placed either underneath or above, the needle will be deflected to the right or to the left, depending upon the direction of the flow of current or whether the wire is above or below the compass needle.

(3) If, for example, the needle is deflected to the right and the current in the conductor is afterward reversed, the needle will change its position and turn to the left.

(4) Or, if the wire is placed above the needle and the latter is deflected to the right and the wire is then placed below the needle, it will turn or be deflected to the left.

(5) The foregoing experiment demonstrates conclusively that the flow of electricity is always accompanied by a magnetic field, because, as previously shown, only magnetism will affect or turn a compass needle. The direction of the magnetic field is evidently at right angles to the wire for, if a strong current is passed through the wire, the needle will take up a position practically at a right angle to the conductor.

(6) The stronger the current the greater will be the deflection of the needle; also the further away from the wire the compass needle is placed the less will be the deflection. (Note Figure 19 following:)

(7) From the foregoing experiments we deduce that the magnetic field accompanying a current-carrying conductor has a distinct direction, which depends upon the direction of the flow of current (explained in detail further on). (Note Figures 20 and 21.)

(8) The strength of the magnetic field may be increased by coiling the wire into the form of a **helix.**

(9) It may be further increased from 200 to 2,000 times by inserting an **iron core** in the coil.

(10) Such a coil is termed a **solenoid** and its polarity will depend upon the direction of the flow of current. This coil is also known as an **electromagnet.**

(11) The magnetic force of the coil **depends upon the strength of the current and the number of turns in the coil.** A coil of 5 turns through which a current of 20 amperes flows will have the same magnetic effect as a coil of 20 turns with 5 amperes flowing.

(12) The product of the number of turns times the amperes is called the **ampere-turns.** The density of the magnetic field increases with the ampere-turns, but there is a limit to the number (of lines of force) which may be stored up in a solenoid with an iron core. This limit is called the **point of saturation.** An increase of current in the coil up to a certain point will increase the strength of the magnetism, but beyond this point an increase of current will have less and less effect until finally the core is completely saturated with flux.

(13) If a direct current of unvarying strength flows through a solenoid, the lines of force will stand still when the flow of current is fully established.

(14) If the rate of flow of current is increased or decreased, the lines of force will increase or diminish accordingly, or stated in another way, when the current rises, the lines of force move away from the wire, but when the current falls, the lines of force collapse back upon the wire.

ELECTROMAGNETIC INDUCTION

(1) If a bar magnet be suddenly plunged into a coil of wire which is connected in series with a current-measuring or indicating instrument, such as the **galvanometer,** the needle of this meter will give a momentary or brief deflection. This experiment indicates the flow of an electrical current through the coil because it requires a current to turn the pointer of a galvanometer. Evidently this current has been set into motion by the magnetic field thrust into the coil by the bar.

(2) If the magnet be suddenly withdrawn, the needle of the galvanometer will be deflected to the opposite direction. This experiment indicates that the current, during the withdrawal of the magnet, flows in the direction opposite to that mentioned in 1) because as previously mentioned, the direction in which the needle of a compass or a galvanometer will turn depends upon the direction of the current.

(3) To put it more plainly, when the bar magnet is plunged into the coil of wire and then withdrawn, an alternating current flows through the coil, i. e., a current first in one direction followed by a second current in the opposite direction. This current is said to be induced by **magnetic induction. It is the cutting of the lines of force through the coil which causes the current to be induced therein.**

(4) This experiment can be repeated by substituting a **current-carrying coil** for the bar magnet. The effects upon the galvanometer will now be much greater because a stronger magnetic field can be created by the **electromagnet,** than by the permanent or bar magnet.

(5) The same principle may be extended further. For instance, **if a wire is moved across a line of force, an electromotive force will be created in the wire. The greater the density of the lines of force or the faster the movement of the wire, the greater will be the electromotive force induced in the wire; and if the wire forms a closed circuit, a current of electricity will flow.** If, instead of a single wire, a number of wires properly connected in series, or in parallel, are employed, the inductive effects will be greatly increased and a much higher voltage or a much larger current will be induced in the coil.

(6) Scientists have determined that the cutting of 100,000,000 lines **of force per second by a wire will create an electromotive force of one volt.** The cutting of two hundred million lines of force per second will generate an electromotive force of two volts and so on.

(7) Machines for generating electricity by rotating a wire through a magnetic field are called **dynamos** or **generators.**

(8) Dynamos may generate **direct or alternating current,** but whatever the nature of the current the basic principle previously explained is employed, i. e., copper conductors are revolved through a magnetic field and the cutting through this field generates an E. M. F.

(9) Dynamos are driven by some source of mechanical power such as a steam engine, gas engine or water wheel. Dynamos driven by electric motors are called **motor generators.**

(10) If an external source of electricity is connected to a direct current dynamo, it will revolve as an electrical motor, the electrical current being converted into mechanical energy. All direct current dynamos will act as motors and all direct current motors if driven by mechanical power will generate a current of electricity.

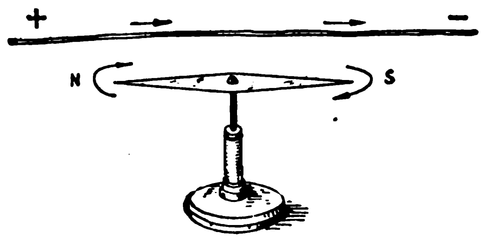


Figure 19

OBJECT OF THE DIAGRAM

(1) To show how a compass needle is deflected by the magnetic field of an electric current.

(2) To prove that a magnetic field accompanies the flow of an electric current.

PRINCIPLE

The flow of electric current through a conductor is accompanied by a magnetic field at right angles.

DESCRIPTION OF THE APPARATUS

An ordinary compass needle is placed on a pivot and allowed to come to rest. A current-carrying conductor is placed parallel to the needle and above it.

OPERATION

If a direct current of electricity flows through the wire, the needle will turn at right angles in the direction shown by the arrows.

If the current is turned off, the needle will return to its original position.

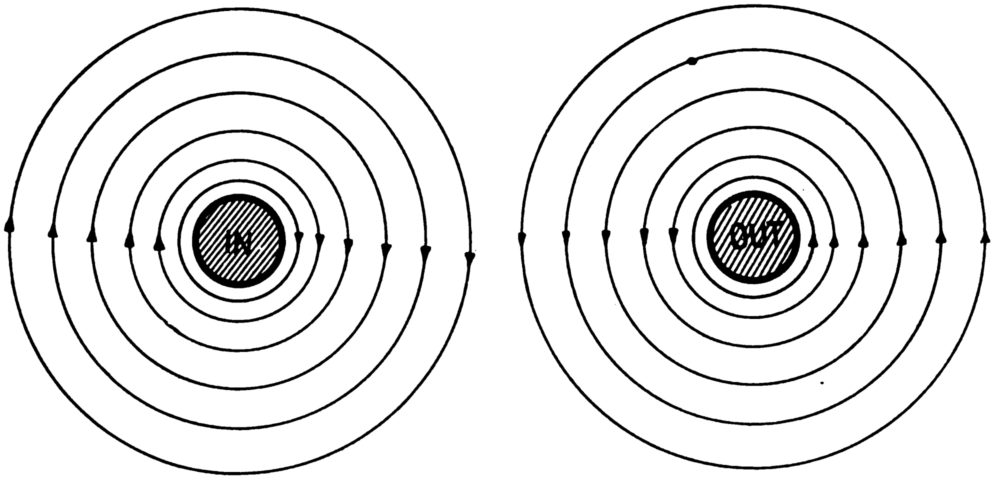
If the current in a horizontal conductor flows towards the north and the compass needle is placed under the wire, the north pole of the needle will be deflected towards the west.

If the current in a conductor is reversed, the needle will be deflected in the opposite way.

SPECIAL REMARKS

(1) From this experiment we deduce that magnetic lines of force exist in concentric circles around a conductor carrying electrical current.

(2) By enlargement of the principle shown in Figure 19, using a coil of wire of several turns, an increased effect upon the needle is produced. (See Figure 28.) The apparatus can then be employed to measure the intensity of currents. Such a device would be called **a galvanometer.**



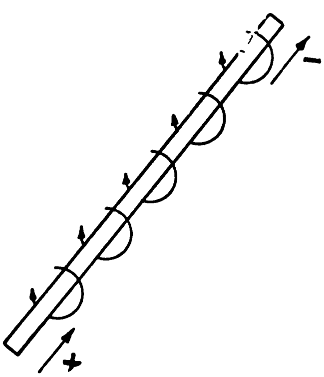


Figure 20

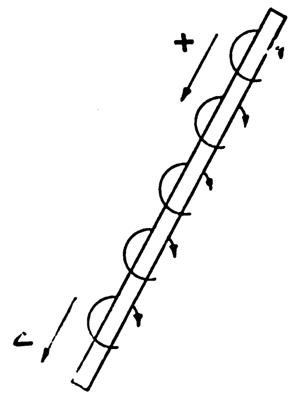


Figure 21

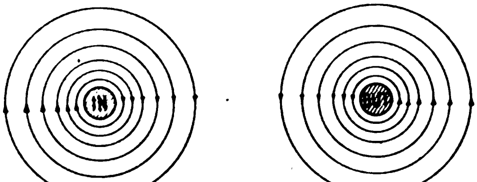


Figure 22

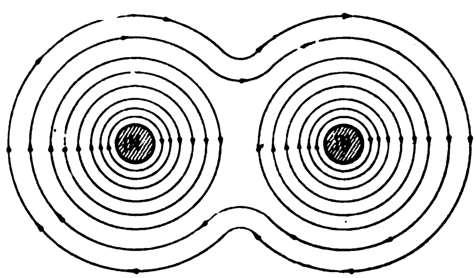


Figure 23

OBJECT OF THE DIAGRAMS

(1) Figure 20. To show the direction of the magnetic lines of force around a current-carrying conductor, with the current flowing in a definite direction.

(2) Figure 21. To show the direction of the magnetic lines of force when the current flows in the direction opposite to that indicated in Figure 20.

(3) Figure 22. To show the lines of force about two parallel conductors carrying current in opposite directions.

(4) Figure 23. To show the direction of the lines of force about two conductors carrying current in the same direction.

PRINCIPLE

The direction of the magnetic field encircling a wire during the flow of electric current will depend upon the direction of the current, and if the current flows away from the reader as shown in Figure 20, then the lines of force will encircle the wire in a clockwise direction.

If the current is reversed, as in Figure 21, the lines of force will reverse, that is, their general direction will be counter clockwise.

The magnetic fields of two wires carrying current in opposite directions will repel each other, but the fields of two wires carrying current in the same direction will attract each other (as shown in Figures 22 and 23 respectively).

SPECIAL REMARKS

(1) The magnetic fields of mutually related coils will have the same effect upon each other as the fields issuing from two parallel wires or the fields issuing from two bar magnets, i. e., for instance, if two coils of wire are suspended end on and current circulates in the same direction in both, then there will be attraction between the coils, but if the current circulates in the opposite direction in each there will be repulsion between the coils. The effects, of course, will be considerably magnified by placing an iron core within the coil.

QUES.—What are some of the applications of electromagnetism?

Ans.—The magnetic field resulting from an electromagnet or number of electromagnets is employed to operate the armature of the telegraph sounder, the diaphragm of the telephone receiver and will cause the armature of an electric motor to revolve. It is also employed to transform electric currents from low voltage to high voltage. It is used in numerous other ways as will become apparent further on.

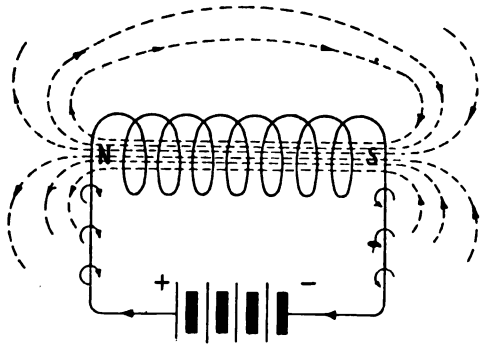


Figure 24

OBJECT OF THE DIAGRAM

To show the direction of the magnetic field around a coil of wire or solenoid.

PRINCIPLE

If a number of turns of wire are wound in the form of a spiral as in Figure 24, the magnetic effect is greatly increased, the lines of force generated by each turn of wire uniting with those set up by adjacent turns.

Such a coil will have poles just as a bar magnet, and if current flows in the direction shown (from the positive to the negative pole of the battery), the lines of force around the connecting leads will have the general direction of the encircling arrows. Inside the spiral there will be a general movement of flux from the south to the north pole and on the outside from the north to the south pole.

If the left hand terminal of the coil were connected to the negative pole of the battery and the right hand end to the positive pole of the battery, i. e., the connections reversed, the polarity of the coil would be reversed, being just opposite to that shown.

DESCRIPTION OF THE APPARATUS

A simple coil of wire is connected to four primary cells connected in series.

SPECIAL REMARKS

(1) If direct current of unvarying strength flows through the solenoid, the lines of force remain stationary when the flow of current is fully established.

(2) If the rate of flow of current is increased or decreased, the lines of force increase or decrease accordingly.

(3) The strength of the magnet field is proportional to the strength of the electric current passing through it and the number of turns of wire.

(4) The magnetic flux of a solenoid may be increased many times by inserting an iron core or bar of soft iron within the coils.

(5) The polarity of a magnet coil is determined by the following general rule: If in looking at the end of the coil the current flows around its turn clockwise, the end nearest to the observer will be a south pole, and by the same argument if the current flows in the opposite direction, the same end will be a north pole.

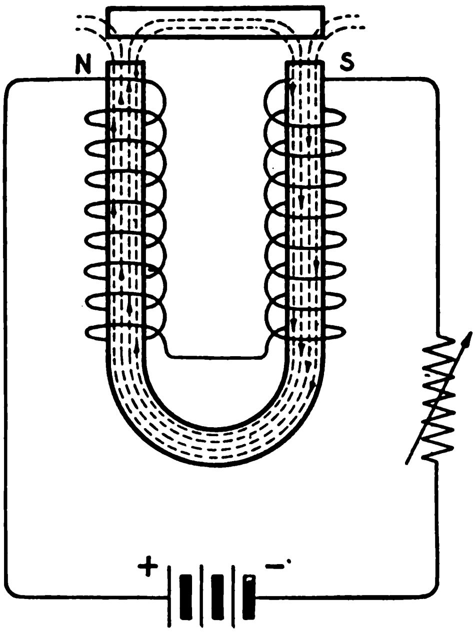


Figure 25

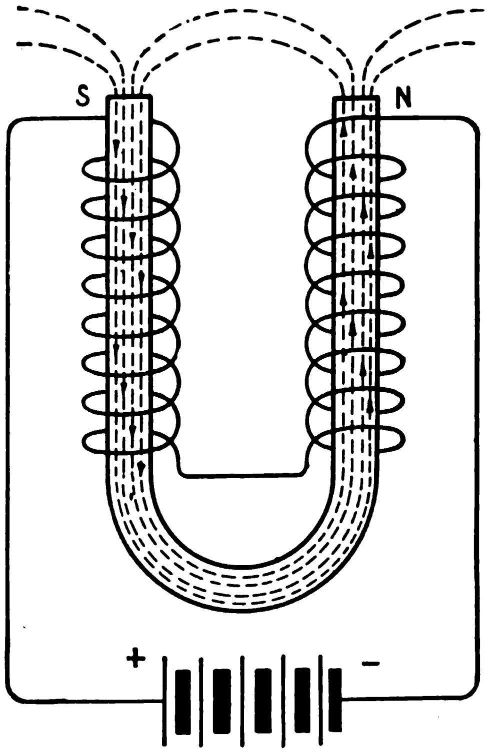


Figure 26

OBJECT OF THE SKETCHES

(1) To show the direction of the magnetic field about a horseshoe electromagnet.
(2) To indicate how the magnetic field reverses with reversal of the current.

PRINCIPLE

Very powerful magnetic fields can be created by an electrical current circulating through a coil of wire wound upon an iron bar, and if the bar is bent in the form of a horseshoe, the north and south poles both can be made to concentrate on a given object and an increased effect thus obtained.

DESCRIPTION OF THE APPARATUS

In Figure 25 a battery of primary cells is connected to the terminals of a horseshoe magnet with a small resistance coil connected in series. In Figure 26 the current flows in the reverse direction.

SPECIAL REMARKS

(1) If the variable resistance in Figure 25 is carefully regulated, the strength of the magnetic field issuing from poles N and S will increase or decrease with the amount of current flowing.

(2) If the current is reversed as in Figure 26, the polarity of the magnetic field will reverse accordingly.

(3) If very high values of resistance are added at Figure 25, the current may be reduced to a degree that the magnet will barely attract the armature.

(4) If a horseshoe of hard tempered steel be inserted in the windings of Figure 25 or Figure 26 in place of the soft iron core and allowed to remain for a few seconds, upon removal it will be found to be permanently magnetized.

(5) An electromagnet may be employed for mechanical work such as lifting masses of iron or for exciting the magnets of a dynamo or motor, and owing to the fact that the strength of the magnetic field can be carefully regulated and moreover a much more powerful field obtained in this manner, the electromagnet is seen to have a distinct advantage over the bar magnet, the strength of the field of which is limited.

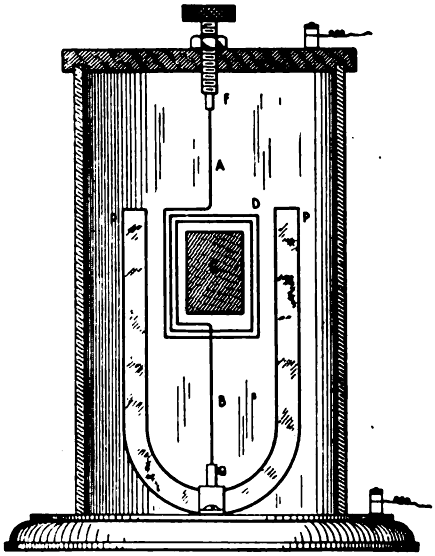


Figure 27

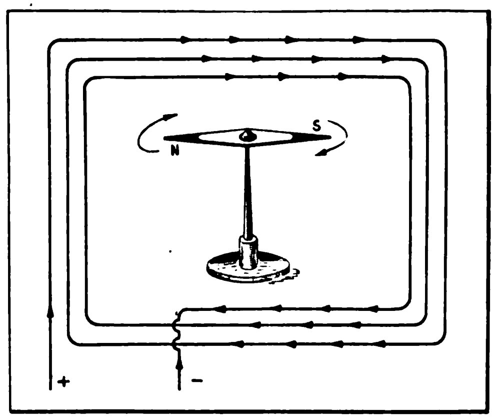


Figure 28

OBJECT OF THE DIAGRAM

(1) Figure 27. To outline the construction of a magnetic galvanometer, i. e., an instrument to indicate the passage of an electric current.
(2) Figure 28. To show the construction of the simplest type of galvanometer.

PRINCIPLE

If a current-carrying coil is placed in a magnetic field, it will tend to turn until it encloses the maximum number of lines of force.

DESCRIPTION OF THE APPARATUS

A rectangular coil of several turns of copper wire, D (Figure 27) is suspended between the poles of a horseshoe magnet P, P. Between the poles is the stationary iron core C which reduces the reluctance of the air gap and thereby intensifies the strength of the magnetic field from pole to pole. The coil is suspended from the screw F and the current to be measured enters at the wire A and leaves by the wire B.

In Figure 28 a simple compass needle is placed inside a rectangular coil of wire.

OPERATION

If the binding posts connected to the wires A and B are in turn connected to a feeble source of E. M. F., the coil D will turn at right angles to the poles of the magnet, but will be resisted by the torsion of the suspended wires. If a pointer and suitable scale are attached to this coil, comparative readings of the strength of the current may be made.

SPECIAL REMARKS

(1) Galvanometers are found to be very delicate and will readily measure a current of .000001 of an ampere.

(2) If the coil, D, had very high resistance, the scale attached to the instrument might be calibrated in **volts**, but if it is of low resistance, it may be connected in series with the circuit and employed to measure the **current strength** or amperes. Used in the first way it would be called a **voltmeter** and in the second way an **ammeter.**

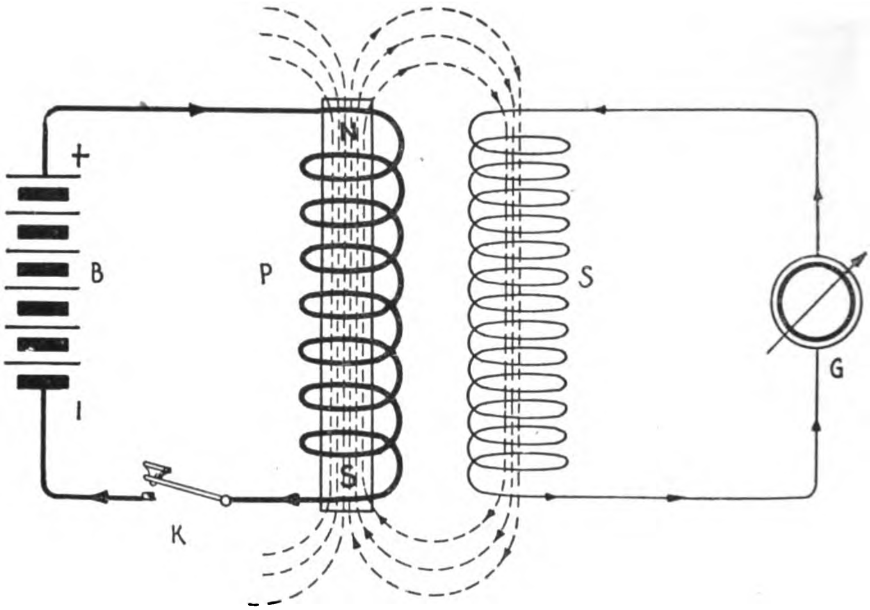


Figure 29

OBJECT OF THE DIAGRAM

(1). To show the principle of electromagnetic induction.
(2) How direct current may be raised to high voltage alternating current.
(3) To indicate the fundamental principle of the transformer.

PRINCIPLE

If a coil of wire is placed in a magnetic field of varying strength and in a defined position, a current will be induced in the coil, the intensity of which will depend upon the rate of change of flux.

If two coils of wire, one of which is connected to a source of direct current, E. M. F., and the other wound directly about it and the current is turned off and on in the first coil, a current of electricity will be induced in the second coil provided it forms a closed circuit.

DESCRIPTION OF THE APPARATUS

In Figure 29 a coil of wire is wound over an iron core, and its terminals connected to the battery B. A key for opening and closing the circuit is denoted at K. Another winding, S, wound directly over P (but for clearness of illustration placed to the side of P) has its terminals connected to a galvanometer, G.

OPERATION

If the key, K, is opened and closed, the needle of the galvanometer will give a deflection in one direction when the key is closed, and in the opposite direction when the key is opened.

SPECIAL REMARKS

(1) This experiment indicates that the magnetic field generated by winding P threading in and out of coil S induces a current in the winding, S.

(2) It is important to note that current is induced in S only when the circuit of P is made or broken.

(3) When current of constant strength flows through P, the magnetic lines of force are stationary, and consequently no current flows in winding S.

(4) When the lines of force about S rise and fall, there will be a movement of current through S.

(5) If winding S were placed at right angles to winding P there would be no induction in S.

(6) When the lines of force increase through S, the induced pressure is counter to that which originally flowed in winding P, but when the lines of force decrease through S, the induced current has the same direction as the original current in winding P.

(7) The lines of force in S are therefore in the opposite direction to those which set up the current in S.

(8) The field of force created around S re-acts upon winding P, tending to build up a current in opposition to that already flowing in P, that is to say, a change in the strength of the primary current, P, induces a secondary current in S which in turn, induces a back pressure in P. The induction due to the two circuits upon each other in this way is called their **mutual induction** which is a measurable quantity.

(9) The field produced by each turn in winding P not only creates an E. M. F. in winding S, but also cuts neighboring turns in its own coil, thereby inducing in them E. M. F.'s that tend to oppose the E. M. F. of the original current. On the other hand when the current in winding P diminishes, the lines of force contract and thereby induce E. M. F. in adjacent turns that tend to set up the current in the same direction as the original current.

(10) This inductive action of the coil upn a conductor is called **self induction.**

(11) **Self induction** may be defined as the property of a circuit that tends to prevent any change in the strength of the current passing through it.

(12) The effects of self-induction are only noticeable in circuits carrying direct current when the current is turned on and off, but in circuits carrying alternating current they are ever present.

(13) All conductors have self-induction, the amount depending upon their size and shape. Coiled wires have greater self-induction than long straight wires. The self-induction of a coil is increased by inserting in it an iron core.

(14) The **coefficient of self-induction** or **inductance** is defined as the property of a conductor by which energy may be stored up in magnetic form.

(15) If a coil has such dimensions that when one ampere flows through it per second, it is surrounded by one hundred million lines of force, and furthermore if this current is turned off, the back E. M. F. generated by the collapsing field is one volt, and the coil is said to have **self-inductance of one henry.**

(16) The unit, the henry, is too large for practical purposes, hence, the **microhenry,** the **millihenry** and the centimeter are in practical use.

1,000 centimeters = 1 microhenry

$$\textbf{1 microhenry} = \frac{1}{1{,}000{,}000} \textbf{ henry}$$

$$\textbf{1 millihenry} = \frac{1}{1{,}000} \textbf{ henry.}$$

(17) If winding P has a few turns of comparatively coarse wire, such as No. 14 or No. 16 B. & S., wound over an iron core, and S has several thousand turns of fine wire, such as No. 36 B. & S., an electromotive force of several hundred thousand volts may be induced in S.

(18) If winding S has less turns than winding P the E. M. F. induced in S will be lower than that of winding P.

(19) To properly distinguish the various circuits, the winding, P, is called the **primary coil;** and the winding S the **secondary coil.** The current in P is termed the **primary current** and in S the **secondary current.**

(20) One type of apparatus which is constructed in accordance with this principle is known as the **induction coil,** which has a primary and secondary winding, a source of direct current E. M. F. and a magnetic interruptor which makes and breaks the current flowing in the primary circuit. This causes a magnetic field to rise and fall about the winding S and induces therein a current of considerable pressure. An E. M. F. of 100,000 volts is thus readily obtained.

(To Be Continued.)

How to Become an Aviator

The Second Article of a Series for Wireless Men in the Service of the United States Government Giving the Elements of Airplane Design, Power, Equipment and Military Tactics

By HENRY WOODHOUSE

Author of "Text Book of Naval Aeronautics"

Photos, Underwood & Underwood

THE AWAKENING OF THE UNITED STATES

THE people of the United States are now beginning to realize the importance of aeronautics, and the steps recently taken to develop our air service are so far-reaching in their scope and importance that we cannot for the moment realize the magnitude of the undertaking or the stimulus to commercial use of the airplane which is bound to follow.

The entire country is co-operating with the Aircraft Production Board and the Army and Navy in developing the air service. Corporations employing hundreds of skilled mechanics for the construction of low and high speed scouting airplanes, scouting seaplanes and special types for special service have been formed. About 30,000 applications have been received from young men wishing to join the air service. Most of these are college men, several hundred of whom are now learning to fly at their own expense in order to be ready to meet an emergency. Six units of the aerial coast patrol are under organization. The members of these organizations are training at their own expense and have purchased seaplanes, the use of which they have offered to the Government. The same is true in the naval militia. Patriotic persons who became interested in aerial preparedness through the efforts of the Aero Club of America have contributed airplanes and funds with which to start aviation sections in the naval militia of a number of states. It is now expected that this country, which has produced such men as Langley, the Wrights, Curtiss and other pioneers, will take giant steps in the development of our much needed air service.

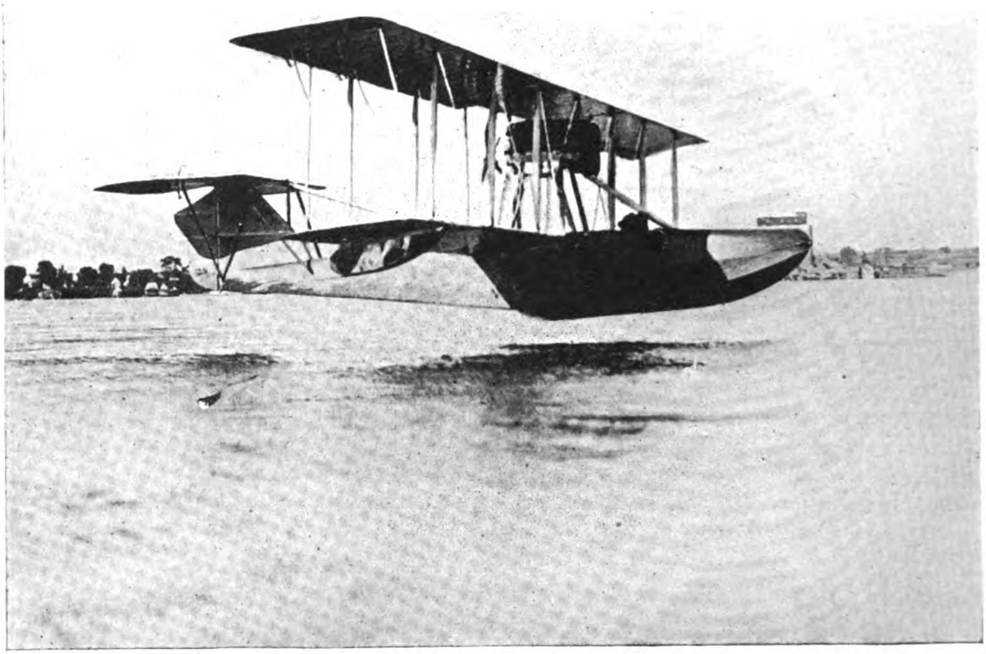
BRIEF OUTLINE OF AVIATION INSTRUCTION FOR SERVICE ON THE WAR FRONTS

The training of aviators is fast becoming an exact science. When, early in the war, aviators were needed in large numbers and were employed mainly for scouting, aerial coast patrol and spotting of shots, even the European navies were willing to suspend practically all the qualifications apart from flying. Later, as the duties of aviators increased rapidly, and the shortage of trained men made it necessary to "break in" civilians, their training had to be carried out on scientific lines.

Whenever the personnel available is untrained in naval matters, it is necessary to teach the students the rudiments of naval discipline and naval regulations as well as aeronautics. Great Britain has been obliged to do so to obtain military aviators, and the British system, which has been adopted by her Allies and Canada, is undoubtedly the best system to follow to-day.

In connection with the training of a naval aviator, the experience of the British Air Organization of which General W. S. Brancker, R. A., is director, will be of interest, particularly to such civilians who heretofore have had no idea of the detailed work required to train a modern aviator. He says in part:

"The civilian who wishes to join the Army or Navy Air Service in Great Britain or Canada at present has first to join the service as a cadet and go through a course in the cadets' school, at which military subjects as well as aeronautic subjects are taught. He gets a grounding drill and discipline, care of arms, interior economy, military law, and the use of the machine gun; this course lasts about two months. From this the cadet is sent to a Flying Corps Training School, School of Military Aeronautics, where he begins his technical training on the ground. In Canada, and in some cases in England, he gets the first mentioned military training at the same time as he gets the rudimentary training in flying or operation of dirigibles and observation balloons. He goes through a course in the care of engines and rigging, is given some ideas of the theory of flight, and is taught wireless signalling and receiving.



The naval type of airplane of recent design starting on a long test flight

"He gets instruction in the care of machine guns, in the use of the camera, in map reading, in the observation of artillery fire with models, and in his spare moments he gets a certain amount of drill. This course lasts another two months, and if he gets through this successfully, he is given a commission on the General List. He then joins a preliminary training squadron as a pupil and starts his instruction usually on the slow Maurice Farman airplane, his training both in military and technical subjects going on concurrently. After reaching a certain standard of efficiency and having completed a certain number of hours in the air, he is sent on to an advanced training squadron or service squadron, where he learns to fly Service types of machines for military purposes, and eventually qualifies for his wings. He is then gazetted as a flying officer of the Royal Flying Corps and posted to a service squadron. If he shows exceptional promise as a pilot after his qualification, he is sent to the Central

Flying School, where he is given extra higher instruction on flying scouts. During the period of advanced training, he goes through a course of aerial gunnery away from his squadron. The total time in the air usually required to reach the qualification stage is about thirty hours' solo in present circumstances, but, of course, the length of time that it takes to reach this standard depends entirely on the weather and the number of airplanes available. During the winter it works out to about four months, but in the summer it is considerably shorter."

All this may seem a long process, but it is doubtless the best and will prove the shortest in the end in producing well-trained aviators.

THE NAVAL AIR SERVICE

The naval air service of any Government should be divided into three distinct, separate branches, whose functions are quite different and which may be designated as:

(1) The Offensive Air Service, which consists of squadrons of seaplanes stationed on seaplane carriers and aeronautic bases, which are used for air raids, independent of the fleet; also dirigibles which operate from bases;

(2) The Auxiliary Air Service of the fleet, including seaplanes and kite balloons which operate with the fleet, using ships as bases;

(3) The Aerial Coast Patrol, which operates from naval stations and naval bases. This patrol is accompanied by aircraft mother ships which contain airplane repair machinery, repair parts, extra seaplanes, and which are also employed to furnish fuel and supplies to airplanes operating on coasts far from naval bases or large cities.

There are numerous services which aircraft render as auxiliaries to the Navy, some of which are here enumerated. These apply particularly to dirigibles, airplanes and kite balloons. Some of the services rendered in the present European conflict follow:

(1) Attacked ships and submarines at sea with bombs, torpedoes and guns. (Seaplanes and dirigibles used.)

(2) Bombed the enemy's bases and stations. (Land airplanes, seaplanes and dirigibles used.)

(3) Attacked the enemy's aircraft in the air. (Airplanes and seaplanes used.)

(4) Served as the eyes and scouts of fleets at sea. (Dirigibles, seaplanes and kite balloons used.)

(5) Protected ships at sea and in ports against attacks from hostile submarines and battleships. (Seaplanes and dirigibles used.)

(6) Defended and protected naval bases and stations from naval and aerial attacks. (Land airplanes, seaplanes and dirigibles used.)

(7) Convoyed troop ships and merchant ships on coastwise trips. (Dirigibles and seaplanes used.)

(8) Patrolled the coasts, holding up and inspecting doubtful ships, and convoying them to examining stations and searching coasts for submarine bases. (Dirigibles used.)

(9) Prevented hostile aircraft from locating the position and finding the composition and disposition of the fleet, getting the range of ships, naval bases, stations, magazines, etc. (Land airplanes and seaplanes used.)

(10) Located and assisted trawlers, destroyers and gunners in capturing or destroying hostile submarines. (Seaplanes, dirigibles and kite balloons used.)

(11) Co-operated with submarines, guiding them in attacks on ships. (Dirigibles and seaplanes used.)

(12) Located mine fields and assisted trawlers in destroying mines. (Dirigibles, seaplanes and kite balloons used.)

(13) Served as the "eyes in planting mines," minimizing the time required for mine planting. (Dirigibles, seaplanes and kite balloons used.)

(14) Served as "spotters" in locating the position of the hostile ships and directing gunfire. (Dirigibles, seaplanes and kite balloons used.)

(15) Served as carriers of important messages between ships which could not be entrusted to wireless owing to the possibility of the enemy wireless picking up the messages, such as communicating to incoming ships information regarding the location of mines, submarines and courses, to avoid mistakes and confusion. (Seaplanes and dirigibles used.)

(16) Carried out operations over land and sea intended to divert the attention of and mislead the enemy while strategical operations were being carried out by the fleet of squadrons. (Land airplanes, seaplanes and dirigibles used.)

(17) Have made it possible for commanders to get films of theaters of operation, photographs of the location, composition and disposition of hostile naval forces, and photographic records of condition and of the movements and operations of their own as well as of the hostile naval forces.

The civilian will now realize the immense importance of a properly equipped fleet of seaplanes to assist the operations of naval vessels. It should be self-evident that seaplanes can reconnoitre any distance into bays, rivers and behind protected fortresses over which coast patrols or naval vessels have positively no control.

One of the most important uses to which aircraft have been put since the beginning of the European war has been the locating of submerged submarines and mines. In any discussion of what can be done against the submarine, it must be first stated whether we mean the protection of ships at sea or on coastwise trips. Nothing could protect the sea lanes so well as large dirigibles, as capable as the Zeppelins are, of cruising for 3,000 miles without stopping.

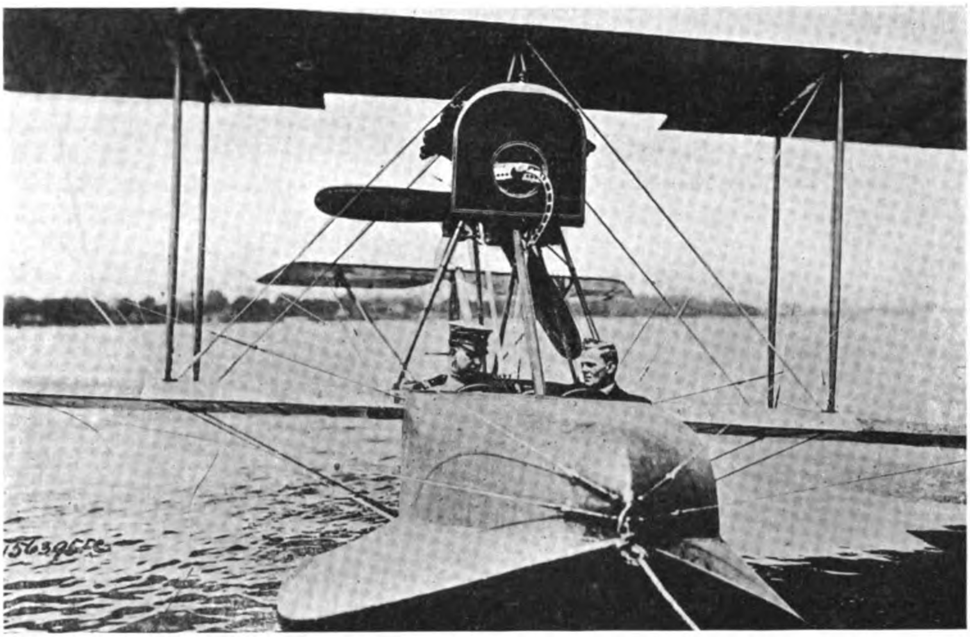
Unfortunately, no country outside of Germany has large dirigibles for use for this purpose. If we had such airships to patrol the ship lanes daily. no submarine would be safe, no matter where, on sea, if large dirigibles were thus patrolling because large dirigibles carry guns of sufficient caliber to sink a submarine with a single shot. Likewise, observers from a dirigible, as in the case of an observer from an airplane, can see a submarine miles away when a man from a ship cannot detect it. The airship travels many times faster than undersea craft, and the submarine could not easily detect the approach of an airship.

The submarine menace could be checked by present-day aircraft—seaplanes, small dirigibles and kite balloons. We are now building large seaplanes which are capable of carrying fuel for continuous flights over a period of fifteen hours and capable of gaining a speed of more than seventy-five miles an hour. A number of such other seaplanes have already been supplied to England and have done very effective work.

The first aerial submarine hunt in American history took place in March,

1917. Following the report of the keeper of the lighthouse at Quogue, Long Island, that there was evidence that two U-boats were "lying in toward the Sound," a fleet of civilian aviators, who later became a part of the Aerial Reserve Squad at Governor's Island, rose from the Mineola, Long Island, Aviation Field in a forty-mile an hour gale and rain and a bad fog. They were detailed to patrol the Long Island coast from Oyster Bay to Montauk Point, while Governor's Island aviators watched over the shore from the island to Oyster Bay. Two of the aviators, Acosta and Briggs, were out for three days. They did not return to their headquarters, merely landing when they were forced to do so.

Considering that there was a gale blowing, the weather was foggy, and it

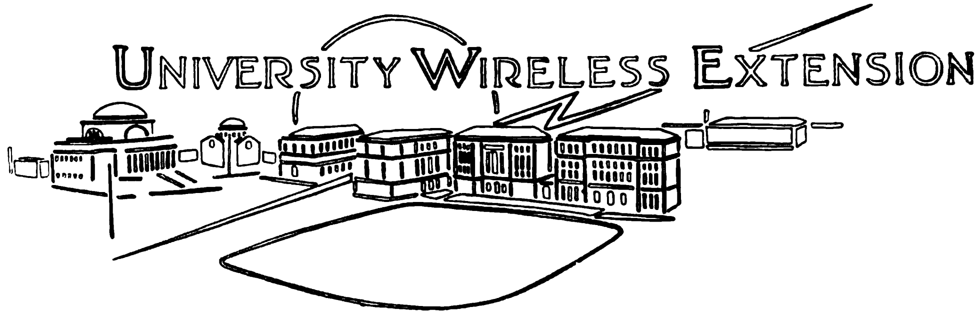


Lieut. C. C. Witmer, U. S. N. R. F., and David McCullough examining one of the latest model flying boats made for the navy

was their first experience of the kind, it was quite a difficult task, but it was well done by all. Captain Briggs and Lieutenant Wehrle flew a distance of 124 miles in a driving rain-storm. The machines went out between five and eleven miles at sea, the inlets and bays were searched, vessels plotted, compass directions and time when located were given, but the submarines were not found. None of the machines were equipped with wireless telegraphy, neither was there a receiving station in operation. But there was a cruiser within range that could have been summoned if the submarine had been found.

It was later found out by the Navy Department that the vessels sighted were new coast patrol boats which were returning from a trial trip and which passed Montauk Point at six o'clock on the evening of March 26th, heading into Long Island Sound. However, the Navy Department was gratified in positively determining that there were no U-boats in the vicinity of these shores.

The flight of the seaplanes was fully justified in view of the recent exploits of the German submarine, U-53, which suddenly appeared one day at Newport Harbor and which during the return trip sank a half dozen ships in succession.



Radio Telephony

By ALFRED N. GOLDSMITH, PH.D.

Director of the Radio Telegraphic and Telephonic Laboratory of the College of the City of New York

ARTICLE IX

CONTINUING our consideration of the generation of radio frequency currents by alternators, we pass to an interesting and important form of alternator largely developed by E. F. W. Alexanderson of the General Electric Company. This machine has generally been distinguished by the direct generation of the very high frequency desired, and its construction has given rise to numerous difficult problems. The experimental work in connection with these alternators was originally undertaken by the General Electric Company at the suggestion of Mr. R. A. Fessenden, then associated with the National Electric

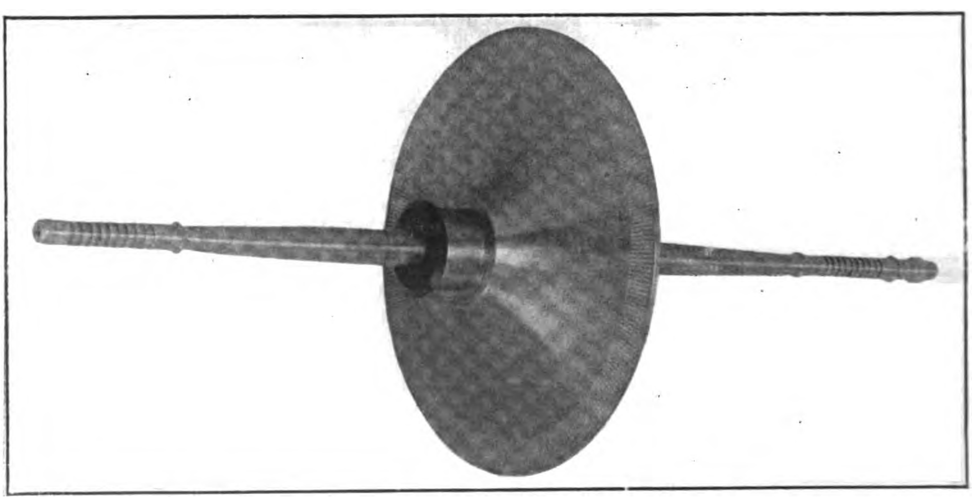


Figure 104—Rotor and shaft of 100,000 cycle Alexanderson alternator

Signaling Company; and much of the earlier development was done in conjunction with that company.

In 1908, Mr. Alexanderson described a 100,000 cycle alternator of this type, built to deliver approximately 2 kilowatts. A later description given by him follows (with brief additions by the author):

"The alternator is of the inductor type (that is, with stationary armature and field, but with a rotating element which causes a pulsating field to cut the armature conductors), and is provided with a novel arrangement of the magnetic circuit, allowing the construction of a rotor which can be operated at exceedingly high speeds. In the final form of the alternator, shown in Figure 103, the rotor, *C*, consists of a steel disc with a thin rim and much thicker hub, shaped for maximum strength (that is, with a width that progressively diminishes from the shaft out, so that the strain on the material outward because of centrifugal force is the same from the shaft to outer rim). The field excitation is provided by two coils, *A*, located concentric with the disc and creating a magnetic field the lines of force, *F*, of which pass through the cast iron frame, *D*, the laminated armature support, *B* and *E*, with its teeth, and the disc, *C*. This flux also passes through the narrow air gaps on each side of the disc rotor, and is indicated in the figure by the dashed line with arrows. *B* represents the two armatures which are secured in the frame by means of a thread, in order to allow an adjustment of the air-gap, the laminations carrying the armature conductors being located at *E*. Instead of poles or teeth, the disc, *C*, is provided with slots which are milled through the thin rim so as to leave spokes of steel between the slots. The slots are filled with a non-magnetic material (phosphor bronze) which is riveted in place solidly, in order to stand the centrifugal force and to provide a smooth surface on the disc so as to reduce air friction. The centrifugal force on each slot filler is no less than eighty pounds at the high speed at which the machine is run.

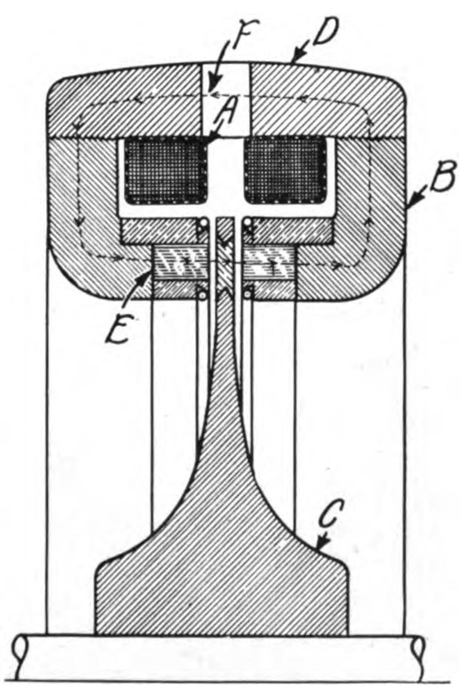


Figure 103 —General Electric Company-Alexanderson alternator

"The standard 100,000 cycle rotor of chrome nickel steel with 300 slots is shown in Figure 104." The shaft bearings are clearly visible at the ends, and it will be seen that they are arranged so as to make forced oiling practicable. The shaft in this type of alternator is long and flexible, thus permitting the rotor to center itself and rotate about its center of mass somewhat as is done in the case of centrifugal dryers for laundries. In this way, excessive shaft strains are avoided. There are certain speeds (1,700 and 9,000 R. P. M.) for which the shaft and rotor pass through their own resonant periods of mechanical vibration, and at these speeds marked shaft vibration tends to occur.

A closer view of a portion of the

rotor, showing the slot fillers of non-magnetic material is given in Figure 105. Some idea of the care required in the construction of such a machine can be gained from the details of the rotor construction. Since the speed of rotation of the rotor is 20,000 revolutions per minute, or over 330 revolutions per second, the actual speed at the rim is nearly twelve miles per minute! (A whimsical calculation has been made which shows that the rotor, if released while spinning at full speed, would, if it maintained its speed thereafter, roll from America to Europe in a few hours!) Such a machine must, accordingly, be considered a masterpiece of engineering design.

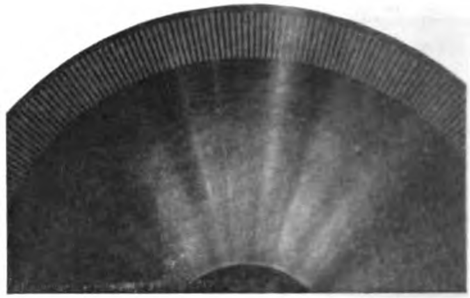


Figure 105—Portion of rotor of Alexanderson 100,000 cycle alternator, showing slots in disc

There are two methods of armature winding employed in the simpler forms of these machines. The first form, which is a simple to-and-fro winding (one turn per slot) is shown in Figure 106. In this form of armature there are 600 slots for a 100,000 cycle machine. A second form of winding for the armature has only 400 slots for the 100,000 cycle machine. It is shown in Figure 107, and really consists of two windings in parallel in each of which, by a sort of vernier action, a 300-slot rotor field produces 100,000 cycle current in the same phase in each of the armature windings. *It is possible, using an 800-slot armature winding of the last-mentioned type, to produce a 200,000 cycle current by direct generation. This is by far the highest frequency which has as yet been produced directly by an alternator.*

Figure 106—Portion of armature winding of 100,000 cycle Alexanderson alternator; 600 slot type

Through the courtesy of John L. Hogan, Jr., of the National Electric Signaling Company, we are enabled to show in Figure 108 a test of an early form of 80,000 cycle alternator built by the General Electric Company and used at the Brant Rock station of the National Electric Signaling Company in 1906. This machine had a double inductor with inward projecting teeth on each half, and the stator lay between the two "saucer" shaped inductors. It will be seen that this machine was belt driven to get the proper ratio of motor to alternator speeds, and that

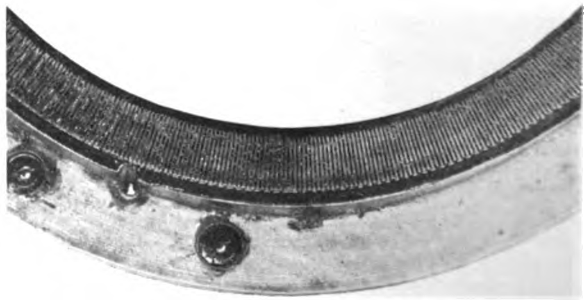


Figure 107—Portion of armature winding of 100,000 cycle Alexanderson alternator; 400 slot type

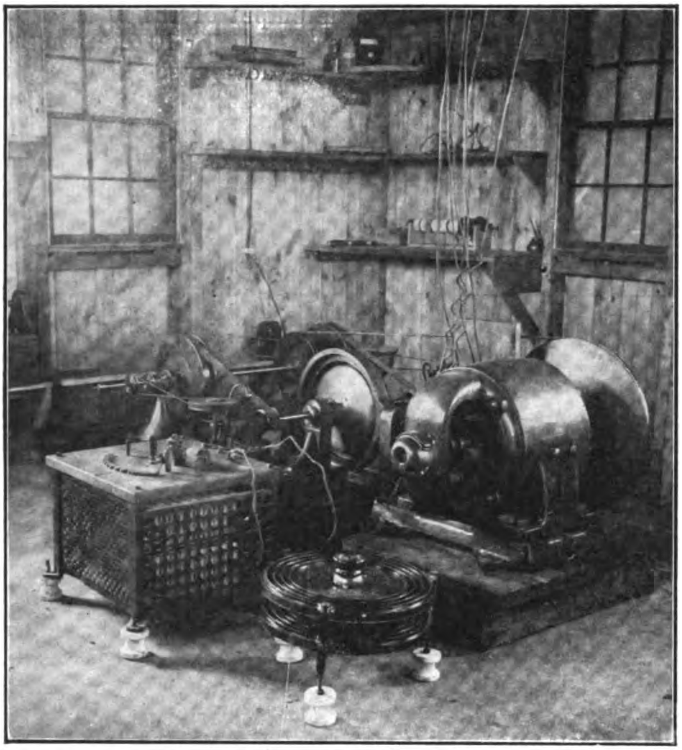


Figure 108—Early form of Alexanderson alternator under test at Brant Rock station of National Electric Signaling Company

the motor is much larger than the alternator. This is quite explicable when it is remembered that the windage loss in these machines at 20,000 R. P. M. is high, it having been claimed that the rotor is actually polished either by air friction or by the friction of floating dust particles. In any case, the air streaming out from the machine is appreciably warmed. This windage loss becomes unimportant in any but the smallest alternators of this type.

A somewhat similar machine built by the National Electric Signaling Company in 1907 and equipped with de Laval steam turbine drive is shown in Figure 109. This has the advantage that, since the turbine is itself an extremely high speed machine, the gearing losses are eliminated by the direct drive. Sufficiently accurate speed regulation of a steam driven machine is secured in practice by maintaining the steam pressure and radio frequency load at constant values. The gearing shown in the figure is used to reduce the main shaft speed in the ratio of 1-to-10 for the operation of the turbine governor. It will be noted that the alternator in this figure has an adjustment to rotate each armature slightly relative to the frame so as to bring the generated currents into phase and also has an adjustment whereby, as stated previously, the armatures may be brought nearer to or further from the rotor for precise adjustment of the air

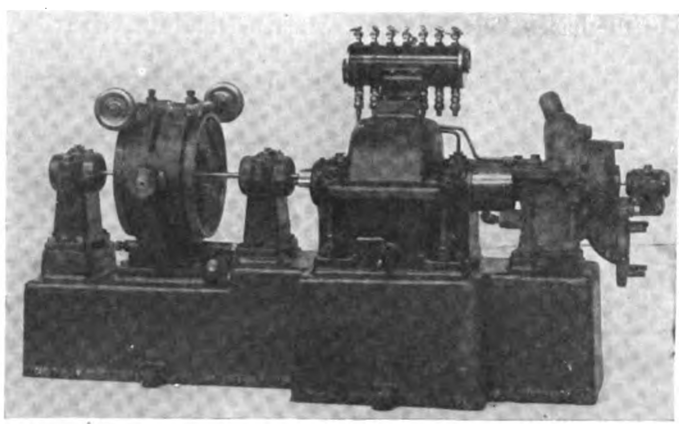


Figure 109—Early form of Alexanderson alternator coupled to de Laval turbine; under test by National Electric Signaling Company

gap. Such an adjustment is of importance since the output of the machine is largely dependent on the air gap, and a very small air gap (of 5 or 10 thousandths of an inch, or a tenth to a fifth of a millimeter) is of advantage. The usual gap is 0.015 inch (0.38 mm.) with a generated voltage of 150, although voltages as high as 300 can be obtained with a 0.004 inch gap.

This machine was in almost daily use at Brant Rock for several years, and ran for hours at a time without attention. The maximum output was something over 1 K. W. at 100,000 cycles.

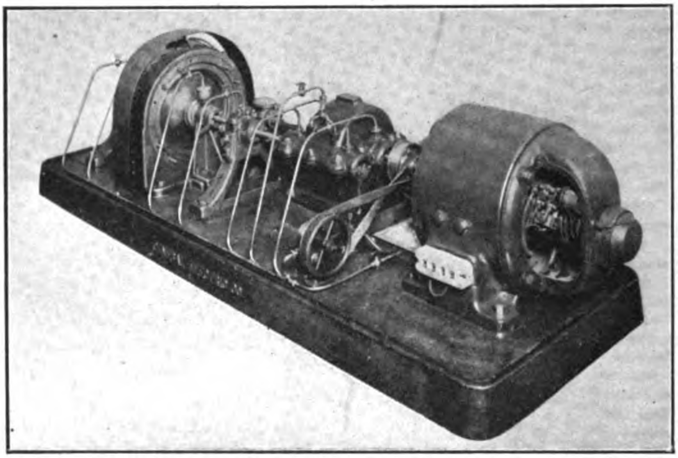


Figure 110—Intermediate type of Alexanderson alternator

A later form of a 2 K. W. Alexanderson alternator is shown in Figure 110. This set shows the elaborate forced-feed oiling system which has been adopted for the later machines. The auxiliary and main bearings to the right of the rotor are clearly visible.

The most recent form of 2 K. W. machine of this type is shown in Figure 111. The oiling system in this machine is provided with an interesting protective device. The oil which is returned to the reservoir at the right of the base plate (the tank having a sheet metal cover with handle) strikes a small pivoted shovel. Its weight depresses this shovel against a controlling spring tension. Should the flow of oil cease for any reason, the shovel flies up and automatically opens the driving motor circuits. In this way, any danger of unoiled bearings "freezing" is obviated. In this set, the alternator is driven by a 110 or 220-volt, direct current, shunt motor with commutating poles. The motor speed is 2,000 revolutions per minute and this is raised to the requisite 20,000 revolutions per minute by the 1-to-10 helical-cut gearing enclosed in the housing at the center of the base. The oil pump, which is chain driven from the motor shaft, is shown at the right hand corner of the base. To prevent any possibility of binding between the two thrust bearings, due to expansion of the shaft because of heating, the machine is provided with a system of equalizing levers to compensate for such shaft heating. These levers are shown in the left front of Figure 111 with the elastic controlling leaf between them. Any tendency which would cause a change in air gap is counteracted by the automatic action of the levers. If the air gap should tend to change at either side, the magnetic attraction at that side would cause an additional pressure and consequent heating on the thrust bearings at that end; and a consequent expansion of the shaft there would bring the rotating disc back to a central position.

The expansion of the shaft by temperature is thus taken advantage of to insure a correct alignment. The usual output of these alternators is from 10 amperes at 200 volts to 20 amperes and 100 volts, depending on the nature of the load and the mode of internal connection of the armature sections of the machine. The effective resistance of the armature is 1.2 ohms, the inductance being 8.6 microhenrys corresponding to 5.4 ohms at a frequency of 100,000 cycles, or wave length of 3,000 meters. The resonance condenser load would, therefore, be 0.29

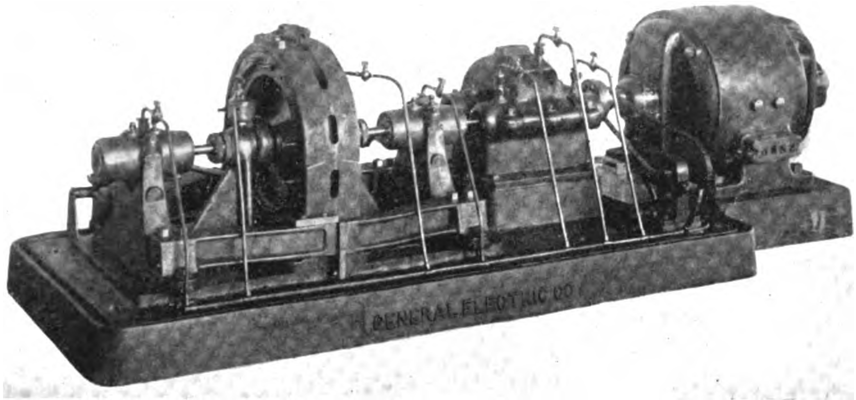


Figure 111—*Recent type of 2 K. V. A.,* 100,000 *cycle Alexanderson alternator*

microfarad at the frequency mentioned, if no loading coil were used external to the machine.

Another recent type of Alexanderson radio frequency alternator is the so-called "gyro alternator." The designation is based on the similarity of bearings in the machine in question and those in a high speed gyroscopic compass. A heavy shaft is used, so that vibration at the "critical speeds" does not occur, these speeds being much higher than those at which the machine is actually run. The use of ball bearings in this machine has simplified the construction. No auxiliary bearings are needed in this machine.

Figure 112 shows one of these machines with belted driving motor and all auxiliaries needed for a complete radiophone equipment mounted on a base. The particular equipment shown has been used for the transmission of speech 160

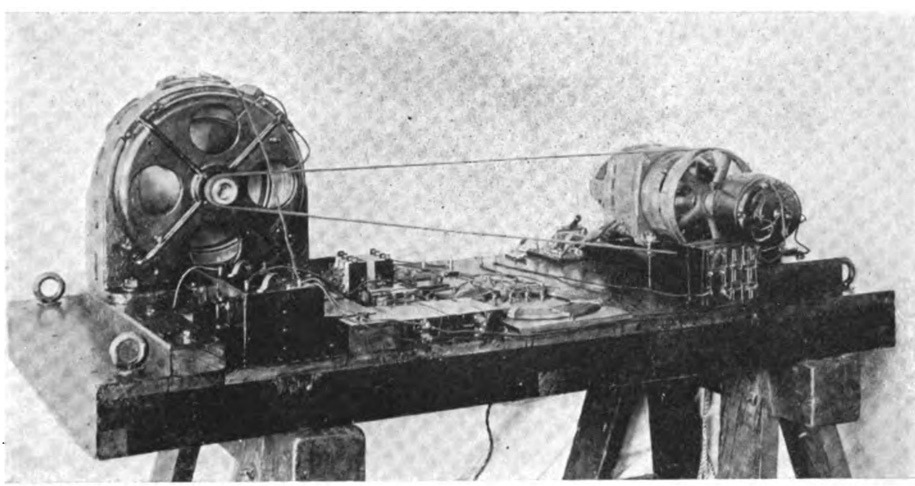


Figure 112—*Recent General Electric Company-Alexanderson alternator of "gyro" type*

miles (250 km.). The alternator generates 33,000 cycles per second, which is transformed into 100,000 cycles (corresponding to a wave length of 3,000 m.). The 100,000 cycle energy is modulated by a magnetic amplifier which is controlled directly by a standard microphone. A description of the magnetic amplifier system of modulation follows under "Modulation Control Systems."

Passing from the smaller machines, Mr. Alexanderson has had built a 50 kilowatt, 50,000 cycle alternator (and very considerably larger machines are under test and construction). This machine is shown in Figure 113. The open circuit voltage of this machine and the transformer described below is about 550 volts, but the machine is normally operated at about 125 amperes and 400 volts. The rotor is similar to, although naturally larger than that of the smaller machines previously described, but an extremely heavy and rigid shaft is used. The machine has proven capable of furnishing 85 kilowatts for brief periods. Operating at 3,500 revolutions per minute, its bearings and shaft construction are similar to those of normal high speed turbines. The machine speed never attains the "critical speed" value, thus avoiding the necessity for auxiliary bearings. Because

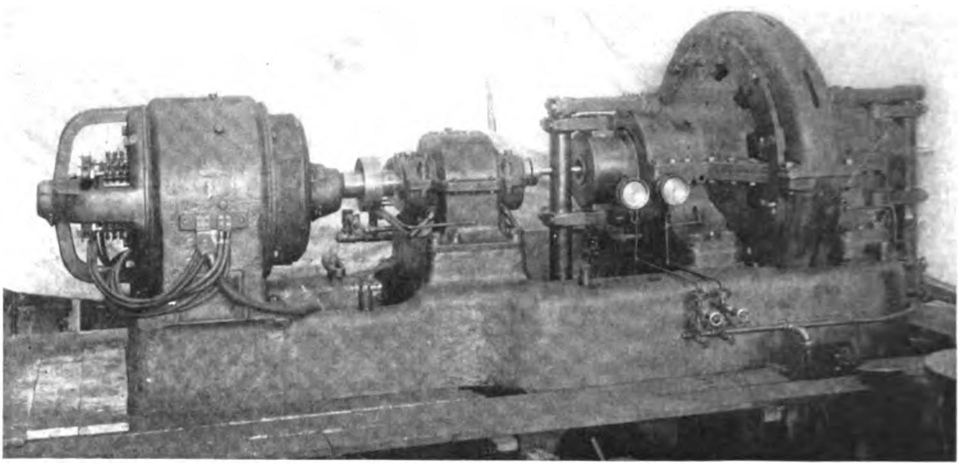


Figure 113—50 *kilowatt,* 50,000 *cycle, General Electric Company-Alexanderson alternator*

of the very rigid shaft, the rotor is not measurably deflected by the magnetic field. "The thrust bearings for the collars shown at each end of the rotor shaft are held in position with a system of equalizers, which have for their object the avoidance of any possibility of binding in the bearings due to expansion of the shaft from change in temperature, and at the same time automatically draw up all slack in the bearings as they become worn. The equalizers are the heavy vertical columns and links shown in the photograph of the assembled machine.

"The direct generation of radio frequencies by a machine working on the principle of a simple alternator is possible only by the use of a very low voltage winding. On the other hand, if the alternator windings were designed to be connected directly in series with an antenna, the terminal voltage would be about 2,000 to 3,000 volts. Thus it is apparent that with this type of machine it is necessary to use a transformer between the machine and its output circuit. The alternator windings consist of thirty-two independent circuits connected to the same number of independent primaries of the transformer. The transformer has a number of secondary circuits which can be connected for various ratios of transformation between 4-to-1 and 24-to-1. Thus the alternator can be adapted to antennas of greatly different characteristics. The primary windings of the transformer are grounded in the middle, so that the greatest potential difference to ground on the alternator winding is one-half the voltage generated by one alternator circuit.

"The transformer is a closely coupled one, the coupling coefficient being 0.95. In the phraseology of the alternating current designers, the transformer may be described as having about 30 per cent. magnetizing current and 30 per cent. total leakage. Although the transformer has no iron core, it has a measurable core loss due to the eddy currents in the conductors caused by the magnetic flux. If it were not for these eddy currents, the efficiency of the transformer would be close to 99 per cent.; as it is, the efficiency is about 95 per cent. This efficiency is approximately constant between frequencies of 25,000 and 50,000 cycles, because what the transformer in one sense gains by the higher frequency, it loses on account of the higher eddy current accompanying that frequency. The numerous multiple circuits in the primary, as well as those in the secondary, are carefully transposed so as to make cross currents impossible between the different circuits.

"While it appears that the most practical arrangement from all points of view is the one described, *i. e.,* a low voltage winding and transformer, experiments have been made with windings distributed in such a way that larger slots can be used with room for more insulation. A sample machine of this type of 3 K. W. output at 45,000 cycles was built, and a diagrammatic representation of the armature cross section and rotor is given in Figure 114. This generates a frequency three times as high as the one for which the slots on the winding are apparently designed. This method may be characterized as generating triple harmonics without the fundamental. The action is somewhat like that of a vernier, the flux through the stator projections changing from that due to two teeth on the rotor to that due to one tooth at three times the apparent frequency of the machine. While the characteristics of this machine have proven entirely satisfactory, in accordance with expectations, it is probable that the original simple form of winding will be adhered to, because the concentration of large conductors with more current in one slot causes not only higher losses, but also a lower rate of heat dissipation and therefore less output can be expected from the same amount of material."

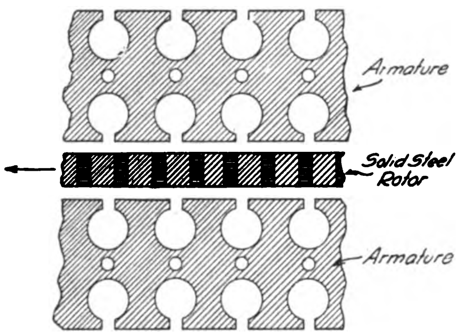


Figure 114—*Diagrammatic representation of Alexanderson alternator for direct generator of triple frequency*

It may here be mentioned that the machines shown in Figures 110, 111, 112, and 113 have all been used for radio telephony in connection with further devices which will be described under "Control Systems." The first was used principally by the National Electric Signaling Company in Mr. Fessenden's tests between Boston and New York (Jamaica), a distance of some 150 miles (240 km.). This was, however, not a matter of regular communication, but rather of test work. The machine shown in Figure 111 has enabled quite regular communication between Schenectady and New York, the distance being 150 miles (250 km.). Even the smallest machine (of Figure 112) running on much reduced power, has enabled the same stretch to be bridged when suitable receiving apparatus was employed.

With the large machine shown in Figure 113, employing the magnetic amplifier controlling device to be described hereafter, the output was successfully modulated between 5.8 kilowatts minimum and 42.7 kilowatts maximum. This is, to date, the maximum amount of radio frequency energy controlled telephonically by any means.

This is the ninth article of a series on "Radio Telephony" by Dr. Goldsmith. In Article X, which will appear in the October issue, the author discusses the modulation of power by the human voice and the degree and stability of its control. The rating of radiophone transmitters is considered and the classification of control systems. In microphone transmitters the work of Seibt, Poulsen, Goldschmidt, Fessenden, Colin and Jeance is described.

A Digest of Electrical Progress

Experiments with Iron and Steel Wires for Power Transmission—The Future Application of Electrical Power—An Electric Truck Garage—Wireless' Phone for Train Dispatching—Government Nitrate Plants

IRON AND STEEL WIRES FOR POWER TRANSMISSION

IN view of the enormous demands of the war upon the aluminum and copper industries we may yet witness the use of steel wires for the transmission of power. Not that such transmission can be carried on equally well by steel wires, but that the lack of material may cause engineers to adopt such systems for transferring power from point to point.

In a recent issue of the *Electrical World*, the results of certain experiments conducted by L. W. W. Morrow of the University of Oklahoma are recorded, and it is shown that if necessary, it would be possible to use such metals at least over short distribution territory.

The *World* remarks editorially:

> "War is a condition which necessarily interferes with normal conditions of supply in commodities. It is useless to cavil or repine at war prices. There would be no credit in being optimistic if the turning of a nation to warfare left all the industry and prices in the ordinary status quo ante bellum. The demands for the electrically-conducting metals tend to raise their prices to economically unattainable values. If copper and aluminum are not at present available for conductors, the question arises of what can be found during the interim to meet immediate needs in electric transmission."

In the experiments of Professor Morrow, three kinds of wire were tested, namely: ¼-inch E. B. B., ¼-inch Siemens-Martin steel, and 5/16-inch standard Bessemer messenger copper cable. These were arranged in pairs on the pole line in such a way that the measurements could be made on the generator and the load-end of the line with the same instruments.

The electrical test consisted of measuring the power input to the line, the impressed and terminal voltages, the line current, the efficiency of transmission and the regulation. Other measurements included that of the impedance, the effective resistance, the ohmic resistance and reactance.

It is a well known fact that losses in copper or in aluminum wires depend only on the cross section at a given temperature, and such losses can be precalculated with the greatest accuracy, but in the case of a magnetic wire, such as iron or steel, the skin effect is very appreciable even at 60 cycles, and this depends to some extent upon the strength of the alternating current carried by the conductor. This is due to the fact that the skin effect depends upon the permeability of the wire at a particular frequency. Some of the results noted were as follows:

> "The effective resistance for a mile of wire or the resistance to 60-cycle alternating current is not constant owing to skin effect and magnetic properties of iron. It increases rapidly until saturation is approached when it becomes almost constant. The Siemens-Martin cable did not show saturation effects. Its resistance increases less rapidly with current than that of the other wires tested and is higher than that of E. B. B. cable for currents less than 15 amperes, but less for currents greater than 15 amperes. The permeability also has a marked effect on the reactance, that of Siemens-Martin cable being much less than that of E. B. B. cable of the same size."

From the mechanical test, it is concluded that the greater strength of iron wire compared with the copper enables the use of longer spans and hence reduces the number of poles and power required. Therefore, the interest on investment saved may partly or wholly offset the inefficiency of transmission of iron wire.

In the mechanical test of three types of cables, it was determined that Siemens-Martin wire has the lowest co-efficient of expansion and the greatest strength, and its resistance and reactance increase less rapidly with the current than for any of the other wires, and with heavy current, the resistance, reactance and impedance are individually less than the same values for other types of iron wire of the same size. At low current values, Siemens-Martin wire has higher impedance than resistance.

The writer concludes:

> "On account of the effect of iron or steel on the electrical characteristics of alloys, it is doubtful whether better transmission can be obtained from the latter than with plain iron or steel wire. Conditions as to cost of copper, power to be transmitted, voltage, etc., will determine the advisability of using iron instead of copper wire, and also will determine the type of iron wire which should be used."

THE FUTURE APPLICATION OF ELECTRICAL POWER

DECRYING the indiscriminate erection of power plants throughout the United States without regard to future developments or cheaper means now available, C. W. Stone, in a current issue of the *General Electric Review,* calls attention to certain phases of the situation which should have the approval of electrical engineers at large. He mentions that there probably has never been a time where there has been more rapid development in the adaptation of electricity to given power purposes than in the last few years, which can be directly accounted for by the fact that manufacturers of this country have been called upon to increase their facilities, and they have found the quickest and best way to secure this increased capacity was to make use of electrical power available from a central station. The word "power" as originally used in electrical industry referred to motors of different characters, but to-day the available energy of the central station is put to other useful purposes such as electrical enameling, ovens, core baking ovens, electrical sherardizing, the heating of glue pots, electrical steel furnaces, electrical brass furnaces, hardening furnaces, electrical welding and many other applications which cannot be enumerated here.

It would seem that this step-by-step adoption of electrical power would finally lead up to its universal application, and although there has been remarkable expansion in this direction, there is probably more work done to-day by hand power or by other mechanical means than by electrical power.

The writer goes on to mention that one of the severest handicaps to further progress in this direction is the fact that two and even three frequencies of alternating current have been adopted as standard for electrical work. He mentions a few isolated developments which unfortunately have adopted the frequency of forty cycles and calls attention to the fact that any engineer who is recommending the installation of any new plant at this frequency is making a mistake which will some day cost the user a large amount of money to rectify.

The standardization of frequencies is not the only standardizing work which should be undertaken, but is that which should have attention first.

He urges that a definite program should be laid out to standardize the speeds of power motors and voltages for different grades of service. Too little attempt has been made in this direction. It has been the common method to develop a mechanical machine first and then fit a motor to it, but better results would be obtained by co-operative work, developing the machine and the motor as a complete unit and thereby eliminating a very large number of special motors which have proven expensive.

Some of the handicaps which Mr. Stone tells us must be removed to make way for the universal application of electrical power are set forth as follows:

> "One of the essential features is that we should have universal frequency on our alternating current systems. Sixty cycles is more commonly used than any other frequency. Twenty-five cycles is probably the next most commonly used frequency, but this frequency is largely confined to systems requiring other than alternating currents; in other words, twenty-five cycles is seldom used for any direct application, as it is usually converted into either low-voltage direct current or high voltage direct current. Consequently 60 cycle could be used just as well for this purpose. There are a few systems using 33 cycles and still fewer using 50 cycles. There is no reason for the existence of either one and the sooner they are eliminated the better.
>
> "It would appear that the future development in this country should be to stop in some way indiscriminate building of small power houses, such as isolated plants, etc., and to start to develop a complete and continuous network of wires all over the country, not necessarily all owned and operated by one company; on the contrary, a probably better arrangement would be to have individual distributing companies in each community large enough to support it, and then have large power generating companies scattered all over the country in places where fuel can be most readily obtained, as well as water, labor, etc., all these power generating stations being interconnected and exchanging power as the demand for power in the adjacent neighborhoods develops. Operating in such a manner would mean that power could be produced for far less than it can be at present, both on account of the great reduction in fuel costs and also in capital investments. Also, there would be additional saving in labor."

AN ELECTRIC TRUCK SERVICE GARAGE BY A PUBLIC LIGHTING CORPORATION

HOW the Commonwealth Edison Company of Chicago, Ill., proposes to enlarge its electrical service department to include a garage for the supervision and maintenance of electric trucks, is the subject of an article by E. W. Lloyd, general contract agent, in a recent issue of the *Electrical Review and Western Electrician.* The decision to supply this service was the outcome of observation of the problems involved, especially those of cost and maintenance.

A large service station is being erected at Jackson Boulevard and Morgan Street, practically in the heart of the trucking center. This building will be complete by the end of the summer and will accommodate one hundred trucks. If the service proves successful, additional space will be provided in the same neighborhood. Additional service stations are contemplated as the project develops.

A comprehensive system has been laid down whereby the customer will be enabled to determine in advance the operating cost of any particular type of electric truck or fleet of trucks. Only new trucks will be accepted in the service. The rate for each size, equipped with a standard battery, will be a flat figure per annum payable monthly in twelve equal parts. Trucks equipped with batteries of larger size than the standard, will be charged for at proportionally higher rates. The service proposed will provide for renewal of battery, tires, and mechanical parts when they wear out. In fact, the customer's vehicle will be practically as good as new at the end of the contract period, except for such depreciation as may have taken place in the non-wearing parts. If this project is successful, it will undoubtedly be taken up by other cities throughout the country. It should result in a great stimulus to the electrical vehicle industry.

The service contemplated is outlined as follows:

> "The proposed service will naturally first cover the ordinary garaging or storage, including the cleaning and care of vehicles. Secondly, it will include the supply of energy for charging the battery and in the third place it will provide for the maintenance or upkeep of the wearing parts of the vehicle, including tires, battery and mechanical parts.
>
> "The maintenance will cover minor repairs of all kinds as well as the renewal of tires and battery when worn out. It will also include painting of the body at specified intervals, and provide for retouching and varnishing at intermediate times.
>
> "Such service will obviously relieve the customer of administrative expense and the cost of supervision, both direct and indirect, which he would have to bear if he operated the vehicles in his own garage. It must be understood that the owner pays the drivers' wages, insurance, and the cost of damage by accidents."

A specially qualified staff for the development and conduct of this service will be employed. Commenting on this, the writer says:

> "Salesmen, supplemented by transportation engineering service, will be able to present to prospective customers having large horse-truck equipments, facts and figures which will satisfy them as to their present expense, and will subsequently present statements which will prove the reduced expense to be effected by substituting electric trucks for these horse equipments."

It is remarked that this undertaking is not only the broadest of its kind, but it is intended to eliminate the difficulties experienced in other partial service systems.

WIRELESS TELEPHONE FOR TRAIN DISPATCHING

If the series of tests about to be carried out by the Public Service Company of Northern Illinois in respect to the use of wireless telephones for load dispatching prove satisfactory, it is quite likely that one set will be installed in the system operator's office at the Joliet, Ill., generating station, and another will be placed in the company's generating station at Blue Island, Ill. It is hoped to use the instruments to facilitate load dispatching in event of any emergency that may be occasioned by failure of the company's private metallic-circuit line. As reported in a recent issue of the *Electrical World*, two wireless telephone sets suitable for communicating between stations 150 miles apart have been purchased and are being tested with the co-operation of the United States Navy Department. While it is thoroughly understood that the Government will not permit the use of wireless telegraph and telephone equipments except under its own supervision, these tests are being made to determine its practicability when conditions will permit its use. The probable extensions of the service are commented upon in the *Electrical World* as follows:

> "If the unit proves practicable in these locations, their use will probably be extended to other important switching centers. The use of the radio telephone rather than the wireless telegraph was favored by the Engineering Department of the Public Service of Northern Illinois because the instruments can be used without a knowledge of the Continental Morse Code and because it is possible to transmit messages with greater speed by telephone than by telegraph."

NITRATE PLANTS TO BE BUILT BY THE UNITED STATES GOVERNMENT

The following statement has been authorized by the Secretary of War:

> "By direction of the President certain plants will be immediately constructed for the production of nitrates from atmospheric nitrogen. The plants to be constructed do not involve the use of water power, but use a process which is a modification of processes previously known, and the total expenditure involved in these projects is about $4,000,000. Nothing further can be said at this time about the process or the location of the works which are about to be constructed. Of the total amount appropriated by Congress—namely, $20,000,000—substantially $16,000,000 remains undesignated as to its expenditure by the President.
>
> "The committee, consisting of the Secretaries of War, Interior and Agriculture, to which the President referred the question of the selection of a site or sites for the development of water power, has made no report to the President on that subject, but is engaged in the making of further engineering studies, and the subject is temporarily closed to further discussion by localities and communities desiring to be considered as possible sites for the plants."

THE USES OF ELECTRICITY ABOARD SHIP

The broadening use of electricity on all types of vessels, sailing, freight and passengers, irrespective of tonnage, is treated at length in a recent issue of the *Electrical Review.* At first, the use of electrical current was confined to the higher class of passenger steamers and naval vessels, but gradually it has been extended to include all vessels except those of small tonnage used strictly for sailing purposes, and even many of this class have found it convenient to install an electric lighting plant for operation of hoists, for ventilation and other purposes.

Chief among the uses of the electric current beyond that of lighting, are the operation of the searchlight, the operation of radio telegraphic apparatus, and the running of miscellaneous power apparatus. It is remarked:

> "In order of development, the searchlight is the oldest application of electricity on shipboard, naval vessels being among the first to employ it soon after the arclight generator came into being nearly fifty years ago. Electric incandescent lighting followed some fifteen years later and now is utilized almost exclusively for general lighting on all kinds of watercraft from small pleasure launches to ocean greyhounds and superdreadnoughts. Electric motors came into use for various power purposes gradually, at first on naval ships and later on merchant steamers; now they are employed for a great variety of machinery driving, from electric fans to the main propellers, especially on navy boats. Wireless telegraphy received its first application on shipboard barely twenty years ago. Its progress has been so rapid that now it is in practically universal use on all ships except those making short coastwise runs or sailing on interior waterways. Electric cooking and baking have in recent years been introduced extensively on navy ships where their safety and reliability have won such recognition as to bring about their use on other vessels also."

The problems encountered in the illumination of vessels vary widely, depending chiefly upon the service in which the vessel is engaged. Launches, ferry-boats and bulk-cargo carriers are the present special problems which require new means of solution.

The problem is especially complicated by the low-head room nearly always available, except in the large rooms which sometimes extend through two or more decks. In these cases, it is possible to employ large lighting units scientifically designed and yet attractive fixtures which will secure a very economical but pleasing installation.

Many parts of a vessel not generally open to passengers require artificial lighting at all times, especially in the engine and boiler rooms, purser's office, etc. Electric lighting of these quarters is the only safe, reliable and economical method available, and so far the tungsten lamps have proven especially suitable on account of their economy as compared with the carbon lamps which are still considerably used aboard ship. Fire rooms are now being equipped with large gas lamps of the tungsten type up to 250 watts, with very good results. On open decks or other places where lamps are exposed to the wash or spray of the sea or to considerable dampness or vapor, it is customary to employ weatherproof or vaporproof fixtures. Safety in navigation also demands certain so-called running lights which include red and green lights on the port and starboard sides of the vessel and white lights on the mainmast which must be kept burning under a heavy penalty. If such lamps are equipped with some such safeguard as tell-tale lamps, the officers are assured of full compliance with the law.

Searchlights have been provided most liberally on navy vessels, which not only have been of considerable aid in naval routine, but also for navigation, signalling and for use in docking, coaling and provisioning the ship at night. Before the event of radio communication, powerful searchlights of the carbon type were employed for signalling over distances of fifty miles. It is mentioned that the most important development in powerful searchlights have been made in recent years, such developments being due principally to Henrick Beck of Germany and E. A. Sperry of New York City.

Commenting upon the expansion of the use of radio aboard ships in the past ten years, the *Electrical Review* says:

> "It is only twenty years ago that the first experiments in wireless communication between a ship and shore were conducted. It took several years before the system was perfected enough to bring about its commercial use on shipboard. Since 1901 the developments have been fast and far-reaching, the range and reliability of radio signals being steadily improved. It was recognized quite early that probably the chief field of usefulness for wireless telegraphy would be as a means of communication between ship and shore stations and between ships at sea. The value of such service was gradually being demonstrated, but it was not until January, 1909, that a most spectacular proof was made of its value in saving life. The steamer Republic, after a collision in the Atlantic, succeeded in calling assistance by wireless, with the result that all her passengers and crew were saved before the vessel sank. This event aroused the whole world and soon afterwards legislation was enacted by the leading countries requiring important ships to be equipped with radio apparatus."

Mention is made of the fact that since July 1, 1911, all vessels leaving American ports were required to be equipped with radio apparatus, capable of transmitting and receiving over a distance of 100 miles by day or night. Later this act was amended to apply to all vessels navigating the ocean or the Great Lakes, carrying fifty or more persons (passengers, crew or both) except vessels plying between ports less than 200 miles apart. An auxiliary source of power was also required, which is usually a storage battery capable of operating the motor generator for obtaining alternating current. An auxiliary engine may be used as an alternative. Efficient and direct communication, however, between the operator in the radio room and the bridge must be maintained at all times. It is shown that safety is the first advantage resulting from radio equipment. Not only is the vessel enabled to call for assistance in case of disaster, but it is enabled to assist other vessels within range.

It is pointed out that an electric fan was one of the first applications of electricity aboard ship, the appealing feature being that it required but small current. It was found very useful on passenger vessels. The naval authorities.

however, were the first to observe that an electric motor could be employed to advantage where a small steam engine, due to the immense length of piping required, was out of the question.

Countless needs for power aboard naval vessels arose, such as for turning of turrets, gun pointing, ammunition hoisting, operation of water-tight doors and hatches, driving of workshop machinery, refrigerating machines, etc. For such work it became very desirable to employ electric motors which have now reached such a stage of perfection that they can withstand extremely severe and exposed conditions without harm. In fact, such motors as are to be exposed to the weather are tested for water-tightness by a hose stream at a pressure head of thirty-five feet which is held ten feet from the motor. They will only pass official inspection if they will withstand this powerful stream without leakage.

Another recent application of electricity aboard ship is that of electric propulsion. Ship propellers operate at highest efficiency at speeds of eighty to 125 revolutions per minute, but the steam turbine proves most economical at speeds varying from 2,000 to 3,600 revolutions per minute. It became necessary to reduce the speed of this propeller by gear reductions. That the advantages of electric current excel the geared drive is emphasized by the writer as follows:

> "Gear reductions have been used, but in comparison with them electric propulsion has advantages under certain conditions, especially on large battleships or cruisers that must be capable of running economically under wide ranges of speed. With electric propulsion, the main turbine drives a direct connected three-phase generator which supplies energy to special induction motors that drive the propellors. On a large vessel there results marked economy of room and weight, greater efficiency, and much simpler and more responsive control that is of special value in maneuvering. The vessels equipped for electric propulsion have given excellent accounts of themselves so that this method of driving is likely to be extended."

It is also shown that electric cooking eliminates the fire hazard because many fires have broken out aboard ship on account of the spilling of grease over an open fire causing an instant blaze which is extremely difficult to extinguish. Some of the more important advantages of electric cooking aboard ship which have been recognized by our Navy where it is employed extensively are as follows:

> "Saving of floor space, cleanliness; elimination of the handling of wood, charcoal, coal and ashes; confining of the heat to the electric range and oven and avoidance of excessive heating of the kitchen; comfortable working conditions for the chef and his assistants; avoidance of smoke and gas; more rapid cooking operations in the case of broiling, frying, roasting and baking, which can be done more speedily on an electric range than on a coal or wood range; more palatable and savory food, because the cooking is under perfect control and not subject to an unreliable fire in the stoves; less waste of food, due to spoilage and shrinkage."

Reviewing the matter in its entirety, it would seem that the Navy man of the future will have to be highly trained in electrical matters, and that his technical training will by no means be sub-ordinated to his nautical training.

Amateur Department

Wireless Class for Women

Under the Auspices of the

NATIONAL AMATEUR WIRELESS ASSOCIATION

IN order to facilitate the study of wireless among women, the Wireless Class for Women, which was formed at Hunter College, New York City, under the direction of the National League for Woman's Service, will in the future be conducted under the auspices of the National Amateur Wireless Association. Following requests for instruction in wireless from persons throughout the United States, arrangements have been made to establish a preparatory course in the art. The salient features of the plan follow:

THE WIRELESS AGE will publish in monthly instalments a preparatory wireless training course.

The course will be conducted by Elmer E. Bucher, instructing engineer of the Marconi School of Instruction, New York City.

The monthly instalments will be in a form similar to the lectures Mr. Bucher delivers to the students in the Marconi School.

These lessons will give the essentials of the art in condensed form. However, they will be sufficiently complete to enable students to acquire the necessary practical knowledge and ability to operate sets in the shortest possible time. They will include every detail that the prospective operator will need.

The course will be complete, beginning with exact elementary instruction and leading, step by step, to the more difficult phases of wireless.

Diagrams and illustrations will accompany each instalment of the course. Wiring diagrams, beginning with the most elementary circuits, and gradually leading up to the more complicated ones, together with illustrations of apparatus and the various parts, will be published. The lessons will be in logical order, in order that students may easily grasp the instructions.

The text relating to each diagram will be brief. Minute instructions will be given in regard to apparatus and equipment and the care, maintenance and operation of stations, together with the operation of sets under ordinary and extraordinary conditions.

This course was designed to prepare efficient woman wireless operators for service at stations conducting Government or commercial radio traffic.

Any student who applies herself conscientiously and consistently to the study of wireless as outlined in this course will be able to equip herself for a profitable vocation. She will also be in a position to render valuable service to the nation.

After mastering the fundamentals and receiving the preparatory training, students who desire to do so may take a supplementary intensive finishing course, without additional charge for tuition, at Hunter College.

The cost to the student of the preparatory course is as follows:

Registration fee, $1.00.

THE WIRELESS AGE for one year, containing Mr. Bucher's lecture course, $2 postpaid.

Head telephones, buzzers, keys, two dry cells, required by students for practice, $7.50.

Additional text books as they may be required. Practical Wireless Telegraphy, cloth bound, 330 pages, fully illustrated, 6½ by 9½, $1.50, postage extra.

"How to Pass U. S. Government License

Examinations," paper bound, fully illustrated, 7 by 10, 50 cents, postage extra.

All communications should be addressed to Mrs. Herbert Sumner Owen, Director of the Women's Division of the National Amateur Wireless Association, Hunter College, Lexington Avenue and 67th Street, New York City.

All checks and post-office money orders for registration fees, equipment and apparatus should be made out to the registrar of Hunter College.

The Wireless Class for Women now numbers five divisions, averaging twenty-five members each. A number of experienced operators have applied for admission. Radio Aid Van Dyke, stationed at the New York Navy Yard, leclectured to the class recently. He called attention to the fact that while a satisfactory speed in code and a knowledge of the technical side of wireless are essential, there are other qualifications in a student which are quite as necessary, and in some ways more valuable. He emphasized the fact that to be a successful operator the student should have steady nerves, good judgment, an alert mind and a capacity for handling unusual situations.

At the Marconi School of Instruction man and woman wireless students work side by side

Mrs. Herbert Sumner Owen, who was formerly national chairman of wireless of the National League for Woman's Service, has resigned from the League to become the director of the Women's Division of the National Amateur Wireless Association. This new affiliation will make possible the nationalizing of an opportunity in wireless for women. Mrs. Owen expects to develop the plans of the Division so that help and advice can be offered those who are ambitious to take up the art, either as a patriotic service or as a means of earning a livelihood.

Students ambitious to take up wireless with the aim of utilizing their knowledge in the national service will find the intensive course of great aid. Preliminary details regarding this course were pub-

(*Concluded on page 954*)

From and For those who help themselves

Experimenters' Experiences.

FIRST PRIZE, TEN DOLLARS

A Panel Type Transmitter With Interesting Features

Now is the time for amateurs to prepare for the grand opening which is to come sooner or later. Attention for the present should be given to the transmitting apparatus which, as is well known, requires more thorough construction than any other part of an amateur's equipment. I have designed a panel type transmitter which, although it is not much different from the average, has a few points that might be of interest to the owner of a first class set.

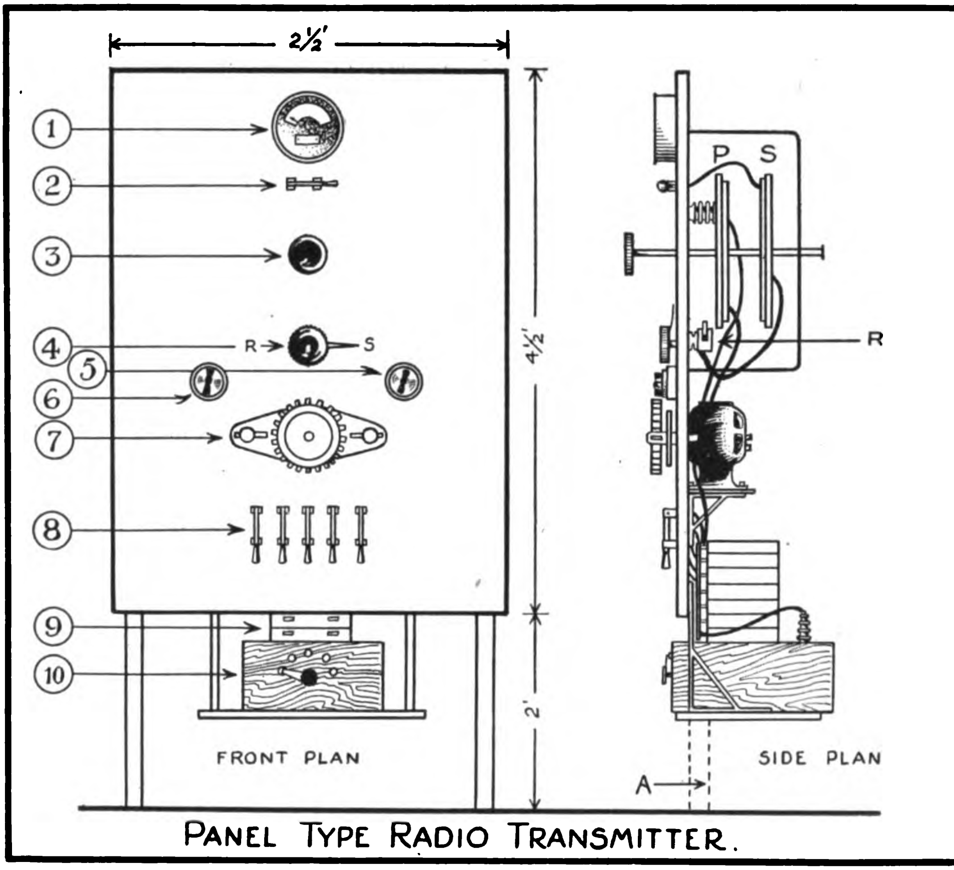
In my station the transmitter is located on the ground floor, which permits the use of a very short earth lead, a most important factor in an efficient transmitter. My panel is constructed after the dimensions shown in the accompanying drawing, but it can be made smaller to suit the wish of the builder, if desired.

The panel board is made of ¾-inch white-wood glued together in strips. After it is completed, it is sandpapered and given a coat of shellac or varnish, the operation being repeated after each coating, using a finer grain of sandpaper. The last coat usually gives a very high finish. The panel is 2 feet from the floor and is supported by two two-by-four's turned edgewise; that is, the 2-inch side faces the panel. Upon the lower end of the panel is mounted a small shelf supported by iron brackets to hold the sending transformer and condensers. It is intended that the panel be located near the receiving operator. I have numbered the working parts, 1, 2, 3, 4, 5, 6, 7, etc., and the function of each part of the apparatus will be explained.

No. 1 is the hot wire ammeter and No. 2 is a small single pole single throw switch that cuts the ammeter in or out of the circuit while testing. No. 3 is a rubber knob on which is fastened a rod to adjust the coupling between the closed and open oscillatory circuits. The primary of the oscillation transformer is stationary and is fastened to the back of the panel with good insulators, while the secondary can be adjusted by sliding No. 3 in or out.

No. 4 is a simple rotary changeover switch to change from receiving "R" (marked on the panel) to sending "S." This is a large brass or copper switch arm fastened to the center rod and must be short enough so it will swing clear of No. 3. The receivers for this switch arm are made of heavy spring brass or copper clips, like those used on the big knife switches, and should be well insulated from the panel board. Nos. 5 and 6 are the large size snap switches. No. 5 opens and closes the circuit to the sending transformer and should be left in the "on" position all the time while transmitting, while No. 6 starts the rotary gap.

These switches can be of the knife type, but the snap type takes up less room and is quicker to operate. The rotary gap is shown in No. 7. The disc extends through the panel so that it can be adjusted and watched. At No. 8 are shown single pole single throw switches for adjusting the capacity of condensers No. 9. These condensers are of the Murdock moulded type, each having capacity of .0017 microfarad. Four to six are generally used, but extra ones can be cut in by the switches in case one burns out. No. 10 is the sending transformer with a variable input which can be regulated by the small switch located on the front of the box. Referring to the side plan, P is the primary of the oscillation transformer and S is the secondary. R shows the side view of the rotary switch and how the arm fits into the clip. The two-by-four is shown at leads, which should be made of wide brass or copper strips. At points where the leads go through the board, very thick porcelain tubes are employed which should be cut a little longer than the thickness of the panel boards. Great care should be taken not to run the 110-volt wires parallel to the high potential wires as this is apt to cause "blowouts" and "kickbacks." In my case the panel



Drawing—First prize article

A, which runs to the top of the panel board, but is not shown in the drawing as it would obstruct the other apparatus. The rest of the drawing is self-explanatory.

As will be noted, the set in this panel type is very compact and will come in handy for "short leads" so important to maximum efficiency. All wiring on the rear of this panel should be carefully insulated, especially the high potential board is set up very close to the wall, but I found that I could not get back of it very well to oil the motor, etc. Therefore I put the entire panel on heavy hinges so it could be swung around for adjustment.

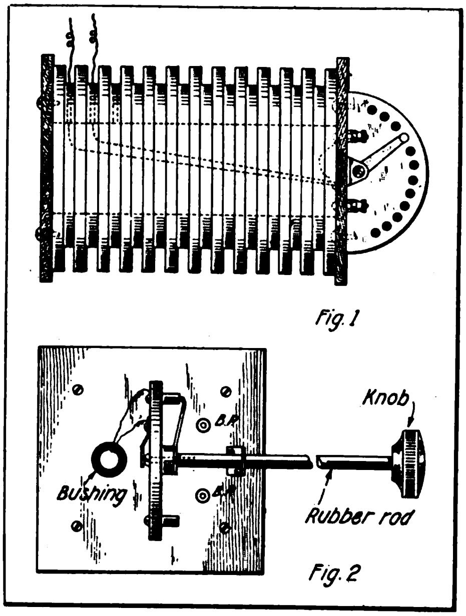
If other amateurs decide to build a set like this one, I should like to hear from them.

HARRY R. HICK, *Rocky Hill, Conn.*

SECOND PRIZE, FIVE DOLLARS

The Construction of a Compact Undamped Wave Receiving Tuner

A receiving tuner which will respond to waves of 12,000 meters when connected to an aerial 200 feet in length is



Drawings—Second prize article

shown in detail in Figures 1, 2 and 3. The receiving transformer is not only very small, but it requires no loading inductances and employs but three variable condensers.

It is to be especially noted that multi-layered windings are employed in both the primary and secondary windings, such windings being made in grooves and wound irregularly to reduce the effects of electrostatic capacity between turns.

Figure 1 shows the general construction of the primary winding which is identical with the secondary winding except the size of the wire. These windings are not arranged to be telescoped, one within the other, but in fact, the tightest coupling is obtained when the windings are "end on."

The primary and secondary forms are made of wood. They are 6¼ inches in length, 4½ inches in diameter, with 12 grooves ⅜ths of an inch in depth, ¼th of an inch in width and ¼th of an inch apart. These are, of course, cut in on a wood turning lathe. A 2-inch hole is cut through the entire length of the core to permit the running of taps from the windings to the switch.

The end supporting blocks are ¼th-inch stock, 5 inches square, which are fastened to the cylinders with ½-inch oval headed brass screws. The constructor should drill a small hole through each tube at the bottom of every groove to admit a tap connection, as shown by dotted lines in Figure 1.

The primary tube should be wound with seventy-five turns of No. 28 S. C. C. in each groove and a wire extended from the hole of each groove to the taps of a multi-point switch as shown.

The secondary winding has 1,200 turns of No. 32 S. C. C. wire which is wound on the second cylinder, 100 turns being placed in each groove. Taps are taken from this winding as from the primary winding.

The construction of the multi-point switch should be noted. A semi-circular piece of 1½ inches radius and ¼th of an inch in thickness is screwed to one end block of each coil to support the switch and contacts. Twelve ¼th-inch contact studs are mounted on a radius of 1¼ inches. These are connected with the taps from the winding which are

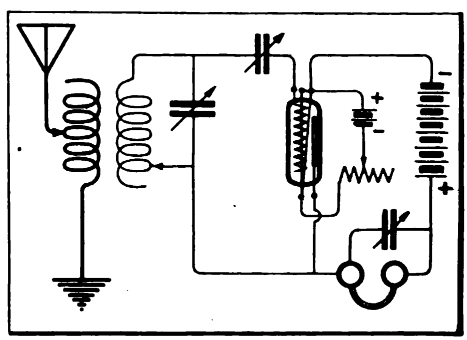


Figure 3—Second prize article

brought through an insulating bushing behind the semi-circle, as in Figure 2.

The construction of the switch will be clear from Figure 2 wherein it will be noted that the lever is held between a threaded washer and a rubber rod which is also threaded. Enough play is allowed between the washer and the screw head so that the mechanism will revolve freely.

The hard rubber rod is ¼th of an inch in diameter and 9 inches in length with a control knob mounted on it for the contact lever. There is an advantage in the use of a long switch handle as shown, because the circuits of the transformer are not thrown out of resonance by the capacity of the body of the manipulator. Both primary and secondary coils are covered with a sheet of hard rubber 1-64th of an inch in thickness. They are placed end to end when in use, the coupling being varied by moving one away from the other. Very loose coupling may be employed when atmospheric electricity is especially severe.

With an apparatus of this kind I have heard Darien, Isthmus of Panama, with the primary and secondary separated by as much as eight feet, and also various arc stations in the United States. I have also obtained good signals from "O U I" and "P O Z."

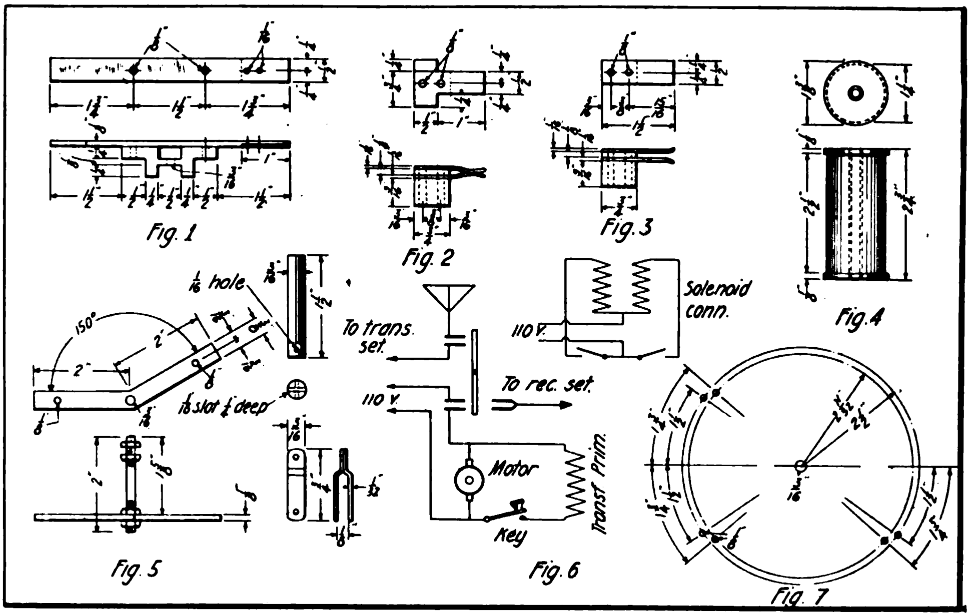
JAMES B. ARMSTRONG, *New York.*

THIRD PRIZE, THREE DOLLARS

How to Make an Automatic Antenna Change-Over Switch

The accompanying drawings, Nos. 1 to 7, show in detail the construction of an aerial change-over switch operated by magnetic solenoids which are energized by 110-volt direct current. A switch of this construction may be mounted on a switchboard on the operating table or at any point convenient to the associated apparatus. It is manipulated by two push buttons, preferably placed near the transmitting key. By pressing one of these buttons, the switch is drawn to the sending position and by pressing the opposite button the switch is changed to a receiving position. It can also be fitted with auxiliary contacts, as shown, for closing the power circuit through the rotary gap motor and the primary winding of the transformer.

As shown in Figure 1, the switch is made of copper with a piece of hard rubber riveted to the under side on one end. Care should be taken to have the rivets well towards the center so that they do not come in contact with the clips.



Drawings—Third prize article

The standard on which the blade is fastened is made of hard rubber and is bolted to the blade with two brass bolts, as shown in Figure 1. As can be seen from the diagram, the shaft is fastened to this standard in a way that it will not touch the blade.

The construction of the high tension clip is shown in Figure 2. The two sections of the clip are of copper, insulated from each other and the base on which they are mounted is made of hard rubber. A bushing 3/16ths of an inch in diameter, 13/16ths of an inch in length, with a ⅛th-inch bore, is inserted to insulate the two sections from the bolts which hold the clip to the switchboard. These two sections should only make contact when the switch blade is not between them. Two fibre washers insulate the heads of the bolts from the clips. In order to fasten on lugs for the leads, the side of each section projects on the opposite side of the clips, as the diagram clearly shows. It is preferable to solder the leads to these extension clips.

The clip for the receiving side of the switch is shown in Figure 3. It is built exactly like the high tension clip with the exception that no insulation is required between the two sides. The standard on which the clip is mounted is of hard rubber and instead of a section of hard rubber being placed in between the two clips, a piece of copper is used. They are held through the switchboard by means of ⅛th-inch bolts.

The construction of the power clip is nearly like that of the high tension clip with the difference that the two sections never come in contact, except when the blade is between them. The power clip closes the circuit of the rotary gap motor through the transformer when the switch is in the sending position and opens these circuits in the receiving position.

The two solenoids which operate the blade are identical in construction. The dimensions are shown in detail in Figure 4. A spool is made out of hard rubber or fibre tube with two circular ends of hard rubber or fibre. Both spools are wound to about 1-16th of an inch from the edge of the end pieces, with No. 22 double cotton-covered magnet wire.

The mechanism of the shaft and armature is shown in Figure 5. The shaft is made of 3/16th of an inch round brass threaded on one end for about ½ inch and on the other end for about ¾ths of an inch. It is 2 inches in length. The switch blade is held against the switchboard by a spring slipped over the shaft and placed between the switchboard and the arm. The arm to which the two armatures are fastened is made of brass and is ⅜ths of an inch in width and ⅛th of an inch in thickness. It is cut so that the two halves are at an angle of 150°. Each half is 2 inches long. In the center a 3/16th-inch hole is drilled to fit the shaft. One-half inch from each end is bored a ⅛th-inch hole to which the armatures are fastened.

The two armatures which slide in and out of the solenoids are 3/16ths of an inch in diameter and are made of soft iron. At one end of each a 1/16th-inch slot is cut to a depth of ¼th of an inch. A hole 1/16th of an inch in diameter is bored ⅛th of an inch from the end at right angles to the slot. Two small connecting rods connect the armatures to the shaft arm so that they move in and out of the solenoids easily and without jamming or sticking. The construction of these pieces is shown in detail in Figure 5.

To mount the switch on a switchboard or table, a line is drawn horizontally to the bottom edge. With a center anywhere on this line, circumscribe a circle having a diameter of 5 inches; inside of this circle and with the same center, draw another circle having a radius of 2 11/32 inches. Taking the point where the outer circle intersects the line on the left as a center, and with a radius of 1¾ths inches, make a mark on the outer circle in the three places as shown in Figure 7. At the point where the inner circle intersects the horizontal line as a center and with a radius of 1½ inches, mark off the points as shown in Figure 7.

At the point just located, holes ⅛th of an inch in diameter are drilled, and the contact clips are bolted in place. The high tension clip is placed in the upper

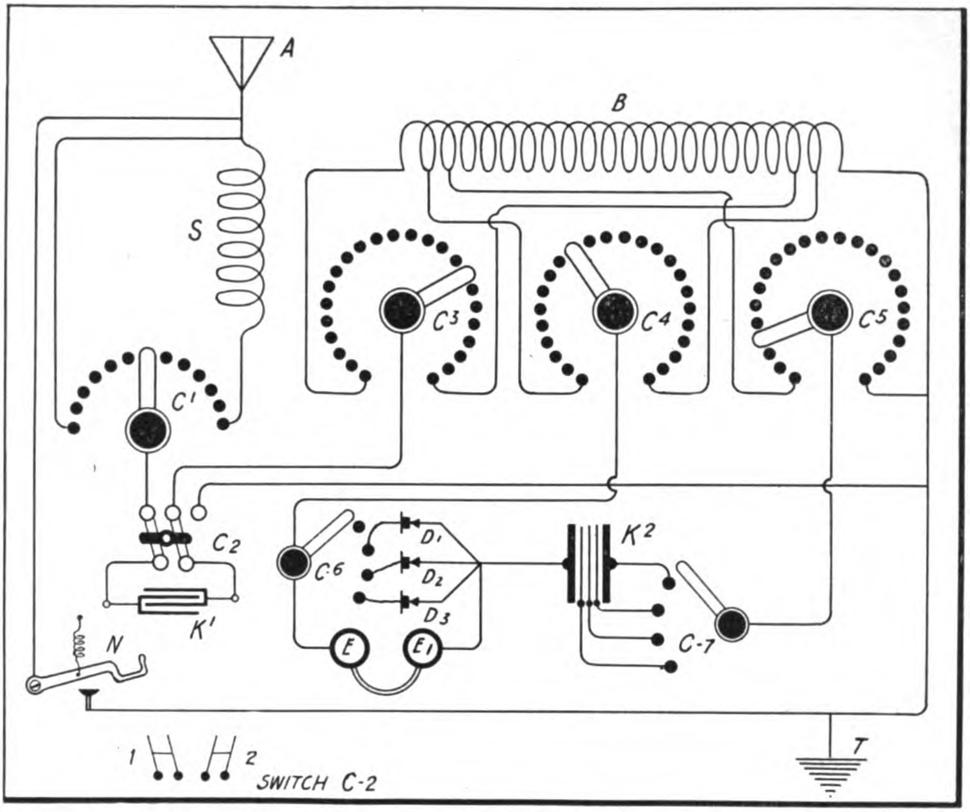


Figure 1—Fourth prize article

left hand quarter of the circle and the receiving clip in the lower right hand quarter. The power clip is placed in the lower left hand quarter. A 3/16th-inch hole is drilled in the center of the circle through which the shaft is placed. The end of the blade which has the hard rubber fastened to the under side is the one which goes into the high tension clip.

The antenna is connected to the upper section of the high tension clip and the lead to the sending set is connected to the lower section. When the switch is in the transmitting position, these two sections touch one another and the blade makes contact between the two sections of the power clip, thereby closing the circuit to the motor.

When in the receiving position the blade makes contact with the receiving clip and the antenna section of the high tension clip only. The diagram of connections is shown in Figure 6.

The two solenoids are fastened to the under side of the table or the back side of the switchboard by straps of brass so that they are parallel to each other, and so that when one armature is entirely inside one solenoid, the other armature is only about halfway in the other. The leads from the solenoid are extended to push buttons as shown in Figure 6.

HERMAN E. WERNER, *Ohio.*

FOURTH PRIZE, SUBSCRIPTION TO THE WIRELESS AGE

A Compact Receiving Set For Damped Waves

Readers desiring to construct a receiving set fitted with a crystal detector will probably be interested in the design I herewith propose. The accompanying drawings represent an apparatus having the unquestionable advantages of selectivity and sensitiveness, both of which are important characteristics of a compact receiving tuner. As will be observed in Figure 1, the set includes the aerial, A, the loading coil, S, fitted with a 12-point switch, C[1], and one variable condenser, K[1], which can be placed in several positions in the tuning circuits by means of the change-over switch, C-2.

When the switch, C-2, is in the position, 1, the condenser, K-1, is in series with the primary circuit which makes the whole circuit responsive to short waves; when it is in the position, 2, it is in shunt across the tuning coil to increase the possible wave-length adjustments of this circuit. The inductance of the primary portion of the tuning coil, B, is adjustable by means of a two 3-point switch. C-3.

The inductance of the secondary circuit of the coil, B, is adjustable by two three-point switches, C-4 and C-5; the circuit further includes three good crystal detectors, D-1, D-2 and D-3, which are cut into the circuit by the switch, C-6. A pair of good telephone receivers, E and E¹, are connected in shunt across the detector and a fixed condenser, K-2, which is adjustable in large steps by means of the four-point switch is connected in series.

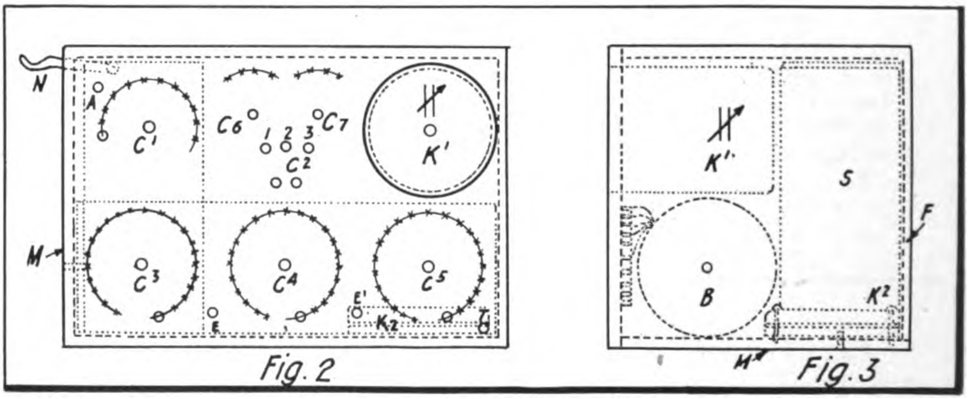
The case shown in Figures 2 and 3 has overall dimensions of 12 inches by 8 inches by 8 inches and it is preferably constructed of hard wood approximately 1/3rd of an inch in thickness. The vertical rectangular back, F, is made in the form of a slider so that it can be readily removed to give the manipulator access to the connections. The panel, P, on which these switches are fastened is a piece of mahogany 12 inches by 18 inches, but if the apparatus is used in damp climates, it is preferable to have it of Ebonite or Bakelite.

Holes are drilled in the panel to receive the contact points, as shown in Figure 2. One way of constructing the multi-point switch is shown in Figure 4. A hard rubber knob, R, is attached to the shaft of the switch as indicated. Switches of this type can be purchased direct from the manufacturer, but in the event that they cannot be purchased, it will be necessary to drill the panel accordingly.

A tuning coil, B, is made of a cardboard tube 11 1/5th inches in length by 3 3/5th inches in diameter wound with 345 turns of No. 22 S. S. C. wire. Taps are taken off all the turns and connected to the switches, C-3, C-4 and C-5, in the following order. The first tap is connected at the first point of the switch, C-3; the second five turns thereafter at the beginning of C-4; the third at the beginning of C-5; the fourth at the beginning of C-3; the fifth at the second point of C-4, and so on to the sixty-ninth connection. To explain at greater length, the sixty-nine taps will cover the entire 345 turns. Each switch controls fifteen turns and very precise adjustment can be obtained if the loading coil is properly employed, likewise the variable condensers.

Two wooden discs, as shown at D in Figure 4, are glued in the end of the tube which is fastened horizontally in the box by two screws at the center (Figures 2 and 3).

The loading coil, S, is constructed in the same manner. The tube is ¼th of an inch in length by 3 and 1/5th inches in diameter, wound for 7 inches with



Drawings—Fourth prize article

No. 24 S. S. C. wire. It will have approximately 264 turns. Taps are taken off at each twenty turns and connected to the eleven points of the switch, C-1.

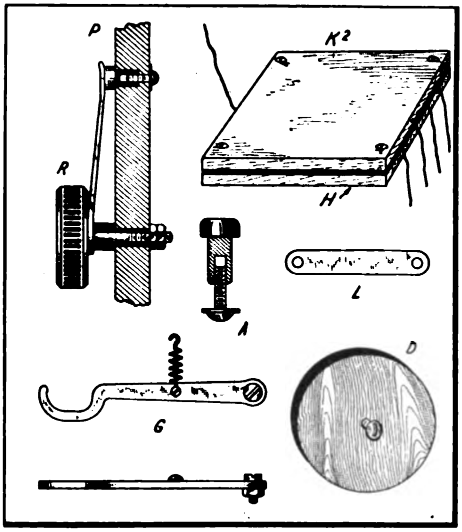


Figure 4—Fourth prize article

This coil is placed vertically in the box (Figures 2 and 3).

It is found of great value to construct the condenser, K-1, so that it can be adjusted progressively. The type of rotary variable condenser which is sold by the average manufacturer will fulfil the requirements. It generally has a maximum capacity of .001 microfarad. To mount it on the panel, a large hole of the diameter of the condenser container is drilled in order that it may be fastened to the front of the panel.

The switch, 2, is one of the ordinary type; in fact, it is the type of reversing switch used in telegraph work. The details are shown clearly in Figure 4. Two holes are drilled at either end of the brass strip, L, to slip over the shaft.

The condenser, K-2, may be of fixed capacity, but to obtain the very finest adjustment of the circuit, it is preferable to have it adjustable in steps as by the switch, C-6. This condenser is constructed of five sheets of tinfoil, 3⅝ths inches by 4 inches, between which are placed sheets of paraffin paper, about 4 by 4½ inches. The entire condenser, after being properly assembled, is placed between two small blocks of wood and screwed together, as shown in Figure 4. It is attached in the fashion as shown in Figure 3. The connections from the various plates of the condenser are clearly shown in Figure 1.

Three good crystal rectifiers should now be selected and mounted on the top of the panel set. They can be connected in the circuit successively by throwing the switch from one point to the other. The most sensitive detector is thus quickly found during the reception of signals. Two binding posts provided for the aerial and earth connections are fixed in the upper left hand and lower right hand corners of the panel. Two additional posts are placed at E and E^1 to connect a double set of sensitive wireless telephone receivers such as the Murdock telephone, varying in resistance from 500 to 2,000 ohms.

I have also shown in Figure 4 a small hook switch which, when the telephones are hung on it, will automatically connect the antenna direct to the earth and

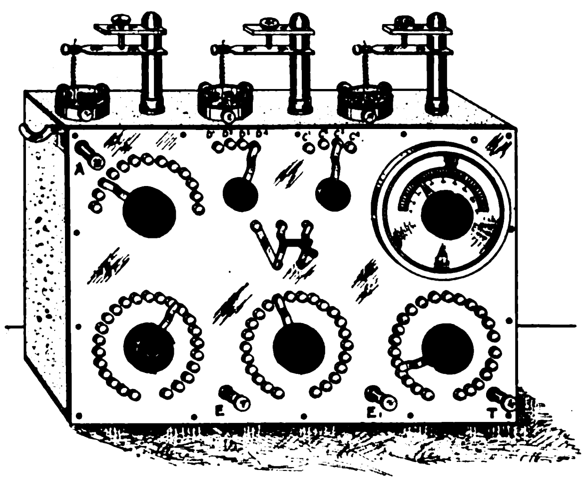


Figure 5—Fourth prize article

protect the apparatus from lightning discharges. The details of this are shown in Figures 1, 4 (G) and 5. The indexes for the switches can be made on white celluloid.

A receiving set of this type makes a handsome appearance and takes up a small amount of space. Connected to a good aerial, well insulated, the reception of spark signals at normal wave-lengths over distances of 1,000 to 1,500 miles is possible; in certain cases this has been exceeded.

Albert Corman, *Paris, France.*

The Monthly Service Bulletin
of the
NATIONAL AMATEUR WIRELESS ASSOCIATION

Founded to promote the best interests of radio communication among wireless amateurs in America

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THERE is evidence on every hand that experimenters who have not been called into the Government Service are taking full advantage of the present opportunity to rebuild their apparatus or to educate themselves technically to a higher degree of proficiency. We have, in fact, received a number of inquiries on very important phases of radio telegraphic design, which bespeak the growing desire for scientific knowledge on the part of experimenters. These communications indicate that the amateur is more alert than ever and is only too glad to have a quiet period in which to reflect upon the radio situation as a whole. He has observed, perhaps, in his experience during the last few years that by rearranging the design of his apparatus he obtained better results, and now he is taking advantage of the opportunity afforded by war conditions to take up this task. So he spends many evenings in his workshop.

Sooner or later every experimenter realizes that the operation and the construction of electrical apparatus are based upon scientific principles; moreover, unless this apparatus is designed in accordance with certain fundamental laws, the maximum efficiency cannot be obtained.

The experimenter building apparatus from designs furnished by others is often in doubt whether his money is being put into material which will give him the best results. There is only one way in which he can assure himself on this point, and that is by gaining such knowledge as will permit him to design apparatus according to a definite principle.

The foregoing assuredly applies to the amateur radio telegraphist because he deals with scientific principles which a few years ago were not well understood, but are now aptly described as representing "the highest form of engineering expression." The genuine satisfaction in constructing a piece of electrical apparatus such as a high voltage transformer, for instance, does not come in merely following the dimensions and working instructions given by another. The real delight is experienced by the experimenter when he calculates for himself the constants for a given instrument. He, at least, experiences the satisfaction of knowing that he will have a transformer that will give the highest degree of efficiency within the present knowledge of the art.

The little use which the average experimenter of to-day makes of his local library is astonishing. Any number of good books on electrical design and construction containing a number of formulae for magnetic and electrical calculations can be found in the electrical division. The man with only average intelligence can easily comprehend these formulae and their practical application will eliminate hours of needless experimenting.

Did you know that the word "amateur" as used in the French language possesses an entirely different meaning than that given it by the American press and public?

Here an amateur who follows any particular hobby is generally considered as one who does not possess the attainments of a professional, i. e., his status has not been passed upon by some board of inquiry, or governorship; but in the French language an amateur is one who is deeply interested with his work or hobby and considers all else secondary to the particular subject in which he is engrossed. It does not imply that he is particularly ignorant of the hobby he has adopted. On the contrary, he may be highly informed upon the subject and vet be an amateur on account of his attitude toward his work.

The word "amateur" well fits the American experimenter for as soon as he becomes absorbed in wireless, he is an amateur, according to the French definition of the word.

We have received several communications at headquarters in reference to the design of 500-cycle generators.

Inquirers should take into consideration the vast amount of calculations and the innumerable machine shop drawings required to answer such a question. A professional engineer has estimated the cost of providing such information at several hundred dollars.

One member of the Association writes as follows concerning regenerative receivers about which so much argument prevails at present:

"I have read with considerable interest the second prize article by F. J. Scupholm in the April, 1917, issue of THE WIRELESS AGE and would like to say that I have built a set somewhat similar to that described by Mr. Scupholm and have obtained even better results than he has. I make the following suggestions:

"First—Do away with the condenser across the secondary as even the slightest capacity at this point will reduce the strength of signals on short waves about 50 per cent.

"Second—To tune the secondary connect a variometer in series with one side of the secondary leads, preferably to the terminal connected to the grid of the vacuum valve.

"Third—To do away with the slightest dead-end effect, take no taps whatsoever from the secondary coil. My secondary winding is 3⅛ inches in diameter and has fifty turns, No. 28 S. C. C. wire. With a variometer, in which the windings are made from No. 30 S. C. C., on tubes 4 inches in length by 3 inches in diameter, with fifty turns on each tube, wave-lengths up to 500 meters can be read.

"These suggestions may seem small, but the one referring to taking out the secondary condenser is alone worth the price of admission.

"Using a single vacuum valve, an aerial only 80 feet long and 40 feet high, I copied 2AGJ at Albany almost every night during the latter part of the season. 2PM was copied about a month. 2LK and 7ZL were heard about three times, and last but not least, 6EA at Los Angeles was copied on six nights. Of course, numerous 8 and 9 stations have been copied and a total of about 190 8's and 9's. Also, I would like to call your attention to the fact that it was 5 BV not 5 BC that Scupholm has down for Little Rock in the April number."

JOHN M. CLAYTON, *Arkansas.*

Wireless communication between the United States and Japan was inaugurated July 27th, 1915, the messages being relayed by the Marconi high-power station at Honolulu. The transmitting station in Japan is located at Funabashi.

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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 one reader can be answered in the same issue. To receive attention these rules must be rigidly observed.

Positively no Questions Answered by Mail.

D. R. Z., Savannah, Ga., inquires:

Ques.—(1) What are the fundamental points of the Galletti system of radio telegraphy?

Ans.—(1) To our knowledge, this system is now employed commercially, but some important experimental work has been carried out at stations in France and Switzerland. The Galletti transmitter is energized by high voltage direct current, from 30,000 to 100,000 volts being employed. A number of oscillating circuits are coupled to a common condenser, which are excited alternately in such a way as to afford practically an even or continuous flow of alternating current in the antenna system. In each discharge circuit there are a number of gaps in series which are enclosed in an airtight drum. The gaps are widened out so that no sparking can take place until an additional E. M. F. from an auxiliary apparatus is supplied. By properly timing the auxiliary discharge voltages the sparks discharge successively and a practically continuous flow of oscillations is obtained in the antenna circuit. This method of obtaining sustained oscillations was first employed by Marconi and his assistants.

* * *

R. W., Portsmouth, Ohio, inquires:

Ques.—(1) What is the cause of the peculiar "gurgle" in the tone of the wireless station at Buffalo? I have heard several other sets with practically the same spark tone, but I cannot recollect their call letters at this writing.

Ans.—(1) The note you hear is due to the use of a non-synchronous spark discharger which gives a peculiar musical tone. Usually these dischargers are adjusted to give about 400 sparks a second when the frequency of the alternating current charging the condenser is sixty cycles per second.

Ques.—(2) What station in Canada signs the call letters B Z Q? I first heard this station about six months ago.

Ans.—(2) We have been informed that B Z Q is the British Government station on the Bermuda Islands, but we are not prepared to make any definite statement on this point.

Ques.—(3) Why do commercial wireless telegraph companies use open core transformers in preference to the closed core type? Furthermore, why is the amateur trade supplied with the closed core type almost exclusively?

Ans.—(3) You will find both the open and closed core transformers used in commercial wireless telegraph apparatus. One reason why the open core transformer was originally adopted lies in the fact that it possessed certain operating characteristics highly desirable for a radio transmitter. You will readily understand this by considering certain phases of the action of a radio transmitter. When the condenser discharges across the spark gap, the secondary winding of the transformer is placed practically on short circuit, and unless there is a certain amount of magnetic leakage in the transformer system there will be an abnormal rise in current which may burn it out. The open core naturally possesses the requisite magnetic leakage and the closed core transformer can be made to have the same operating characteristic, provided the magnetic circuit is fitted with a magnetic leakage gap such as is used on the Clapp-Eastham transformer.

In the Marconi apparatus, the requisite magnetic leakage does not take place at the transformer, but is obtained by a peculiar design of the generator of the motor-generator.

You will find about an equal number of both types of transformers in the Marconi service.

Ques.—(4) Is there any physical examination connected with the Marconi service?

Ans.—(4) The general statement of the applicant for admission is accepted, but if there are any prominent physical deformities, such as loss of arm or limb, or other disfigurement, the applicant will be rejected.

Ques.—(5) What is your idea as to what the status of the wireless amateur will be at the close of the war; that is, the really serious amateur?

Ans.—(5) It is too early to answer this question precisely. We see no reason whatsoever why the original rights of the amateur should not be restored. The amateur station will, of course, always be subject to Government restriction, but we see no reason why amateur stations cannot be allowed to reopen under the same restrictions in force previous to the war.

F. J., Baltimore, Md., inquires:

Ques.—(1) Will you kindly furnish me with complete information and detailed instruction concerning a ½ K. W. 500-cycle generator suitable for the operation of a wireless transmitting set? I wish to construct such a generator in order that I may have it ready by the time that amateurs are allowed again to operate their sets.

Ans.—(1) The data you require could only be obtained at a great expense from a designing engineer connected with some reputable concern. We are of the opinion that any electrical supply house or any electrical engineering corporation would supply you with this information provided you were willing to pay for it. You, of course, appreciate that for us to discuss this matter in detail in these columns is impossible because of lack of space. Furthermore, manufacturing concerns are somewhat reluctant to disclose details of construction of these high frequency generators. We believe, however, that if you are willing to pay a fair price for such design, you will be able to obtain it. All in all, you would probably find it just as cheap to purchase a generator of this type as to attempt to construct it, for a special set of jigs and templets would be necessary to carry out the work.

* * *

The "C" Brothers, Newark, N. J., inquire:

Ques.—(1) We note that Mr. Tompkins' article, which won third prize in the June issue of The Wireless Age, was not accompanied by a wiring diagram. As we desire to construct a receiving set of this type, we should like to see the diagram published.

Ans.—(1) We regret that this manuscript was not accompanied by a diagram of connections, but the designer's idea is clear. The extreme lefthand coil is the primary winding of the receiving transformer and the middle coil the secondary winding. The extreme righthand coil is inductively coupled to the secondary in order to have the wing circuit re-act upon the grid circuit of the three electrode vacuum valve.

* * *

D. M. D., Newark, N. J., inquires:

Ques.—(1) Explain how the logarithmic decrement of damping is measured?

Ans.—(1) A detailed explanation of this measurement would require too much space in these columns, but the subject is taken up in detail in the book, "Practical Wireless Telegraphy." To measure the logarithmic decrement of damping, a wave-meter fitted with some sort of a current indicating device, such as a hot wire ammeter, or a hot wire wattmeter is required. The wave-meter is then placed in resonance with the antenna circuit of a given transmitting set and the condenser is shifted to a capacity above resonance and to a capacity below resonance where the deflection of the indicating instrument is one-half that obtained at resonance. By noting the three condenser capacities, their values may be inserted in a simple formula, as follows:

$$\delta 1 + \delta 2 = \frac{C_a - C_b}{C_r} \times 1.57$$

Where $\delta 1$ = the decrement of the circuit under measurement.

$\delta 2$ = the decrement of the wave-meter.

C_a = the capacity of the variable condenser at a point above resonance (as above noted).

C_b = the condenser capacity at a point below resonance (as above noted).

C_r = the capacity of this condenser at resonance.

Generally a table of decrements for the wave-meter at various adjustments of wave-length is furnished, but if not, the decrement of the instrument can be determined by the method shown in "Practical Wireless Telegraphy."

Ques.—(2) What is the value of plotting a resonance curve, and how would you go about it?

Ans.—(2) You should use precisely the same apparatus employed for measurement of the logarithmic decrement. The data for the resonance curve can be obtained by adjusting the wave-meter to various wave-lengths on and off resonance, noting at the same time the corresponding deflections of the hot wire wattmeter. To plot a resonance curve, the experimenter should have some knowledge of co-ordinate geometry. The value of such curves lie in the fact that they permit an estimation of the apparent "sharpness" or "broadness" of the radiated wave.

The logarithmic decrement, of course, can be calculated directly from the resonance curve.

Ques.—(3) Where can I obtain a diagram of a modern 2 K. W. 500-cycle transmitting set of the Marconi panel type, and also the Marconi type 103 receiving tuner? Give the function of each part of the transmitter.

Ans.—(3) A complete answer to this query would require all the available space of this Department, and since this information appears in full in the publication, "How to Pass U. S. Government Examinations," also in the text-book, "Practical Wireless Telegraphy," you are referred to either book for further information.

* * *

A. C. A., Evanstown, Wyo., inquires:

Ques.—(1) Please explain how the Marconi magnetic detector works. Is it being displaced in commercial work by the modern crystal rectifiers?

Ans.—(1) The Marconi magnetic detector possesses extreme stability of adjustment, and it is very sensitive at wave-lengths of about 2,000 to 3,000 meters. It is

used on practically all the vessels of the English Marconi Company, being employed largely for obtaining long distance press dispatches. In fact, by the use of the magnetic detector, operators frequently report the reception of signals from South Wellsfleet, Mass., or Poldhu, England, at distances up to 2,200 miles. This proves conclusively that it is a detector which can be relied upon for long distance work. It is found, however, that it is not so sensitive on the shorter range of wave-lengths. However, it is a very satisfactory device for communication up to several hundred miles. There is some argument concerning the principle upon which it works, but it is believed that the incoming oscillations which circulate through the fine wire winding (which is wound over the glass tube through which the iron band circulates) temporarily demagnetize the iron band which causes a change of flux in the small bobbin of wire connected to the receiving telephone. A single sound is therefore produced for each group of incoming oscillations.

Ques.—(2) Is the magnetic detector practical for amateur use?

Ans.—(2) There is no reason why it cannot be employed for amateur use as well as for commercial use. It will be found an extremely interesting detector and possesses the great advantage that it is not affected by the local transmitter. Of course, it is not as sensitive on the lower waves as the better class of crystal rectifiers.

Ques.—(3) Please give the formula for calculating the current in a receiving antenna during normal conditions?

Ans.—(3) We herewith give you the AustinCohen formula which is now generally accepted by radio engineers as correct in the present knowledge of the art:

$$I_r = \frac{635\ I_s\ h_1\ h_2}{D\lambda}\ \epsilon\ -\ \frac{0.0762\ D}{\sqrt{\lambda}}$$

Where I_r = the current in the receiving antenna in microamperes.

I_s = the current in the sending aerial in amperes.

h_1 = the height of sending aerial in feet.

h_2 = the height of receiving aerial in feet.

λ = the wave-length in meters.

D = the distance in miles.

The factor, 635, in the equation is correct for a receiving antenna of 25 ohms equivalent resistance, which is probably a little lower than that obtained in the average amateur land stations. The factor, 0.0762, is the absorption co-efficient; that is, it is the measure of the rapidity with which the waves are absorbed in their travel. This formula is strictly applicable to transmission over sea-water, and has been determined by Professor Taylor and A. S. Blattermann. It is believed to be applicable for transmission overland during the early hours of the evening in the United States.

Ques.—(4) Discarding all guess work, what is the method used in obtaining the difference of intensity of incoming signals?

Ans.—(4) No strictly satisfactory method has been devised so far, but the shunted phone method is employed for most experimental determinations. This method is completely explained in the "Naval Manual" and "Practical Wireless Telegraphy," also in other text-books on the art. A calibrated resistance is connected in shunt to the head telephone and the value of the resistance is gradually decreased until the signals just disappear. If the resistance of the telephone is known, then

$$\text{The current in the receiver} = \frac{R+T}{R} \times Ca$$

Where Ca = the least audible current required to make a sound in the head telephone;

R = the resistance of the shunt;

T = the resistance of the telephone.

This formula does not take into account the impedance of the telephone receiver windings which, of course, changes with each change of spark frequency at the transmitting apparatus. The use of this method, while not extremely accurate, is, of course, much superior to mere guesswork.

* * *

A. C., Paris, France, inquires:

Ques.—(1) What is the best system for selective tuning consistent with the strength of signals and long distance range? Which gives the best tuning, a two or three-slide direct coupled set, or an inductively-coupled receiving tuner? Why?

Ans.—(1) Equal degrees of selectivity will be obtained with the three-slide tuner or the inductively-coupled transformer, but the inductively-coupled transformer gives the advantage that it is much less difficult to alter the coupling between the primary and secondary windings. With the straight single coil tuner fitted with three sliders, it is necessary to work all three of them to lower the mutual inductance to any degree desired. You will readily understand that the inductively-coupled transformer will be more convenient in this respect.

Ques.—(2) What is the best length and diameter for the primary and secondary windings of a receiving tuner for tuning on all wave-lengths up to 15,000 meters? Please give the length of the coils, the diameter and insulation of the wire and tell me whether or not it should be adjustable by taps or by sliders; how should the current be divided?

Ans.—(2) The dimensions of this tuner will depend very largely upon the type of

receiving aerial with which it is to be employed. If you should include all the primary and secondary inductances in the coupler, the tuner would be rather inconvenient to manipulate. Therefore we recommend that the primary winding be about 14 inches in length and 6½ inches in diameter. The secondary winding should be 14 inches in length by 6 inches in diameter.

The primary coil should be wound with No. 24 S. S. C. wire and the secondary coil with No. 32 S. S. C. A loading coil, about 18 inches in length and 6 inches in diameter, wound with No. 32 wire, should be included in series with the secondary winding. The dimensions of the primary winding will vary according to the size of the antenna, and consequently the exact values of inductance will have to be determined by experiment. It makes practically no difference whether the inductance of these two windings is varied by a multi-point switch or by a sliding contact, but the multi-point switch is preferred because it does not wear off the wires.

It is customary in the United States to insert a variometer inductance in series with the receiving antenna and then fit the primary winding with a simple multi-point switch, each of the taps for which are attached about one-half inch apart on the primary winding.

It is not necessary to tap the secondary winding more often than by spaces of 1 inch.

The necessary fineness of adjustment in the secondary circuit is obtained by a variable condenser connected in shunt.

Ques.—(3.) Which method of connection in the receiving apparatus do you prefer: to connect a crystal detector in series with the head telephone, or to place the head telephone in shunt to the crystal detector?

Ans.—(3) In the majority of cases, a louder signal will be obtained with the telephone in series with the crystal and shunted by a telephone condenser. This has been explained by one writer as being due to the fact that the flow of radio-frequency currents in the secondary winding of a receiving tuner is invariably accompanied by harmonic currents, and when the condenser is thus connected in shunt to the head telephone, all these harmonic currents are collected as well as the fundamental current; therefore an increase in the strength of signals is obtained. We are not prepared to say that these are the actual facts of operation but they represent one theory which has been set forth.

Ques.—(4) What do you consider the best resistance for each receiver of a head telephone?

Ans.—(4) General practice seems to indicate that 1,500 ohms for each headpiece are sufficient.

Ques.—(5) For the adjustment of receiving apparatus, do you prefer a receiving tubular adjustable condenser, or a rotary variable condenser?

Ans.—(5) Generally the rotary variable condenser is more convenient to operate, but equal strength of signals will be obtained with either type provided identical values of capacity are used.

A. T. R., Wisconsin:

The diagram you forwarded concerning the dimensions of the radio-frequency amplifying circuit shown in the January, 1916, issue of The Wireless Age has just come under our observation. Referring to the notations on your drawing: The coils, L-7 and L-8, are in variable inductive relation, also the coils, L-5 and L-6. Their dimensions should be such that the circuit, L-7, C-3, L-6, is in resonance with the circuit, L-2, C-6, L-3.

The coils, L-3 and L-4, can approximate the dimensions used in the average amateur coupler for tuning up to 3,000 meters. Similar dimensions would apply to the coils, L-5 and L-6. The dimensions of L-1 and L-2 will, of course, vary with the dimensions of the antenna and for response of signals up to 10,000 or 12,000 meters, the primary winding should be 14 inches in length and 6½ inches in diameter, wound with No. 24 S. S. C. wire. The secondary winding should be 14 inches in length, 6 inches in diameter, wound with No. 32 S. S. C. wire. Small loading coils would then be required in both the primary and secondary circuits. The secondary loading coil should be from 12 to 18 inches in length and about 6 inches in diameter, wound with No. 32 S. S. C. wire.

If this apparatus is to be used on the shorter range of wave-lengths up to 3,000 meters, you will be able to obtain the dimensions of such a coupler from the book, "How to Conduct a Radio Club" and also from previous issues of The Wireless Age.

* * *

H. S. A., Operator, Spokane:

We cannot agree with you that the placing of soap on the spark gap electrodes is good practice, and we urge that it be discontinued in commercial work. The effect of placing soap on the spark electrodes is about the same as using a very fine pointed electrode, namely, the spark note is increased thereby because the discharger points are not blunt. Under the heat of the spark discharge, the soap volatilizes and therefore offers less resistance to the condenser discharge, but this does not necessarily imply that the effectiveness of a transmitting set is thereby increased. As a matter of fact, the amplitude of the antenna current may be decreased. Of course, increased response is obtained in the receiving telephone by the use of a musical spark note, and operators should do everything possible to maintain clear notes. In fact, a greater volume of sound will be obtained in the average receiving telephone when

the spark discharge is uniform rather than rough or irregular, but there is nothing in the instructions issued by the Marconi Company permitting an operator to use soap or any other volatile substance on the electrodes of the spark gap.

* * *

A. B. J., Warren, Pa.:

Your questions concerning the diagrams and the mode of operation of certain receiving apparatus evidently refer to various forms of regenerative circuits in use, although you did not make this clear. We therefore advise you to purchase a copy of the third revised edition of the book, "How to Conduct a Radio Club" and note therein a complete set of diagrams for the various types of such circuits. These are also shown in "Practical Wireless Telegraphy." Further diagrams will be found in the September, 1915, issue of the Proceedings of the Institute of Radio Engineers.

* * *

A. B. Q., Boston, Mass.:

The results of Dr. Austin's experiments with receiving detectors follow: At the wave-length of 900 meters, it was found that it required 2.1 times as much energy to make an audible sound in the receiver with the magnetic detector as with the zincite-bornite detector. It was also shown that the magnetic with the telephone circuit tuned to the spark frequency of the transmitter gave signals one and one-half times as strong as the zincite-bornite detector at the wave-length of 3,000 meters. At the wave-length of 350 meters the zincite-bornite combination was nearly five times as sensitive as the magnetic detector. Whether the results of this investigation would apply to all types of receiving circuits now in use we are unable to say. This merely represents a single set of measurements taken under a given set of operating conditions which may not always be duplicated in actual practice.

* * *

T. B. R., Omaha, Neb.:

There is a distinct difference between a starting box and a speed-controlling rheostat. The resistances of a starting box are only intended for temporary use and if they are allowed to remain in the circuit for several minutes, the coils will doubtless burn out. The speed controlling rheostat, however, is of such resistance and has such an amount of heat radiating surface that it will withstand a continuous flow of current without burning out. The handle of the speed controlling rheostat may be placed at any desired contact point and left there indefinitely.

The motor-generators of commercial wireless telegraphy employ differential and plain shunt wound motors. In cases where very careful speed regulation is required, the differentially wound motor is used. The Robbins and Meyers motor-generators have an accumulative compound generator field which is intended to give a regulation of the A. C. voltage under load.

You are quite right in believing that 500-cycle generators are of special design. In fact, those used in connection with quenched spark transmitters have special operating characteristics which are not found in the ordinary type of generator. Generally the method of designing these machines is withheld by the manufacturer, and complete details are not available for publication.

The permeability of a good grade of soft wrought iron is sometimes three thousand times that of air, but, of course, it varies with the quality.

* * *

B. D. H., St. Louis, Mo.:

The apparent current of an alternating current circuit having self-induction is sometimes considerably greater than the actual current depending upon the value of the inductance. The apparent current, however, determines the heating effect, and the conductors must be made large enough to take care of its value even though it represents partly a "wattless component" or "idle" current.

* * *

N. R. A., Montreal, Canada:

The safe current carrying capacity of .0000 B. & S. wire with rubber insulation is 210 amperes and with other insulation 312 amperes. A cable of 1,000,000 circular mils will carry a current of 1,000 amperes. No. 18 B. & S. wire will carry 3 amperes with rubber insulation and 5 amperes with other insulation. Tables showing the safe current carrying capacity of various wires can be obtained from the fire underwriters in your city.

Slow burning wire generally consists of a copper conductor covered with several layers of cotton or thread, which is saturated with a fireproof compound. Wires of this type are generally employed for work behind switchboards or in places where several copper conductors are grouped together in a small space.

In designing a wireless telegraph transmitter to radiate a definite wave, it is, of course, best to begin with the antenna, giving it such dimensions that a small amount of inductance can be inserted in series to act as the secondary winding of the oscillation transformer. Generally it is not feasible to boost the natural wave-length of an aerial to twice its value because beyond this point the insertion of inductance is apt to reduce the flow of current. The dimensions of the aerial having been decided on, the power of the set must next be taken into consideration. With 500-cycle generators, 2 K. W. can be easily handled at the wave-length of 600 meters. As a matter of fact, it would be possible to take care of 3 or 4 K. W. at this wave-length, but it would be rather difficult to handle

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this power at the wave-length of, say, 300 meters. At the wave-length of 200 meters, ¾ K. W. as about the limit of power consumption of the apparatus. You can readily understand that the wave-length limits the size of a condenser in a closed oscillation circuit because a certain amount of inductance must be inserted in the primary winding to transfer energy to the secondary circuit.

In designing wireless telegraph sets, experimenters often do not take into consideration the fact that the efficiency of the set is greatly governed by the design of a spark gap. A spark gap that has quenching properties is the one most desirable. Quenching effects will be obtained from almost any type of gap, provided it is designed so the transformer arc will not follow the discharge of the condenser across the gap.

* * *

H. B. Q., Vancouver, British Columbia: Marconi's famous patent No. 7777 was issued in 1900. The claims of this patent have been sustained in practically every court in which they were contested.

The report of the British Association for the Advancement of Science on the subject of static or atmospheric electricity shows conclusively that atmospheric electricity is much severer during the night hours than during the day hours, and these observations evidently hold good throughout the world. There are a number of other interesting observations reported in the "Year Book of Wireless Telegraphy and Telephony" for 1916.

The special diagram of connections for the measurement of signal intensity to which you make reference appears on page 670 of the "Year Book of Wireless Telegraphy and Telephony" for 1916.

WIRELESS CLASS FOR WOMEN

(*Concluded from page 927*)

lished in the July issue of The Wireless Age. The cost of the intensive course will be $35.

Mrs. Owen has received the following letter from C. McK. Saltzman, acting chief signal officer of the United States Army:

"My dear Mrs. Owen:

"Permit me to congratulate you, and through you the twenty-eight young women who have begun their training in telegraphy at Hunter College, for the spirit of self-sacrifice and patriotism. As the present war goes on more and more men must be released from civil employment to take their places in the active field forces of the Nation and their present position filled by women. Particularly is this true in the cases of radio and land line telegraphs.

"The womanhood of America must be depended upon to assist in bringing this war to a successful termination, and while there is no fear as to what their response will be, still it is most reassuring to see such concrete evidence of the fact as your League offers.

"Very truly yours,
"C. McK. Saltzman,
"*Colonel, Signal Corps,*
"*Acting Chief Signal Officer of the Army.*
"By: (Signed) Geo. G. Gibbs,
"*Lieutenant Colonel, Signal Corps.*"

The United States Government has need of land line telegraphers as well as wireless operators, according to word received from Washington by Mrs. Owen. She has approved a plan to establish a class in land line telegraphy in connection with the wireless class.

The wireless class recently adopted resolutions thanking George F. Davis, president of Hunter College, and Professor Louis D. Hill of the college, for their efforts in behalf of the class. President Davis acknowledged the resolutions.

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