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J. H. MORECROFT

Professor of electrical engineering at Columbia University, New York, is the author of several of the most important technical books on radio

RADIO BROADCAST

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The March of Radio

THE AMERICAN BOY IN RADIO

THE tremendous popularity of radio in America to-day is due to the keen enthusiasm with which the American boy has taken it up and experimented with its possibilities. For the past ten or fifteen years he has been spending his extra hours and dollars in acquiring the apparatus and skill needed for operating a wireless transmitting or receiving station. Many a long hour has he spent at the Morse key, and later with the "bug," learning to send clean-cut, snappy code signals to his fellow enthusiasts—for those coming into the game during the past year or two must remember that until very recently all radio transmission was by dots and dashes, by a code that required considerable practice before a speed of even fifteen words a minute was reached, and much more before the thirty-five and forty word speed of the best operators could be attained.

Every evening, before the phenomenal expansion of the interest in radio occurred, the characteristic musical notes of certain stations could be heard, as attempts were made to beat previous records in speed or distance. The short-wave field was occupied entirely by the amateurs with spark stations; practically no transmission was carried on by other stations on wavelengths below 600 meters. In exceptional cases an amateur's 1-KW station could establish communication over two or three thousand miles, provided that a skilful operator was tuning at the other end. Many men, who as boys excelled in the field in those early days, are now occupying important positions in commercial radio enterprises and they have carried their boyish enthusiasm right along with them. Practically all the radio engineers of to-day are the amateurs of yesterday. Radio is an art which the older engineers, trained in other branches of electrical engineering, have not always found it easy to break into.

Not only have the amateurs carried a very personal enthusiasm into the field of radio engineering, but they have continually pushed the commercial companies to develop and improve their radio apparatus. In this respect, radio differs from other phases of applied electricity: although few private experimenters could develop a lamp or electric motor to compare favorably with the product of the large research laboratories employing specialists in lamp or motor manufacture, many a boy has rightfully claimed that his home-made radio set was better than those put out by well known firms. The commercial engineers have had to be keenly alert merely to keep pace with the amateur, much more so to surpass him.

In no other country has the boy taken such a prominent part in the development of radio, partly because of the severe governmental restrictions in foreign lands, but largely owing to the different attitude here. A new application of science has an excellent chance for rapid development in a country which is itself new and rapidly developing: witness the automobile and the telephone. And as a simple radio outfit does not require a large outlay, it has been possible for the boys to play the same part in the development of radio as their fathers did in the automobile and telephone industries. If the boy of to-day should suddenly lose interest in radio, it would probably mean the loss of many millions in business in the coming year alone. But he won't. His influence will probably continue to be felt more than ever, not only as a consumer of "parts," but in developing an occasional Godley or Armstrong to increase the value of radio for all of us.

Slightly Different Wavelengths Will Do

HOW far apart in wavelength must two broadcasting stations be so that the interference produced at receiving station may be inappreciable?

Any one versed in radio theory could make certain assumptions regarding proximity and power of stations, conditions in receiving sets, etc., and upon these assumptions he could give a more or less definite answer to the problem. It would be hard to apply the results to practical conditions, however, because of the variations of these conditions at different places. From a multitude of computations, an average could be obtained, but there would still be certain elements of the problem in doubt. How efficiently for instance, does the average listener tune his set? What is the resistance of the average receiving set as installed? How much interference can be allowed without causing appreciable bother to the listener?

A sensible attack on this problem has been started by Mr. Arthur Batcheller, Radio Inspector of the second district, by suggesting that the General Electric station at Schenectady, N. Y., WGY, try operating on 400 meters at the same time that the station at Rensselaer Polytechnic Institute at Troy, N. Y., WHAZ, is operating on 360 meters. Listeners in the vicinity of these two neighboring stations are requested to tune first for one station and then for the other, and report whether troublesome interference between the two is encountered. If sufficient answers are obtained, and if they are passed upon, the test will have been proved a valuable one.

With good receiving sets in the hands of skilled operators, little interference should be encountered if the wavelength difference is only twenty meters, instead of forty, as in the trials referred to above. But even if the forty-meter wavelength difference between stations has to be allowed, enough separate ether channels will be opened to improve broadcasting greatly, if the radio bill, referred to in our last issue, is finally passed by Congress.

Crystal Detector Patents

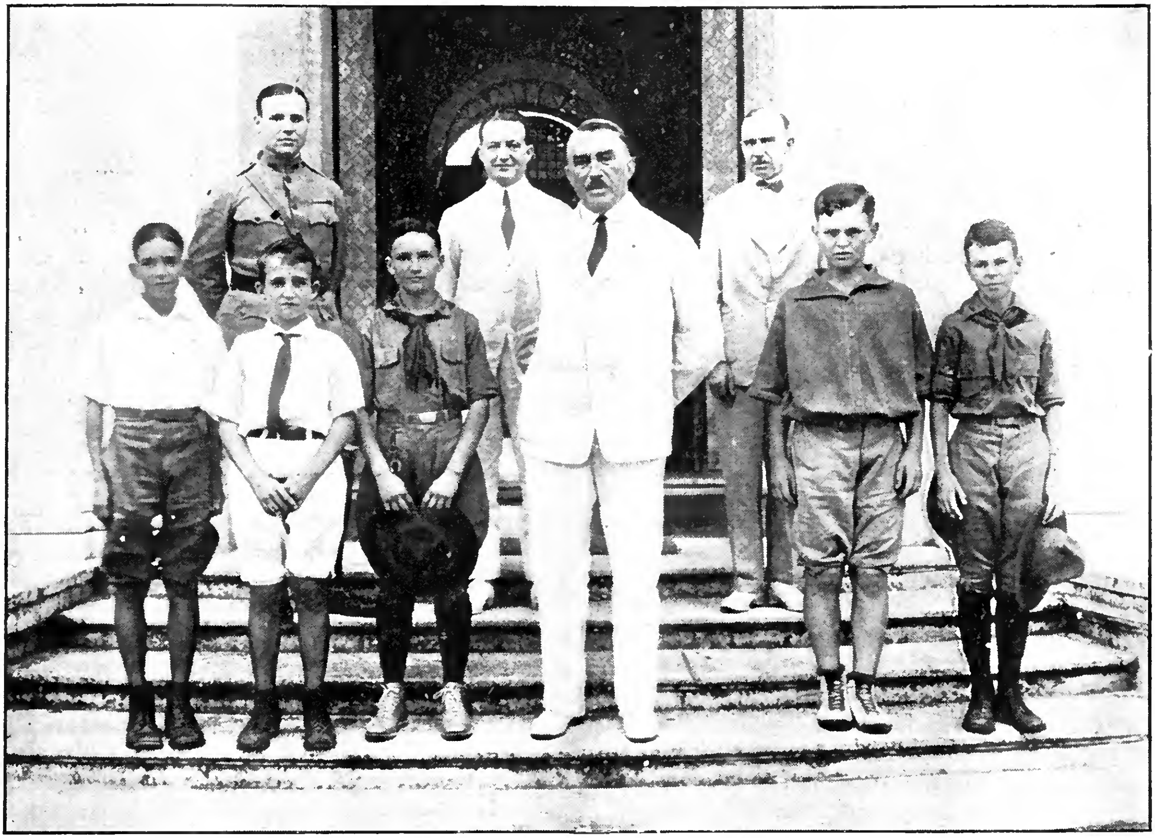
THE Wireless Specialty Apparatus Company has been trying to stop the sale of crystal sets of other manufacturers by advertisements intimating that any dealer handling crystal sets not made by or licensed by it would be held liable for damages. Among other ideas contained in the advertisements is the suggestion that all radio dealers should require the manufacturers of crystal sets to sign guarantees of protection against recovery of damages in case the court should declare certain of the crystal patents valid. Evidently the circulation of such an idea would harm the business of those not working under license from the Wireless Specialty Apparatus Company and suit was therefore brought against this company by one of the alleged infringers, the Freed-Eisemann Corporation, with the idea of testing the legality of the methods used by the owner of the patents.

The case was tried in the Supreme Court before Justice O'Malley, with Mr. W. H. Taylor, Jr., representing the plaintiff. The circulars and advertisements were declared to be unfair in giving the impression that the buyer of a crystal set must investigate for himself, or get expert opinion on all the twenty-one patents owned by the defendant, as the circulars stated that "one or more" of the defendant's patents were being infringed. As a result of the suit, the Wireless Specialty Apparatus Company was enjoined from a further advertising campaign along the lines it had been pursuing.

Modern Miracles

IN AN article dealing with the history of radio, which appeared in a recent number, comment was made on the complacency with which we accept the wonders which have come into existence only during the last generation. Illustrating this point we note the rather slight mention made of the remarkable progress of radio telephony in aviation, the development of which most of us have seen from its beginning.

In a brief paragraph in our foreign news, it is cited as a mere incident in the day's work that, in the regular service of the London-Paris Air Line, a storm over the Channel damaged one of the planes badly enough to necessitate landing, upon reaching the French side; that the pilot, realizing this, phoned ahead to the nearest Air Line service station, three miles beyond Calais, stating his trouble; that a corps of expert mechanics awaited his landing soon afterwards, with the new parts required for repairs; that in fifteen minutes these were completed, the pilot with his dozen passengers ascended to his air



THE PIONEER BOYS' RADIO CLASS

Of the Philippines was recently greeted by Governor-General Leonard Wood. These boys are credited with being the first in the Islands to build their own sets. The Governor-General is an enthusiastic booster for the boys and has assured them of his assistance

lane, and arrived in Paris only twelve minutes behind schedule time!

Radio and Land Lines Coöperate

AN ARRANGEMENT by which the service of the Radio Corporation could be made available at all points in the United States was sure to come; it is a scheme by which the business of each system would receive added business with little additional investment. Until recently, most of the Radio Corporation's transatlantic business originated either in New York or Washington. Now, the country-wide network of the Postal Telegraph-Cable Company will serve as a feeding system to the transoceanic radio channels. It is possible to file a message in practically any city, and it will be sent over an American-owned system to England, France, Norway, or Germany. With the opening of some of the new stations now being erected by the Radio Corporation in other countries, direct service will soon be available also to Belgium, Holland, Italy, Poland, and Sweden.

Messages originating at any point in the United States will be forwarded to the Radio Corporation offices in New York, there put into the form of perforated tape and run through the transmitting apparatus in this office which, by remote control, operates the immense machines at the radio central station miles away. In announcing the new service, Mr. Nally, president of the Radio Corporation, pointed out that his company was the out-growth of the Marconi Wireless Telegraph Company of America, the result of the appeal of government representatives for an American-owned, American-operated communication system extending over the whole world.

When the Barges Broke Loose in New York Harbor

A FLEET of coal-laden barges, forty or fifty in number, broke away from their moorings a short time ago and were carried in a jumbled mass straight down the channel of the East River, which at the time was crowded with ferry boats and other craft. Several of the large passenger steamers which ply between New York and eastern ports were starting up the river on their trips, ignorant of the uncontrolled fleet of water juggernauts bearing down upon them through the narrow channel, racing with the ebbing tide through Hell Gate.

All these steamers were notified by radio in time to get in shore, out of danger of collision. No casualties were reported following the incident, whereas if warnings of the danger had not been flashed out at once, accidents would undoubtedly have occurred.

Rum-Running by Radio

A LETTER published in the New York *Times* a few days ago unfolded a most remarkable tale of the sea. Although the incidents related took place only a few months ago, the story reads like the pirate narratives of our boyhood days—except for the part played by radio. A Jules Verne might have put even this into the story, had he been writing it, just as he used the submarine of his imagination.

The steamer *Korona*, under Peruvian registry, left New York with clearance papers for Greece, having a mixed cargo in which there were 400 drums of alcohol. Her machinery was in poor condition when she sailed, and the captain kept in radio communication with the owners, ostensibly, of course, to inform them as to how he was faring with the defective pumps and boilers. It developed later that the radio reports which apparently dealt with machinery were in reality code messages giving orders regarding the smuggling of the 400 drums of alcohol back into the United States. After getting well out to sea some armed gunmen appeared on deck for the first time, and forced the crew to carry out the orders for returning to within a few miles of our coast and loading the alcohol on some barges which were waiting at the spot specified by radio. After having thus disposed of her cargo, valued at $800-000, the *Korona* received orders to proceed to Bermuda, load up with whiskey and then steam back to Block Island, where barges had been ordered to meet her, and there dispose of her second cargo.

The vessel then sailed for Greece, whither her clearance papers indicated she was bound in the first place, got into trouble with the Spanish authorities at Cadiz and was there held. Without the use of radio, this smuggling would scarcely have been possible, as the meeting place where the unloading occurred could not be well determined until the position of the "Dry Fleet" had been ascertained. Through radio communication, with accomplices on shore, the smuggler's ship could avoid the government agents just as our transports avoided the German submarines. Radio is impartial and takes no account of the law in rendering prompt assistance.

Stolen Transmitter Reveals Its Whereabouts

AFTER a few incidents like that related herewith, thieves will probably leave radio transmitting apparatus alone for fear that it will call out "Stop thief!" while they are getting away with it. A small transmitter was stolen from an amateur operator. Of course, the only use for such apparatus is to transmit with it, and this the thief soon proceeded to do. The owner of the apparatus, and probably all his amateur friends, listened each evening to hear signals from a new transmitting station, and were soon rewarded. Moreover, the rightful owner recognized his own set by a certain peculiar quality of the signal tone. Knowing that his apparatus was being used somewhere within a few miles of his home, he made a radio compass by mounting a small listening set with a coil aerial in an automobile. Traveling about through the neighborhood, he succeeded in getting "cross bearings" on the location of the apparatus, and within a short time had located the station and recovered his set.

Making the Get-away a Give-away

FROM its earliest days radio has seemed to offer valuable assistance to those concerned with the capture of criminals. Every law-breaker needs a certain length of time to make his "get-away"—his crime may be discovered soon after it is committed, but as the news of it and possibly his description cannot be spread immediately, sufficient time often elapses to permit disguise and flight before the police nets can be drawn about him.

That this interim is rapidly being lessened, we were reminded a few evenings ago, when the musical programme of one of the popular broadcasting stations suddenly stopped, and the announcer sent through the ether the news that some criminals had just broken jail and fled in the direction of a neighboring village. Descriptions of the men and the clothes they wore were given over the radiophone, and at once hundreds of people within a few miles of the jail were on the watch for them. In this instance the criminals were apprehended a few hours after their escape.

The Police Department of New York City has now invoked the aid of radio and has installed at headquarters a modern radio telephone transmitter. All the district headquarters, station houses, and police boats are being equipped with receiving sets so that a few seconds after a report is received at headquarters, information regarding a crime can be broadcasted over land and water. It is expected that this new service will be especially valuable in light of the almost universal use of automobiles by fleeing criminals—a method of flight which has frequently outdistanced the ordinary methods of spreading news.

Transmission will be on a wavelength other than those used for regular broadcasting, so that interference with other stations will not occur. By coöperation with similarly equipped police stations in neighboring cities and with innumerable amateur stations at present being operated, a country-wide net can be thrown out within a few minutes of the reception of news at police headquarters.

THE CHIEF POLICE INSPECTOR'S OFFICE

In New York City has been equipped with this powerful broadcasting station which is being used to run down escaped convicts and other criminals. By coöperating with the police in other cities by radio, a huge network may be thrown over the entire country

The Talking Movies

IT HAS been a foregone conclusion that when talking movies arrived they would be of great interest to the radio world because of the almost certain use of radio's most valuable instrument—the three-electrode vacuum tube. In the light of this fact, it does not seem strange that announcement should come from De

Forest, inventor of the audion, that he has perfected a process for producing talking films, in which the audion plays an important part both in taking the film and in reproducing it. Simultaneously with this announcement, word was sent from Germany that several inventors of that country had joined forces in this particular field and had succeeded in perfecting a talking film better than anything hitherto seen in Germany.

The talking movie film as it has been developed so far utilizes two phenomena which have heretofore been found almost entirely in the realm of pure physics, namely the luminosity of rarefied gas when carrying an electric current, and the variation of resistance of certain rare metals when they are illuminated to a greater or less degree. Within a short time after the experiments are shown to be reasonably successful in their new field, millions of dollars will probably be invested in this new process.

DE FOREST'S PHONO-FILM

Is of the same size as standard motion picture film. The speech is recorded on the outside of the strip and appears in the form of horizontal lines of different widths upon the "speech line," shown at the right. This is a picture of Dr. De Forest, and the speech recorded on the film is his own

Comparatively few people have heard of Richardson's study of the evaporation of electrons from hot metals, or of Thomson's book on the discharge of electricity through gases or even of the experiments on the property of light in changing the electrical resistance of selenium, yet these two actions will probably soon be represented in many moving picture machines.

When the film is being made, the sounds to be recorded make a diaphragm vibrate, by which an electric current is controlled. This variable electric current, properly amplified by an audio-frequency amplifier, flows through a small glass tube in which a rarefied gas is contained. This gas glows as current flows through it and the light it gives off is proportional to the strength of the current. As the voice current goes through the tube, therefore, the gas varies its glow in step with the frequency of the voice, and the amount of variation in the glow depends directly upon the intensity of the voice sounds impinging upon the microphone.

Through a very fine slit in the light-proof covering of the tube, the luminous gas shines upon one edge of the film as this moves past the lens, causing a fine line of varying intensity to appear on the film at one side, between the picture and the row of registering holes. This line consists of a series of lines of varying strength, separated from each other by perhaps one-hundredth of an inch. Each of these fine lines represents one vibration of the voice and the closeness of the lines is determined by the pitch of the voice: a note of 1,000 vibrations per second would give 500 fine lines per foot of film if the film were being run two feet per second.

In the reproduction, a bright light shines through this series of fine lines upon a light-sensitive cell and as the lines move by, the intensity of light falling upon the cell will evidently vary 1,000 times per second; this variation in light intensity will make the resistance of the cell correspondingly vary. A battery connected to the cell will deliver a corresponding variable current through the cell, and this current, properly increased again, is sent through a loud speaker and reproduces the sounds occurring when the film was taken.

J. H. M.

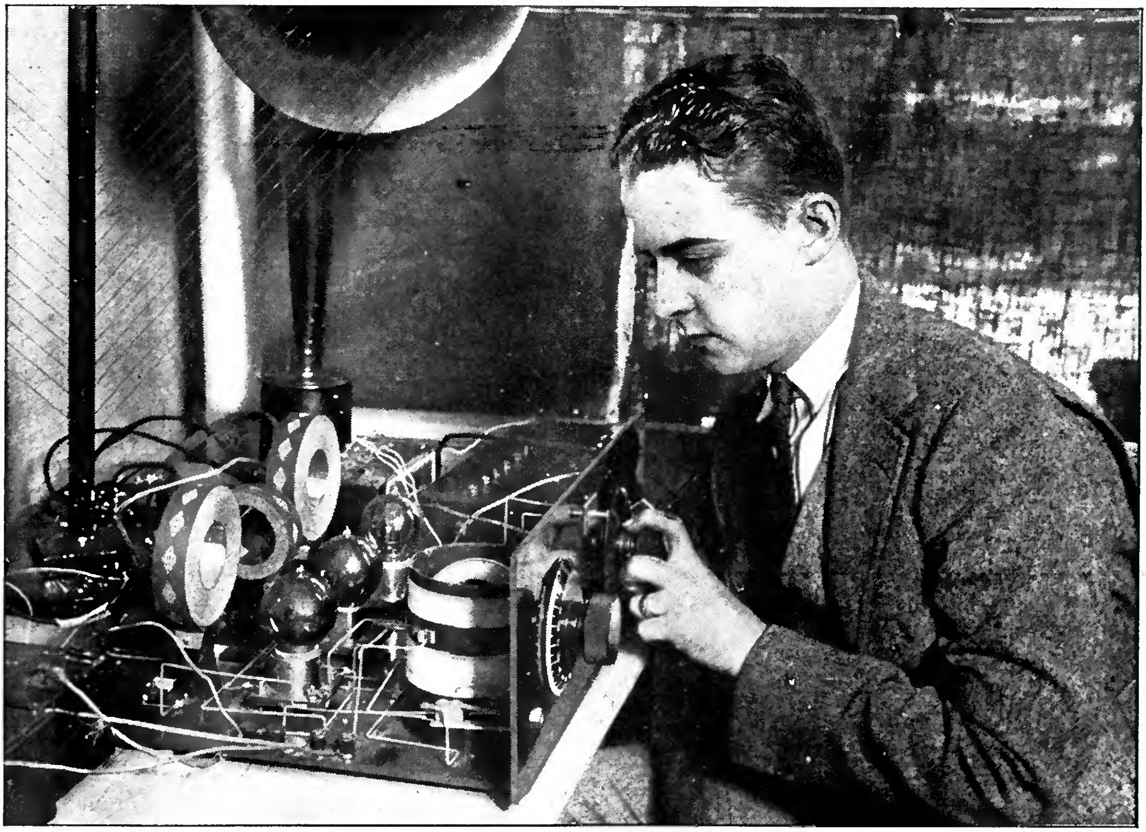
Young America Building His Own

The American Schoolboy is not Content With the Purchase of a Complete Receiving Set—He Must Know What Goes on Inside and Tinker with it till He has Wrecked or Improved it

By HENRY L. ARTHUR

GONE are the days when the indulgent parent persuaded Santa to bring the Christmas mechanical and electrical toys to the house a week in advance. Santa has learned that many a dad has ruined an expensive railroad outfit or high-grade radio set before it ever reached the hands of the family young hopeful, who, no doubt, could have uttered the magic "Open Sesame" before the damage was wrought.

A failing, common to many fathers, is that which impels them at every opportunity to show their youngsters how to do things better—especially the so-called "technical" things. It is safe to say that few there are among the dads who would permit their boys to connect an electric train circuit, fly a new kind of kite, shoot a new rifle, or cut with a new jack-knife, without first unloading a certain amount of superfluous parental instruction. Not that we revel, particularly, in the fact that there are certain lines of endeavor in which Young America can offer some real pointers to the older generation—but, as we have said, many an otherwise useful Christmas gift has been damaged beyond redemption by an over-zealous dad who felt that the only way to



THE MOST CRITICAL OF CIRCUITS

Does not intimidate the American youth, and wrinkles he is responsible for sometimes find their way into the design of commercial equipment. This boy made the three-tube super-regenerative receiver he is operating present the gift properly was to have it in operation on Christmas morning.

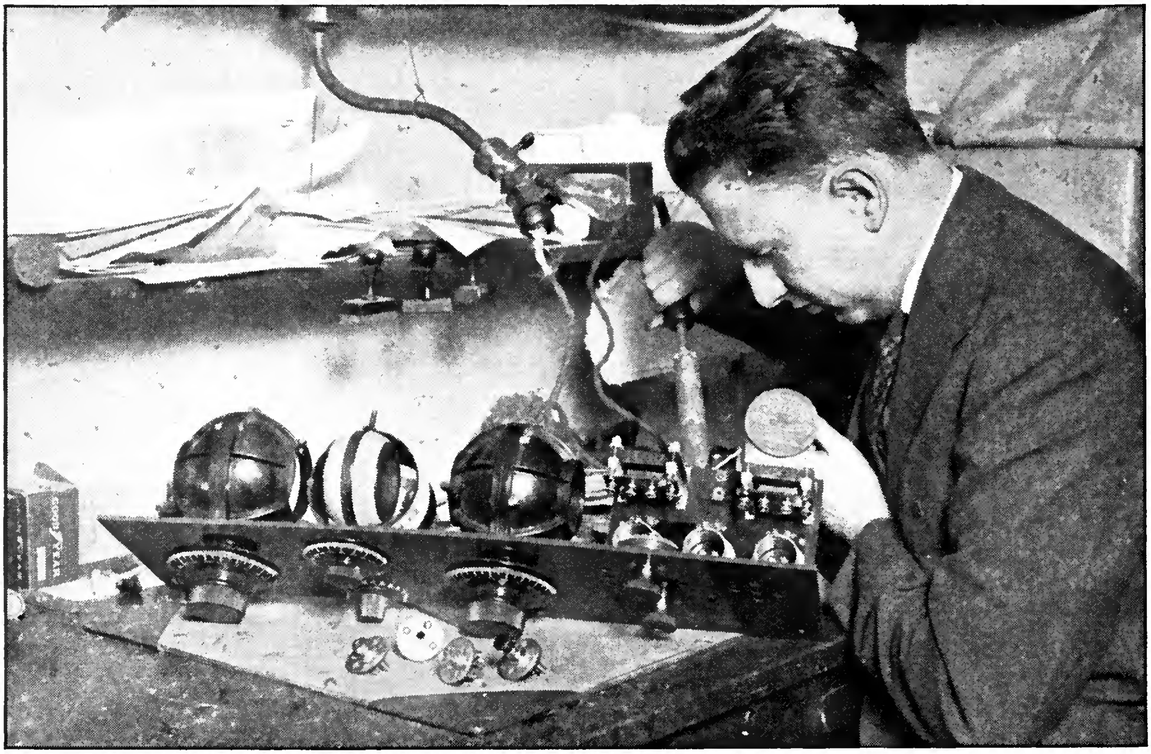
And further—does it not frequently happen that the ruler of the roost is somewhat keen about electrical toys himself and has a sneaking idea that he will get as much genuine fun from the gift as his son? How many nights does the receiving outfit, given a boy for Christmas, do extra duty for the "governor" after the boy has been tucked in bed or is doing his lessons! How many times has an anxious youngster had to stand patiently by, waiting for a chance to listen-in while the donor of the set listens to a concert under the guise of "adjusting it, so the boy won't have any trouble with it!" Most of the boy's trouble is getting near enough to the new wonder to become even casually acquainted with it. His joy of possession is sometimes reduced by having it too well "adjusted" for him.

So the day has come when the boys are no longer waiting for Saint Nick to bring them receiving sets to which their title is not entirely clear. They are making their own—and are doing a mighty fine job of it.

Among the articles made by boys in the grammar and lower high-school grades and exhibited at many of the county fairs this year has been radio equipment of various sorts, and most of it compared favorably in design and workmanship with the devices offered for sale by the best manufacturers. The boys recognize a good design very quickly and lose no time in duplicating it, whereby they gain the large difference between the cost of their apparatus and the cost of commercial sets, to say nothing of considerable pleasure and knowledge.

A BOON TO MANUAL TRAINING CLASSES

IT IS doubtful whether a better practice could be established than having the manual training classes in our schools take up the building of radio sets, since this work offers opportunities for study and development otherwise impossible. The fact of the matter is, no work is hard that is interesting—nor does one learn much when the work is irksome. Many an idle period was spent in the school carpenter shop in days gone by when the class simply couldn't work up a lot of enthusiasm over making a pair of book ends or a miniature table.

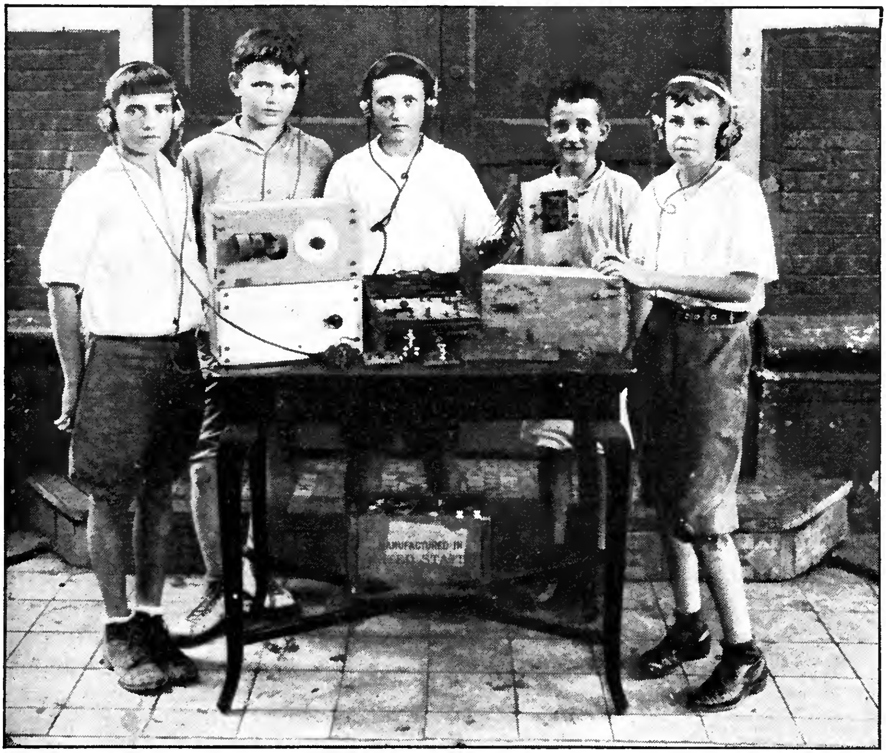


A BOY BUILT THIS OUTFIT FOR $27.80

It is a three-circuit regenerative receiver with detector and two-stage amplifier and would cost between $100 and $130 if purchased ready-made

In a well-equipped school shop a boy may learn some very helpful facts about short cuts in several trades, if instruction in radio is adopted. For instance he learns about carpentry and cabinet-making and wood-staining and finishing by making the cabinet for his receiver. He learns something of wood turning by making the rotor balls for variometers or the wooden discs used for tuning-coil ends. He learns how to measure and lay out his work accurately when planning the receiver panel; he learns the proper way to use drills and taps and dies and how to work with brass, copper, nickel, slate, and bakelite. He learns how to use a soldering iron and a blow torch; how to make electrical machines from diagrams which would have been unintelligible to his father at the same age. He learns how to reason for himself by improving upon or altering a design to suit his particular purpose, or to reduce the cost of the material that he must have. By comparing the prices of parts and raw materials he secures a knowledge of comparative values never to be had from books. In short, he learns much that will help him in later years—learns it thoroughly because he is interested, because he *wants* to learn.

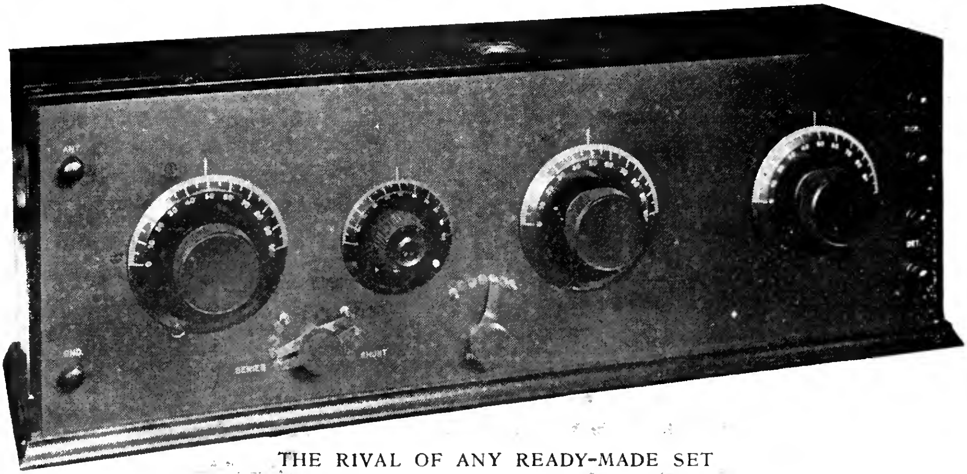
Radio sets made by boys are usually anything but amateurish. As a rule, youngsters can discuss the reasons for and against a certain arrangement in the language indulged in only by engineers a few years ago, and the test of their knowledge is seen in their work. The cabinet work is generally of a very good grade and boys show great patience in acquiring just the desired finish for their handiwork.



AMERICAN BOYS IN THE PHILIPPINES
Are progressing very rapidly in acquiring real technique in home-made sets. They are handicapped somewhat by being so far from the source of supply and large broadcasting stations, but their work is already quite creditable

This interest is nation-wide and increases with the opening of every broadcasting station. Boys on the West Coast and in the South are busily engaged in making receivers to hear the broadcasting, and the programmes to be available this winter are the best in radio's rapidly moving career.

Some idea of the activity of boys in and around Chicago may be had from Mr. George P. Stone's article: "Radio Has Gripped Chicago" which appeared in the October issue of RADIO BROADCAST.



THE RIVAL OF ANY READY-MADE SET

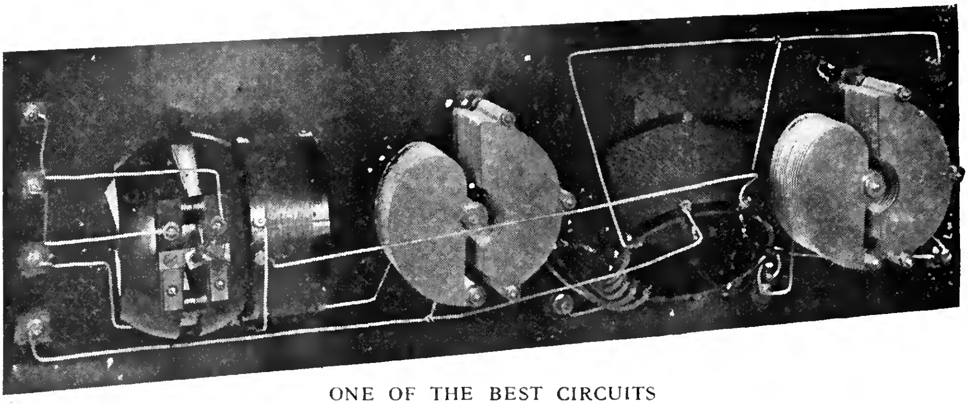
Is found in this receiver, made by Donald Pierri, of New York. The cabinet is elegantly finished in dark mahogany. The bakelite panel is grained and engraved in a manner not excelled in the highest-priced receivers. The interior is shown below

The activity in New Jersey may be judged from the following paragraphs taken from *School and Society* for July 15, 1922:

"Several years ago radio sets were made in the manual arts departments in the schools of this state, but the boys' interest could not be sustained so long as only the dot-and-dash system of signals was available. Now the opportunity of hearing the actual voices, words, songs and music of the best kind has taken this project out of the more experimental stage and made practically every boy anxious to build and own a wireless set for his own use. Every effort has been made in schools throughout New Jersey to give boys a chance to design and build radio sets. The shop teachers have made a special study of radio construction; and boys have been given an opportunity to make various types of wireless sets. Schools have installed large radio sets. Montclair, N. J., has erected over its high school an aerial that equals in size and construction those seen at broadcasting stations. A receiving set has been installed in the physics department, and at the last meeting of the Board of Education money was voted for the purchase of a sending set. Many of the high-school boys are licensed radio operators. In the manual arts department of the grammar schools of Montclair more than 600 wireless sets have been made.

"A report from Jersey City states that 655 radio sets have been built by upper-grade boys, while in the Hoboken high and junior high schools during this year 350 wireless sets have been made. The boys in the Bayonne public schools have made 249 sets, and it is reported that all of them are working.

"A great deal of attention has been given to the study of wireless in the public schools of



ONE OF THE BEST CIRCUITS

Has been incorporated in this receiver, which is home-made. This arrangement was completely described in RADIO BROADCAST for October, in an article entitled "Shielded Receivers"

East Orange. In the elementary schools 750 crystal sets have been constructed by boys taking shop work. The high-school boys have made 327 crystal receiving sets, 29 tube outfits with one and two stages of amplification, and one sending set is nearly completed.

"The city of Elizabeth was among the first places to encourage boys in building radio sets, and thus far, 251 sets have been made in the manual arts departments of the grammar schools. More than 100 sets have been made by the boys in the vocational schools.

SANTA CLAUS TELLS A CHRISTMAS STORY

"Interest in this project has been encouraged in places quite close to broadcasting stations, and in virtually all of the school shops of the Newark public schools one may see boys working on wireless sets. More than 500 sets have been completed by the boys during their manual training period. Kearny and Nutley public schools have given their boys an opportunity to use the manual training departments for the construction of radio sets, and report that nearly 300 sets have been completed.

"Boys working on radio sets have not limited their time to school hours, but have worked with their shop instructor after the close of the regular school day, and many of the instructors report that a great deal of work has been done after school hours. Boys are learning more through wireless about electrical circuits, batteries, the telephone and other phases of electricity, it is asserted, than text-books can ever hope to teach."

A more fitting tribute to Young America's interest in radio than this report could hardly be imagined. It means that the boys are learning a lot that is good for them and there is less time for their minds to cultivate, or even pay attention to that which is bad—they are keeping pace with every improvement in the art and by reason of their knowledge are making it necessary for those manufacturers who can reasonably expect to stay in the business to supply nothing but the best equipment. The boys are providing entertainment for many a household. They deserve the encouragement of every dad in our land. It looks as if radio will solve, for thousands of parents this year, the problem of selecting Christmas gifts for their sons.

MANY AN OTHERWISE USEFUL CHRISTMAS GIFT
Has been damaged beyond redemption by an over-zealous dad

Simple Bulb Transmitters

By ZEH BOUCK

FOR low-power bulb sending sets, there are three simple and inexpensive methods of obtaining the required high voltage. They are, by using the "B" battery, the 110-volt electric lighting current—D.C., unrectified, or untransformed A.C. (alternating current)—and the spark coil system. Each of these systems is characterized by individual advantages and drawbacks, and the experimenter will do well to consider the possibilities of each, in order to determine which one of them is best adapted to his own requirements.

This article continues the explanation of the action and construction of simple vacuum-tube transmitters which was begun in RADIO BROADCAST last month. There are several methods by which you can make an effective short-range outfit without a great deal of expense.

Various types of bulb transmitters operated from a lamp socket—replacing the "A" and "B" batteries by the ordinary house lighting current—will be described next month.—THE EDITORS.

In the transmitting set described last month, "B" batteries were indicated as the source of high voltage, first, because their operation requires the least experience and experimentation, and secondly, because by their use the set may be operated as a radio telephone. This is not practicable with the lighting-circuit or spark-coil methods. "B" batteries are a source of constant current—there is no variation whatever—so that cumbersome chokes and condensers are not required to filter the current of ripples and similar fluctations which invariably accompany generator and rectified systems. Furthermore, the advantages due to this smoothness of current are not confined to radiophone operation, but manifest themselves very noticeably in straight C.W. (continuous wave) transmission, where the clear flute-like note, identical to that of an arc station, is very easily copied. For low-power work, "B" batteries are fairly economical, and the average person can afford a 100 to 200 volt battery. However, when the potential runs over 200 volts, or when more than one tube is used, the drain on the cells is likely to exhaust them quickly. A plate current in excess of 15 milli-amperes (the average tube in receiving draws from 1 to 5) will rapidly deplete the battery, necessitating an expense of ten or fifteen dollars every few months. The most economical method of building up a high-voltage battery is to purchase standard flash-light batteries (the five and ten cent store variety is remarkably good!), connecting them with soldered connections in a rack. "B" batteries built up in this manner will often give double the service that would be obtained from a bank of block batteries, due to the fact that the exhausted units, with their resistance, can be removed. When the plate voltage shows a sudden drop of from 10 to 20 volts, the cells should be tested, and the faulty ones eliminated.

If the amateur is fortunate enough to be supplied with 110 volts D.C., he may substitute this for the dry cells. This power supply, for purposes of bulb transmission, is practically without limit, and three or four tubes may be efficiently operated in parallel, and, although for transmitting tubes 110 volts are inadequate, five or ten miles can thus be covered. However, the use of lighting current (this also applies to untransformed A.C.) almost always limits the experimenter to an inductively-coupled transmitter (one wherein the oscillating power is transferred by induction from a closed circuit to a coil in series with the antenna and ground). There must be no metallic connection between the ground and the power supply, as one side of the electric light circuit is grounded. Such a chance connection would possibly result in a short, or complicate the circuit to such an extent as to render it inoperative. Also, the 110 D.C., when used for speech (radio telephone), requires a filter system, which, though not difficult to install, makes this source of power less simple than the battery. Straight C.W., transmitted with D.C. on the plate regardless of the source, can be received only on a set equipped for the reception of undamped waves. The signals cannot be copied on a conventional crystal set.

A.C., untransformed and unrectified, is the next consideration. This system supplies an adequate potential for low-power C.W. transmission, in which case it is almost as efficient as direct current. However, as it is interrupted from 40 to 120 times a second, it cannot be used in transmitting speech. It possesses an advantage over the previous systems, in that its wave is interrupted by the spark-coil vibrator, and it may be copied on non-oscillating and crystal detectors. The note is generally very low and consequently rather difficult and unpleasant to read. It may be improved, however, by including a chopper (a commutator wheel that interrupts the grid circuit many times a second) which breaks up the sixty-cycle throb into a higher and more agreeable note.

The output of a small spark-coil operated by a 6-volt storage battery, furnishes a fairly efficient source of semi-direct current for the plate of a single tube, and transmission in excess of fifty miles has been achieved with such sets. The great difficulty lies in reducing the secondary voltage below the point where the tube would be injured due to the breaking down of the insulation, and in drawing sufficient current from such a high potential, low power source. The best results with this type of transmitter have been secured by rewinding the spark-coil secondary to the desired voltage.

YOUR RECEIVING SET AS A RADIO TELEPHONE

THE conventional regenerative receiver is capable, when oscillating, of setting up wireless waves. In this respect it is a "B" battery bulb set, and by a few simple alterations, it can be converted into an efficient combined transmitter and receiver. To accomplish this, the following accessories should be obtained:

One amplifying tube that functions well as a detector.

Two porcelain-base rheostats.

One double-pole, double-throw switch.

One microphone.

One key (if continuous wave telegraphy is to be employed) preferably of the land-line variety with a closing switch.

It would be clumsy to shift tubes or throw a switch for sending and receiving, and the experimenter is advised to procure a single audion to serve both purposes. Many amplifying tubes, particularly the A.P. and Western Electric J tubes, are satisfactory.

Fig. 1 indicates how the extra apparatus is connected with the receiving set. The change from sending to receiving is effected by the switch AB. When the switch is in the receiving position, side B, rheostat R1 is varied in conjunction with the standard panel rheostat

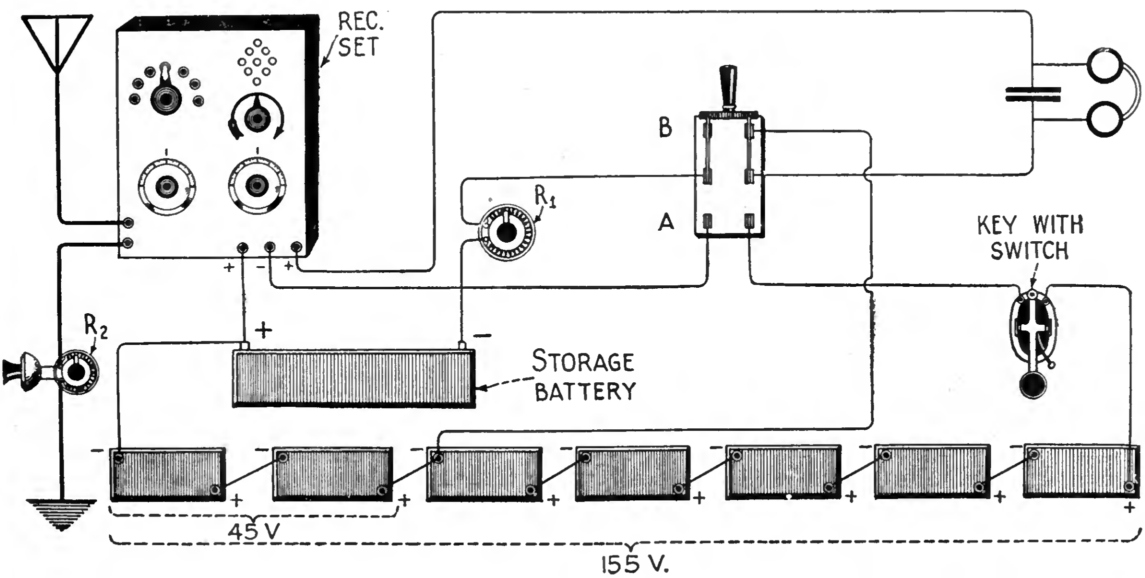


FIG. 1

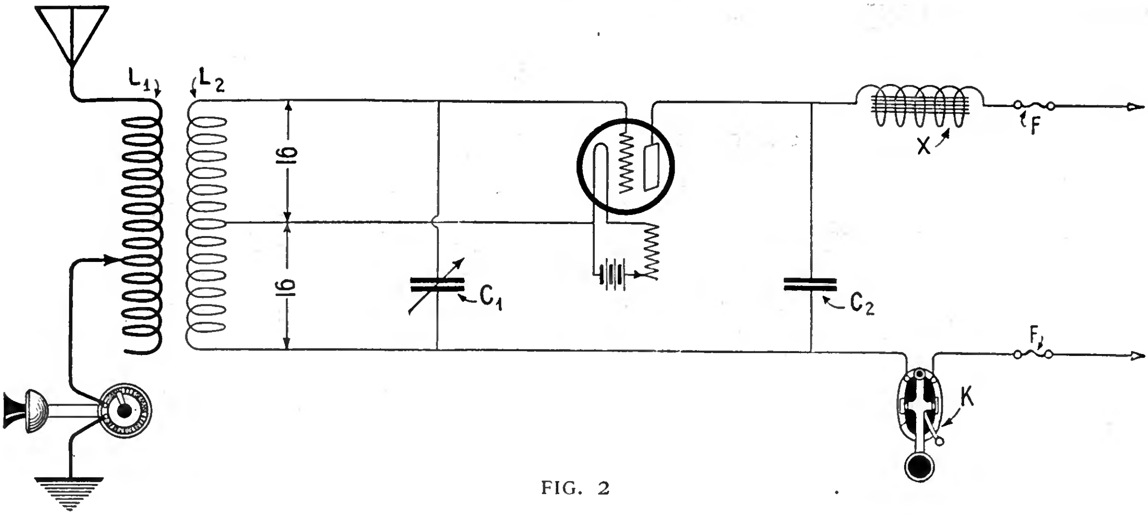


FIG. 2

until the amount of resistance in R1 is just enough to stop oscillations, i.e., if the resistance were short-circuited, the set would oscillate. The switch in this position also throws the normal receiving plate voltage of 45 volts in series with the telephone receivers. (Amplifying tubes detect best at about this potential.) The microphone and rheostat R2 in the ground lead will have no effect on incoming signals.

As the switch is thrown up to position A,the extra resistance in R1 is shorted, which, brightening the filament, as before explained, causes the set to oscillate. This position also throws in the complement of "B" batteries—from 100 to 200 volts. The phones are always in the circuit, where they occasion but a negligible potential drop. They indicate the quality of modulation, and show that the set is oscillating, while in some circuits they act as a necessary choke or reactance.

For preliminary tuning, the switch is thrown up to the transmitting position, and the microphone short-circuited by the rheostat R2. Rheostat R1 is likewise cut out, and the filament adjusted altogether by the panel rheostat. By tickler or variometer variation, the set is made to oscillate powerfully. Speaking into the microphone, the resistance of R2 is gradually admitted into the ground lead until the voice, as heard in the phones, is loud, yet clear and free from distortion or breaks. Switch AB is then thrown down to the receiving position where it is probable that the set will continue to oscillate. Rheostat R1 is now brought into action, and the filament reduced until the circuit is quiescent. The knack of tuning the combined adjustments for transmitting and receiving on any wave will be acquired with a little practice.

A set of this type will necessarily send and receive on the same wave, and for this reason, during communication between two such stations, tuning is greatly facilitated. If one station shifts wave in an endeavor to avoid interference, the second station, in following the frequency variation, will shift his own wave, getting under or above the same interfering signal. In this manner, the station that is experiencing the interference selects the wave on which transmission is clear!

If a continuous wave is used, the key may be inserted in series with the "B" battery as indicated in Fig. 1. The key, of course, must be shorted when voice transmission is employed. The range of such a set is dependent on many factors, but, under favorable conditions, and using a well located antenna, a mile or two should be easily covered using the voice, and considerably greater distances may be expected when the key is employed. As with all bulb sets, the C.W. range is several times that of the radiophone, owing to the fact that the wave itself is of a more efficient character, and that a certain amount of amplification is secured in its autodyned reception.

A SIMPLE 110-VOLT SET

THE split filament circuit recommends itself to the beginner through its simplicity and reliable operation. Adjustments and parts are minimized, and the set will oscillate powerfully on low plate potentials without a grid condenser or leak.

This circuit is indicated in Fig. 2, showing a radiophone transmitter operated from 110-volt direct lighting current. Both inductances may be wound with any convenient insulated wire from 18 to 24, superior results possibly being secured with the larger size. L1 and L2 are best wound separately on tubes of different size, so that L2 will fit inside the larger coil in the manner of a loose-coupler. However, if desired the coils may be wound alongside each other on a common 3½-inch tube. L1 has 12 turns of wire, and L2 has 32 turns with a single tap taken at the centre. If L1 is wound on a separate tube fitting over the other winding, its turns should be reduced to 10. Two tuning elements are indicated in Fig 2: the variable capacity C1, a 43-plate condenser, and a variable primary inductance, which may be tapped every other turn if it is desired to shift wave. C2 is a large by-pass and filter condenser from two micro-farads up. The conventional mica-foil condenser of this capacity is rather expensive, and it is suggested that the experimenter obtain one of the electrolytic type which, in cents per micro-farad, is much cheaper. Reactance X is a necessary part of the filter system, and may be wound of 2 lbs of No. 30 insulated wire on a core with a cross-section of one square inch built up of iron wire or strip. F and F are fuses of any convenient current capacity from 1 to 5 amperes, and should be invariably included on the power side of *all* instruments whenever the lighting current is employed for experimental purposes. Such fuse blocks are easily made by stretching the fuse wire, or ⅛ inch strips of tinfoil, between terminals on a small wooden

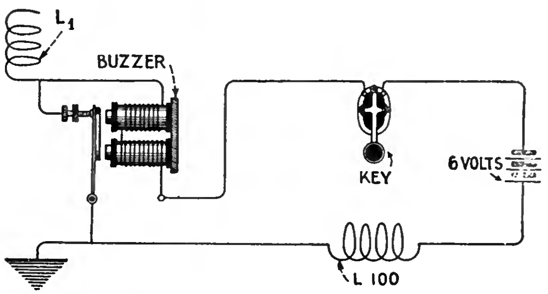


FIG. 3

slab. While it is not necessary, with so low an amperage, to cover the block with a sheet of mica, it is a practice compatible with caution, a habit, in all electrical work, well worth cultivating.

Modulation, in Fig. 2, is effected by the system employed in the combined transmitter-receiver, and it is adjusted in the manner there described, listening-in on either a wavemeter or the receiving set.

If it is desired to use only continuous-wave telegraphy, the circuit in Fig. 2 can be further simplified by substituting a bell or telephone receiver bobbin for the choke coil X, and a thirty-five cent telephone condenser for C2. In any case it is essential that the positive side of the line lead to the plate. It is therefore necessary to determine polarity; and the simplest method is by "feeling" for positive. This is accomplished by grounding one hand on a steam or water pipe and touching, singly, the two electric light wires with the free hand. As the negative side is grounded, a shock will be felt when the positive is touched. This method of determining polarity is neither painful nor dangerous under three hundred volts, if the precaution is first taken to dry the fingers thoroughly. However, the more timorous may resort to the water test. If two electric light wires, carefully separated, are immersed in a tumbler of water in which a *few* grains of salt have been dissolved, the liquid will be decomposed, i.e., broken up into its component parts hydrogen and oxygen. These gases will escape, rising in bubbles to the surface about the wires, hydrogen from the negative wire, and oxygen from the positive. But water, H_2O, contains twice as much of hydrogen as of the other gas; thus there will be twice as many bubbles about the negative pole, easily identifying it from the positive.

A NON-TRANSFORMED A.C. CONTINUOUS-WAVE CIRCUIT

AGAIN referring to Fig. 2, with the simplifications suggested for use as a C.W. set, (choke X, a bell bobbin, and C2 a small telephone condenser), 110 volts A.C. may be substituted for the direct current, and the set will function as a sixty-cycle, unrectified bulb transmitter. Voice transmission of course is impossible, due to the interrupted current, thus eliminating the microphone and shunting the rheostat. In the A.C. set (and in the direct current apparatus also, when continuous wave is used) the filament may be lighted by a small toy step-down transformer, with the secondary shunted by a spark-coil vibrator condenser.

In any one of the three foregoing sets, "buzzer modulation" may be effected. This consists of breaking up the continuous wave into rapidly consecutive wave-trains, giving a

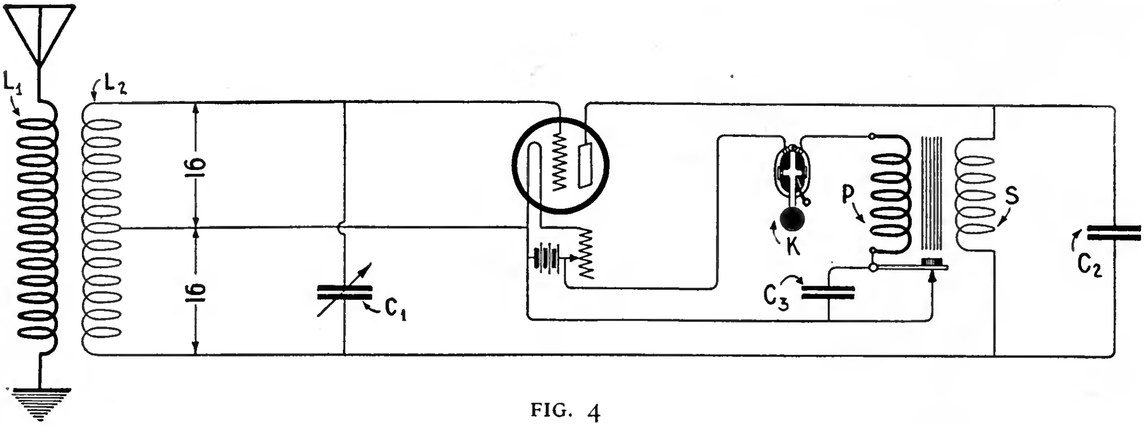


FIG. 4

pleasing high-pitched note that is audible on crystal and non-oscillating detectors. With the A.C. equipment, the buzzer, in effect, is the same as the chopper mentioned above. The connections of the buzzer vibrator in the ground lead are indicated in Fig. 3. L100 is a honeycomb coil of that size, which, in conjunction with the buzzer coils, acts as a high-frequency choke, preventing the passage of current through them to the ground when the vibrator breaks the direct circuit. The battery is conveniently three dry cells, but in any case, separate from the filament lighting source.

A SPARK-COIL BULB SET

THE output of a spark-coil is a semi-direct current. Strictly speaking, it alternates, but the alternations are many times more powerful in one direction than in the other, owing to the fact that the magnetic field collapses as the vibrator breaks the circuit, much more rapidly than it is built up.

Fig. 4 shows the circuit with which we are already familiar, employing this source of high potential. The induction coil is a $\frac{1}{2}$-inch to $\frac{3}{4}$-inch affair, such as is sold by radio dealers for spark transmission. A Ford coil cannot be used unless the common terminal to the primary and secondary is broken. A comparatively low note, which is more pleasing than a high pitch and carries very much farther, may be obtained by fastening a small piece of solder to the vibrator.

C2 is a by-pass condenser of sufficient capacity, .01 micro-farad at least, to lower the potential to a voltage that will not injure the tube. The condenser must be of mica or glass plates in order to stand the high voltage. A satisfactory capacitance may be built up of 30 sheets of 4 x 6 inch tinfoil separated by 5 x 7 inch photographic plates.

The bulb for spark-coil C.W. should be a transmitting tube or an extraordinarily hard amplifier. With the exception of this, and the condenser C2, the values for this set are identical with those of Fig. 2.

If, after experimentation, the transmitter is inoperative, it is probably because sufficient current cannot be drawn from the spark-coil. To rectify this, the secondary must be rewound with No. 34 or No. 36 insulated wire, to approximately 100 times the number of turns in the primary. In the case of a half-inch coil, this will amount to about 17,500 turns. With the special secondary, C2 may be of much less massive construction, 30 layers of 2 x 3 inch tinfoil, separated by mica, working very well.

As before stated, the output of the coil is semi-direct, so it may be necessary to reverse the secondary connections in order that the plate be supplied from the terminal that is positive the greater part of the time.

In tuning the various sets covered in this article, it is advisable to procure a radiation milli-ammeter, which, in series with the antenna, will indicate when the best adjustments are secured. In some cases, particularly with the spark-coil C.W., a small two-volt flashlight bulb may show resonance when substituted for the meter. In the absence of either indicating device, transmitting conditions can be fairly accurately determined by listening in on an adjacent wavemeter or receiving set. With the spark-coil transmitter, a smooth hum will be heard when it is radiating, in contrast to the rough, scratching note if the set is not oscillating.

O Woe! Radio

By ALICE R. BOURKE

Drawings by STUART HAY

> We have here a cry of despair, a burst of laughter, a tragic comedy and a sly, sound estimate of human character, all rolled into one. "O Woe! Radio" presents as accurate and entertaining a picture of the effects of radio in the home as we have seen. In thousands of homes is surely found an echo of the excitement and discouragement, the complications and absurdities which visit the Bourke household—that "radio-devastated remainder of What Was." Is the author describing your predicament, too, when she says: "The neighbors are still rooting for the K. of C. war slogan, 'Everybody Welcome. Everything Free.' We have been nominated and elected unanimously. Having heard, they want more. I can set my Ingersoll for five to eight by their nightly arrival"—THE EDITORS.

ON THE 27th day of April in the current year, no bells spilled their joyous peals into the calm morning air. No cessation from business had been declared, no cannons succeeded in having themselves shot off, and there was no unusual prodigality in the city display of the national emblem.

Yet, despite the fact that none of these evidences of general rejoicing flaunted themselves to the eyes and ears of the populace, it was My Birthday, and it marked the end of that happy period when we had a Home, and when the only tobacco ashes I was obliged to sweep from the roof of the piano belonged to the Boss. (I put that last line in because he may see this article some time. Of course I am the boss, but it shows a nice disposition on my part, and incidentally it is handy in many ways to let him think he is the Great Voice around this radio-devastated remainder of What Was.)

As I said, it was my birthday, and on that roseate morn, if I had been asked, I could not have stated authoritatively whether trouble was spelled with one or two l's, so slight was my acquaintance with it. But be patient, there are more words to follow.

At breakfast, my Irishman told me my birthday gift was to be a radiophone, and during the forenoon the radio man and his assistants came. They had a heavy forty-foot mast with them, and immediately commenced adapting the landscape scheme of the far corner of my garden to their pedal extremities and the pole. They assured me that a good antenna was of the utmost importance.

Now do not throw the magazine away until you get your money's worth. I certify upon my honor that this is *not* a technical article.

When school was out at noon, all the dear little boys and girls in the vicinity curtailed their gastronomic endeavors so they could hurry back to give their advice to the radio man and finish the decapitation of those tulips which the workmen had accidentally missed.

When my husband came home to dinner I was waiting in my pink organdie and new white pumps. With my very own hands I coaxed from the rubber-bunioned, carbolic-scented mahogany box the facts that Liberty bonds were going strong, and that it would be cooler tomorrow with variable winds.

We did not Fletcherize our dinner that evening. We impatiently awaited the eight o'clock concert. It was not to be. The thoughtful little people who had paid our horticultural exhibit the noontime visit had a rather neat little broadcasting system of their own.

At five minutes to eight, the Jones and Smith families presented themselves in complete editions on our front porch. It was quite a coincidence that both Mrs. Smith and Mrs. Jones had believed I might like a little fresh lettuce!

Their remembrances made me very happy, but piqued my curiosity, inasmuch as we have such a large lettuce bed ourselves. Ah! How young I was then!

By eight-thirty a passerby would have thought the Bourkes were holding a mass-meeting.

The eldest Smith boy attends high school and knows all about radio. His father is very proud of him, and he kindly decided, in his

"THEY HAD A HEAVY FORTY-FOOT MAST WITH THEM

And immediately commenced adapting the landscape scheme of the far corner of my garden to their pedal extremities and the pole. They assured me that a good antenna was of the utmost importance"

positive way, that Gordy would run the set tonight, because he just knew I felt strange with it yet.

We had two head-sets, and a well-developed sense of hospitality, so my husband and I did not hear any of the concert; but we at least had the fun of turning off the current after they all went home at twelve-thirty. Gordy was not interested in the unimportant details of radio operation.

The night of the 28th John dropped into the Elks Club (to get some matches) and he spread the glad tidings that we had a great little radio set, and that the wife was a clever kid the way she could switch the kazazzies around and produce entertainment.

Those fatal words!

John has oodles of friends, and we know several nice obliging gentlemen of the medical profession, but honest, our private stock didn't last ten days.

I wouldn't mind if they would only come, hear, sample, depart, and allow sufficient time for pleasant memories to take root. But they do not. No repeater in the First Ward does his duty so nobly nor so often as do John's playful club fellows. They are all doing their durndest for Society, too. Married. Householders. And they *always* bring the Mrs. and the entire collection of descendants.

The wife invariably hails from some small town. After scrupulously coating her nose with my powder ($2.75 per box, war tax extra), she will smile her killingest and say: "Oh, Mrs. Bourke, *do* get Oshkosh for me. Mama writes that the *Daily Prevaricator* puts on a progrum every night!"

The sweet little darlings want to know what makes the storage battery store, and what do them things do when you twist 'em around, and can't they play with it for a while now? Most of them cry because they cannot call their Uncle Tobias up over it.

We always have our fingers crossed that they will go home after the first concert, but do they? Nay, not so. They stay until everything is over, then make a feeble pretext of leaving.

Oh, no, we couldn't dream of troubling dear Mrs. B—— further, could we, Henry? But they are sure to make the weather and their appendicitis operations last while I hustle the coffee, dilute tomorrow's breakfast cream so there will be enough to go around, and develop writer's cramp slicing bread for sandwiches.

Each departing guest uses the same original conversational sally: "My, but it must be fun for you two, with nothing to do but listen to the radiophone every night!"

That calm, light-hearted statement sears my soul as I bathe and massage the dishes which have been bequeathed to me as part of my share of the evening festivities.

We are the most popular couple for miles around. Everybody loves us. My husband is a philanthropist. He gave me a birthday present with unguessed coöperative possibilities. It has become an item of common ownership, like a Carnegie Library, or gossip.

The neighbors are still rooting for the K. of C. war slogan, "Everybody Welcome. Everything Free." We have been nominated and elected unanimously. Having heard, they want more. I can set my Ingersoll for five to eight by their nightly arrival.

One man in particular is the joy of my young life. If the Nobel prize is ever awarded for persistency, I shall burn up the wires entering his cognomen. He never misses a night. He generally greets me with: "Say, last night you told me so and so, and tonight the *News* says"—and I know I am in for another Star Chamber session, my tongue and intellectual content not having properly coördinated the preceding evening. I've tried a million odd times to justify my manipulation of the set during atmospheric disturbances, and have spoken to him so learnedly about "static" that a college professor would hang his head in shame, but does this doubting Thomas believe? His eyes say what his lips yearn to: "You can't fool me. You gotta bum set, and don't know how to work it!"

Do not, I pray you, labor under the delusion that only my evenings are devoted to Public Service. Far from it.

In the morning, just about the time I am beginning to wonder how in the name of Heaven John *can* poke such big holes in his socks, the door-bell rings, and one of my fellow Household Slaves enters. The *Jacksonville Bazoo* has inaugurated a woman's hour from nine to ten. Would I please, etc.?

I accommodate, but the ether does not. She goes home possessed of two eggs, a cup of my butter, and the belief that I wouldn't let her hear Jacksonville because I did not want to be bothered with her.

One of the ladies nearby has intimated to me that she would like her son Wallie to have a key to my *ménage*. She thinks it would be nice if Wallie could come in, very quietly, of course, after 2 A. M. on Saturdays and Sundays and listen in, as she undertstands that this is the best time for amateurs to learn the code.

Station KYW punctuates its musical programmes with news bulletins.

Last week John bet $50.00 on the outcome of the Michigan City fight. Naturally, he was interested in his half century. During the news service, the head-set was occupied by a little bride of the neighborhood. When the announcements were over the bride said to her husband: "Oh, Lovey, there was a nasty prize-fight somewhere, and one man beat another. Isn't that terrible?"

Of course she could not remember the name of the brute who won, so John had to wait for the morning paper to learn that he would see his fifty dollars nevermore.

We are about desperate for a chance at the thing ourselves.

All last week, at all the nightly séances, we religiously spread the news that we were to bestow the favor of our presence upon a Saturday night presentation of dramatic art. In reality, we intended staying home in a darkened house and gorging ourselves on what made Westinghouse famous.

However, I was not to hear the golden voice proclaim that KYW is located on the Edison Building, Chicago. Thursday another popular neighbor borrowed our radio battery-charger in an attempt to recharge the battery of his family chariot. He then went away on a week-end motor trip, carefully locking our charger in his house so the naughty burglars could not get it.

JOHN HAD BET $50 ON THE MICHIGAN CITY FIGHT

When the news announcements were over, the bride who had monopolized the phones, cried out, "Oh, there was a nasty prize fight somewhere, and one man beat another." Of course she could not remember the name of the brute who won and John had to wait for the morning paper to learn that he would see his half century nevermore

There was nary a kick left in our battery by Saturday and even front row seats, with lobster salad and cream puffs after the show, could not take the edge off my disappointment.

I see red when I read the newspaper inquiries of my fellow townsmen as to how they can tune KYW out and Detroit in. If I could only hear the music from KYW I would die with a sweet smile on my lips.

The only time our guests ask *me* to listen in is when the Sunday sermon is on or when the set gets out of focus and they want it readjusted for their shell-like ears.

We have thought some of purchasing a loud speaker but cannot do so for the present: John's employer will not hear of another increase in salary. Without the increase we cannot afford to have the foundation of our house strengthened, and until it is strengthened we are simply courting disaster by doing anything to increase the nightly load our floors bear at present.

Now, please do not get the idea into your heads that John and I are disappointed in our radiophone or do not like it. We do. We are crazy about it. In fact, if we knew of any one who owned one, we would go over to his house every night to get a chance to hear the music.

They are like flivvers, nice when someone else owns them.

I'll tell you something else, too.

If you have some person in mind who has beaten you in a business deal or wagged a wicked tongue at your expense, waste no more time deciding between cyanide in his drinking water, or squealing about him to the prohibition agent.

Just buy him a radiophone for a present. Then tell his friends.

Where Radio is Helping the Phonograph Business

By W. T. WHITEHEAD

THERE is a general belief existing among those who do not know, that the advent of radio, with its broadcasted entertainments from many stations, is working to the detriment of the phonograph and record business in those parts of the country where the amateur receiving outfits are numerous. One section of the country which is not being hurt, but helped, is the Hudson River valley in New York State. This district is fairly well supplied with receiving outfits. It is mainly an agricultural district, and there are few farms which have not aerials of one kind or another on top of the barns, silos, or other buildings. The Newburgh *Daily News*, which maintains broadcasting station WCAB in the centre of this district, sends out concerts, farm talks, and lectures three times daily.

Now, phonograph selections are one of the features of the WCAB concerts. Wishing information as to the report that radio was reducing phonograph and record sales, the writer sought out the manager of a musical instrument store in Newburgh. He was told: "There isn't a thing to it. In fact, just the reverse is true. Since a broadcasting station has been located in Newburgh, our record business has increased 45 per cent. while our phonograph business has jumped 50 per cent. We have customers come into our store every once in a while to ask for a number 'that was broadcasted from Newark, N. J., Pittsburgh, Pa., Schenectady, N. Y., or Newburgh, N. Y., the other night.' We keep files of the concert programmes of all the concert broadcasting stations. We go over these with the patrons, and invariably find what they are trying to ask for.

"Yes, this radio broadcasting has stimulated the record and phonograph business wonderfully. Any dealer will tell you that August is the dull month of the year in the phonograph business. But August, 1922, was by far the biggest summer month we have had in our seven years of existence. I believe this same condition is true all over the United States. We find that it pays us to keep tabs on every antenna that goes up. In this manner we know just where to send our outside salesmen. The phonograph business and the radio business seem to be going hand in hand."

Poor Fish!

Six Hundred Thousand of Them a Day Make a Tidy Haul, When Radio, Applied to the Menhaden Industry, Saves Time and Money and Helps to Make the Corn and Cattle Grow

By EVERETT EWING

WHAT are menhaden?

This appears as the last of fifty stickers proposed by Thomas A. Edison in his recent questionnaire.

While the answer that is forthcoming may not be exactly what Mr. Edison expects, it is not inappropriate: Menhaden are the original "poor fish."

The term fits menhaden better to-day, with the application of radio to the menhaden fishing industry, than ever before.

This year, fishing vessels operating on the Atlantic coast from Maine to Florida are being equipped with radio. Radio might have come sooner to the menhaden industry but for the war, which halted the application of radio to private commercial enterprises. But now that radio has made a visit to this industry, it has been found "necessary" (so quickly do accompanying developments make anything that saves time or labor indispensable), and has been prevailed upon to stay. It is a time saver, a money saver, and perhaps a saver of vessels and of men's lives.

The C. E. Davis Packing Company, manufacturers of fish fertilizers, fish meal, and fish oil, started the ball rolling by erecting a station at its plant at Fleeton, Va., and installing radio equipment on three of its fishing vessels. Part of last season this company directed its vessels from the company's $\frac{1}{2}$-kw. station at Fairport, Va., the location of the rendering plant, near the company's offices. Enough was learned by the experiment to demonstrate the value of radio, and when the last season started, early in June, other fertilizer, meal, and oil industries were equipping their boats with radio.

"We have two Navy standard Emil Simon $\frac{1}{2}$-kw. sets on the *East Hampton* and the *G. S. Allyn*," said Mr. Slaughter, general manager and chief engineer of the Davis Company. "On the *M. M. Davis* we have a $\frac{3}{10}$-kw. Cutting & Washington transmitter, and receivers specially built to meet our requirements are on all three boats.

MENHADEN RUN IN SCHOOLS

Hordes of them—hundreds of thousands to a school!

"There has been no trouble working our steamers five times each day while they are between Cape May, N. J., and in False Cape, Va., and we have been successful working them between Sandy Hook and Boddie Island. Sometimes, when the big stations at Cape May and Norfolk are sending, it is hard to get our traffic through when our boats are beyond Cape May or False Cape.

"Our captains say," Mr. Slaughter continued, "that radio is worth what it costs to install and keep up, just to get the weather reports and storm warnings. Before we installed radio equipment, our steamers would run for hours to get to a harbor to spend the night. Now they get the weather report and stay at sea if the report is satisfactory. If it is bad, they get into a good harbor.

"Between 8 and 9 A. M. we give the steamers a report on the catch of the entire fleet, and state where catches were made on the day before. We usually get this to them by the time they reach the Virginia Capes. If the fish were caught on the 'south beach' or the 'north beach,' as our fishermen call the coast north or south of the Capes, they make a straight line for the place of the last catch. Then, as the steamers spread out looking for the schools, the first to sight the fish notifies the others. Usually it is only a few hours before our steamers are fishing.

"Between 5 and 6 P. M. steamers notify us of their catch and whether or not they will be in that night. They also state about the hour that they will arrive, so that we can be ready for them. If they are not coming in, we can save considerable fuel which would otherwise be wasted, because we can bank our fires. Formerly, we had to keep them going, as the plant had to be ready all the time. In the event of machinery trouble or a torn net we are advised as soon as the trouble occurs and we get busy and have new parts ready when the steamer gets in; that is another big saving."

The Fairport station works with its ships on 600 meters. Not only does it keep the plants of the Davis and other companies which operate in the Chesapeake Bay section in touch with their fleets at sea, but it assists communication between the air stations at Langley Field and the Hampton Roads naval base, and aircraft operating out of those stations on flights up the bay. Although the planes are equipped with radio, there are times when they are unable to get through without being relayed. So, in a measure, the menhaden industry is repaying the naval flyers for favors done by them during the last two years.

For a "poor fish," the menhaden is a valuable animal. There are millions of dollars invested in the industry in which the menhaden is "raw material." Spread out along the Atlantic seaboard, back in the bays and up the rivers, are immense plants which cook, grind, and otherwise treat the fish, producing nitrogen, one of the most important fertilizer elements, yielding a fish oil that has many uses, and providing a fish meal that is steadily growing in favor in the United States as a cattle and livestock food.

There are nearly sixty fish oil and fertilizer plants scattered along the Atlantic and Gulf coasts. North Carolina has eighteen of them; Virginia, seventeen, centred in the lower Chesapeake, with seven at Reedville alone. In the North, Massachusetts has one active plant; Connecticut, two; Long Island, two; New Jersey, four, and Delaware, four. Farther south, South Carolina has one; Georgia, one; Florida, three, and Texas, three.

More than 5,500 men are employed, and about 150 vessels. During the war a large number of these vessels were used in European waters as mine-layers, and some of them, prior to their return to industrial pursuit, as minesweepers. The men who make up the crews of these steamers are, for the most part, skilled seamen, and during the war their hardiness and seamanship proved of great value.

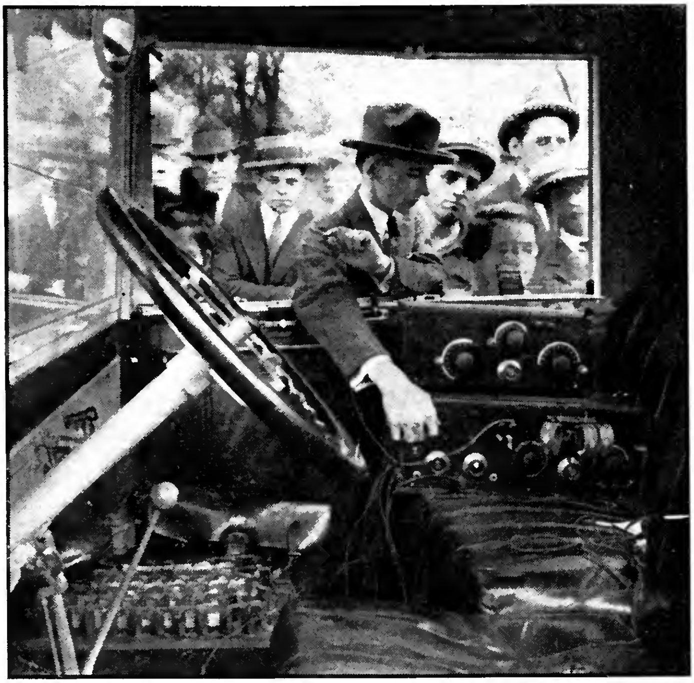
The capital invested in thirty-four of the Atlantic Coast plants is approximately $13,000,000. The annual value of the product of these thirty-four plants is about $11,000,000. The menhaden industry is about seventy years old, but no considerable development in it has occurred until recently. With the application of radio, menhaden fishing is due for a rapid growth during the next few years.

The discovery that a rich stock food, the fish meal, was a valuable by-product, is comparatively new. The use of fish meal in feeding and fattening livestock permits thousands of acres that have been used for growing cattle provender, and for grazing purposes, to be turned over to the production of food for the human family!

The fish oil is an important commodity of varied uses, and new uses for it are constantly being found. Today it enters into the manuwithout necessitating the purchase of any additional receiving equipment. Such a receiver is now in operation in our office. The crowd around the automobile in the accompanying photographs are listening to the results of the World's Series baseball game. There is no antenna, no loop, nothing but a ground wire fastened to a fire hydrant. The speech could be heard a block away.

During the course of the baseball game someone happened to step on the wire connected to the fire hydrant and it came off, but the speech continued to come in and the crowd was none the wiser.

This led to the conclusion that no connections were necessary, and the next day a radio-equipped coupé was traveling around the city with a loud speaker, telling passers-by of the plays as they occurred.



THERE ARE TWO RECEIVERS

The upper one is used with a detector and two stages of audio-frequency amplification for receiving, with nothing more than a ground connection. The lower set includes three stages of radio-frequency amplification in addition and is used for either ground or loop receiving

We saw another receiving set mounted on a large truck used to tell the crowds of the progress of the games. But, though the latter outfit consisted of a loop aerial four feet in diameter, and a receiver employing seven vacuum tubes for radio-frequency amplification, detection, and audio amplification and a Western Electric power amplifier and loud speaker, the speech was not given to the crowd directly. An operator wore ear phones, heard the announcements, and then repeated them into a microphone attached to the loud speaker for the benefit of the crowd. Using no aerial at all and within twenty feet of this van, Mr. Wagner used a detector and two stages of audio-frequency amplification for producing speech from a Western Electric loud speaker which could be heard more than a block away and there was no need for repeating the announcements.

As a general rule, Mr. Wagner employs a detector and two-stage audio-frequency amplifier for operating a loud speaker, and a single tube for telephone operation. Some of the stations he hears include:

STATIONS	MILES FROM N. Y.
WIT—Philadelphia, Pa.	100
KYW—Chicago, Ill.	750
WGU—Chicago, Ill.	750
KSD—St. Louis, Mo.	935
WOC—Davenport, Iowa	900
WHAS—Louisville, Ky.	675
WSB—Atlanta, Ga.	800
WBZ—Springfield, Mass.	235
KDKA—Pittsburgh, Pa.	325
WWJ—Detroit, Mich.	500
WFI—Philadelphia, Pa.	100
NOF—Anacostia, D. C.	210
WGY—Schenectady, N. Y.	150
WHAZ—Troy, N. Y.	125
Shepard Stores, Boston, Mass.	200
	6,755

From the Log of a Radio Man

Many a ship operator's log book is born to blush unseen, yet often the hastily jotted notes could reveal graphic and thrilling pictures of life at sea. This excerpt from a radio log written two summers ago appears to you, except for the changing of names and places, just as it stood originally.—THE EDITORS.

SHE WAS a small cargo vessel, and left Halifax in July, 1920. The first part of the voyage was made without special comment in the log, but on July 24th we find the following entries:

8:50 p.m. The engines were stopped and I tho't some minor repairs were necessary. Listening to several ships working when the Captain came into the wireless office with a strained look on his face, saying "You're in for it now."

Taking a pad he wrote the following:—

"SOS—*SS Verance* with broken propeller shaft in Lat. 4250 N. Long. 3326 W. 225 miles N 25 W true from Delgada Head."

8:57 p.m. Cleared air—broadcasted distress call on 600 meters, full power, main set. Confusion reigned supreme, several ships answering at same time.

Finally, arrangements were made for the *Wilca*, another vessel of the same line, to tow the *Verance* to the Azores. The *Wilca* arrived about daylight and by 10:40 a.m. the disabled vessel was taken in tow.

For July 25th, we read:

10:00 p.m. No sleep for 44 hours. Have arranged with oprs on *SS Wilca* to answer calls for me, and if they or any one else wants me badly to communicate by blinker light to our bridge.

1:40 a.m. Bridge called me to ans *Wilca* on Radio. *Wilca* said they did not signal us.

2:00 a.m. Back to sleep.

On July 29th, the following entry is made:

7:50 a.m. I must say right here that the operator on the *Wilca* is so poor he can hardly send, and I never worked harder in my life copying than this past 50 minutes. One thing the communication service should impart to the new men is that when the Captain gives them something to send, they should use his wording and stick to it, and not try and send fast, as they sure will make a fizzle of it. My trouble this morning was that the *Wilca's* Capt. would give his opr something to send to me and the kid would bat it out like fire, never stopping to make a perfect letter. Consequently I asked him to repeat, as I did not want to make any bulls. When he repeated he changed the entire wording of the message. This is not only out of order but very unbusinesslike.

12:15 p.m. Arrived Ponta Delgada.

Aug. 9th. Orders rec'd that we are to be towed to Gibraltar for repairs by the *SS McKender*.

Aug. 10th. Our Capt. tells me the *SS McKender* operator is very poor. Heard *SS McKender* working. Yes, the opr is even worse than the *Wilca* oprs were.

Aug. 11th. 6:00 p.m. *McKender* takes our anchor chain and commences towing us to Gibraltar.

7:50 p.m. *McKender* operator is very slow and both a poor sender and receiver, but think we shall get along O.K. He is using too much power. Will endeavor to coax him to use his head.

10:10 p.m. Circuit breaker went bad.

Aug. 12th. 10:40 a.m. Circuit breaker once more in commission. Have had more trouble with this breaker than any used before. It works magnificently until all the heavy work is over, and then lies down on the job.

Aug. 12th. 7:40 p.m. It's nice to be towing in back of another fellow and he wanting to work everybody on the Western Ocean. Nice for your Crystal Detector. Ha Ha.

Aug. 13th. 12:50 p.m. Our glass is down to 28.74. Blowing pretty bad with a heavy sea.

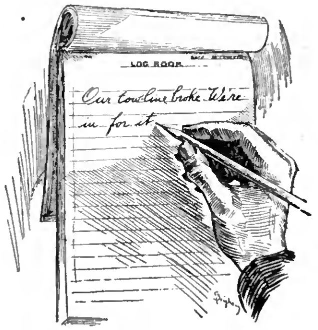
2:00 p.m. The sea is heavy. The *McKender* is pumping oil over, to knock down the sea. We have our storm tanks (oil) open, also bags of oil over the side.

4:30 p.m. Gale blowing.

4:45 p.m. Our tow line broke. We're in for it, no doubt.

4:57. We ask *McKender* if she can pick us up. Impossible.

7:00 p.m. Gale force 10 blowing. It's a question if we can stand it.
9:30 p.m. Wind and sea furious. We are worse off than a barge.
12 mid. Gale at its height. A couple of seas shook the old tub till she trembled as with grief.
Aug. 14th. 2:00 a.m. *McKender* loses us. Goes over horizon. Our ship is riding it out pretty well. The crews are surely terrified.
4:00 a.m. I am all in. Sea continues. Ship lurches, but holds together.
5:00 a.m. Cap't says "She's a good ship and will ride it out."
5:30 a.m. Tried to catch a wink of sleep but impossible.
7:00 a.m. Still blowing about forty and sea is large. We take them green, over the top.



3:00 p.m. *McKender* is now abreast and endeavors to get close enough to shoot us a line but her Lyle gun refuses to work after two different complete turns around us.
4:00 p.m. We try our Lyle gun but it doesn't work. It's no fun lying in this sea with our only means of rescue, the Lyle guns, on both ships, failing.
5:00 p.m. We try to float a line to her and she tries same, but of no avail.
6:30 p.m. *McKender* captures one of our floating buoys but the strain is too heavy on the line and it parts. The crew is restless.
7:50 p.m. After several more attempts to float lines to one another, the *McKender* steams a mile away. Captain says he thinks it's best to wait until morning.
10:30 p.m. Have been up since 8 a.m. 13th—38 hours—and am all in, my second siege this trip.
Aug. 15th. 6:30 a.m. They are coming for us again.
8:00 a.m. Sea going down slightly. After yesterday's failure to float lines and the non-working of the Lyle guns, we put a boat over to get a line to the *McKender*.
11:00 a.m. Our boat got a line to the *McKender*. Happy.
3:30 p.m. The *McKender* heaved on tow line before we had cut our anchor chain away. Almost tore our forward port bulwarks away. Some trip. We cut the chain to save the bulwarks.
3:45 p.m. The *McKender* started ahead slowly.
3:50 p.m. Tow line parted again. Talk about disheartened! I feel sorry for our crew. I feel resigned, myself. Surely a heavy strain on this ship's company. The crew of both ships working in rain and wind to get line back on board.
7:00 p.m. The *McKender* reports her end in.
8:10 p.m. Our end up. Captains decide to wait till daylight. Our nerves are about strung to the limit.
11:10 p.m. Going to sleep.
Aug. 16th. 4:30 a.m. Sea very choppy but wind only about 4 force. Cannot launch a boat. We started a series of oil bbls. as floats. All morning it was lines parting here and there and lines getting caught. Getting rough again. We are pumping oil over the side to help smooth out the sea. A nerve-racking morning. The *McKender* opr. is oh so poor this morning. No doubt he's sick. I'm forced to send about 4 words a minute and we have msg after msg to get off. What a life. This cures me of wireless, if we ever get in safely. Never in my 11 years of radio have I had such a poor opr at the other end.
1:50 p.m. The *McKender* Captain dared to come close on leeward side. He came astern of us and when ten feet astern, a sea took us to leeward and him to windward. I heard yelling, went out on deck and saw her. It looked like the end. She was about to plough through our stern, when a sea took her one way and us the other. Our Capt. said "She'll hit us sure." Everybody stood transfixed, but she passed to windward a scant two feet from our rail. Our chance to get a line to her, yea. Never had a better chance, but all were so frightened, they could not move. When finally one of our men came to, he heaved a twenty pound lead line. Lead got over to her, but the line was too short and before another line could be tied to its end, we lost it and the *McKender* had again eluded us. After that experience we knew we had faced death. Everybody was solemn as we watched her steam away, seemingly to recover.

2:00 p.m. *McKender* floats more bbls. and comes on our lee side (not quite so close this time).

2:50 p.m. We finally get a line from her and bend on a two-inch wire cable.

3:05 p.m. She is heaving in our two-inch wire, slowly, very slowly.

3:50 p.m. They are bending our two-inch wire on to their towing cable.

4:10 p.m. We commence heaving the tow line aboard, slowly. Everybody is helping, watching, hoping.

5:10 p.m. We have the towing line aboard and shackling on the chain.

5:18 p.m. Paying out our 60 fathoms of anchor chain which will be the complete tow line.

5:21 p.m. *McKender* going ahead slowly to take up slack.

5:40 p.m. *McKender* stopped.

5:55 p.m. Captain comes in radio room. Can see a look of haggardness all over his face. Still, he's smiling, and gives me msg for the *McKender* to go ahead slow.

6:05 p.m. *McKender* gives us congratulations, thanks God for everything, and starts pulling us, slowly. As we have used up every bit of line and gear aboard, and the *McKender* the same, our hope lies in the present cable. It consists of about 250 fathoms of 4½-inch steel cable, the same that parted in the storm. We have been adrift for 75 hours and the feeling is great to have some hope of reaching land again.

6:50 p.m. The crew are wondering whether or not she is going to hold. Three of them never were to sea before. It's telling on them.

Aug. 18th. 8:30 a.m. We are still going ahead slowly.

7:25 p.m. Engineers have been working on shaft, have repaired same, and the engine is turning over slow. No one knows what a relief it is.

Aug. 19th. 8:50 a.m. Engine still running and we are making around five miles per hour.

1:50 p.m. We are turning 34 revolutions. Our ship is quivering first time since July 24th when we broke down. Making good time.

Aug. 22nd. 3:25 p.m. Arrived Gibraltar.

© Ewing Galloway

"ARRIVED GIBRALTAR"

"Here in Great Britain—"

The Peculiar Broadcasting Situation on the Other Side of the Atlantic Contrasted With That in the United States. Profiting by America's Horrible Example

By PHILIP R. COURSEY, B. Sc., F. Inst. P., A. M. I. E. E.
Editor of *The Wireless World*, London

POPULAR interest in wireless has recently come to centre on the broadcasting of concerts and similar entertainments from a few special stations provided for the purpose. Broadcasting in the United States for many months past has created tremendous enthusiasm for the reception of such transmissions in the home; but at the present time our position as regards this form of entertainment is not entirely clear. Although formal permission has already been given to the effect that licenses will be granted for such transmissions, it yet remains to be decided which wireless manufacturers will take part in such programmes, and what will be the terms of the licenses.

Here in Great Britain, one difficulty that has been raised concerns the financial return that the broadcasting companies are likely to obtain for their expenditure on the transmitting stations. In America, the large population, in conjunction with the nation-wide interest in anything new, has resulted in the rapid building up of a very extensive industry for manufacturing and selling apparatus for receiving the broadcast transmissions. A fear has been expressed that in the case of Great Britain, although many people will wish to purchase receiving sets, there may not be a sufficient number to recompense the maintenance and running of the stations.

It is interesting to put ourselves in the place of the British amateur, for a moment, and to look at the broadcasting situation in both England and America from the British point of view. Our readers will see that Mr. Coursey is misinformed when he states that "almost every one of the tens of thousands of amateurs [in America] is licensed not only to receive but to transmit messages," but he does reflect the apparently general opinion of those in English radio circles that our ether jam ought to be a lesson to them.

Captain Wedgewood Benn, M. P., expressed this idea in the columns of the *Westminster Gazette* not long ago. "If we [in England] are to enjoy the benefits of broadcasting," he said, "control of sending is essential, otherwise the air will become a Tower of Babel. We know a little of the horrors which might ensue, from what we read of the situation in America. From nine o'clock in the morning, when crop reports and prices are sent, followed by programmes of music, news from the race-course, baseball scores, weather reports, and gospel sermons, right down to the 'bedtime message for the chicks,' there is no rest. Clearly there must be control."

Yes, clearly there must. But is it possible that the British have been enjoying a little too much of it?—The Editors.

There is every indication at present that the British Government will retain a much closer and more stringent supervision of the broadcasting arrangements in this country, and will retain more control over them than the American Government apparently has done in the United States. It has been stated that the broadcast transmissions are to be restricted to purely orchestral and concert transmissions with occasional news items, and that all forms of advertising matter will be prohibited. The only direct advertisement that the firms carrying out the broadcasting will obtain will arise from the announcement of the name of the company owning the transmitting equipment. The hiring out of broadcasting stations for the transmission of other classes of matter by various individuals or firms is not to be allowed, since the use of the stations is to be restricted solely to the broadcasting company.

In many cases this may be advantageous to the wireless industry itself, but at the same time it cannot but be felt that a freer policy might tend to a greater expansion of the broadcasting facilities available to the general public.

The question is closely linked up with that of the wireless amateur or experimenter. There are in Great Britain at the present time several thousand wireless amateurs who are licensed by the Post Office to receive wireless signals, but only a few hundred who are licensed to transmit. These figures contrast strongly with America, where almost every one of the tens of thousands of amateurs is licensed not only to receive but to send messages. Since the War it has been felt in official circles that the great developments that have taken place in the way of ease of long-distance transmission and reception would be impeded if too great freedom were granted the wireless amateur.

To a certain extent this feeling is brought about by the proximity of England to other European countries, since any interference that may be caused by amateurs is not necessarily limited to our own territory. The number of transmitting licenses that have been granted has therefore been strictly limited in order that any possible interference may be kept down. For this reason also the granting of all amateur wireless licenses in Great Britain has been restricted to their use for purely experimental work only; they are not granted merely for communication purposes.

In the United States, amateurs may and do communicate with each other and transmit any kind of message to each other, often over very long distances, since the granting of their licenses is not provisional upon their carrying out definite scientific research or experiment. Were such freedom of communication to be granted here, it would be a violation of the Postmaster-General's monopoly of communication under which the Post Office alone is empowered to transmit intelligence from one point to another by any form of telegraphic or telephonic means.

The Wireless Society of London and its affiliated Wireless Societies throughout the country number among their members most of the best wireless amateurs, and they already have secured from the Post Office authorities considerable concessions as regards amateurs' work. They were, for instance, instrumental in obtaining permission for the first regular broadcast telephony transmission in this country. This transmission, it is true, is only allowed for a period of about *fifteen minutes on one day each week*, but it represented, particularly at the time it was granted, a considerable concession on the part of the Post Office. Other arrangements with the Post Office have also been made by the Society for the benefit of amateurs, and it is to be hoped that in the near future still further privileges will be granted. The more extended use of transmitting apparatus by wireless amateurs for general communication purposes would considerably augment the volume of trade in such material.

TRANSATLANTIC TESTS BETWEEN ENGLISH AND AMERICAN AMATEURS

IN SPITE of the less extended use of wireless by British amateurs, the development of amateur apparatus has at least kept up with, if not surpassed, the standard attained elsewhere. In December last, a series of special tests was organized between American wireless amateurs, represented by the American Radio Relay League, and the amateurs of this country, with a view to establishing communication between America and England solely by amateurs, using the ordinary apparatus as licensed by their respective Governments. The maximum transmitting power licensed to the Americans is some hundred times that allowed here, and therefore the transmissions were all made in one direction—from America to Britain. The tests were successful, and the American signals were heard—not merely one or two, but many transmitting stations being identified and their calls and messages taken down. Some of these stations were using no more electrical energy than is required to light one or two small electric lamps, so that is a tribute to the development of the receiving apparatus that such feeble radiations could be detected and heard over a distance of more than 3000 miles.

The Americans themselves sent over to this country a representative equipped with their best apparatus. He, too, heard some of the signals, but although he used an aerial eight and a half times the size allowed to the British amateur, he did not hear many more stations than did the British listeners.

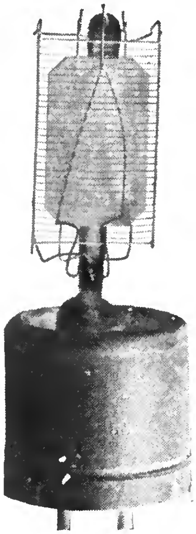
The radio amateur in Great Britain is, on the whole, not so hardly treated as he is in certain other places. In France, for instance, it is only during the past few months that the amateur has been recognized and has obtained any privileges at all; while in other countries he is still prohibited altogether from indulging in this hobby.

How the Vacuum Tube Works

By ARTHUR T. ENGLISH

EVERY radio amateur is of course familiar with the structure of the vacuum tube and its use in receiving circuits as a detector and an amplifier. He can answer the question, "How does it detect?" readily enough be saying, "It rectifies the high-frequency waves and so makes them audible." But when pressed for a detailed explanation, he usually must take refuge behind some general statements such as "one-way conductivity," "characteristic curve," etc., until his questioner's attention can be diverted to the next selection from the broadcasting station.

Thoroughgoing explantions have of course been made, but they have usually been couched in such mathematical terms that they have received little publicity beyond the columns of technical journals. It is the writer's belief, however, that intelligent amateurs are interested in knowing both the "how" and the "why" of vacuum tubes in radio telephony. The subject is an interesting one, for it is vital to an understanding of some of the limitations of the art.



The filament, grid, and plate are seen here in their relative positions. The glass bulb has been broken away

HOW THE RADIO VOICE IS CARRIED

TO BEGIN with the "why" of the vacuum tube, it is necessary to make one apparently dogmatic statement, viz.: that electrical energy in "commercial" amounts can be radiated from an antenna of workable dimensions and a portion of it received on a similar antenna, only when the wavelength lies between, say, 100 meters and 20,000 meters. Below the lower wavelength, the energy radiated is too small; above the other, the antenna is too long to be handled readily. These limiting wavelengths correspond to alternating currents of 3,000,000 and 15,000 cycles per second, respectively, in the antenna. In order that radio telephony may be possible, a means must be found by which audible sounds, having a frequency of anywhere from 50 cycles to, say, 3,000 cycles, can be transferred through the ether by means of electric waves. To cite a typical instance, when a violin note "high c" is played at a broadcasting station whose wavelength is 360 meters, the musical note of about 1,000 cycles must be "carried" by an electric wave whose frequency is 833,000 cycles. This condition is fundamental to radio telephony.

In the transmitting station, the musical note is caught by a telephone transmitter and becomes an alternating electric current, colloquially called a "voice current" of 1000 cycles per second. (Fig. 1). We shall not explain how this current is combined with the 833,000 cycle current, save to say that vacuum tubes are used. As a result, electric waves are set up in the ether, and when your receiving set is suitably tuned, a corresponding current (Fig. 2) is set up in the primary coil of your receiving transformer. This current can be considered as made up of:

Component A, proportional in volume to the carrier, and of frequency 833,000 cycles. (Fig. 3)

Component B, at carrier frequency, (833,000 cycles), but whose volume at any instant is proportional both to the volume of the carrier and to the actual voice current at that instant. (Fig. 4)

Now, since both these components are at such high frequencies, they will be inaudible in a telephone receiver, partly because the diaphragm cannot vibrate fast enough, and partly because they will not pass through the high impedance of the receiver magnet coils.

Our problem, therefore, is so to transform the antenna current that we shall have a current at voice frequency, which will pass through the telephone receivers and produce an audible sound in them.

Now, if we impress an alternating voltage upon any device, such as a crystal detector, (Fig.5) which conducts current more readily from terminal A to terminal B than in the reverse direction, we shall find that the resulting current, instead of being equal in both direc-

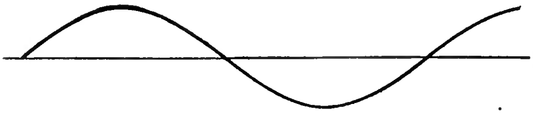


FIG. 1
A voice-current wave of 1000 cycles

tions, is greater in the direction A to B than in the other direction. As shown graphically in Fig. 6 the quantity of electricity flowing from A to B is indicated by the area of one loop above the zero line, and it exceeds the quantity flowing from B to A by the area shown in solid black. After a number of waves have passed, more electricity has flowed from A to B than from B to A which is the same as saying that an interrupted current from A to B is flowing in the circuit. If *no* current can flow from B to A, the alternating current is said to be completely rectified.

WHEN THE VOICE COMES IN

LET us suppose such a device introduced in a receiving circuit, as in Fig. 5. Then an incoming wave of constant volume, like Fig. 3, would be broken up into two components—the lightly shaded parts of Fig. 6 equal and opposite, and therefore an alternating current at radio frequency; and the heavily shaded parts,

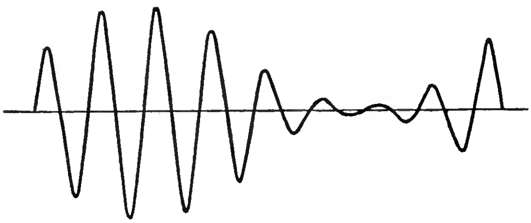


FIG. 2
A graph of antenna current—the sum of component A (carrier) and component B (modulated current)

pulses of direct current at radio frequency, and therefore exerting the same effect on the rather sluggish telephone receiver and human ear as a steady direct current. Suppose, however, that the incoming wave is carrying a 1000-cycle voice wave. Graphically it would look like Fig. 2. Since the rectifier will allow more current to flow above the zero line, the resultant current is as shown in Fig. 7. Here the lightly shaded areas are equal, and indicate a radio-frequency (inaudible) alternating current; the black areas indicate pulses of direct current whose magnitude is seen to increase and decrease in step with the voice current wave. Since these pulses follow each other so rapidly, they will give the effect in the telephone receiver of a steady current which increases and decreases in step with the voice wave. This will set up a sound in the receiver which will be a reproduction of the sound at the transmitting end.

HOW THE TUBE DETECTS

HAVING explained the nature of detection, we now come to the interesting story of how the vacuum tube performs that work.

The simplest form of tube for detection alone

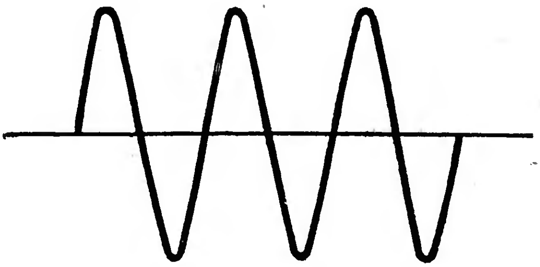


FIG. 3
Pure carrier wave for 360 meters (833,000 cycles), known as component A

is the two-electrode tube, or Fleming Valve. As shown in Fig. 8, this tube contains only a filament, heated by an "A" battery, and a plate. The hot filament gives off electrons which carry current from filament to plate. The amount of this "space current" (symbol, Ip) is proportional to the physical size of the tube, the temperature of the filament and the voltage between filament and plate (symbol, Efp). For any given tube, with constant filament current, the relation between the space current and the voltage across the space is shown in Fig. 9. From this curve we may learn two important facts:

(1) If the voltage Efp between the filament and plate is such that the plate is negative with respect to the filament, no current will flow, because the negatively charged plate repels the negative electrons,

FIG. 4
Graph of a pure modulated wave formed by the carrier wave of Fig. 3 being modulated by the voice current of Fig. 1. This wave is known as component B

emitted by the heated filament, and the cold plate cannot give off electrons itself.

(2) If the plate is positive with respect to the filament, the plate will attract negative electrons given off by the hot filament, and current will flow, but the current Ip will increase more rapidly than the voltage Efp.

This last statement means that if a battery is introduced into the plate-filament circuit,

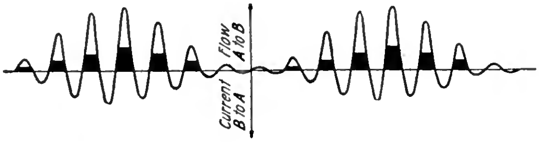


FIG. 7
The dark section in this graph illustrates the pulsations of current which result from the rectification of an incoming radio telephone wave. The pulsations occur so rapidly as to form a practically direct current which actuates the receiver diaphragm

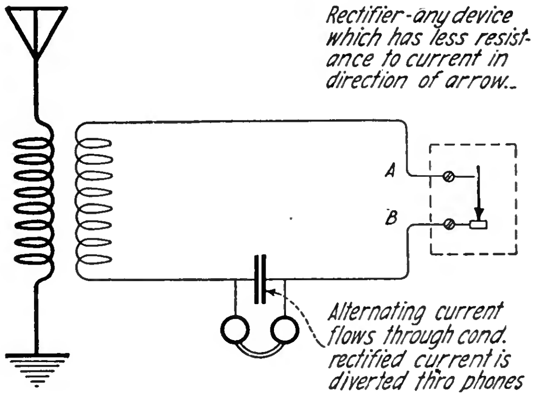


FIG. 5
A simple receiving circuit

as at B, Fig. 10, the plate current Ip will have a steady value OM. In actual practice the small voltage ON is secured by omitting battery B and connecting the plate to the positive end of the filament. The voltage drop in the filament itself, due to the heating current, will keep this end more or less positive to the rest of the filament, so that the plate can be considered as positive to the filament by half the amount of the voltage drop across the filament.

Suppose, now, with Efp held at a "normal" value of ON (Fig. 9), a radio wave impresses an alternating current upon the plate-filament circuit. At one extremity of the alternating current cycle, Efp goes up by the amount NR; at the other extreme, it goes down by the equal amount NQ. But the current in the circuit increases first by the amount MU, then decreases by the smaller amount MT. In other words, the resulting current is greater in one direction than the other, which is precisely the condition necessary for partial rectification, as we have seen. The Fleming Valve, then, is a detector which will give an audible sound in a telephone receiver in series with it.

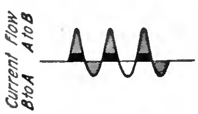


FIG. 6
The received current

WHY WE USE "BLOCKING" CONDENSERS

LET us now insert into the secondary circuit a small condenser C, omitting for the moment the high resistance L. (Fig. 11) When the filament is first lighted, there will be no charge on the condenser, and its two sides will be at the same voltage with respect to the filament. Due to the voltage drop in the filament, that end of it to which the secondary, condenser, etc., is connected will be positive to the filament and so the plate will be positive to the filament.

But as negative electrons cross from filament to plate and flow along the wire, they are blocked by the condenser C. Soon a sufficient number of electrons accumulate to charge the right hand coating of the condenser, and also the plate, negatively. This negative charge repels the negative electrons, and so they no longer come to the plate, i. e., the plate current decreases, and may even become zero. This phenomenon is called "blocking."

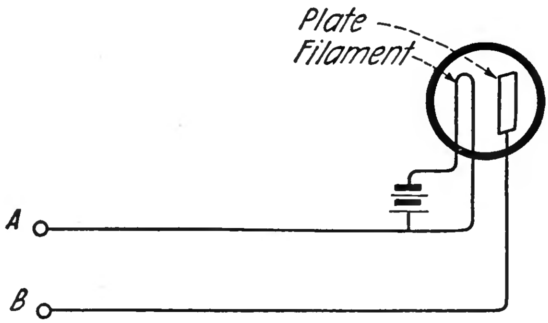


FIG. 8
The Fleming Valve Circuit

The vacuum in the early Fleming Valves was none too good, and molecules of oxygen,

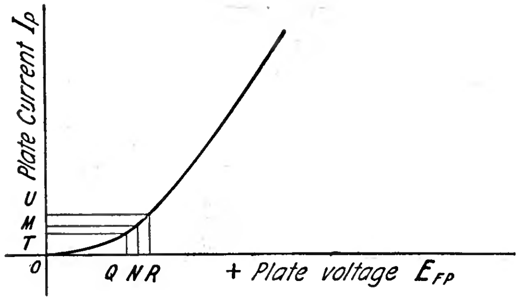


FIG. 9
The relation between the "space current" and the voltage across the space (between the plate and the heated filament) is illustrated by this curve

nitrogen, etc., were usually present. Some of these act as carriers of electricity, which will move from plate to filament. This will of course reduce the negative plate charge and allow the electrons to flow again to the plate. But a more reliable method is to use a high resistance, L, as a "leak" which will keep the voltage across the condenser from rising high enough to "block" the tube.

So long as the tube is lighted, but while no radio waves are coming in, the plate current (OM in Fig. 9) will flow through the high resistance L and raise the voltage across the terminals GH. When an unmodulated carrier wave comes in, it is partially rectified by the valve, and the resulting steady additional current through L will create an additional steady voltage across GH. When the carrier wave is modulated by voice-frequency current, then the rectified current will vary with the voice current and so the voltage across GH will vary. If we connect an extremely high-resistance receiver

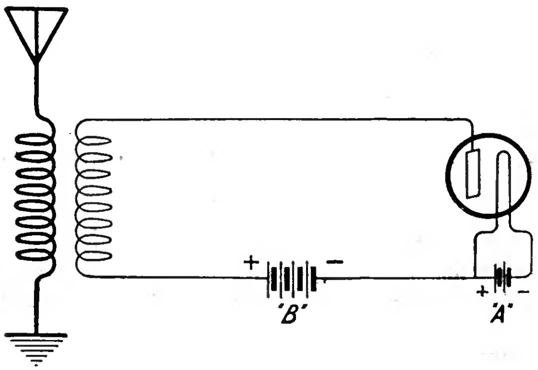


FIG. 10
A battery, commonly termed a "B" battery, is placed in the plate circuit in order to keep the plate current steady. In practice this battery is omitted and compensated for by connecting the plate to the positive end of the filament

here, we shall hear the transmitted sounds, and if we connect an amplifier, especially one that takes little or no current through its "input" circuit, we shall get a largely increased volume of sound. All amplifiers use a "three-electrode" tube, sometimes called "audion," or by other trade names; and this type of tube can also be used for detecting. We shall now review its characteristics.

WHY THE GRID IS USED—AND HOW

THE three-electrode tube contains a filament, preferably of platinum, and sometimes coated with oxides of certain metals; a grid of fine wires, and a plate of aluminum or other metal. In certain tubes, the filament forms an inverted V, with two grids, one on each side of it, and in planes parallel to the

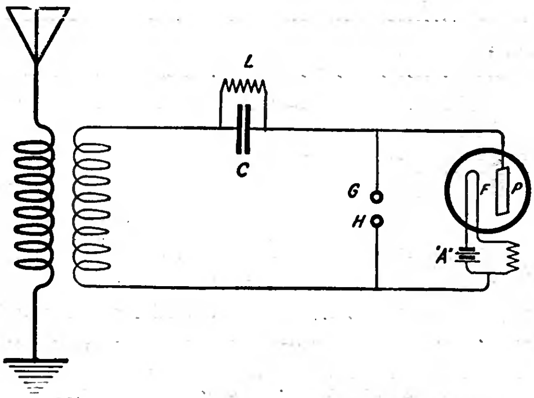


FIG. 11
By the combination of a condenser and a high resistance it is possible to control the voltage in the plate circuit

plane of the V. There are two plates, outside and parallel to the grids. In other tubes, the filament forms a short spiral, enclosed by the filament wound in a somewhat larger spiral, and the whole surrounded by a cup-shaped metal stamping which forms the plate. In all types, electrons emitted by the filament must pass through the grid to reach the plate.

The operation of a three-electrode tube is as follows: Assume first that the grid is absent. We have then a Fleming Valve, in which electrons emitted from the filament are drawn toward a positively-charged plate. Now let the grid be inserted in the stream of electrons, but kept insulated from both filament and plate. A few electrons strike it and cling, giving it a sufficient negative charge to repel any further electrons. Now let the grid be given a varying voltage with respect to the filament, and we shall see that this voltage has a great effect on the flow of electrons. If the voltage is sufficiently negative, all the electrons will be repelled from the grid, and none will get through to strike the plate. This is the starting point "A" in Fig. 12. As the grid becomes less negative (ABC), it offers less and less resistance to the electrons, and more of them flow past it to the plate. When the grid becomes positive (CDF), the flow of electrons is increased still further until at last a point F is reached where the current can increase no more, because the filament is giving off the maximum number for that particular temperature and filament-plate voltage.

The first part of the characteristic is curved (A to B); the importance of this we shall see later. The second part BCDE is practically a

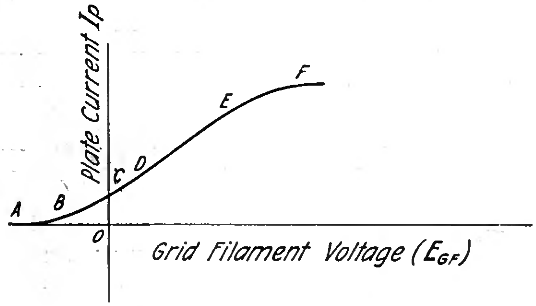


FIG. 12
The flow of electrons from the filament to plate is controlled by the relative charge on the grid as shown in this graph

straight line. This means (1) that each change in grid voltage causes a large change in plate current; and (2) that the current change is exactly proportional to the voltage change. The significance of (1) is that the voltage change of the grid requires very little current, and hence very little power; the current change in the plate circuit, on the other hand, may vary the power in its circuit through a wide range. Exact proportionality (2) means that if the input voltage is a voice wave, the output current will be a perfect copy, but on a much larger scale. In other words, the device will *amplify* without distorting.

MAKING ONE TUBE WORK AS TWO

IF NOW we connect the "input" terminals G'H' of a vacuum-tube amplifier set (Fig. 13), to the terminals GH of Fig. 11, we shall greatly increase the loudness of the signals

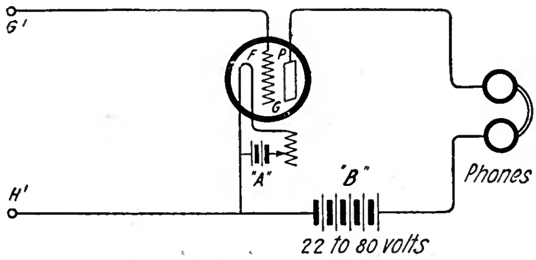


FIG. 13
Altering the circuit GH in Fig. 11 by adding this amplifier arrangement permits much better reception and results in a circuit represented by Fig. 14

which were heard when we connected the telephone receivers directly to GH. A diagram of part of this "hook-up" is shown in Fig. 14, in which it will be seen that the filaments of the two tubes are connected, and that the plate of Tube 1 is connected to the grid of Tube 2. It is evident that the filament and grid of a three-electrode tube can operate the same as the filament and plate of a Fleming valve, i. e., that the filament and grid will rectify incoming high-frequency currents just as do the filament and plate. So we can eliminate the Fleming valve and rectify and amplify in the same three-element tube. This circuit is shown in Fig. 15, and is familiar to most radio amateurs.

Let us now review briefly what happens in this circuit. The high-frequency voltage across the secondary S varies in proportion to the voice currents at the transmitter. This voltage, rectified by the filament-grid circuit, produces a small direct current through the tube, the high resistance L and the secondary S. This current will of course produce a proportional voltage drop across L, by Ohm's

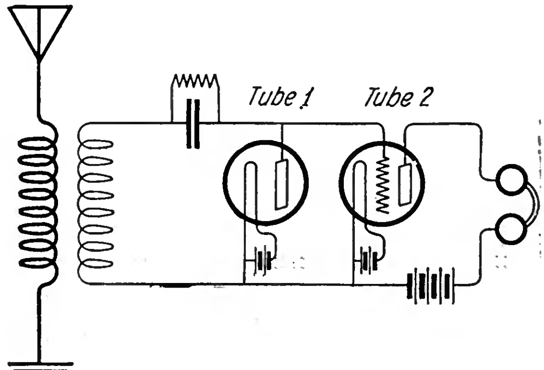


FIG. 14
A Fleming Valve detector with a three-element tube used as an amplifier

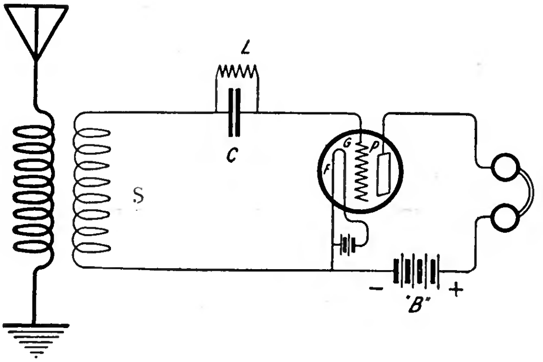


FIG. 15

By this further modification of Fig. 11 a single three-element tube is made to function as a rectifier and amplifier as well

law, which will vary the voltage of G with respect to F. But we have seen that this is the means by which the current through the plate circuit is varied. So this current, which flows through P, Phones, and B, will vary in step with the original voice current, and will reproduce the original sound in the telephone receivers. The condenser C serves as a by-pass around the resistance L, enabling the high-frequency voltage induced in the secondary circuit from the antenna to reach the grid.

It is interesting in this connection to study the operation of a less common scheme, which is sometimes called the "C-battery hook-up." This employs a few dry-cells connected in place of the grid condenser and leak, and poled so as to make the grid slightly negative to the filament. Fig. 16 is an enlargement of the left hand part of Fig. 12. Suppose with no waves being received, the C-battery gives a voltage ON between grid and filament. The corresponding plate current is OM, which is a steady current through the receivers, and inaudible. Now suppose an incoming wave gives a voltage swinging between Q and R as negative and positive maxima. As a result, the plate current will vary between OT and OU, with an average value at V, half-way between. This variation is of course at radio-frequency, and therefore inaudible. But due to the curvature of the characteristic at this point, UM is greater than TM, and hence the average value of the direct current is increased by an amount VM. The quantity VM is proportional to QR, which in turn is proportional to the amplitude of the high-frequency current in the antenna. This amplitude varies in step with the voice current at the transmitting station, so that we can sum up by saying that the direct current VM varies in step with the original voice current. Hence this varying direct current, passing through the telephone receiver, will reproduce the original sounds.

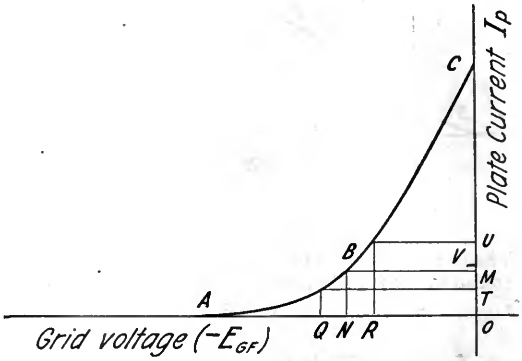


FIG. 16

Grid voltage and plate current are affected in this manner when a "C" battery is used instead of the grid condenser and leak resistance as in Fig. 15

EDITORS' NOTE

It is of the utmost importance to the radio public who are receiving broadcasting that this business develop to its maximum service and effectiveness. The Editors of Radio Broadcast *would be glad to hear the opinion of its readers on such questions as:*

What voice should the receiving public have in selecting broadcasting programmes?

Should the public get broadcasting free or should it pay for it, and if so, how?

If the public should get it free who should pay for it and how are they to be reimbursed?

Do You Know Them by Sight or by Sound?

CHIEF STRONGWOLF

Whose Indian name is Guy You Ma Wanda, is an eloquent speaker. Perhaps you have listened to one of his very convincing pleas for citizenship for the American Indian

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GRANTLAND RICE

Who reported the World Series Baseball games play by play

GEORGE T. JOHNSON

Is the Chief of Police at Pueblo, Colo. He has established a police service between Denver, Colorado Springs and Pueblo. Possibly you would be as well pleased if the Chief did not mention your name

© Underwood & Underwood

ELMER E. BUCHER

Finds time to send and receive now and again, despite his very busy life. He has written some of the most popular radio books, and directs the sale of amateur equipment for the Radio Corporation of America

Paris and Honolulu are Calling You

Stations Thousands of Miles Away are at Your Finger-Tips if You Convert Your Broadcast Receiver into a Long-Wave Set. Most of These Stations Can be Picked Up With a Single Vacuum Tube

By A. HENRY

AFTER several months of listening to the concert programmes, it is not unlikely that those of you who have recently taken up radio will seek additional fields to explore. You will find none more fascinating than that of long-wave, long-distance experimenting—bringing in and copying the high-power radio telegraph stations. It is by no means uncommon for amateurs in America to pick up the stations at Honolulu, Cavite, Bordeaux, Paris, Rome, San Francisco and Darien; sometimes, it is even possible to get Japan. Perhaps this sounds improbable; but you may be surprised—and encouraged—to learn that no radio- or audio-frequency amplification has been necessary in bridging these distances. They have been covered by using *a single vacuum tube.*

These statements should be qualified, of course, by mentioning that very distant stations cannot be picked up at all hours of the day or night, nor can you expect success without a certain amount of experimenting with your set in order to get it operating at the highest efficiency. But that is where individual skill and perseverance come in.

In order to convert a broadcast receiver into a long-wave set, you must have some idea of the circuits employed in each. Short-wave sets, especially those of the regenerative type, were described last month in RADIO BROADCAST in an article called "Regenerative Radio Reception" by Phil M. Riley, and the theory of tuning has been comprehensively covered by John V. L. Hogan in a series which appeared from May to October.

THE STANDARD REGENERATIVE RECEIVER

A STANDARD regenerative receiving set employing a tickler coil in the plate circuit to accomplish regeneration is shown in Fig. 1. If all the parts are removed other than those shown in Fig. 2, we may have the nucleus around which all vacuum-tube receiving sets are constructed. C_3 is the grid condenser, ordinarily of .00025 mfds. shunted from the grid leak resistance R_3, ordinarily of 1 megohm. A is the six-volt storage battery used for lighting the filament. R_1 indicates the filament rheostat used to control the temperature of the filament. R_2 is a 200- or 300-ohm potentiometer shunted across the "A" battery with its

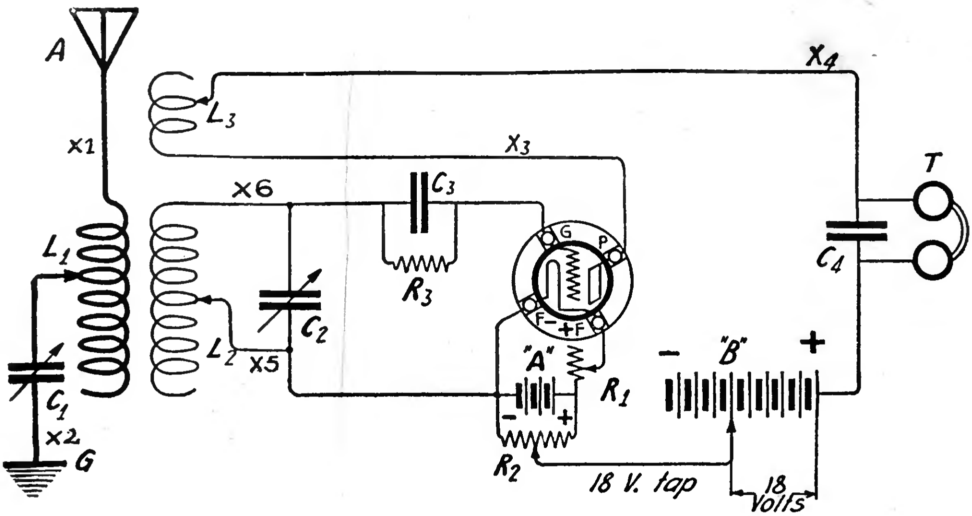


FIG. 1

third or movable contact connected to the 18-volt tap of the "B" battery. The potentiometer is used to control the voltage on the plate of the vacuum tube. C4 is the telephone condenser but is not necessary in most circuits as the telephone cords themselves have enough capacity for this purpose. T, of course, indicates the telephone receiver. X3 and X4 are the points at which the plate circuit is altered for different purposes. For instance, in a simple vacuum tube receiver where the regenerative principle is not employed, X3 and X4 are connected together. Where a circuit such as is shown in Fig. 1 is used, the tickler coil in the plate circuit is connected between X3 and X4. Where a variometer is used to tune the plate circuit for the production of regeneration, it is placed between X3 and X4 as shown in Fig. 3. Having the nucleus shown in Fig. 2, it is a simple matter for us to proceed with the development of a long-wave receiver.

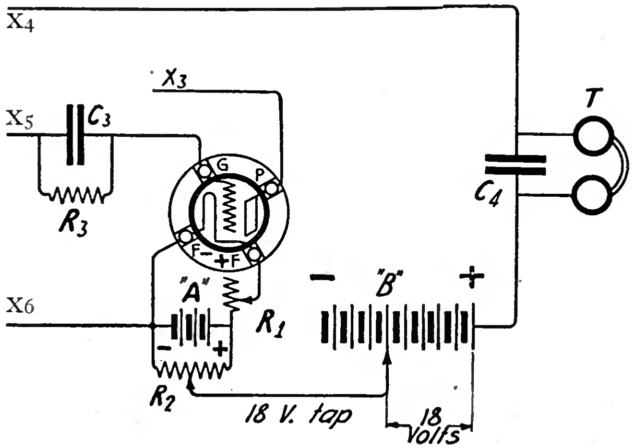


FIG. 2

CONVERTING A HONEYCOMB COIL SET

IT IS much simpler to convert a receiver of the character indicated in Fig. 1 than the one in Fig. 3, but in either case they must be stripped to the circuit shown in Fig. 2. For a combination long and short-wave receiver, it is quite necessary to procure a three-coil mounting. This mounting is provided with plugs for holding the primary, secondary and tickler coils. If a short-wave receiver of the kind shown in Fig. 1 is to be converted for long wave use, the only change necessary is the substitution of long-wave coils for short-wave coils. The variable condenser C1 in series with the antenna circuit and C2 shunted across the secondary circuit will function satisfactorily in both instances. The antenna coil is placed in the circuit between X1 and X2; the tickler coil between X3 and X4 and the secondary between X5 and X6. Where the circuit employed in Fig. 3 is to be converted, both variometers are taken out and the points X2 and X3 are joined together and a variable condenser is connected between X1 and X2 for tuning the secondary circuit. The variometer V4 connected between X3 and X4 is exchanged for a long-wave coil; otherwise the arrangement is as described with regard to Fig. 1.

A very convenient method of changing from short to long waves may be obtained by using a "Tunit" unit for the short waves and honeycomb, duo-lateral or Remler coils for the long waves. This arrangement is shown in an accompanying photo of a receiver made in the office of RADIO BROADCAST (page 136).

The results obtained with a receiver such as this depend largely upon the adjustment of the filament current and plate voltage. For this reason the use of a "Bradleystat," or at least a vernier rheostat for controlling the filament current for the detector tube is suggested,

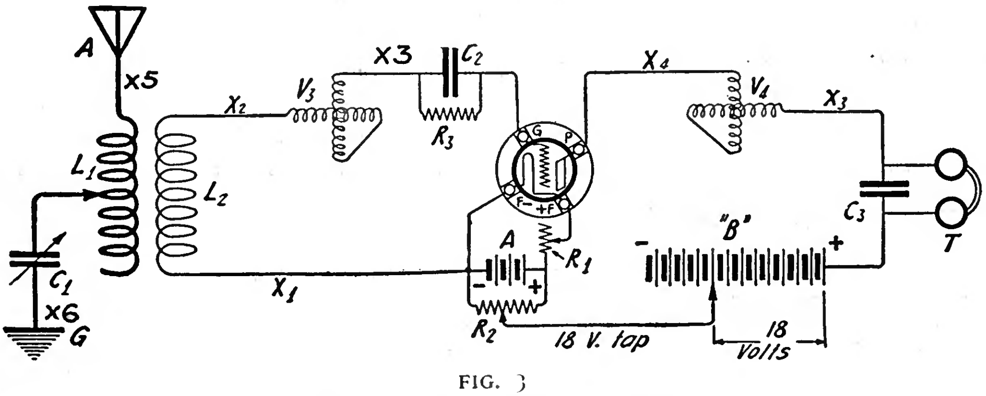
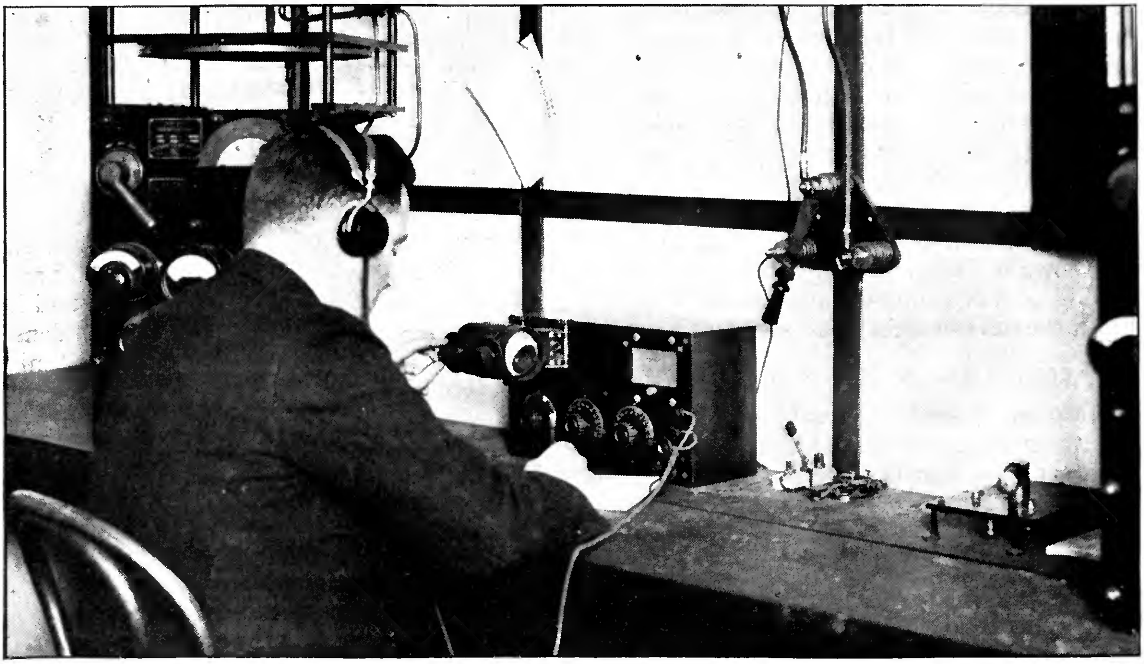


FIG. 3

and the plate battery should be of the storage type, or a dry battery variable in steps of $1\frac{1}{2}$ volts. Even though the potentiometer provides a means for controlling the plate voltage, it has been found that a variable "B" battery is essential. The use of vernier condensers is highly recommended and where they are not available, some adjustment permitting very fine variations should be attached to the condensers C1 and C2.



W. J. ROCHE OPERATING THE "TUNIT UNIT," DEVELOPED BY HIMSELF AND HERBERT PEARSON

In tuning the primary and secondary circuits, it has been found that a fixed condenser shunted by a well-designed variable having a comparitively low maximum capacity works excellently. For this purpose, satisfactory results may be had with the "Faradon" UC-1820, which has a capacity range of .00004 to .0003 mfds. shunted by fixed condensers of .0025, .001, .0005 and .00025, mfds. or combinations of these values which allow close tuning.

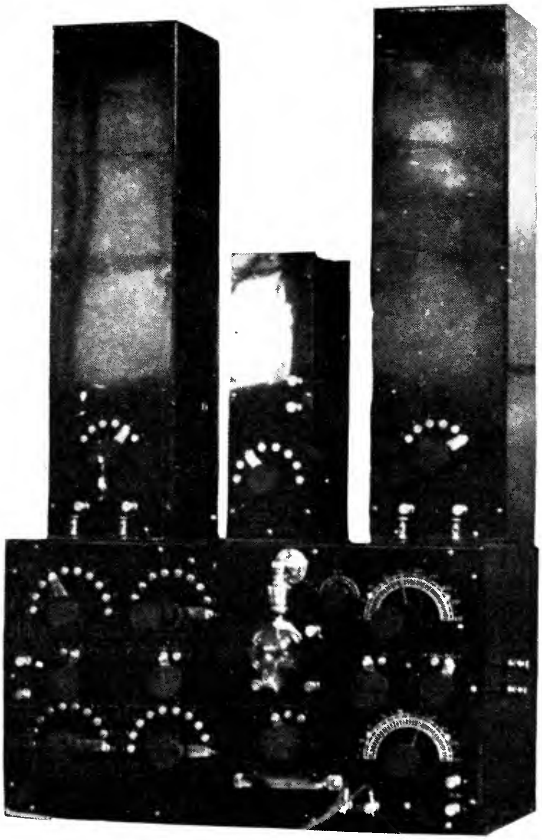
With some types of vacuum tubes, notably the "Radiotron" UV-200, the variable grid condenser of about .0003 mfds. (maximum capacity), shunted by a variable grid leak, assists in tuning and helps to eliminate interference. A simple method of making a variable grid leak is to take a piece of bakelite or hard rubber and drill holes in each end with a number 19 drill, and mark the space between the holes with a graphite pencil. To the opposite side of the screw the circuit connections are made by a hexagon or battery nut. The resistance of the grid leak may be varied by rubbing the pencil line lightly with an eraser until the desired value is obtained.

The size of the coil necessary for any particular wavelength depends to a great extent upon the value of the variable condenser employed in the circuit. The following table is included for your guidance, and in most instances, the values of all three coils may be identical:

Type	Milhenries inductant approx.	Approximate wavelength in meters in shunt with ordinary .001 M. F. D. Variable air condenser	Approximate price mounted on plug
L-25	.040	130-375	$1.54
L-35	.040	180-515	1.54
L-50	.15	240-730	1.65
L-75	.3	330-1030	1.65
L-100	.6	450-1460	1.71
L-150	1.3	660-2200	1.76
L-200	2.3	930-2850	1.82
L-250	4.5	1300-4000	1.87
L-300	6.5	1550-4800	1.93
L-400	11.	2050-6300	1.98
L-500	20.	3000-8500	2.20
L-600	40.	4000-12000	2.37
L-750	65.	5000-15000	2.59
L-1000	100.	6200-19000	2.86
L-1250	125.	7000-21000	3.30
L-1500	175.	8200-25000	3.85

A very simple manner of obtaining wavelengths of 1,000 to 15,000 meters is found in the Remler Q.S.A. 850 inductance units. In appearance they are quite like other multilayer coils but an inductance switch has been added. There are four taps—at 25, 45, 75, and 100 per cent. of the coil winding. Shunted by a .001 condenser, these coils help to reduce the cost of the long wave receiver considerably.

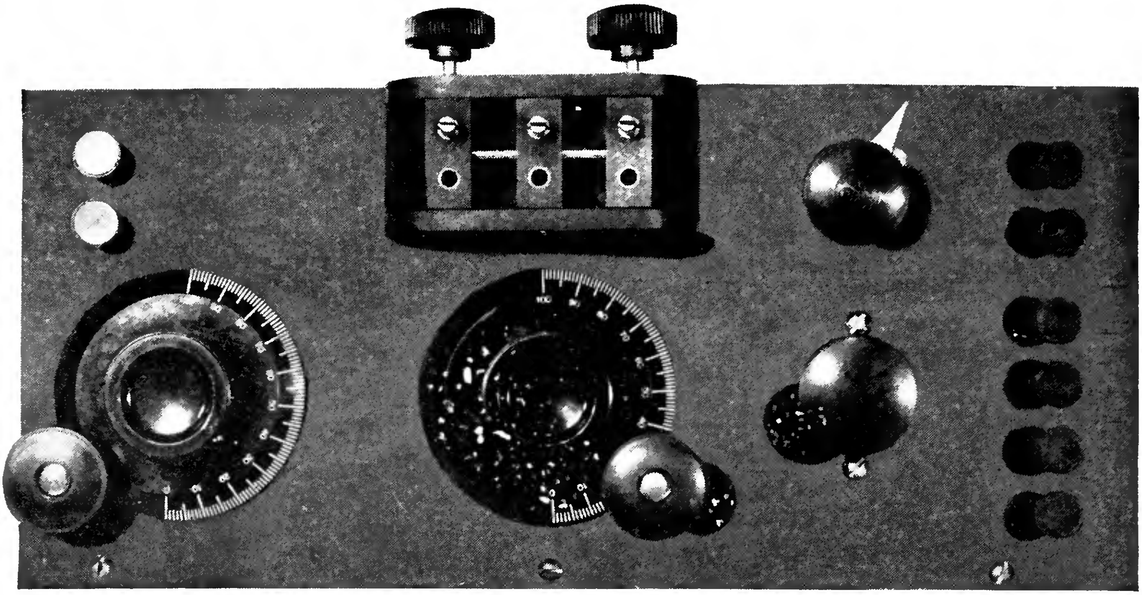
The coils are designated by letters and numbers, honeycomb coils being marked L–, duolaterals being marked DL, and Giblin-Remler coils, RG. These letters are followed by the number which indicates the number of turns in that particular coil, for example, DL–250 is a duo-lateral coil having 250 turns. By selecting several sets of coils whose wavelength ranges overlap, it is possible to run from 130 to 25,000 meters without going to very great expense. Thus, a set of 25-turn coils should cover a wavelength range of from 130 to 375 meters; a set of 75-turn coils should cover 330 to 1,030 meters; a set of 200-turn coils will function between 930 and 2,850 meters; 400-turn coils will cover a range between 2,050 and 6,300; 1,000-turn coils will cover a range between 6,200 and 19,000; and 1,500-turn coils between 8,200 and 25,000. In each of these groups, the upper value of the first set of coils overlaps the lower value of the next set, so that there is a continuous wavelength range of from 130 to 25,000 meters. Coils of this nature are not



A PRE-WAR MULTI-RANGE RECEIVER
Designed for transatlantic work with a single tube

IN THE RADIO CLUB OF PORTO RICO

A receiver of the character we are considering is employed to receive broadcasting from the United States, and long-wave telegraphy from distant parts of the world. Remler tapped inductances are shown in the coil mountings



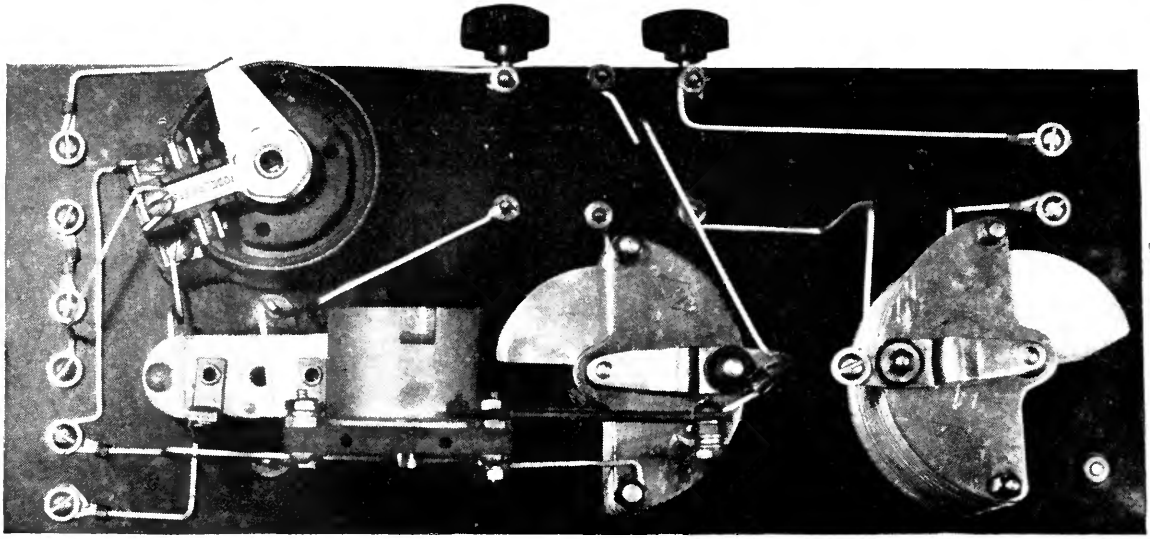
THIS IS THE NUCLEUS

Or equipment used in receiving either long or short waves merely by changing the values of the coils which fit in the mounting at the top of the panel

particularly efficient on wavelengths below 600 meters, but it is doubtful if they can be improved upon for ordinary long-wave use.

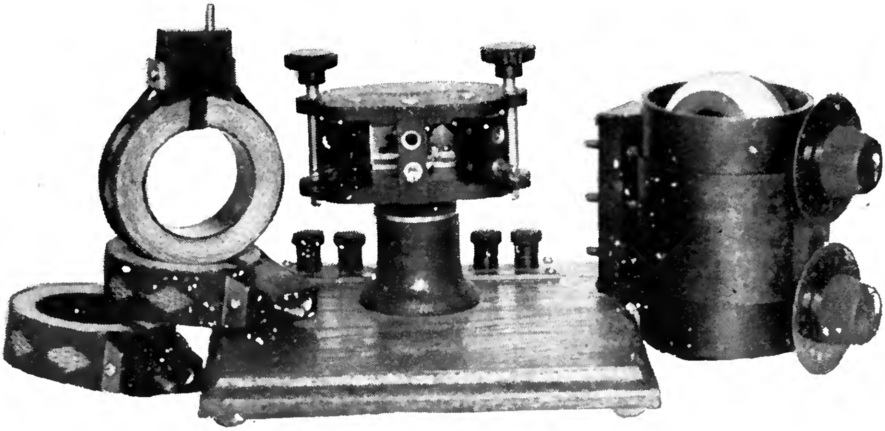
BUILDING THE RECEIVER

IF, INSTEAD of converting your present receiver, you consider making an entirely new one, why not make a good one rather than a poor one? First of all, it's easier! Before drilling a single hole, make sure that everything needed for the completed set has been procured. If possible, mount every unit directly on the panel, leaving the base and walls of the cabinet clear. The various units may be mounted most satisfactorily if templates are used. Templates, or "life-size" patterns, may be made of paper for each unit mounted. For instance, a variable condenser is generally



BEHIND THE SCENES

Showing a convenient arrangement of the units of the above receiver, with two variable condensers, a vacuum-tube control circuit and a potentiometer, all mounted on the panel. This receiver was assembled in the office of RADIO BROADCAST in a few hours



A DE FOREST COIL MOUNTING

To which the remainder of the receiving circuit is connected by six binding posts (two are behind the center support). Two of them are connected to the primary; two to the secondary and two to the tickler

made with three holes in the upper plate, designed to accommodate the supporting screws. By passing the axle to which the rotary plates are attached through the paper, you can stick a pin through the paper just above the points where the three holes are located. This paper template is then used for drilling the panel.

In order to know which of the trans-ocean stations you are hearing, it is necessary to know the code, and perhaps the simplest method of learning it, after having memorized the code letters, is to listen to the automatic sending from one of the high-power trans-ocean stations in this country. These stations frequently operate at a very slow speed, and sometimes send each word twice. Their transmission is generally carried on by means of a tape machine and is therefore absolutely regular. "Learn the code" is the best advice we can give you, for your own pleasure.

SUPPLEMENTAL LIST OF BROADCASTING STATIONS IN THE UNITED STATES FROM SEPTEMBER 16 TO OCTOBER 5 INCLUSIVE

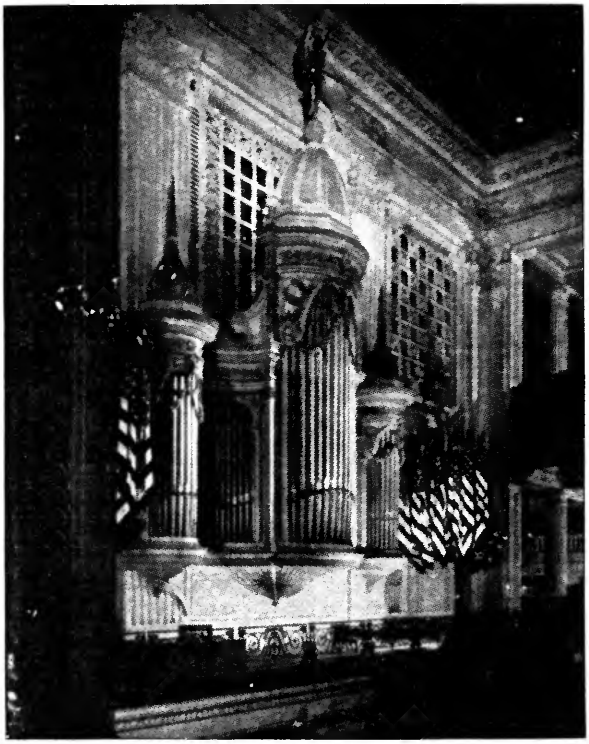
CALL SIGNAL	OWNER OF STATION	LOCATION OF STATION	WAVE LENGTH
KFBU	Thomas, Bishop N. S.	Laramie, Wyoming	360
KFDA	Adler's Music Store	Baker, Oregon	360
KFEC	Meir & Frank Co.	Portland, Oregon	360
WLAD	Arvanette Radio Supply Co.	Hastings, Neb.	360
WLAO	Anthracite Radio Shop	Scranton, Pa.	360
WLAS	Hutchinson Grain Radio Co.	Hutchinson, Kansas	360
WLAV	Electric Shop Inc.	Pensacola Fla.	360
WLAW	New York Police Dept.	New York, N. Y.	360
WLAX	Greencastle Community Broadcasting Station	Greencastle, Indiana	360
WLAY	Northern Commercial Co. of Alaska	Fairbanks, Alaska	360
WLAZ	Hutton & Jones Elect. Co.	Warren, Ohio	360
WMAG	The Tucker Electric Co.	Liberal, Kansas	360
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	360
WMAP	Utility Battery Service	Easton, Pa.	360
WMAQ	The Fair Corp. & The Chicago Daily News	Chicago, Ill	360
WMAR	Waterloo Electrical Supply Co.	Waterloo, Iowa	360
WMAT	Paramount Radio Corp.	Duluth, Minn.	360
WMAU	Louisiana State Fair Ass'n.	Shreveport, La.	360
WMAV	Alabama Polytechnic Inst.	Auburn, Alabama	360
WNAB	Park City Daily News	Bowling Green, Ky	360
WNAD	Oklahoma Radio Eng. Co.	Norman, Okla.	360
WNAF	Enid Radio Distributing Co.	Enid, Okla.	360
WNAG	Rathert Radio & Elect. Co.	Cresco, Iowa	360
WNAH	Wilkes-Barre Radio Repair Shop	Wilkes-Barre, Pa.	360
WOAA	Hardy, Dr. Walter	Ardmore, Okla.	360
WOAE	Medland College	Fremont, Nebraska	360
WPAN	Levy Bros. Dry Goods Co.	Houston, Texas	360
WQAQ	West Texas Radio Co.	Abilene, Texas	360
WRAU	Amarillo Daily News	Amarillo, Tex.	360

Stations That Entertain You

Are Any of These Old Friends of Yours? WOO, KSD, WJZ, WHAZ, WGM, and KDYL, Located in Six Different States, are Heard From Coast to Coast

PERHAPS you have wondered what some of the large broadcasting stations look like, as you have heard the announcer say: "This is XYZ, the Blankety Blank station at So-and-So." You may have listened to them night after night until they seem like old friends, and still you have not met them "face to face."

But it is interesting to become acquainted with the sources from which emanate the concerts you have heard. Take the case of WOO, for instance, the Wanamaker station in Philadelphia, which has aroused great interest by broadcasting the music of the store's beautiful organ. Organ music has for years almost completely baffled reproduction and it is therefore rarely found on phonograph records. In spite of this, Mr. Wanamaker was anxious that the music from the organ—the largest musical instrument in the world—be broadcasted. The Western Electric Company undertook the task, even against the advice of experts who said that no microphone could be constructed to transmit the organ's music successfully. A long series of experiments finally developed a microphone of the condenser type and an amplifying device constructed upon a new principle which has not yet been made known.



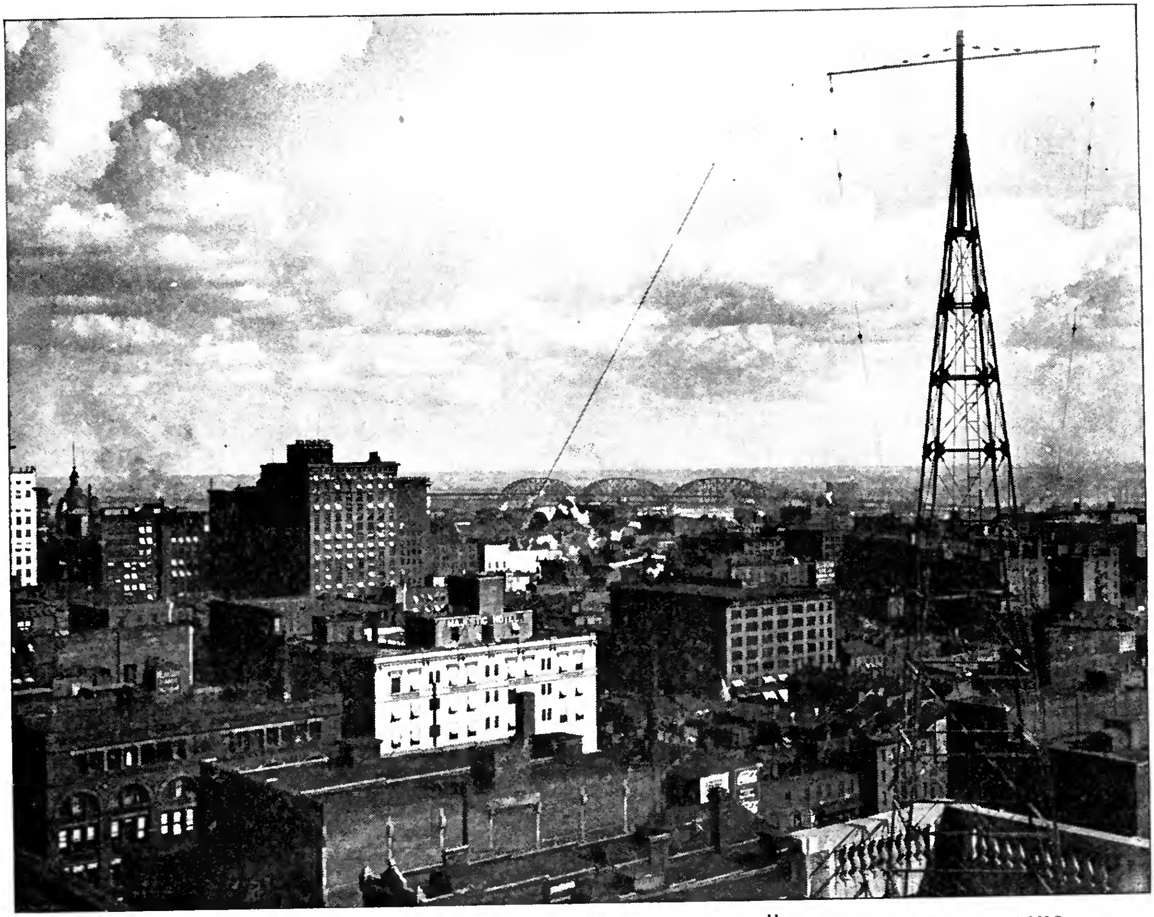
THE ORGAN AT WOO

Although the Wanamaker station was designed to cover a region of from 100 to 150 miles from Philadelphia and to deliver 500 watts of radio-frequency power to the antenna system, it can be heard, under favorable conditions at much greater distances. Reports have been received from California and Porto Rico. Recently, WOO was re-licensed as a Class B station, with the privilege of transmitting on 400 meters

KSD

ANOTHER station with the 400-meter privilege—the first, in fact, to receive it—is KSD, operated by the *St. Louis Post-Dispatch*. Opened on June 26, 1922, the new station KSD is already something of an "old-timer", so rapidly do broadcasting stations spring up and so widely is this particular one known. On September 12, KSD was heard in every one of the forty-eight states in the Union. On that occasion, a ship operator wrote in: "We are off the Coast of California about 50 miles north of Point Arguello and about 30 miles out. Am getting you fine now, 9:50 P. M. You are QSA and modulation clear and distinct. Am using honeycomb set and one step of audio-frequency amplification, all home-made."

This is something of an achievement, but now that winter has come, it will be strange indeed if even greater distances are not covered by this station. Its central location in the United States should allow it to be heard beyond the boundaries of the country in all



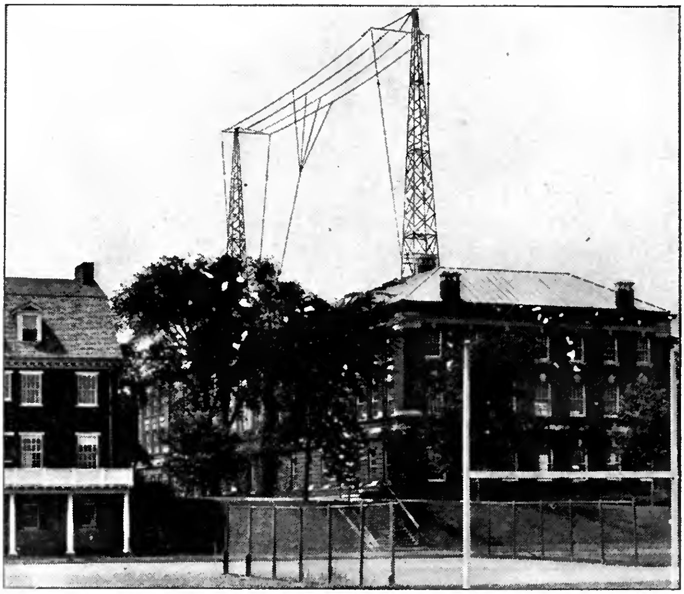
(ABOVE) KSD'S AERIAL ON TOP OF THE "POST-DISPATCH" BUILDING IN ST. LOUIS

(BELOW) THE STUDIO AT WJZ, NEWARK, N. J., SHOWING MICROPHONE STAND IN BACKGROUND

directions. And why not? KSD radiates only a measly 1,000 watts!

WJZ

TO THOUSANDS of radio enthusiasts who do their tuning-in somewhere between the Mississippi River and the Atlantic Ocean, WJZ is as well known a combination of letters as the initials of their own names. Many operators in Texas, Kansas, and Iowa have reported good signals from this Radio Corporation-Westinghouse station, while Canada and Florida have compared notes with Maine and Newfoundland regarding the signals that originate in Newark, N. J.



WHAZ, RENSSELAER POLYTECHNIC STATION AT TROY, N. Y.

WHAZ

WOO, KSD, and WJZ are controlled by three different kinds of interests: by a department store, a newspaper, and a sales and manufacturing corporation, respectively. Now we come to a station owned and operated by an engineering institute—Rensselaer Polytechnic in Troy, N. Y. WHAZ was opened only in September, and is of particular interest in that it has no commercial side. It hopes that its service will have a far-reaching educational value.

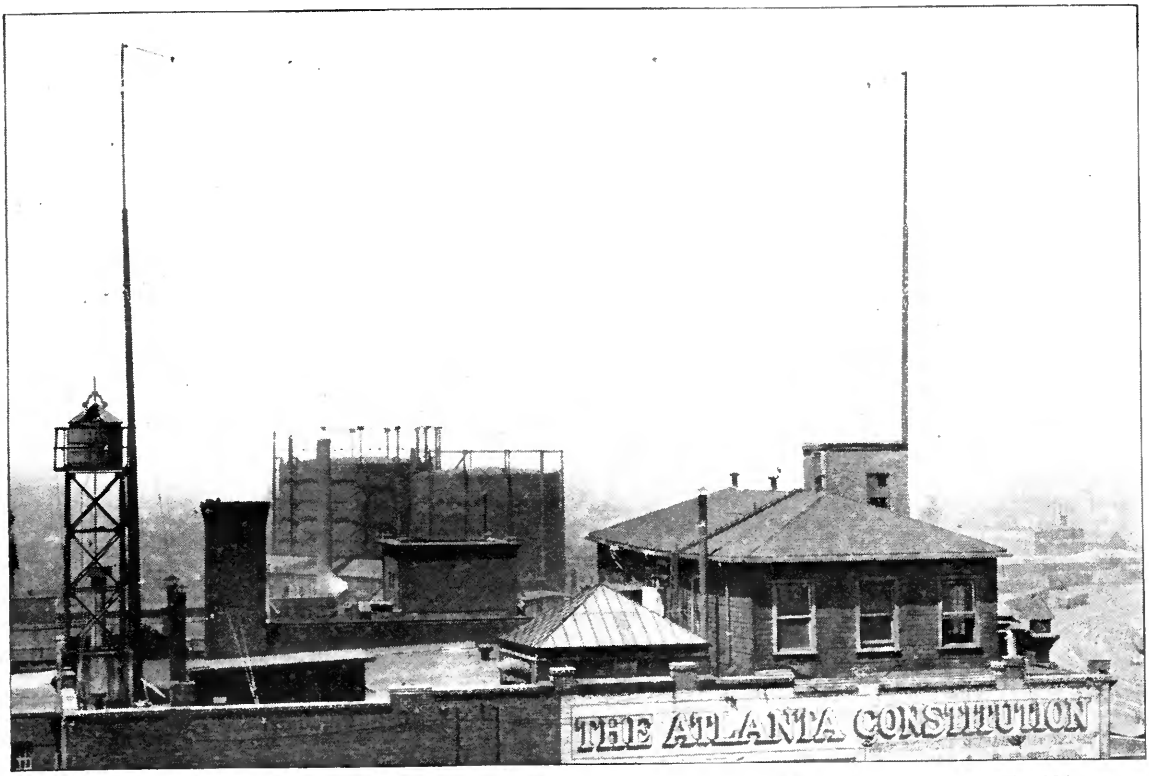
This new station, located at the oldest American engineering college, is under the direction of the professors, instructors and practical radio men of the faculty. These men, who have conducted research in radio ever since the first practical wireless was given to the world, have long looked forward to establishing this station, the most powerful and most complete in any educational institution in the country. It was made possible through a gift in the names of three well-known graduates of Rensselaer Polytechnic: Washington A. Roebling, the late Charles G. Roebling and John A. Roebling, the wire rope manufacturers, who built the Brooklyn Bridge.

The equipment is designed to give wide play to experimental development, not only in the field of the science of communication, but in the study of acoustics, the relation of color to the artistic temperaments of singers, musicians and dramatic readers, and the relation of light to the radio processes, besides the less aesthetic matters of wave transmission, power generation and antenna wiring. To make the broadcasting station of practical value, however, it must provide a radio service that will be of interest and benefit to the general listening-in public. Coupled with the experimenting of the Electrical Engineering department, the broadcasted matter will undoubtedly be of much service to the average schoolboy.

ANOTHER station which opened up with a powerful transmitter in September, 1922, is WGM, belonging to the *Atlanta Constitution*, of Atlanta, Georgia. Previously, a small set of low power had been used to provide local entertainment, but the new 500-watt set is sending music and speech not only throughout the entire South but even into most of the states on the eastern seaboard and in the Middle West.

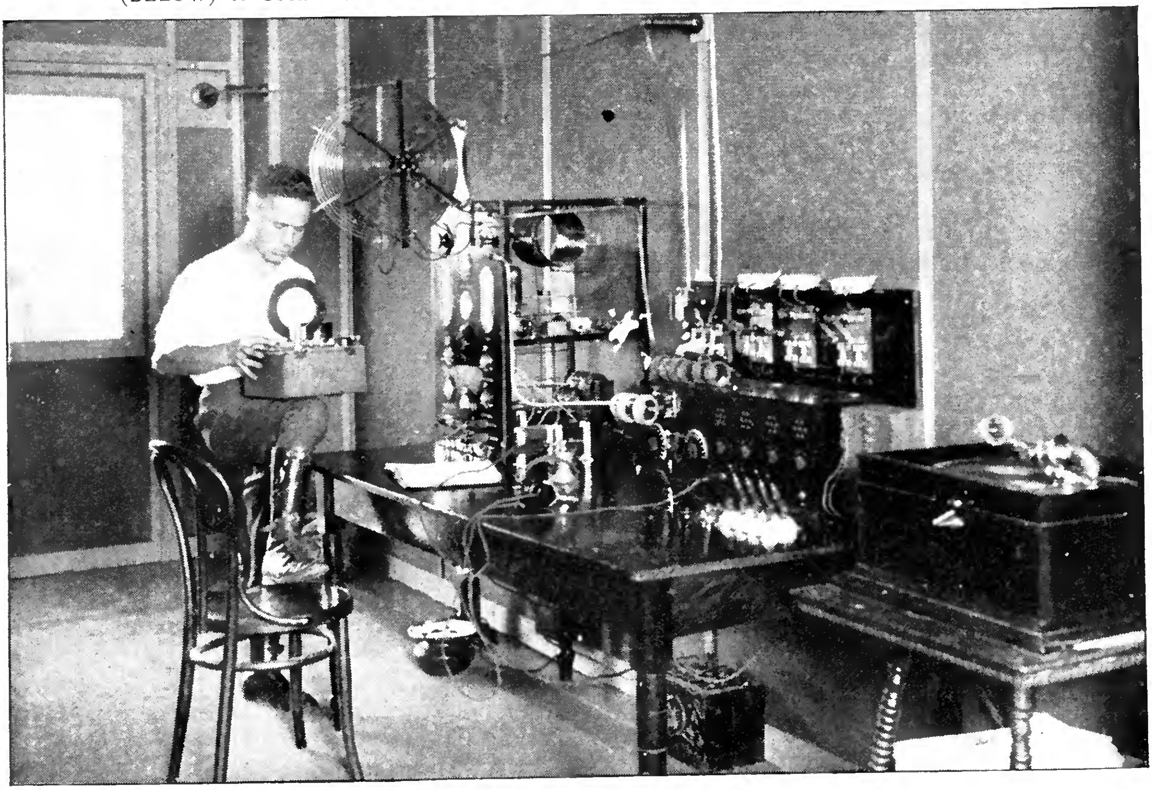
KDYL

IS THE broadcasting station owned by the Telegram Publishing Company, Salt Lake City, Utah. It is one of the few broadcasting stations in the country where most of the work has been done by a single man. Mr. Ira Kaar designed and superintended the installation of this station. It opened on the evening of August 28th and has been heard in a great many states as well as by ships at sea.



(ABOVE) ANOTHER NEWSPAPER BROADCASTING STATION: WGM IN ATLANTA, GEORGIA

(BELOW) A CORNER OF THE KDYL OPERATING ROOM, SALT LAKE CITY, UTAH



The Signal Corps in Alaska

By DONALD WILHELM

SINCE there are two sides to most questions, it behooves us to listen to the old-timers in the Signal Corps who assure us that "the Navy hasn't done it all in radio!"

They take you back and show you how, quite uncontroverted, it seems, the annual reports of the Signal Corps, for a half dozen years in succession hammered this paragraph home:

"As is well known, to Mr. Marconi's inventive genius and persistent application is due the demonstration of wireless . . . to the civilized world. Prior to his extensive work at the expense of the New York *Herald* and in connection with the international yacht race, the Signal Corps, on September 30, 1899, had operated its own system successfully between Fire Island and Fire Island Lightship, a distance of ten miles. In April, 1900, it opened two stations in New York Harbor, where messages were passed daily to and fro between Governor's Island and Fort Hamilton."

A LONELY OUTPOST
Of America's vast communication system

This work, the Annual Report of 1900 says, was originally undertaken by Lieutenant-Colonel James Allen and a certain Captain George O. Squier. Moreover, the Signal Corps then had in operation two additional stations in San Francisco Harbor and "was looking to the establishment of stations in the Philippines, at suitable points."

The old-timers add, for good measure, that 'way back in 1862 the Navy got even its wig-wag system from the Signal Corps!

Then, coming forward again, they tell the simple yet startling story of an event that resounded literally around the world, that, for the first time in history, linked this continent by radio with the Continent of Asia; or would have done so if there had only been someone or other with a receiving set on the Kamchatka Coast!

That was in 1904, a long time back in the history of radio. So the meager records of this event, which filled space in newspapers the world over long before the word "radio" was used, are all the more interesting.

In the years immediately following the initial work with wireless by the Signal Corps, there were disappointments, both in results and in funds. That is why, when the Filipinos were still in rebellion, the Signal Corps gave over its contemplated plan of bridging the big gaps of the Island Archipelago with wireless, even though some of our outposts were "so remote from headquarters that two weeks' time was required to receive communications." And that is why you find a Congressman expressing his views of instruments now casually

A CLOUDY DAY ON THE YUKON
This is typical of the remote regions which the Signál Corps spanned by radio in 1904

referred to as transmitters, like this: "Sounded like a battery of guns, that thing! And sparks! I tell you this wireless business is impossible, practically!"

Nevertheless, there were officers who were devoted enough to wireless to continue their experiments out of office hours. And one also finds references to wireless tests made, in connection with Army and Navy maneuvers, of the De Forest, Fessenden, and Marconi systems, with the preference in one instance given to the De Forest system, because, as the old record says, "unfavorable conditions interfered with the work of the experts of the Fessenden and Marconi systems."

Then the time came, after two years of experimentation and very doubtful success in wireless generally, when the only conceivable way to bridge two gaps in Alaska, at the end of the Signal Corps' new Alaskan cable, was by the use of wireless.

Here was this enormous country, Alaska, which, if superimposed upon the United States, would extend from Wyoming to the Bahamas, off the Florida Coast; here was a submarine cable reaching it, a distance as great as that between Newfoundland and Ireland; here, in Alaska, were land wires as long as from Washington to Texas; here were these gaps that wires could not bridge. Also, here, was the coldest of cold weather!

So in 1901 the Signal Corps made contracts for wireless stations "to operate between Fort Davis (Nome City) and Fort St. Michael, and also covering the Tanana Marshes . . . between Fort Gibbon and the vicinity of Bates Rapids."

But, it was provided in the contract that no payments should be made until these lines had operated ten consecutive days!

Result: The stations were not built.

Hence, when 1903 came round, on the one hand you find the Chief Signal Officer thinking it advisable "to stop experimental work in wireless pending development of that science by experts in civil life", and, on the other hand, Captain Leonard D. Wildman, of the Signal Corps, working more or less on his own, between Forts Wadsworth and Hancock, in New York Harbor, a distance of twelve miles. By 1904 he and his men had linked up Safety Harbor (Nome City) with Fort St. Michael, a distance of 107 miles, by wireless!

Then, in the late summer of 1903, Captain Wildman directed the establishment of two bases in Alaska, at Safety Harbor and Fort St.

Michael, preparatory to reaching across 107 miles, a distance which could not easily be covered in any other way. At these bases were built portable houses in which were installed gasoline engines and wireless apparatus supplemented by two masts at each station 210 feet high, between which were supported fan-shaped antennas consisting in each case of 125 copper wires one foot apart. The power consisted in each case of "a 5-horsepower gasoline engine and a 3-KW motor dynamo, 60-cycle alternator". The report added that at one station there was "a transformer stepping up from 500 to 20,000 volts, and at the other, one stepping up from 500 to 25,000 volts."

At noon on August 4th, of the following year, 1904, the wireless material which Captain Wildman had been developing in the States was delivered at St. Michael. "At 9 o'clock on the 6th," he reported, "complete messages were exchanged and the telegram from me at Safety Harbor was released and sent forward. No serious trouble of any kind was experienced and every part of the machinery worked in a perfectly satisfactory manner. Since that time we have been pushing the machinery overloaded to 20 per cent. in order to see if it could be broken down. . . .The signals are fine, and louder than I have ever heard them at either the stations at Schuyler or Wright. The operators have no difficulty in reading messages while the relay is working in the same room and with the engine running in the next room and men walking about and talking in an ordinary voice anywhere in the house."

The next day, the Nome station was thrown open for commercial traffic between Alaska and the outside world. Moreover, had some fan or other possessed a receiving set, somewhere along the Asiatic Coast opposite Nome, he could have been in communication by radio, for the first time, with our hemisphere.

And to top off this bit of a forgotten story, let us quote an official report:

"During the long winter, there was work to be done up there. Broken Leyden jars were successfully replaced by air condensers, the spark was muffled, and many other improvements applied. In fact, the efficiency of the service is largely attributed by Captain Wildman to the ingenuity and resourcefulness of his subordinates, Sergeants Harper, Monroe, Treffinger, Wilson, and McKinney, the latter being especially noted because he devised a key that increased the sending capacity from fifteen to thirty words per minute."

BACK IN '99

The Signal Corps used the heliograph for "wireless" communication. Like radio waves, the heliograph messages traveled at the rate of 186,000 miles a second

Locating Illegal Radio Stations*

By L. E. WHITTEMORE

Alternate Chief, Radio Laboratory, U. S. Bureau of Standards

ALL transmitting stations within range are really sources of interference if you are trying to listen to some other station. No receiver thus far developed can tune out absolutely all signals excepting those it is desired to hear. Receiving sets differ greatly in this particular, and it is possible to tune much more sharply now than a few years ago; but the problem of eliminating the signals from certain stations is particularly troublesome when you have to deal with near-by transmitters. In fact, it has been suggested that high-power transmitting stations be prohibited from operating in regions where there are a number of receiving stations handling a large amount of commercial traffic.

Since these difficulties are all too plentiful among stations which are handling commercial business and are entirely legal in their operation it is of particular importance that interference be avoided from stations which are operating illegally.

Sometimes stations cause interference quite unknowingly, and sometimes radio waves which cause a great deal of trouble are sent out from electrical apparatus or circuits whose useful performance lies entirely in some other field of activity. It has been observed that there may be serious interference from X-ray machines, violet-ray machines or apparatus employed in electrical precipitation processes. Leaky insulators on high-voltage power transmission lines may also be the cause of radio waves capable of reception by near-by sets. The recent radio telephony conference recommended that a study be made of the means required to avoid interference from such sources. It is sometimes difficult, especially on the part of operators who are not thoroughly acquainted with radio apparatus, to distinguish between the interference caused by these electrical machines and power lines and the interference caused by actual transmitting stations.

Those who have just become interested in constructing their own transmitting sets sometimes find it convenient to use a small automobile spark coil with a plain fixed gap, instead of a well-designed transformer and quenched gap with its associated circuits. Entirely by ignorance, these operators in experimenting with their sets send out waves which are extremely broad and cause serious interference in their immediate localities over a wide band of wavelengths. Certain operators of radio telephone broadcasting stations do not realize that when the programmes have ceased or during an intermission, the transmitting set, if allowed to continue to operate, emits unmodulated waves which cause a blanketing of other signals in the immediate neighborhood, or give a troublesome beat note in receiving sets which are tuned to closely adjacent wavelengths. These radio telephone sets should, therefore, be disconnected from the power supply at all times when the broadcasting service is discontinued. Much unnecessary testing is done with the transmitting set connected to the antenna instead of disconnecting the antenna circuit entirely while using a "dummy" or "phantom" antenna which causes very little radiation.

It speaks very highly for the radio amateurs of this country that in spite of the fact that there are over 15,000 licensed amateur transmitting stations at the present time, there has been so little willful and unnecessary interference that almost no attention has been required from the radio inspectors in tracing sources of such trouble. The amateurs have, through their local clubs, coöperated very heartily in almost every case in solving for themselves the problems arising from ignorant use of transmitting stations.

The rapid growth of broadcasting, however, has brought forth a number of complaints of interference which perhaps seem more aggravated on account of the fact that many of those who listen in are not familiar with the limitations of radio as a method of communication.

The radio laws call for the licensing of all transmitters whose signals can affect the reception of messages from beyond the bound-

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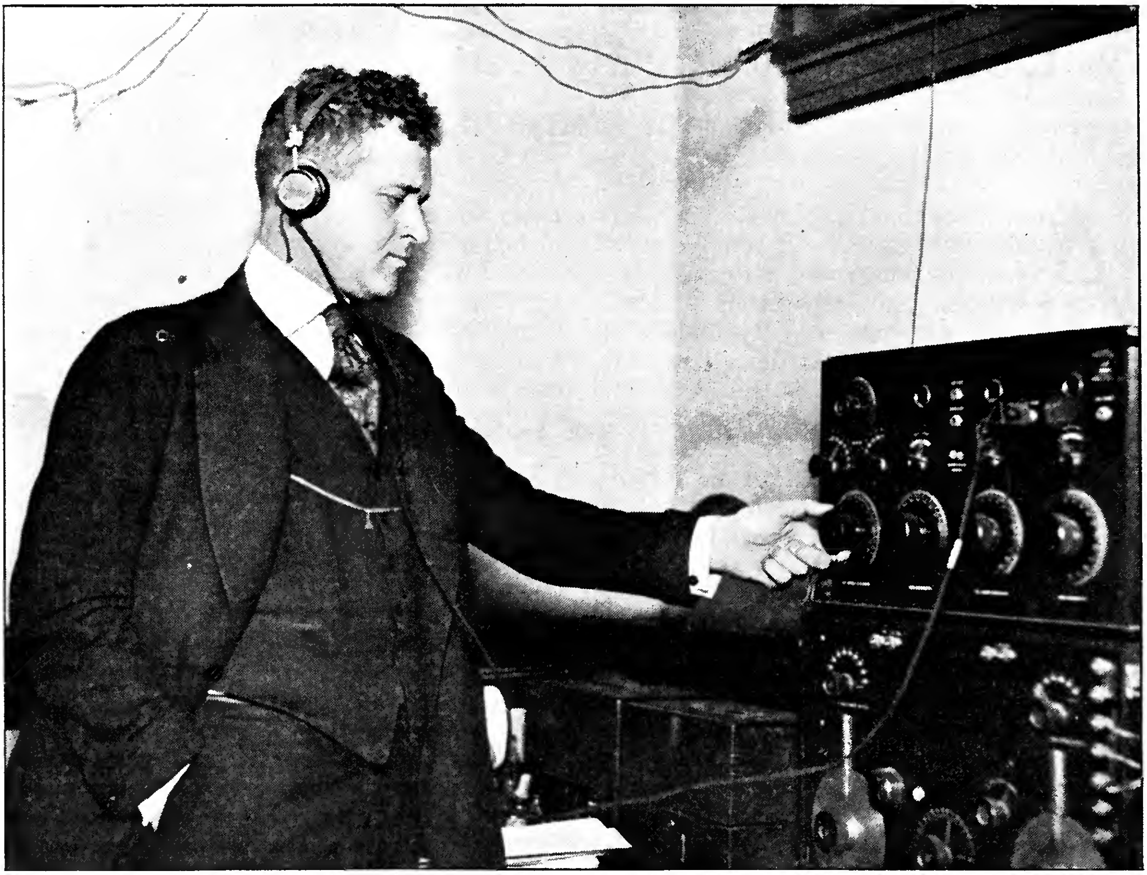


ARTHUR BATCHELLER, U. S. RADIO INSPECTOR
In charge of the Second District, keeps a close watch on the ether

aries of the state in which the transmitting station is located. On account of the very sensitive receiving apparatus now employed, this practically means that all transmitting stations must be licensed in order to operate legally. The call letters which are assigned to them at the time they are licensed, are for use in identifying the transmitting station whose signals may be heard. Sometimes the operators forget to sign their call letters at intervals during the handling of traffic and this raises a question as to whether or not the messages are being sent out from a station which is properly authorized.

In locating outlaw stations, the direction finder is indispensable. By its use it is possible to determine promptly the general direction of a transmitting station, and often to find its position exactly within a short time.

A direction finder in its simplest form consists of a few turns of wire wound upon a frame 3 or 4 feet square. The two terminals of this coil are merely connected to the terminals of a variable air condenser. From these terminals connections are made to the grid and filament terminals of a detector-amplifier. The signals from the transmitting station are loudest when the coil is turned so that its plane is in line with the direction in which the received waves are traveling and the signals are weakest when the coil frame is turned at right angles to this direction.

The coil constituting a direction finder is really merely an antenna so constructed as to be easily portable. Such an antenna when used with a radio-audio-frequency amplifier constitutes a receiving set sensitive enough to receive loud signals from considerable distances when the coil is turned in the maximum direction, or to obtain a sharp indication of the direction of the minimum signal when used within a few miles of the transmitting station.

It happens, unfortunately, that in densely populated districts, where sources of radio interference are most likely to be serious, the waves from a transmitting station are distorted and carried out of their normal path by electric power lines, trolley wires, the metal frames of large buildings and other metallic objects. The effect of such distorting influences was described in an article in the June issue of Radio Broadcast, entitled "Objects that Distort Radio Waves." A radio detective should be able to make good use of the knowledge of the distortion which radio waves undergo, but without this knowledge he might be seriously handicapped in his efforts to locate an illegal radio station or determine the location of some electrical machine which is causing interference.

The rapidly increasing congestion of radio traffic will require that amateurs and radio inspectors be equipped in the future to trace illegal radio stations and determine their locations. Whenever possible, direction-finder observations should be made in open fields or parks where the distortion is not serious. Two or three such observations of direction at points quite distant from one another will enable the inspector to locate on his map quite closely the position of the station which is being sought. Sometimes this brings him close enough to see the antenna and approach the station without difficulty.

Where these open spaces are not available, or after the general location is first determined, it may be necessary to use the direction-finder in city streets or among buildings where distorting wires are present. In such a case the inspector will set up a radio direction-finder and receive the signals or communications which are being transmitted by an undesirable station. He will observe the apparent direction of the transmitting station, make note of the surrounding objects which may cause a bending of the waves and an apparent change in the direction of the station which is being sought. He will then move his direction-finder to some distant point possibly symmetrically placed with respect to the distorting structure and make another observation of the direction of the received wave. By moving his direction-finder to several points some distance from one another and taking his observations with proper consideration of the effect of the surroundings, he can rapidly go toward the point of intersection of the direction lines and finally move up to the transmitting station itself.

In the streets of a large city the objects which cause a bending of the radio waves are so numerous and so varied in size as to make this problem a difficult one. Sometimes the waves will appear to travel along the street while the transmitting station is actually in the line of a cross street, but by taking a series of observations at carefully chosen points and noting particularly the location of large steel buildings, bridges, elevated lines, or trolley wires, the errors may be foreseen to a great extent and the inspector may find the transmitting station much more quickly than if he were merely to move in the apparent direction of the wave as first determined. The cases which the inspector or the amateur radio detective finds which do not give the correct direction serve as interesting examples for further study leading to a fuller knowledge of the behavior of radio waves.

Radio Personalities

VI

DE FOREST—THE DREAMER OF A DREAM THAT CAME TRUE

By C. S. THOMPSON

A SLOW-MOVING river—a broad field of green—white tents—the sound of soldiers marching—bands playing—lowering of colors—and my first day in the "Yale" Battery of the Spanish-American War found me alone in the hour of camp hilarity.

My attention was soon attracted by a young soldier, alone too, deep in study, in the tent next to mine. He was a dark, rather tall angular-looking lad.

"Studying regulations?" I asked.

"No, just a little of the old college work," he said, without looking up.

But that same night, as we were walking along the Niantic River, this soldier-student said to me:

"This little book you've found me reading means a good deal to me, in fact, the subject it deals with will mean everything to me after we've defeated the Spaniards. I feel it may also prove some time of great importance to humanity—I've felt that way ever since I entered college. When my father died, a few years ago, and I was thrown upon my own resources, I decided to continue my studies by working my way through college. I mowed lawns, waited on the table and worked in summer hotels. I graduated from the Sheffield Scientific School in '96, and ever since I've been preparing for a doctor's degree. It is my thesis you saw me working on just a few hours ago—the subject is 'The Reflection of Hertzian waves along Parallel Wires.' Hertzian waves!—that means a whole world to me!—a new world of communication—without wires—wireless! There's no other enterprise like it to-day in fascination and in future possibilities."

Marconi was yet to pave the way for public interest in wireless by his early demonstrations, but even then my soldier friend, Lee De Forest, saw what was to come. The universal development of radio on a practical basis—his life-long dream!

Among the busy duties of camp life, I soon lost track of my enthusiastic companion and forgot the idealistic vision of the future which he had on that one evening revealed to me.

Shortly after the war was over, De Forest obtained his doctor's degree and went to work in Chicago. His first job was at the Clinton Street shop of the Western Electric Company, at $8 a week. Teaching night classes in mathematics at the Lewis Institute and translating French at one time or another for the *Western Electrician* also helped. For a year and a half, the young inventor lived on next to nothing, so that he could conduct his research freely at the Armour Institute.

It was in the midst of these early-day struggles and privations that De Forest developed the self-restoring detector to take the place of the Marconi coherer, the telephone receiver to replace the relay and Morse inker and the alternator-generator and transformer to replace the induction coil and the interrupter.

In 1901, with his apparatus perfected to the point where it could be used commercially, De Forest left for New York. Financial aid was necessary to float his company and develop his new American System, which, even then, had been proved superior to the older and well-established Marconi and Telefunken systems of Europe. Nevertheless, in the summer and fall of that year, De Forest walked his shoes out in Wall Street and Lower Broadway before he obtained the necessary backing.

His first commercial undertaking with the De Forest Wireless Telegraph Company, that same year, was the reporting of the International Yacht races. Then, during the historic tests by the British Post Office between Holyhead and Howth across the Irish Sea, De Forest demonstrated over all competitors the great advantages of his system. In 1904, he attained wider recognition for his system through the spectacular success of the London *Times* war correspondent, Col. Lionel James, in reporting the Naval maneuvers at Port Arthur during the Russo-Japanese War. In the summer of that same year, also, came the first continental overland wireless service, established by De Forest between Chicago and the Exposition in St. Louis. In 1905, the honor of constructing the first high-powered wireless stations at Colon, Guantánamo, San Juan (Porto Rico), Key West and Pensacola, was accorded him by the United States Government.

Success had come, but only for the moment, for the fortune and recognition, won after so many years of struggle and sacrifice, were soon swept away, and the young inventor saw his company in the hands of others, with even his name removed from the corporation which he had made famous.

It was after this period of financial depression that I met him again. De Forest had made a crude laboratory in the old Parker Building in New York City. As he was explaining his laboratory to me, he picked up an audion bulb.

"This is my greatest discovery!" he said. "This little bulb is going to revolutionize the world of communication! It will make it possible for us to talk by radio telephone, not only over short distances, but across the lands and seas. I took out my first patents on this audion a little over a year ago, but it was in the hard days in Chicago that I first conceived the idea.

"I was at work in my room, one night, experimenting with an electrolytic detector for wireless signals. It was my good luck to be working by the light of a Welsbach burner. That light dimmed and brightened again as my little spark transmitter was operated. The elation over this startling discovery outlasted my disappointment when I proved that the startling effect was merely acoustic and not electric. The illusion had served its purpose. I had become convinced that in gases enveloping an incandescent electrode resided latent forces which could be utilized in a detector of Hertzian oscillations far more delicate and sensitive than any known form of detecting device. And now at last I have managed to bottle this same gas effect!"

As he went on, he became even more enthusiastic:

"I've been asked to put radio telephones on the fleet going around the world. It won't be long then before all the ships will be equipped with it. It'll be on the yachts, tug-boats, steamers and sailing vessels too, and we'll soon be able to talk with our friends at sea. Passengers on moving trains will be able to radiophone to stations, and there be connected with the wire telephone. Church sermons, lectures, orchestral and grand opera music, too, will be sent out by radio throughout the country! The world needs this little audion; it is the one thing towards which I have been working all these years!"

In the spring and summer of 1907, through the transmission of music by radiophone, through reporting yacht races on the Great Lakes, and later by broadcasting grand opera from the Metropolitan Opera House at New York, De Forest sought to create interest in the new art.

DR. DE FOREST
Experimented with bulb transmitters for airplane use, during the war, when patriotic service suspended his efforts in the field of broadcasting

Even thus early, foreseeing the field of public interest, he built radio apparatus for the amateur—for the citizen who was interested in picking up words and music out of the air. With his second De Forest Radio company, all his available funds and ingenuity were thrown into the cause of broadcasting.

It is clear that the public of that day was fully informed by De Forest of the possibilities of radio development. Newspapers were filled with his predictions. Reporters obtained from him long interviews. The Sunday pages were highly decorated with the stories of his achievements. Nevertheless, his appeals fell on empty ears. "The radio toy," some described it. Others read and forgot. Leaders in engineering, scientific, and educational circles were skeptical as to the possibilities of broadcasting.

In the end, borne down by commercial rivalry, the Radio Telephone Company through which the inventor had hoped to interest the public, and to establish the radio telephone, was forced to suspend activity.

All that remained for him in the wreckage was the patent rights to the audion. Even these had been returned to him because they were considered of no value!

There was nothing left apparently, in 1911—the year when I next chanced to meet him—nothing except the spirit of other days.

"I've got to begin all over again," he told me, "and that means—just a little more delay. That's all. The day is coming, when things will be different. I don't mean financially. I can stand the poverty and work—I mean the day will soon be here when people will see the thing as I see it—will recognize the part the audion will play in human progress!"

Nevertheless, that same year, De Forest was reading the Help Wanted ads in the very papers which, only a few years before, had been carrying pages relating his achievements. The position of Research Engineer of the Federal Telegraph Company was offered him in San Francisco, and he was glad to take it—finding joy in the thought of being able to experiment further on his audion. In the summer of 1912, in that little Palo Alto laboratory, he was led to still higher dreams of success. The audion had already proved to be a detector of remarkable sensitiveness as well as an amplifier of telephone currents; he then discovered it could also be made to oscillate, or to generate sustained currents of any frequency!

The engineers of the period were fully informed by De Forest on the possibilities of the audion. The newspapers and technical magazines were filled with it. Full descriptions of it were to be found in the patent office applications of 1906. De Forest took out his first patents applications on the audion as a wire telephone amplifier as early as 1907. But it was not until 1912 that the inventor was given his first opportunity to demonstrate the audion before the engineers of the American Telephone and Telegraph Company—the audion which, when further developed by them, made possible the transcontinental telephone service between New York and San Francisco, and later on the radio conversation from Arlington to Honolulu.

With the funds thus secured, the inventor established his De Forest Radio Telephone and Telegraph Company, and thereby sought to realize his first dream of radio broadcasting. In 1916, many an amateur heard his nightly concerts, news bulletins, and election returns by radio from the Highbridge laboratories. The press told of this and of dancing to radio music, and from these reports emanated the idea of the educational as well as the entertainment value of radio. But though the inventor appealed to many, there was still no one to take the first step in this commercial or public enterprise.

Even government officials, who were in a position to help the broadcasting of news and music, vetoed this "pastime" on the score that it interfered with the Navy's wireless telegraph.

The new era of radio which De Forest had predicted as far back as 1907, which he had so plainly demonstrated, appeared to be fading away!

Patriotic service during the World War interrupted his efforts towards broadcasting. Immediately afterward, De Forest made a desperate appeal to the publishers of the various newspapers of the country for recognition of the many possibilities of radio transmission. Only one responded, and the first newspaper radio service in the world was established in 1920 by the *Detroit News*.

With New York still blind to radio, De Forest went to San Francisco, where he started the broadcasting of orchestral music from the California Theatre. Shortly afterward, the directors of the Westinghouse Company opened their permanent stations at Pittsburgh and Newark. But the public interest was yet to be aroused!

De Forest sailed for Germany in November, 1921 to experiment on still another use of the audion—the production of talking motion-picture films. At about this time came the radio awakening in America, and some six months later, the inventor stepped ashore in New York from a European steamer. His hair was tinged with gray, but in his eyes shone a new light, as he turned to me and said: *"My dream of radio is finally coming true!"*

What Would You Like to Have in Radio Broadcast?

The editors would be pleased to hear from readers of the magazine on the following (or other) topics:

1. *The kind of article, or diagram, or explanation, or improvement you would like to see in* Radio Broadcast.

2. *What has interested you most, and what least, in the numbers you have read so far?*

Captain Kay Makes Port in a Fog

The Passing of "the Old Substantial Feel and Sound Method"

By ORTHERUS GORDON

ALTHOUGH the radio operator had successfully obtained bearings from the coastal Radio Compass Stations on the last vessel he was assigned to, and although the Third Officer had once before used this position-finding service, Captain Kay, of the oil tanker *W. L. Summers*, was frankly dubious.

"He's superstitious, too, like the rest of the old-timers", said Frazer to me. "He won't even give it a try."

This was two and a half years ago, in the days when nine out of every ten skippers entering New York Harbor in a fog were fighting shy of the newfangled service which flashed a ship's position to it through the air. Most of those who did adopt the service had made the acquaintance of the rectangular aerial while serving in the Naval Auxiliary during the war. Captain Kay was one of these, but he had not seen a radio compass, and wasn't willing to trust his ship to something which was "worse than supernatural on the very face of it."

Not even in this present instance would he give way before modern science, although he was as hopelessly lost as he ever expected to be. He didn't admit it, of course, but he was. The soundings every thirty minutes didn't jibe, the log was running irregularly and the fog was getting thicker. According to his calculations, Ambrose Channel Lightship should be somewhere in the dark ahead. Either that or the shoals at Shrewsbury, or the long, wicked beach of Fire Island. To stop and wait for the fog to lift was out of the question—oil was wanted in New York and he had sixty thousand gallons of it on board. There was nothing to do but flounder around, trying to pick up a line of soundings which looked as if they led to the lightship, and sounding the whistle regularly every two minutes.

"At a loss of five hundred dollars an hour," said Frazer disgustedly. "It's disgraceful—and an insult to our intelligence."

Frazer was a practical radio man, who chafed at the thought of the captain's blindness to the help radio could give him.

"Not to mention the jackass he's making of himself in the bargain," he continued. "Oh, if people ashore only knew how their intrepid skippers shiver and quake out here in a fog—if the company only knew that they had a man who won't take advantage of a scientific achievement, who is this very moment on the bridge of their pretty ship, hanging on to the rail and praying to heaven that he sees something before he hits it. I'm going up to see him."

On the bridge, Captain Kay stood by the whistle cord. The second mate was on the starboard wing of the bridge, listening anxiously for the slightest indication of a fog signal. On the foc'sle head was a lookout, placed there to scan the water close down in an effort to see a ship, or land, or a light-vessel fifteen or twenty seconds before it could be seen from the bridge.

"The *Western Bridge* just got her position by bearings—," Frazer began.

"And I suppose you want me to ask for the same help," broke in the old sea captain. "This is not the first time I've made New York in a fog, young man, and I am not crying for help at this stage of the game."

That is the trouble with most of the old-timers—they feel they are asking for help, and that it is a disgrace to send in to a radio station for a position.

"It's not crying for help—you can use it as a check on your soundings." This from Frazer.

"You know where you should be and what you should be doing, don't you?" said Captain Kay swelling up in rebellion like a pouter-pigeon; "then do it," he pursued, as if to an imagined reply.

Frazer left the bridge, went to the shack, which was in with the officer's quarters, and asked New York for radio bearings. He got a standby, then orders to go ahead with the distinctive dashes used by all stations requesting bearings, and finally got his location. One from New York, the second from Cape May, and the third from Fire Island. He took them on the bridge and gave them to the captain.

"These are true bearings, Captain," he said, "and they don't have to be corrected for deviation or variation."

The captain swore. Then he looked at the sheet of paper. Then he swore again. Nevertheless, he took the bearings to the chartroom and plotted them on the chart. Much to his annoyance, Frazer hung over him.

"I'm not there—radio bearings or no radio bearings. They're no good. I'm at least thirty miles ahead of that position."

"Perhaps the log has been over-rating," suggested Frazer.

"I go by engine revolutions."

"Then we must have more current than usual—or a deeper drag. But that's where we are." Frazer was as confident as though he had just worked out a sun observation for longitude and latitude. "You are against a scientific exactitude—it can't be wrong."

This was strong; he watched the effect it would have on Captain Kay.

"Get another one," snapped the captain. "When we get in New York by the old substantial feel and sound method, we'll take the occasion to write these radio people and show them how much they're wrong."

So the captain went on the bridge again, and Frazer returned to the radio shack for another set of bearings. The first and third mates were amused spectators of this war between the skipper and the "radio" and were anxious to see how it turned out. Every fifteen minutes, when the second mate came down from the bridge to take a sounding, he dropped in to grin and to report progress.

"He's been looking for Ambrose for the last two hours," he said. "If it wasn't for the bearings, he would have stopped and floated around long ago. He's lost all confidence in his own reckoning, and for the first time, two soundings ago, the depth agreed with his idea of where we ought to be—and that idea was gained by the last radio bearings."

Something did seem to be changing in the Skipper's attitude. And the change, once begun, became rapidly more apparent.

Frazer was getting reports every thirty minutes now, and the instant he arrived on the bridge with a set of them in his hand, the captain rushed into the chart-room to lay the bearings down and check them with the last position. Finally, on the strength of three positions in line, he changed course, and increased his speed when the next two bearings indicated plainly that there was no mistake. He took soundings regularly, and was tickled to see them jibe with the radio positions.

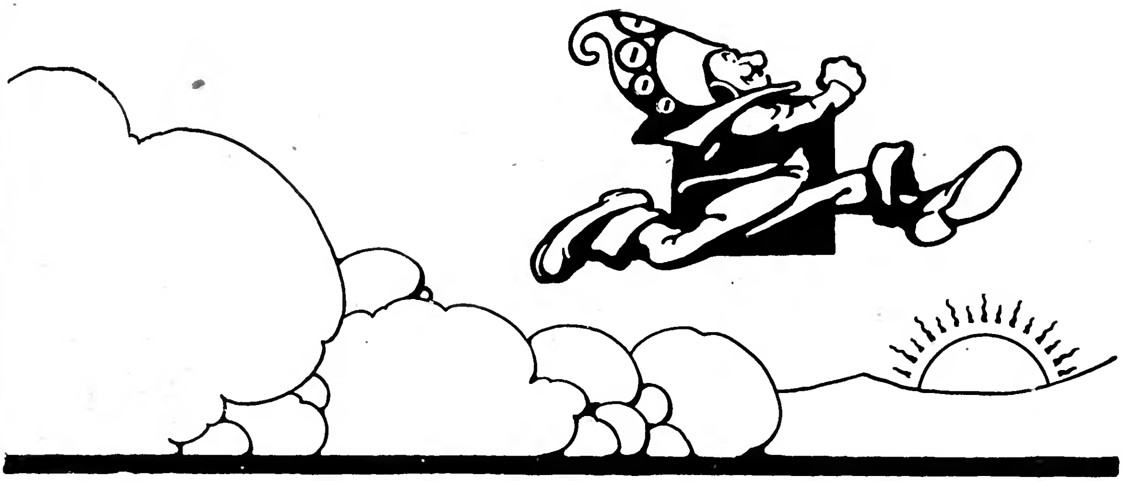
The captain now capitulated—signed on the dotted line, as it were, and handed over his sword to the enemy.

"All a fellow wants," he said, "is one of these things. Why, it's like seeing a lighthouse! You can go right in on your own hook."

All this time, the *W. L. Summers* was approaching the end of her journey, and for the second time that afternoon the captain was looking for Ambrose Channel Lightship. The number of ships whose whistles he could hear reassured him, and he steamed almost at full speed on the course line taken from the positions secured by the radio operator. Frazer was as happy as a child. He knew enough, of course, to keep away from the bridge and not to come out with "I told you so" to the skipper; but when finally the fog whistle of Ambrose was reported dead ahead, he was as pleased as the port superintendent of the line was next day, when that official heard that the *W. L. Summers* was at her dock in Bayonne and had already discharged twenty thousand gallons of her cargo.

"Made it in the fog, eh?" he asked the skipper.

"Last night," replied Captain Kay, "I had what might be called a twentieth century adventure, and in waters I have known since I was a kid. I came in by wireless, and you have the U. S. Government to thank for saving us about twenty hours' delay—a matter, I believe, of some ten thousand dollars. Well—it looks as if my business has gone ahead of me—but I'm not too old to chase after it."



KING ELECTRON M.D.

Several Pills for Radio Ills

By R. H. RANGER
Engineer, Radio Corporation of America

Illustrated by TOM MONROE

NOTHING works.

The set seems dead!

The case may be serious, or it may be easily remedied. In any event King Electron will start his diagnosis at once.

First, a rapid survey will be made to see if there are not some obvious breaks in wires, or even a part missing. If not, tests may then be rapidly made, starting with those parts which are ordinarily the first to give trouble. The best test for any part of a radio set is also the simplest—is that part functioning as it is supposed to? For example, a battery is designed to furnish power. Will it? If none of the bulbs light in your tube set, disconnect the filament battery leads from the set and touch them together for an instant. There should be a good spark from a storage battery and a fair one from dry cells. If not, the trouble is either in the battery or in its leads. If no break is evident in the leads and the connections seem good, try a direct test on the battery by touching a single connecting wire for an instant directly to its output poles. If the battery is obviously dead, there is nothing to do but to get a new one in the case of a dry battery, or to recharge it if a storage battery. If recharging produces no results, there are fortunately many experts in the automobile battery repair shops. It is far better to take a storage battery to an expert in the early stages of evident trouble than to wait until it is practically ruined.

KEEPING THE BATTERY IN GOOD HEALTH

THE condition of the battery at all times should be known, even when it appears to be giving satisfactory results; and the hydrometer provides a simple means for determining it. This instrument consists of a glass tube with a rubber bulb at one end which will draw liquid from the storage cell up into the tube where a small float indicates the density of the solution. The following table indicates the density condition of an ordinary lead battery:

Condition	Voltage per cell	Density
Charged	2.2	1.260-1.280
In Service	2.0	1.225
Discharged	1.8	1.175

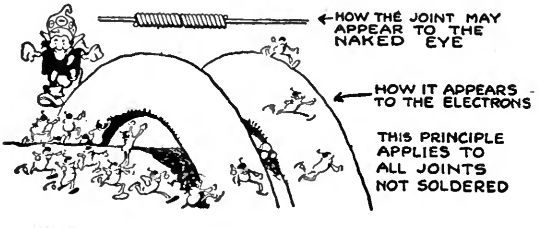
King Electron has found many of the hydrometers furnished with sets in the original box unopened! No wonder batteries develop all kinds of ills. The hydrometer is King Electron's thermometer.

It is most important that the direction of charging storage batteries be correct. The positive output terminal of the charging set should be connected to the positive or red terminal of the battery. King Electron has found one case at least where the charging was carried so far in the wrong direction, that the pole which had been negative (—) was made positive (+) and *vice versa*. However, it could not give good results in such a condition. A little care will easily prevent this sort of mistake.

If everything else seems as it should be about an amplifier set, yet a poor signal, or none at all, results, try reversing the filament battery connections to the set. The wires may have been connected wrongly after charging. Also, see that the plate battery connections check up with the hook-up as shown in your (correct) circuit diagram.

LOCATING TROUBLE WITH KING ELECTRON'S STETHOSCOPE

KING ELECTRON has one of the very best testing outfits for electrical instruments at hand with the usual radio set. This is the ordinary telephone head-set. The telephone receiver is a most sensitive indicator of electric currents, so with this as his stethescope,



King Electron can quickly determine the condition of the various parts.

The telephone receivers are not apt to give trouble, and for the moment it will be assumed that they are in good condition. That they are may be readily determined by putting them on, holding one of the cord terminals in one hand and touching the terminal swinging free to almost anything metallic. A distinct click will be heard. For example, touch it to the antenna wire. Or, if there are electric lighting wires in the house, touch the free terminal to the metal part of a fixture and the characteristic humming sound of the power current will be heard although there is no direct connection to the electric power.

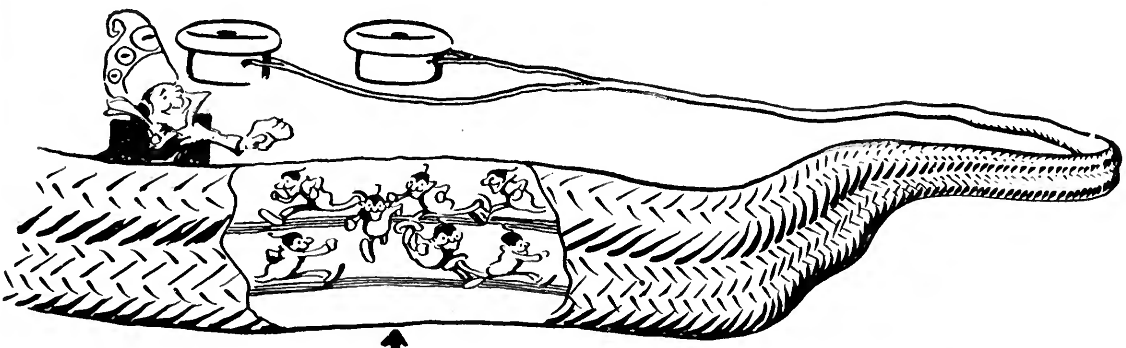
NOISY BATTERIES AND TUBE TROUBLES

IF THE radio set is noisy, the trouble is likely to be with the batteries. King Electron takes the telephone receivers and puts them rather loosely on his head in order not to get too loud a crack in his ears. First he tries the storage battery. If, when he makes a connection between the two sides of the battery, he hears a good click and then nothing, the battery is acting normally. If there is noise, the battery is at fault. A sound similar to escaping steam indicates the need of charging a storage battery. The same test applied to a plate battery may indicate a crackling sound. There is nothing to do but to throw away such a dry battery.

Having assured himself of a good battery supply, King Electron now looks to the tubes as the next most common source of trouble. If none of them light, the battery connection is bad, or the tubes do not make good contact in their sockets, or are burned out. In connecting up a set, King Electron always leaves the plate, or "B" battery to the last and gets the tubes lighted correctly without it. There is then no chance of ruining a tube by getting the plate battery connected to the filament terminals. The battery is then connected.

It is usually possible to see whether a tube is burnt out by looking to see whether the filament is broken. A break near one of the filament supports is many times caused by shock occurring in shipping or handling the tube.

If no tube lights in a particular socket, the trouble may be in the springs of that socket, which should be bent slightly to make firmer contact with the base terminals of the tube when it is placed in the socket. If this does not remedy the situation, the rheostat is the next thing to examine. If the same rheostat controls other tube sockets which are working, the trouble must be in the connections between the rheostat and the socket. Rheostats will burn out themselves, but usually only



DAMP SPOT IN TELEPHONE WIRES CAUSING SHORT CIRCUIT

when tubes are used which take a larger current than those for which the set was designed.

With the tubes now properly lighted and still no signals, King Electron puts the telephone receivers back in their proper place and tests out the amplifier and detector. By tapping lightly on the tubes in succession, a ringing sound should be easily heard. If this is heard distinctly each time, the trouble is further ahead. If not, it is necessary to test the amplifier and detector connections. When the telephone receiver is disconnected and reconnected in its proper place, there should be a distinct click in the receivers. If not, there is an opening somewhere between the plate battery, the telephone receiver connections and the plate connection in the last tube. If the click is heard but no ringing sound when the last tube is tapped, either the tube is itself at fault or the transformer, which is connected to the socket of the last tube. It is always a good plan to have one or two extra tubes in order that they may be substituted to determine whether or not a particular one is at fault. In fact, much better results may often be obtained by substituting one tube for another. Although each of them may work to a certain extent, by getting just the right sequence of tubes, better quality will result.

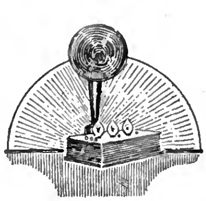
If the trouble does not appear to be in the last tube, it is in the transformer ahead of the tube. In some amplifiers, resistances are used in place of transformers. About the only remedy here is again substitution of other transformers or resistances, and this is best done in a repair shop. Be sure the connections are right before condemning the transformer itself.

With the last tube now working correctly, the others may be tested in succession. For this, the receivers are removed from the regular connection. One of the terminals of the cord is then connected to the plus "B" battery terminal in place of the plate battery connection, which is removed. Any of the amplifier and detector stages may now be tested in most sets by turning on the respective tubes alone. With any tube but the last on, a distinct click will be heard in the telephone receivers when the free telephone cord terminal is connected to the loose positive terminal of the plate battery. No click should be heard with the tubes all off. If a loud click is heard under this last condition, a short-circuit, either in the connection or in one of the tubes, is indicated.

If no click is heard with any particular tube lighted as the free telephone terminal is tapped on the plate battery "plus" wire, the connections to that tube or the plate of that tube are at fault. Again try the method of substitution to see if the trouble is the tube. If not, if no tube gives a click when lighted in that socket, the trouble is in the transformer. A transformer is made of very fine wire, and this wire may burn out, particularly if excessive currents are put through it to the plate of its connected tube. Again, this argues the use of as low currents as possible to give good signals. As in medicine, an ounce of prevention is worth a pound of cure. The use of transmitting tubes in receiver sockets may also cause transformers to burn out unless they are designed for just such use as will be indicated in the instructions that come with the sets.

A burnt-out transformer, as a burnt-out tube, is only remedied by a new one. The labor involved in repairs is much greater than the value of the actual materials that go to make them up. Only machinery makes these delicate instruments satisfactorily. And machinery does not know how to remedy trouble which has developed in its finished product.

The first (or in some sets the only) tube is the detector tube. It is usually at the left of the set, as seen from the front. If a tube set works for an instant and then plugs, the trouble is in the connection to the grid of the detector tube. This occasionally may happen in the input to one of the other tubes, where there is an opening in the grid side of a transformer, but this is rare. With the detector tube, this is usually caused by a faulty grid leak. The grid leak has too high a resistance, so that the "trapped electrons" which pile up on the grid when signals are received cannot get off the grid as they should. They will actually bring the set to rest for an instant until they have had the time to get off through the poor high-resistance grid leak. Most grid leaks are made of India ink on cardboard. A short immersion of such a grid leak in steam will usually add enough moisture to it to lower its resistance considerably. If the resistance is too low, the set will be continuously dead. The judicious heating of the grid leak will usually increase this resistance. Dirt lodged in the grid leak base may also make the resistance too low for signals. Dirt anywhere for that matter in the connections of the set will reduce the efficiency. It is well to look also for the green copper oxide which is to copper what rust is to iron. It will cause leaks and may even indicate a place where the wire is eaten away.



TESTING THE GRID CONDENSER

IF THE set still fails to function, the trouble may be in the grid condenser. One of the wire terminals may be loose or open, or the condenser may be shorted. To determine this, a small dry battery (the plate battery will do) is connected to the condenser and the telephone receivers in series; i. e., wires connect each one to the next in such a way that current from the battery has to pass through each in turn and then back to the battery. Now as the final connection is made and broken, a soft click should be heard if the condenser is all right. This click will be much fainter on the second making of the connection as the condenser has been charged the first time. If a steady click is heard each time, the condenser is most likely shorted.

With all the tubes lighted, the telephone receivers connected back in place, and a ringing sound on tapping each of the tubes, and *still* no signals—the trouble resolves itself in the tuning elements of the set or in the antenna and ground.

If the set has a variable condenser, a scraping should be looked for which would indicate that the condenser was shorting from one set of plates to the other, which it should not do. The condenser may also be tested for its value as a capacity to hold current as just outlined for the grid condenser.

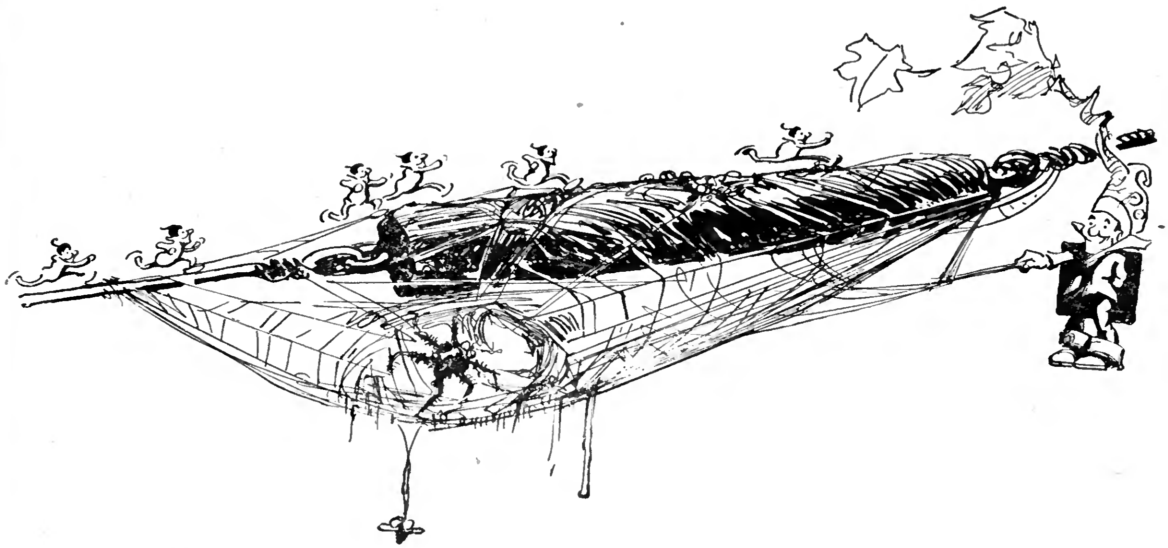
The inductance coil of the tuner should be tested for continuity by connecting it in series with a battery and the telephone receivers. A good click should be heard each time the final connection is made and broken if the inductance is working properly.

If there is a "feed-back" coil connected to the detector tube, this forms part of the plate connection of the first or only tube and will be tested along with the plate circuit of this tube as given before.

STILL NO SIGNALS?

THERE remain now only the antenna and the ground. To see if the antenna is alive, disconnect the lead-in wire from the set and let it hang free. Now take the telephone receivers as before, with one of the cord terminals held in the hand. The other terminal is touched to the lead-in. A distinct click should be heard. If not, there may be an opening from it to the outside wire, or the antenna may be grounded. Many people use great care in keeping King Electron and his band on the proper route in the antenna wire outside the building, and then grow careless of the insulation of the wire inside the building. This insulation should be well attended to, with insulated wire touching the woodwork at as few points as possible. Every point of contact with the antenna before it reaches the set means just that much more energy lost. Length is most important in antenna wires. For 360-meter waves, 150 feet of antenna is much better than 125. Very little is gained above 175 feet, however, except for the longer waves. If so long a single wire cannot be stretched, on account of space limitations, additional wires may be added in parallel to the single wire to make the best of the situation.

There seems to be a popular superstition against the use of insulated wire for antennas. The ether waves will act through insulation



LEAKING ANTENNA INSULATORS CAUSE TROUBLE

This applies to other kinds of insulators as well, such as lightning arresters. Keep your insulators clean. Dirt absorbs moisture, and moisture is an electric conductor

on such wire perfectly well, and the added insulation which such wires give against possible contact with trees or buildings is well worth while, unless the wire is strung absolutely clear. The insulator at the far end of the antenna should also be of the very best. It should be of such design that dampness will not cause a conducting layer from the wire to the support except over a very long path, made long by the corrugations on the insulator, or by its actual length.

SEE THAT THE LIGHTNING ARRESTER IS O. K.

THE lightning arrester may be at fault. If there is a fuse in the arrester, make sure that it is not burnt out or open, by a series battery and telephone test. Dirt in the arrester gap will also short the antenna directly to ground. To determine this, disconnect the antenna wire completely from the arrester for a while, and connect it directly into the set, and see how active it becomes electrically. If the set goes dead again when the wire is connected back to the arrester—there you are! (Be sure the arrester is connected properly.)

AND NOW—THE GROUND

THERE remains but the ground, and it should be to a real ground. A water-pipe is excellent, a steam-pipe very poor, except when the steam is on, and then only mediocre. As for the gas-pipe, its use is forbidden by the National Board of Fire Underwriters. The chief trouble in a ground is apt to be in the actual connection between the wire and the pipe. The pipe should be well scraped, and preferably a clamp used to fasten the wire to it. The ground lead should not be over twenty feet long. This may make it necessary to use a ground rod under the window. Dry sandy soil makes a very poor ground. In such cases, what is called a "counterpoise" may be used to advantage. This consists of virtually a second antenna under the first, preferably longer (or covering more area, if several wires are used) than the antenna proper. The counterpoise should be as well insulated as possible from ground. The counterpoise may be made of weather-proof, insulated wire.

Many people are still discovering that radio signals can be received either without a ground or without an antenna. Of course they can, and they always have been. But most of these people have never discovered how much a real antenna and a good ground will help the signals. If a set works just as well with the ground on or off, the ground is surely not good. In some cases, the storage battery may be acting as a ground. It should be kept from direct contact with the ground, as many sets are so wired that a direct connection between the ground and the battery, together with the ground to the set, will short-circuit the battery and the radio energy as well.

A good test of the quality of an antenna and ground may be obtained with "tickler" or feed-back sets. If but little tickler has to be used, the aerial system of ground and antenna is good.

Now that all these tests have been made, surely good signals are being received. A word may then be said on the actual quality of the signals.

HINTS ON THE USE OF TELEPHONE RECEIVERS

IT HAS been supposed that the telephone receivers were working. Of course, breaks in the cord may be determined by pushing the cord together along its length. A break may show up this way, particularly near the ends. The weakness at the ends is overcome by the use of the tie-string placed on the cord at these points. If one of the receivers appears dead, tap the iron diaphragm gently through the centre hole in the cap, to see if the diaphragm is clearing the pole pieces. If not, a slight tightening of the cap may remedy the fault. A paper washer placed under the diaphragm may help also, particularly on strong signals to keep the diaphragm well away from the poles. The receivers may also be weakened by the loss of permanent magnetism in the poles of the receiver. To determine this, remove the cap and see if the diaphragm is well held by the magnetism of the poles. This magnetism is lost by the use of too large currents through the receiver coils. Alternating current, if it accidentally gets into the telephone receivers in good quantity, will destroy this magnetism almost instantly.

A PRESCRIPTION FOR DEMAGNETIZED RECEIVERS

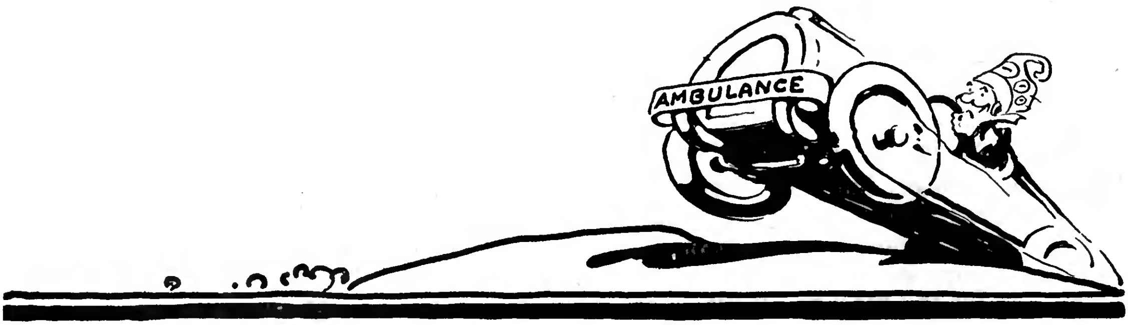
TO REMAGNETIZE the receivers, which is of course best done in a shop, the receiver must be taken apart carefully, to prevent breaking the fine wire of the coils. The semi-circular magnets in the bottom of the receiver are taken out and wound with some fifty turns of about number 18 insulated wire. The coil so formed is connected for a few moments to the storage battery, and the pieces of iron will have become good permanent magnets again.

Tone Quality. To get the best quality out of a telephone receiver, the cap should not be too tight. Loud speaker horns should be centered well on the hole in the receiver. The diaphragm itself should also be in the centre of the receiver case. This is especially true in the lever type of receiver such as the Baldwin.

The direction of connection of telephone receivers may make considerable difference in loudness as well as in quality. Try reversing the connections. The small vibrating metal armature should be well centred between the magnets of the Baldwin type of receiver.

All the electrons will do their best in the production of good quality music from radio waves, and it is largely a matter of common sense in giving them the best possible chance. The attempt to overwork them should be guarded against, as something is bound to give way sooner or later, besides the quality. In all cases, the instructions with sets or parts should be followed. Gas tubes should be used for detection only, amplifier tubes for amplifiers, and power tubes for power amplifiers, suitably arranged with so-called negative grid batteries.

Many tubes, especially the low-current consumption tubes, should be burned only at a very low heat point for best results. They are so designed as to give off plenty of electrons under these conditions. If they are heated to the brilliancy of electric lights, all the electrons will get away at once. Keep the batteries charged, and the set thoroughly cleaned, and the results will amply justify your efforts.



Making the Radio Department Pay

By ARTHUR H. LYNCH

WE CAN sometimes understand how a certain thing may be done properly, by first learning how it should not be done. "We all make mistakes, but only the wise profit thereby"; and it would seem that the lesson might just as well be taken from the errors of the other fellow. Since by learning the pitfalls it is easier to hold to the correct road, let us study some of the pitfalls in retail radio merchandising.

No matter how long a radio department or a radio retailing company has been in business, if it is to continue, it must keep alive to the newest developments. The departments of this character which are making record sales are run by men who live and breathe the atmosphere of amateur radio; they know the amateurs' pet expressions, their whims, and their enthusiasm; they can talk intelligently with the amateurs, because they are generally amateurs themselves when their daily work is over. Having their own outfits at home, they can think as the other amateurs think because they frequently encounter the very same difficulties their customers come in and tell them about.

DEALERS AND THE RADIO CLUBS

THERE are not enough dealers who belong to radio clubs. Those who do are generally observed to be successful. Naturally, some dealers have little time for the radio club, which they sometimes consider nothing more than a gathering of youngsters, anxious to exploit their knowledge. This knowledge is oftentimes profoundly greater than the dealer's own, and he could learn a thing or two if he would spare the time. Other dealers do not like to attend, because they know that their own knowledge is not so great along radio lines as that of some of the younger members of the club, and they feel that their prestige can best be upheld by aloofness. That is a sad condition, but it may be remedied.

There is a man in one of our Southern cities who has been retailing electrical apparatus and sundries for many years. His business has been very successful. When radio came along—that is when it began to gather a little strength—he realized that it would be a good line to handle and he stocked up. He could afford to spend as much as he desired to furnish such a department, and he ordered just about everything there was listed in radio catalogues and began to get all the radio business for miles around. He not only got the radio business, but managed to pry loose some of his competitors' best customers. (The value of a radio department does not terminate with the department itself, but let us consider that more specifically anon.)

A second dealer soon realized that he was going to suffer more than a small loss, if he did not do something to stop the other's inroads upon his trade. Instead of taking up some radio magazine, making a list of the advertisers, and ordering apparatus from them, he joined a local radio club. For some reason or another he was not held in very high esteem by the young folks of the town but he was permitted to join the club. Then he attended a radio school during the evening and picked up information on both amateur and commercial radio. He read and he listened and he learned—then ordered, not a lot of miscellaneous parts, which were advertised as being for use in connection with radio, but units and sundries for which he knew there would be a demand.

His stock, upon the receipt of his initial order, was just about as great as you would find it if you went into his store to-day, and its value was just about one half that of his competitor's. There was little deadwood and it has only been necessary for him to make a few additions to his line occasionally and re-order what he has sold.

He did a little advertising and the amateurs began coming into his store; some of them out of mere curiosity. He made every effort to satisfy them, and he is now selling most of the apparatus in that particular city. His competitor still has a large stock and probably will have until he wakes up.

Now, the successful dealer did not sell his apparatus simply because he happened to study the "game" and gradually pick up a knowledge of the equipment which would be in demand; it was because he could talk intelligently with his customers; he could give them advice concerning their purchases which would help them to get the greatest satisfaction from them; he knew their needs and could supply them. His competitor, however, could have sold the same units, for his stock covered about everything needed for radio, but the only knowledge he had of them was their trade names and the prices he paid for them and for which they should be sold; he knew nothing of how they were to be used. In the beginning, he secured the trade because he was the only dealer in the vicinity who could supply the demand; he lost it as soon as his competitor was in a position to supply the demand *intelligently*.

ONE OF THE BEST FORMS OF ADVERTISING

AT THE radio club, the second dealer, by nothing but consistent application and attention, managed to break down the original feeling against him. The fellows admitted that he knew what he was talking about. The club was not endowed with great funds for the purchase of equipment, so, when any particular lecture was to be given, the lecturer would only have to seek this man who would loan all the apparatus necessary for the actual demonstration of the lecture. Can you beat that for advertising?

The practice of one club member's telling all about some new wrinkle and showing how it could be done with apparatus which could be purchased at the local store, soon became a regular thing and the sales went up with leaps and bounds. This particular dealer now requires two counter men to take care of his radio trade, and he does a good mail order business as well.

The men who are behind his radio counter were selected from the best amateurs in the city and he pays them well. They, also, are members of the local radio club and have stations of their own. One of them teaches radio in a local evening school.

GOING OUT MILES TO GATHER IN SALES

THERE are so many good points about this business and the method of carrying it on, that we may well consider more of them. At his home, this dealer has erected a complete radio station; he didn't go and hire someone else to do it, but put up the whole shebang himself, to learn just what sort of a job it was. He can work with other stations within more than a hundred miles of his home and, in this way, can keep in personal contact with many of his mail-order customers. They meet him, via the air, and they buy from him because they happen to "know" him.

Both his counter men continue to operate their amateur stations, and, by reason of the fact that they are well-known in amateur circles, have a following which they bring to the store merely by being connected with it. They have many a chat over the wire, and are able to let the fellows within miles know how things are progressing.

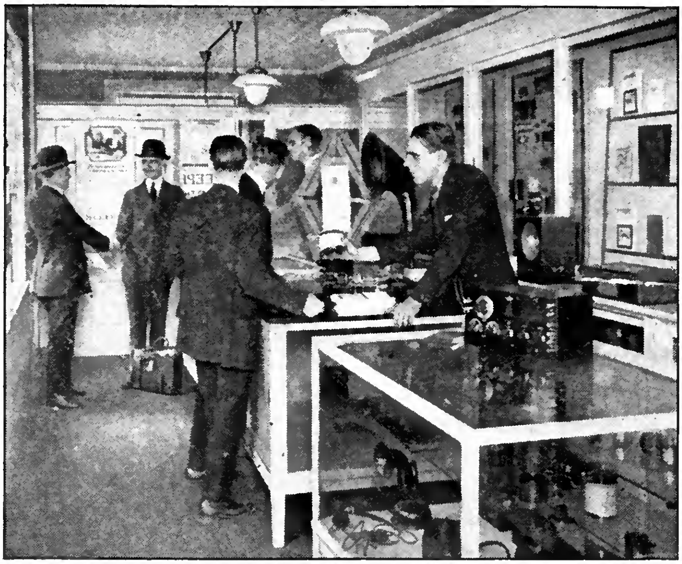
Do you wonder that this dealer's competitor frequently displays radio equipment in his window, with cut-rate price tags attached to it? He is certainly up against a stone wall, when trying to buck such an efficient radio department as this. The progressive dealer, by the way, has managed to increase his business not less than 20 per cent. *a month*, even during the comparatively dull summer period.

A BAD AND COMMON BLUNDER

IT MAKES little difference what you are selling; the fault we will now consider may be found just as often in the sale of automobile tires, frying pans, or cut-glass bowls, as in radio.

Bill Jones ambles up to the radio counter and asks to see a set, made by the So-and-So Company, and this is about the sort of thing that happens frequently:

After Bill has made known his desire to the man behind the counter, who happens to belong to the same radio club and with whom he is acquainted—let's call him Jack,—Jack's face lights up and he says: "Why, Bill, you are here just at the right moment to get all the dope on a So-and-So outfit." Then, nodding in the direction of a gentleman further down the room, he says, "I want you to meet Mr. Smith, who represents the So-and-So Company, and who is going to give us a little talk at the club this evening. Mr. Smith, meet Mr. Jones, one of our prominent amateurs and originator of the greatest little portable transmitter you could imagine; he is going to have it over at the club with him to-night."



"MR. JONES, MEET MR. SMITH
He is the man who knows all about the So-and-So Company."
At these magic words the Radio Department ceases to function

There is nothing apparently wrong with such an introduction, but let us examine what follows right in its wake. The set which Bill Jones came into the store to buy is now the least of his troubles. He has heard about Smith and wants to know what sort of a fellow he really is. It is then up to Smith to "sell" Smith to Bill Jones. Bill begins to find out all about Smith by describing to him the portable transmitter he, Bill, has perfected and bases his opinion of Smith by the interest he displays in the recounting of the wonders of the outfit. Smith, of course, has to listen with great patience and register interest, though he may have heard similar stories in the last ten towns he visited; he has to agree what a wonderful little outfit it must be and all that sort of thing. Then he has to tell Bill all about the So-and-So Radio Company—going over, for this one man, the whole story he is to tell the club that evening. Finally, he must sell Bill the outfit he came into the store to buy.

In the meantime, all the customers who happened to be at the radio counter at the time of the introduction, likewise forget that they came to make purchases and listen to the conversation of the two, who are reputed to be well versed in radio technique.

The radio department goes out for the air, so to speak, until Bill has made his purchase, said a lot of nice things to Smith, hoped he would surely see him at the club in the evening, and made his departure. Other customers who happen into the store and meet friends at the department, have, "There's Smith, of the So-and-So Radio Company", whispered to them. Bango! for everything they had in mind when they came in, and it is not at all unlikely that Smith will be called upon to perform again, before he has a chance to grab his hat and bag and escape.

This sort of thing happens so frequently and with such a great loss of time for the entire department, that is is decidedly to be avoided. The better practice to follow is for Jack, behind the counter, to sell Bill Jones everything he wants to buy; clear everything off that slate and then, without any fuss, make the introduction. Smith will not then have to sell first himself, then his company and the set which Jones came into the store to buy. Those who desire to meet Smith will have the opportunity at the club meeting which, after all, is the proper place.

The man behind the counter should make every effort to hold the patron's attention until there is no further prospect of sales rather than divert his attention to other persons or events.

HERE'S ANOTHER

MANY dealers fail absolutely to take advantage of some of the manufacturer's efforts to make sales easy for them. A customer asked for a certain radio unit in a store where I happened to be making a few small purchases. The salesman did not have the unit he wanted—that is, not the desired make, though there were units designed for identically the same use, made by three other manufacturers, in his show case. The customer had a general knowledge of what the unit was to be used for, from a description he read in a catalogue, but he did not know what the thing looked like. When he was told there were none in stock he took it for granted that he would have to look elsewhere. Without his knowing it, I followed him to another store and hung in the offing while he was being waited on.

In the second store, the man behind the counter also had to tell his customer that the

THE SALE WAS MADE
The instant the salesman placed the desired unit in the customer's hand

stock of the particular units he sought was depleted, but there was another unit designed for the same purpose and he had a number of them in stock, asking if his patron would like to see it. Of course he wanted to see it!

So, down came a little cardboard box, from among a number on one of the shelves, the tissue paper was quickly removed from the unit after the box had been opened, and the unit was then placed in the customer's hand. Do you suppose any sales talk was necessary? Not a bit of it! The fellow who wanted to buy that article was so tickled to have it actually in his hands that he could hardly wait to have it wrapped.

In the first instance, the man behind the counter could just as well have made the sale, in fact he could have sold a unit which was less costly than the desired one, and which would also have yielded him a greater profit, but he let it slip by because he did not know what the units were used for, and the one called for, instead of going under its technical name, carried a trade name. The man who did make the sale, as it happened, disposed of a higher-priced article than the one called for, because he knew his stock and the uses to which it could be put as well as the substitutions which could be made without resulting in less service to the consumer.

It is this service to your customers which will determine the value your radio department will be to you. If you are not well versed in radio, you will do well to put men behind your counter who *are*, or the success which should follow the sale of radio equipment will not come up to your expectations. On the other hand, if your department is well directed, the profits will surprise you.

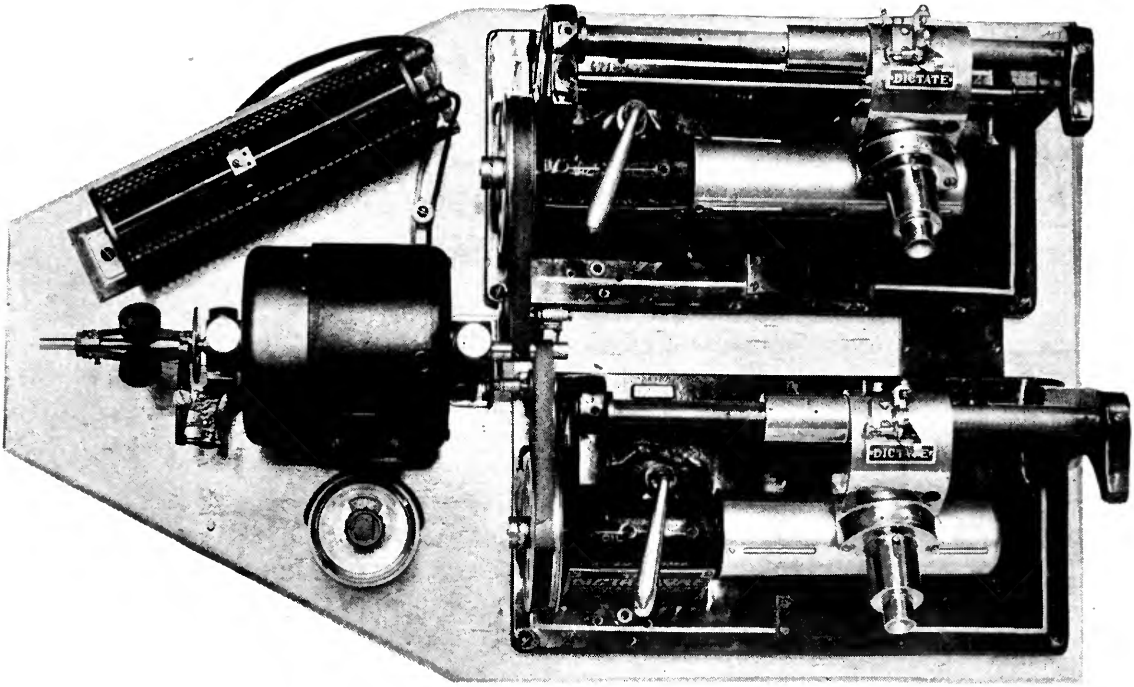
The Dictaphone High-Speed Recorder

By B. G. SEUTTER

AN INTERESTING and simply-operated high-speed recorder for radio signals is the Dictaphone shown in the accompanying photograph. This machine has been used by the New York *Times* for several years, for taking down European press. Its use, of course, is not limited to radio telegraphy: speech and music may be recorded equally well—to say nothing of static and all manner of interference! However, in transcribing, the records may be repeated as often as desired, and at any speed, so that the interference is a factor of far less importance than when the operator takes down a message directly.

RECEIVING THE MESSAGE

IN operating the high-speed recorder, assurance must first be had that the intensity of the incoming signals is great enough to make a good impression on the wax recording cylinder. One telephone of the receiving set is attached to the mouthpiece of each recorder, and the motor started, with the blank cylinders on both mandrels. A single motor drives both recorders, and at a constant speed, determined



MACHINE USED FOR HIGH-SPEED TRANS-OCEAN RECEIVING

By the New York *Times*. A single motor operates two recording machines which are arranged so that one takes up the recording when the record on the other is nearly filled. Messages may be received at a very high speed which is reduced when the record is placed on the transcribing machine. Records containing important messages may be preserved indefinitely

by the conditions and speed of the transmitting station. The gears at the left of the mandrel on one machine being in mesh, this machine alone begins recording. When the carriage has nearly reached the end of the cylinder, it is automatically thrown out of gear and the other machine is started. This second machine begins recording a few revolutions before the first is stopped, so that no part of the message can be lost during the shift.

The operator in attendance then moves the carriage of No. 1 machine back to the starting point, and slips a fresh cylinder in place. When the carriage of No. 2 nears the end of the cylinder, No. 1 is automatically cut in, and the operation repeated as long as desired. When the Dictaphone is receiving high-speed messages, it is found by actual practice that the cylinders should make about one hundred and fifty revolutions per minute.

TRANSCRIBING THE MESSAGE

In transcribing from the imprinted cylinder, a special Dictaphone is used with rubber hose attachment to fit the operator's head, somewhat like the ordinary head telephone receivers. For best results, the cylinder should now be reduced to about ninety revolutions per minute, enabling the operator to transcribe with ease. He can also stop and start the record at any point desired, and if the signal is not sufficiently clear the first time, he can have it repeated over and over by pressing a key which shifts the carriage, in a way similar to the action of the back-spacer on a typewriter.

When the messages have been copied from the various cylinders, the cylinders are taken to an electrically driven cutting machine which leaves them with fresh surfaces, ready to be used again.

The Dictaphone has long been used for dictation in offices, taking the most complex words as easily as the simplest ones. In the radio field the adapted form of this machine has proved equally accurate. One advantage it has over the type of apparatus which records signals by an ink marker on a paper strip, is that the necessity of employing expert tape readers is obviated. Moreover, the ink-and-tape machine is good only for telegraphy; the Dictaphone or similar device is necessary when the complex sounds of the human voice, or of music, are to be recorded.

A Few More Books About Radio

Eight Works of Varying Merit Which Have Been Published, or Reprinted, During the Current Year

IF ENOUGH books, dealing in one way or another with radio, have not appeared to satisfy the needs and longings of every sort of reader, it is certainly not the fault of the writers on this subject. They have done their level best to keep the presses from remaining idle and the public from remaining ignorant. Whether or not the public emerges from a plunge into the bewildering mass of verbiage and diagrams enlightened or hopelessly entangled, cannot in every case be stated with certainty. At any rate, the current of books flows on, for better or for worse. It is agreeable to note that several of them are "for better," notably the

LEFAX RADIO HANDBOOK, *by Dr. J. H. Dellinger and L. E. Whittemore; Lefax, Inc., Philadelphia, Pa. 1922, illustrated; price, $3.50.*

This is a loose-leaf book of pocket size, with cloth index tabs projecting beyond the page margin, bound in black, flexible leather. It is compact and practical, written in English, not Radio, by two men who are especially well qualified for the work. Dr. Dellinger is Chief of the Radio Laboratory of the U. S. Bureau of Standards at Washington, and Mr. Whittemore is his assistant. The matter is arranged under the following heads: What Radio Does, How to Receive, Antennas, Fundamental Principles, Receiving and Transmitting, Lines of Advance, Apparatus, and Appendix (in which you will find a variety of things, from a map showing the location of broadcasting stations in the United States to sheets of perforated, ruled, and squared paper on which you may add whatever of importance you find the authors have omitted). An excellent and unusual feature of the book is that "new developments in radio, including new apparatus and hook-ups, will be described on additional sheets and mailed periodically to all holders of the handbook. This service will be supplied without charge until July 1, 1923." One of these supplements, already sent out to owners of the handbook, contains six pages of text and circuit diagrams relating to super-regenerative reception. Throughout the book, the explanations and diagrams are clear, adequate, and logically arranged: they breathe an air of practical common-sense. If you are just beginning to do a little experimenting with radio telegraphy or telephony, and can scrape together the necessary $3.50, the "Lefax Radio Handbook" should prove of considerable value to you. It is a book for your coat-pocket or workbench, rather than something to read through and put aside. If the authors continue to provide the means of keeping the handbook up-to-date—and there is every indication that they will do so—this book should live a long and useful life.

Another book, no less unusual than the Lefax product, but entirely different in presentation of material, is

THE RADIO PATHFINDER, *by Richard H. Ranger; Doubleday, Page & Company, Garden City, N. Y. 155 pages, illustrated; price, $1.50.*

It is clearly written and amusing—yes, one of those rare birds among textbooks that actually refuses to be dull. The text itself is mostly "strictly business," progressing from the chapter on broadcasting history through the general theory of sending and receiving to practical instructions for installing and operating a modern radio set. But over fifty unusual line drawings by Thomas E. Monroe, as well as aptly chosen quotations for the chapter-heads, help to raise this book above the average level, and to make it a source of information and pleasure to the person newly interested in radio, who wants to read something in a language he can understand.

There is a certain amount of useful information for the young boy who would build his own wireless set, in

THE BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, *by A. Frederick Collins; D. Appleton and Company, New York. 227 pages, illustrated; price, $1.50.*

There is, we repeat; but it is rather hard to find much of it in the mass of pictures of every old-fashioned instrument from the Leyden jar to the tuning-helix. In bringing the book, which was originally published in 1915, up-to-date, the author or publishers have apparently forgotten to throw out a great quantity of material that no young boy, starting in to-day to make his radio set, would have any use for. One unconscious purpose served by this book is to show how much neater and more efficient our present-day home-built apparatus is than the stuff turned out six or seven years ago. Radio progresses too quickly to allow the text and diagrams of several years ago to be successfully reprinted and served up as a modern textbook for young boys. To read this book is something like picking up a best-seller of the vintage of '75 and doing your best to plow through a few pages of it. Invariably, you lay it down with a sigh, sadder if not wiser. Just think—it was once alive! You know how Hamlet must have felt when, picking up the skull of one whom he had long forgotten, he said: "Alas—poor Yorick! I knew him, Horatio!"

A book of interest to the experimenter is the

RADIO EXPERIMENTER'S HANDBOOK, *by M. B. Sleeper; The Norman W. Henley Publishing Co., New York, 1922, 143 pages, illustrated; price, $1.00.*

This is characteristically a Sleeper work. It is exceedingly well illustrated and is full of explanations of the various kinks and wrinkles which come only from the pen of an author who knows whereof he writes. This little book tells, in a very practical manner, a great deal about transmitting, receiving, the new fire laws, etc. It is particularly helpful to the enthusiast who listens on long waves.

A volume that has been written as a guide to those who have not followed radio from its beginning is the

STANDARD ENCYCLOPEDIA OF RADIO APPARATUS, *by A. Howland Wood; Perry & Elliott Company, Boston, Mass., 1922,* **128** *pages, illustrated; price, $2.00.*

Special attention has been given in this book to making the reader familiar with the symbols used in radio, and the devices they represent are depicted beside the symbols. A glossary of terms used in radio has been included and there are chapters on the proper method of installing and operating sets. The chapter on receiving-set costs, which also points out the approximate ranges over which various receiving combinations may be expected to function, should be helpful. A chapter describing the construction of a 5-watt radio telephone transmitter is also included.

Another book, and one which has been needed for some little while, is

HOW TO RETAIL RADIO, *McGraw-Hill Book Company, Inc., New York, 1922, 226 pages, illustrated; price, $3.00.*

This is a discussion of the subject of radio merchandising. Part of the matter described and illustrated includes What Successful Radio Retailing Requires, Choosing a Radio Store Location, Good Business Records Make Good Profits, Financing the Radio Department, What Kind of Stock and How Much, Displaying Radio Goods in the Window and Store and How a Club Room for Amateurs Builds Sales. The subject matter has been taken from the writings of such merchandising authorities as Stanley A. Dennis, C. W. Muench, Frank Farrington, F. W. Christian, J. C. Milton, J. S. Older, Roi B. Woolley, Harry A. Mount, C. S. Funnell, and Arthur H. Lynch. It is indeed a good book for any radio merchant.

One of the most comprehensive descriptions of the Armstrong super-regenerative circuit is

THE ARMSTRONG SUPER-REGENERATIVE CIRCUIT, *by George J. Eltz, Jr., A. I. E. E., Radio Directory Publishing Co., New York, 1922, 52 pages, illustrated, price $1.00.*

The work is as non-technical as a very technical subject will permit. The subject is covered from the point of view of the practical operator rather than the technician, for the man who is not so much concerned with the technical as with the practical application of the circuit. A method for applying the super-regenerative circuit to a Grebe CR-5 receiver is illustrated and described. As most single-circuit receivers which operate over a range of from 150 to 3000 meters are patterned after the CR-5, this application is an important one.

From the view-point of the listener-in, it is doubtful that any more comprehensive group of books can be had than those which comprise

THE EASY COURSE IN HOME RADIO; *Morrison, Kaempffert, Hogan, Morecroft, Ould, Yates, and Boucheron; 6 small, paper-covered vols., illustrated, price, $3.00.*

The course has been prepared by such authorities as Abby Morrison, Instructor in Radio, Y.W.C.A., Waldemar Kaempffert, John V. L. Hogan, Prof. J. H. Morecroft, R. S. Ould, R. F. Yates, and Pierre Boucheron, and Major-General George O. Squier is Editor-in-Chief.

The course covers all phases of radio from simple electricity to the super-regenerative circuit and is particularly well illustrated with diagrams, sketches, and photos.

Do You Want Broadcasting?

If so, it is highly important for you to sit right down and write a letter to your Senator and Congressmen, demanding that they exert every effort to have the White Radio Bill passed at the next session of Congress. If this is not done, the hands of the Department of Commerce will remain tied and no relief can be obtained from a rapidly increasing bedlam in the ether.

There are some objections to the bill—but the good overbalances the bad in it, and it is our only hope before 1924.

Exhort your representatives to have the bill passed—amended, if possible—but passed, whether amended or not.

The greatest crisis in radio history is at hand—you can help to make radio of value to every man.

A meeting of representatives of the radio press of the United States is being called to join in forming a definite policy to place before you. A comprehensive survey of the situation, written by Paul F. Godley, will appear in the January issue of RADIO BROADCAST.

But do not wait a minute—write a letter now demanding that the bill receive the attention it deserves and follow it next month with concrete suggestions drawn up by those who, with you, are most vitally interested in better radio, that is, the radio press.—THE EDITOR.

During National Radio Week

Which will extend from December 23rd to 30th inclusive, special broadcasting programmes are to be sent out from stations throughout the country. New York is holding a great radio show at Grand Central Palace, where practically all types of apparatus and parts made in this country will be on exhibition. The music of prominent violinists and singers at the exposition will be sent by land line to various broadcasting stations for transmission throughout the East and the Middle West.

You should make every effort to have your receiver working like a Swiss watch during Radio Week, for you and your friends will want to listen-in on the special programmes that will fill the air.

What kind of a show are you going to put on in your own home town?

The slogan for National Radio Week is the slogan that appears on our front cover:

"THIS IS A RADIO CHRISTMAS"

Doctor Stratton Leaves Bureau of Standards

His Election as President of Massachusetts Institute of Technology Deprives Bureau of Its Founder and Directing Genius

DR. SAMUEL WESLEY STRATTON is leaving the Bureau of Standards for good. Probably no other governmental change except a vacancy in the White House would create a greater stir in Washington than knowledge of this fact. The man who will take up his duties as President of M. I. T. in January in a sense *is* the Bureau of Standards. Called from a professorship in physics at the University of Chicago in 1901, he engineered through Congress a bill creating the Bureau, of which he promptly became the head. The expansion of services and facilities from that time up to the present, until the Bureau of Standards has become renowned the world over, has been directly due to Doctor Stratton's organizing and scientific genius.

To touch on the Bureau's war work alone would be to record a list of discoveries covering almost every physical function of the army, the navy, and the chemical plants. The thought of the losses in efficiency of equipment which our military forces would have undergone had not the Bureau of Standards been in existence is terrifying to any one who has read the Bureau's report of work conducted during the war.

Dr. Stratton has always been an enthusiastic supporter of amateur radio. Last February he acted as Chairman of the Technical Committee of the Radio Conference which made recommendations for a national radio policy. It is hoped that Dr. Stratton's successor will be a man whose interest in other branches of science will not overshadow his realization of the necessity of intelligent radio regulation.

Secretary Hoover, while congratulating Technology on obtaining Doctor Stratton as its head, is evidently exceedingly sorry to have him leave.

"The loss of Doctor Stratton as head of the Bureau of Standards," he says, "is a real national loss. He has built up that service from a bureau devoted to scientific determination of weights and measurements to a great physical laboratory coöperating with American industry and commerce in the solution of any problems of enormous value to industry which the commercial laboratories of the country, from lack of equipment and personnel, have been unable to undertake.

"While the Massachusetts Institute of Technology is to be congratulated on securing Doctor Stratton, one cannot overlook the fact that the desperately poor pay which our Government gives to great experts makes it impossible for us to retain men capable of performing the great responsibility which is placed upon them."

© Harris & Ewing

DR. S. W. STRATTON

Progress of Radio in Foreign Lands

Latin-American Activities

SLOWLY but surely our Latin-American neighbors are getting more and more interested in radio communication and radio broadcasting. It is announced that the Radio Corporation of America has secured orders for the erection of five stations, each of which will have a sending radius of more than 2,000 miles. Three will be in Central America—in Honduras, Nicaragua, and Panama, respectively—and the other two in the United States. There is news, also, to the effect that certain South American republics are formulating new radio laws to take care of early broadcasting activities. Uruguay, for instance, has just made public its new laws. Private stations will be permitted anywhere except at points where State stations exist, provided that (1) they are not within 31 miles of the sea coast or of the Argentine and Brazilian frontiers, and (2) they are not installed in important cities or towns. Without being too inquisitive, it occurs to us that 31 miles in from the sea and from the two frontiers leaves very little room in which to operate, remembering that Uruguay is the smallest of the South American countries. Again, important cities and towns are barred to radio workers. We trust there is still a section of territory left for the followers of radio; they might go there and establish a colony!

Then there is good news from Cuba. Radio broadcasting has just been introduced in that Republic, and Cubans can now receive an all-Cuban programme instead of depending on the greatly attenuated programmes from the States. The demand for radio apparatus in Cuba is said to be enormous.

Radio Communication in Mines

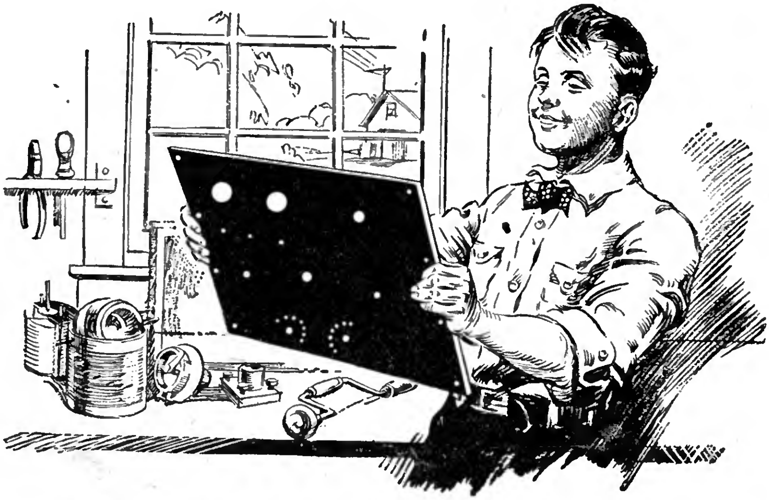
EXPERIMENTS designed to demonstrate the possibility of radio communication between the shaft head and the lowest workings of a mine have been recently carried out in England by a party of Birmingham radio amateurs. The colliery used for the tests was chosen because its main shaft is one of the deepest in that country, nearly 700 yards. The receiving set employed in the experiments was of the three-tube type, and a temporary antenna was made by suspending a length of insulated copper wire between the top of the steel hoisting gear above the shaft, and an adjacent railway bridge. The ground connection was made by clamping a wire to one of the rails of the permanent way. From this makeshift arrangement, messages were heard from the station at Bordeaux. The portable transmitting set was first installed in the steel cage of the shaft, the aerial being insulated wire suspended in a lattice pattern across the roof of the cage, the ground being a connection to the steel floor. It was expected there would be much "screening" on account of the steel framework of the cage, and by the structural steel work built inside the shaft for a depth of more than 100 feet. This did affect the first transmissions, which were begun from the cage at the top. As it slowly descended, however, signals became much stronger. When the cage was at a point 300 yards or so down, the maximum signal strength was attained, and this remained undiminished until the cage reached the bottom. When the bottom was reached—and here there was more steel work—the signals became inaudible. The transmitting set was therefore taken from the cage and a new aerial made by suspending the wire between pit props. The ground was improved by attaching the wire to a length of cable laid along the ground. The new arrangement resulted in faint signals being received above. A distance of nearly three-quarters of a mile was spanned by the radio set, working through solid earth. Radio telephony was tried and worked quite well.

Radio Outfits for Mexican Lighthouses

THE installation of small radio outfits in all lighthouses of the Mexican Department of Communications is reported in the Mexican press. Two sets of the apparatus are being installed on trial, after which, if they prove satisfactory, all lighthouses will be similarly equipped.

Nauen's Latest Improvements

GOOD progress is being made with the extension of the radio station at Nauen, in Germany, according to *The Engineer*. It is expected that by the beginning of next year it will be possible to establish



permanent communication with the new Argentine station at Monte Grande, near Buenos Aires. Four of the existing masts at Nauen, which are more than 390 feet in height, have been removed and replaced by a series of seven towers 688 feet in height, which provides four additional antenna circuits, each of which is served by a high-frequency alternator. The new antennas will be used for American, Asiatic, African, and European services. For distant stations, such as those in South America, two or more antennas may be used together. The transmitting installation has been improved and enlarged, and the system of grounding connections has been extended.

The Grid

QUESTIONS AND ANSWERS

The Grid is a Question and Answer Department maintained especially for the radio amateurs. Full answers will be given wherever possible. In answering questions, those of a like nature will be grouped together and answered by one article. Every effort will be made to keep the answers simple and direct, yet fully self-explanatory. Questions should be addressed to Editor, "The Grid," Radio Broadcast, Garden City, N. Y. The letter containing the questions should have the full name and address of the writer and also his station call letter, if he has one. Names, however, will not be published.

What is wavelength?

THOUGH wavelength has often been discussed in this and other publications, a great deal of confusion still exists in the mind of the novice as to just what wavelength is. The accuracy of the average broadcast enthusiast's conception of the subject is well reflected in a recent newspaper write-up of an installation capable of receiving waves sixty meters long. The writer goes on to explain: "—which means that the set is particularly susceptible to atmospheric disturbances sixty meters above sea level."

The term "wavelength" is really self explanatory, for it is generally understood that the impulses from a transmitting station assume somewhat the form of a wave. Wavelength is, obviously, the size or length of the wave in meters (1 meter = 39.37 inches).

Electromagnetic impulses (radio waves), under practically all conditions, and *regardless of length*, travel 300,000,000 meters in one second, during which time a certain number of waves are sent out. If only one wave leaves the antenna each second, the first part of it will travel three hundred million meters before it is broken off and a new wave starts—in other words, the wave is "stretched" over a distance of three hundred million meters. If the frequency is two, the first wave will travel one hundred and fifty million meters, in only half a second, before it is terminated by the commencement of the following wave. If the frequency is three, the wavelength will be 100,000,000, meters, etc., thus establishing an evident relationship between frequency and wavelength; 300,000,000 divided by either quantity giving you the other. The frequency at a two-hundred meter wave (300,000,000 ÷ 200) is one million, while the wavelength at a frequency of one million cycles (300,000,000 ÷ 1,000,000) is three hundred meters. It will be observed that frequency varies inversely with the wavelength, and short waves are often referred to as "high frequencies."

The above relationship, stated in a mathematical formula, is $\lambda = \frac{V}{N}$ and, transposing, $N = \frac{V}{\lambda}$ where λ = wavelength in meters, N = frequency in cycles per second, and V = velocity of radio waves in meters per second.

It is evident from the above that wavelength, in one sense, does not directly affect the number of turns of wire on a receiving coil. However, more than one tyro in his desire to receive 360-meter stations, has multiplied 360 by three (three feet to the meter), and, zealously wound 1080 feet of wire on a tuning coil!

But, in a less literal way, wavelength does determine the amount of wire on our receiving instruments. Alternating currents (radio currents are alternating currents of high frequency) in traversing a circuit, such as from antenna to ground, experience not merely the retarding effect of resistance, but also that of "reactance." Positive reactance is a result of inductance, a quality existing in almost every circuit, which causes the amperage and voltage to reach their maximum strengths at different moments. Work, such as turning a motor, or actuating a telephone receiver diaphragm, can be best accomplished only when volts and amperes work in unison (giving watts). Reactance thus results in a loss of power, which, in small radio currents, makes reception impossible. To overcome this negative reactance, condensers are introduced into the circuit, which, when properly balanced, exactly councract the reactance caused by inductance, bringing the lagging amperes back into phase with the volts, thus permitting work to be accomplished. *But reactance varies with the frequency of the current, and, therefore, at different waves, various values of condenser and coil windings (inductance) must be used.* Tuning is nothing more than a balancing of the two kinds of reactance, positive and negative, so that at the wavelength to which the receiver is tuned, they nullify each other, and the weak radio currents will encounter only the comparatively negligible effect of resistance.

What is regeneration?
How can a non-regenerative set be made to regenerate?

REGENERATION, briefly, is a method of securing amplification with a single tube, by coupling the output of the bulb back to the grid in such a manner that it intensifies the slight potential applied to it

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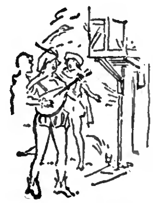

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by the incoming wave, the strength of which determines the audibility of the signal.

An incoming signal is impressed on the grid of the vacuum tube as a certain variation of a positive or negative charge, and by either repelling or attracting the electrons flowing from filament to plate, it varies the strength of the plate current. The plate or space current passes through the receivers, or the primary of an amplifying transformer, the high voltage battery, and finally across the elements of the tube. As the changes are thus caused by grid variations, it holds that the grid and plate fluctuations occur practically simultaneously, the change in the plate current being, in fact, nothing more than an intensified replica of the grid variations. Thus, if a part of this energy in the plate circuit is properly transferred back to the grid circuit, it will augment the like variations there, with a resulting greater change in the space current. This again reacts on the grid, and regeneration may be continued up to a certain point at which the circuit is said to oscillate. (The ultra amplification in the Armstrong super-regenerative set is secured by carrying out this feed-back principle considerably further, and effecting regeneration far past the stage at which conventional receivers commence oscillating.)

Regeneration may be obtained in either of two ways—by inductive or by capacitative feed-back, each system functioning, as its name implies, by the respective means of inductance and capacity.

Inductive feed-back is the simpler system, and its action more easily understood. It consist of a coil or inductance in series with the plate battery and phones, coupled to another coil in the grid circuit, generally the secondary of a vario-coupler or its equivalent. Any receiver can thus be made regenerative by the installation of a "tickler" system, built up in the form of a small variometer with no electrical connection between the rotor and stator. Two cardboard tubes should be secured, one, the stator, approximately three and a half inches in diameter, and the second, of such a size, about three inches, that a one-inch

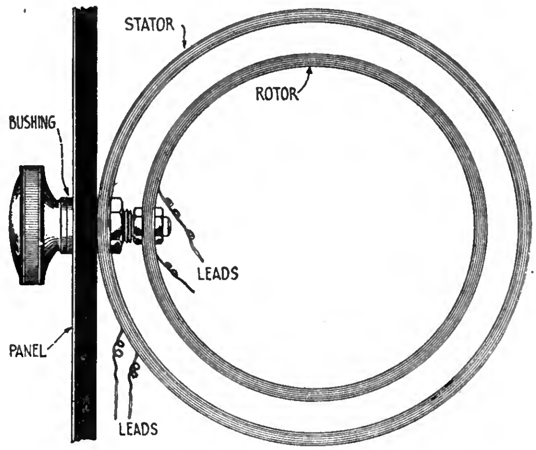


FIG. I

Showing a simple method of mounting a tickler or variometer

length of it will turn within the stator. Ten turns of any convenient insulated wire is wound on the stator, and twelve turns on the smaller tube, the rotor. The experimenter may mount the tickler as his ingenuity suggests, but a switch knob, minus the lever, and a bushing, probably afford the simplest method. Fig. 1 shows how the stator is clamped under the nut of the bushing, while the revolving tube is held between the lock nuts on the switch shaft.

The diagram for including the tickler unit in the conventional audion circuit is shown in Fig. 2. In any cir-

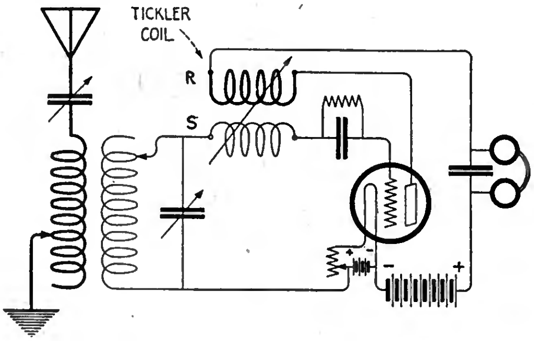


FIG. 2

A non-regenerative circuit made regenerative by the inclusion of a tickler coil. In the variometer set, the rotor and stator, R and S would be changed for individual variometers, well separated

cuit, one coil, generally the stator, is connected in series with the grid condenser on the A battery side, and the remaining coil, between the receivers and the plate.

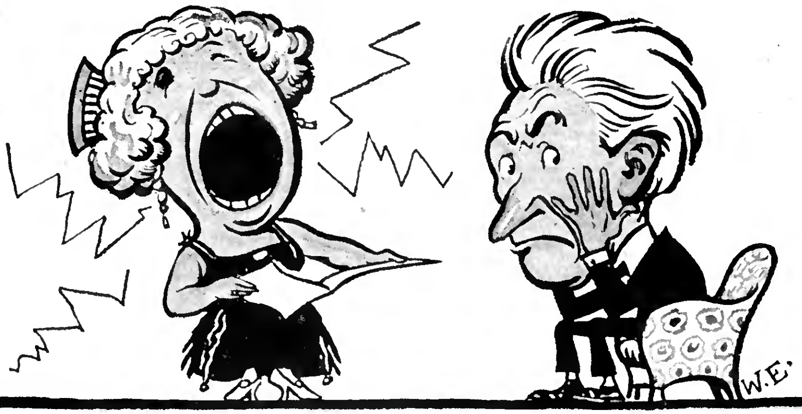
Tuning is effected in the usual manner after having first set the coils at right angles to one another. When the station is tuned to maximum loudness, the tickler is brought into play by turning the rotor in the correct direction (to be determined by experiment). As this is done, the signal strength will increase until just before the circuit oscillates, beyond which point reception will be distorted and unsatisfactory. (Except for continuous-wave—C. W.—signals, which are most commonly received on an oscillating set.)

The tickler unit just described will give regeneration over a range of wavelengths up to six hundred meters, above which, larger coils must be made.

Regeneration by capacitative feed-back finds its most popular modification in variometer sets, where it is accomplished through the capacity between the grid and plate elements of a vacuum tube. However, as is easily understood, the capacity between these parts of a vacuum tube is very small, and to achieve an appreciable transfer of energy requires very careful adjustment of the two circuits—an adjustment that is effected by the variometers. Efficient transference of energy from one circuit to another is possible only when the two circuits are in resonance, or tuned to the same wave. Variometers, which are continuously variable tuning units, make it theoretically possible to arrive at this ideal condition.

This last type of regenerative set is the most efficient short-wave receiver, because, on higher frequencies (short waves), resonance plays a much more important part. Due to the variometers, *complete* resonance is sustained throughout the set, from the antenna through the plate circuit, thereby utilizing to the utmost the barely perceptible current of the incoming signal, as well as gaining an initial amplification by regeneration.

Two small variometers may be wound in the manner described for the construction of the tickler unit, except



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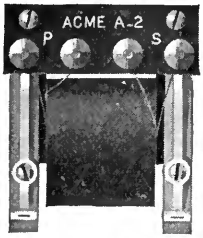

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that the rotor and stator are connected, leaving only two open wires from each variometer. These variometers may be added to almost any non-regenerative set, by connecting individual variometers in place of the rotor and stator coils indicated in the tickler hook-up (i. e., one variometer in the grid circuit, and one in series with the telephone receivers).

Tuning with a variometer set requires considerable practice, but once the operator becomes accustomed to the peculiarities of his apparatus, the remarkable reception will repay him for his efforts. The grid variometer will require certain definite settings for different wavelengths (which must be determined by trial), and should be first set on the wave adjustment for the signal it is desired to receive. The plate variometer is set at any non-oscillating position, and the station tuned by varying the antenna condenser or inductance. When the station is tuned in, generation is controlled by manipulating the plate variometer. The final adjustment is a very delicate tuning of the grid variometer.

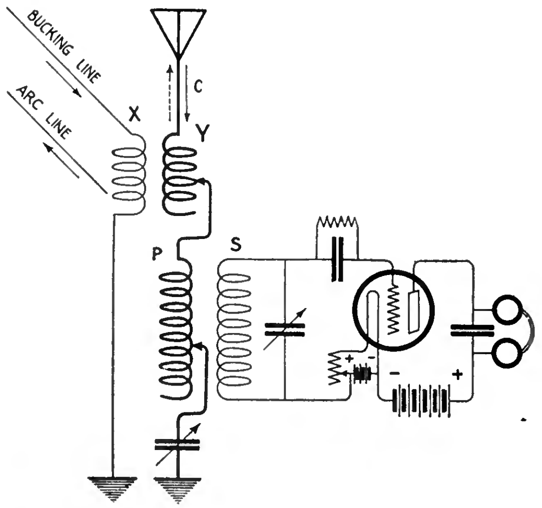

FIG. 3
A method for eliminating power-line noises in receiving sets

S. W. B., Davenport, Iowa is bothered by neighboring arc-light circuits, reception being practically impossible after sundown.

"Every evening, when the arc circuit is turned on, we get a continued roar in the receivers that sounds as though we were in the power house standing alongside one of the generators. . . . This trouble is not only at our place, but affects an area of about one hundred city blocks. . . . The current which is supplying these arcs is direct current, and each circuit has about 80 lights on it."

THIS problem has been a bugbear of radio experimenters since the early days of wireless, and many more or less successful solutions have been offered. Arc circuit interference is reducible, for the purpose of dealing with it systematically, to one of two causes: audio frequency variation of the supply current; or radio frequency. This last, however is often modulated at a sound frequency.

If the interference is in no degree tunable, it is probably interference of the first mentioned class. An audio-frequency disturbance may be due to many causes—generator hum, other line fluctuations, leakage in wet weather, arc sputtering, and sometimes, owing to certain values of capacity and inductance, the arc oscillating at audio frequency.

Radio-frequency variations are slightly tunable, but will probably force oscillations at any wavelength due to the proximity of the line.

If the annoyance comes under the first classification, (audio frequency) it will affect only single-circuit sets, and the solution is obvious. An inductively coupled receiver, such as a variometer short wave set, should be installed. Here, the inductance in the primary and secondary of the coupler (which is virtually a radio frequency transformer) is not sufficiently high to effect a transfer of pure audio frequency energy.

The simplest, but not always successful, solution to radio frequency interference is to vary the position of the aerial in relation to the arc line, making, if possible a right angle. In some cases, the erection of a fan antenna has reduced the annoyance to a negligible hum.

A logical, and in several instances successful system is the installation of a wave trap, a method, of course, only applicable when the interfering wave is considerably above or below the wave on which reception is desired. A wave trap is a circuit in resonance with the disturbing signal and in inductive relation to the antenna, which absorbs the undesired frequency, while not appreciably affecting signals on other waves.

The most successful systems employ the principle of "bucking" the disturbing oscillations by similar oscillations in the opposite direction. It is known that two sets of oscillations of the same frequency, but differing in phase by 180°, that is, one reaching its positive peak at the moment the other attains its negative peak, will nullify each other if they are approximately the same strength and vibrating in a common circuit.

This effect may be occasionally secured by erecting a counterpoise, one end of which is free to swing so that the relative position of the counterpoise to the arc line may be varied. This system, however, is not so effective as a separate bucking circuit shown in Fig. 3.

X and Y are respectively the *secondary* and *primary* of a variocoupler. The secondary is connected between the ground and a wire running as far as feasible (several hundred feet if convenient) parallel and near to the supply line. The primary is in the antenna circuit of the receiver. Arrow A indicates the momentary direction of the current in the arc line; B and C the current simultaneously induced in the parallel wire and the aerial. The dotted arrow shows the direction of the current induced from X to Y (provided X or Y is connected in the right direction). This last indicated current, by varying the coupling between X and Y, can be made to nullify the interfereing current, designated by arrow C.

As was suggested, it may be necessary to reverse the connections to *one* of the coils, X and Y, for, if connected improperly, the disturbance will be magnified. The amount of winding on Y should be kept at as few turns as is compatible with the elimination of the interference, so as to increase the wave of the receiving set as little as possible.