

Radio Digest



READ-
The Construction of
An Efficient Radio
Receiving Set.
-This Issue-



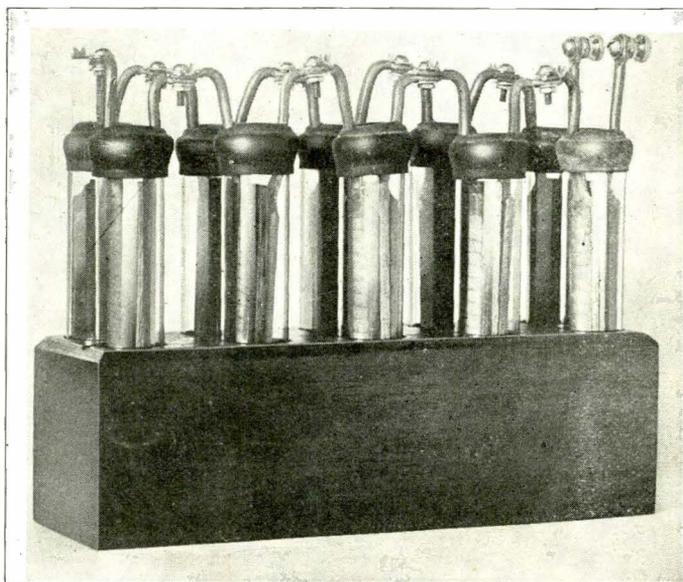
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Shipped dry with simple directions for setting up and charging.
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The Construction of an Efficient Radio Receiving Set

One of the first questions which comes to the mind of anyone who wishes to receive radio signals is "what do I require and how do I put it together?"

This article will describe the actual construction of a radio receiving set which is efficient in operation and simple to construct, requiring a minimum of material and tools as well as a very small expenditure of money. It is capable of picking up the telephone signals, music and lectures as well as telegraph signals from all amateur and commercial stations which do not use a frequency of less than 500,000 cycles per second for transmitting. This is equal to a 600 meter wave. Since the frequency which is used for the broadcasting of telephone signals at present is approximately 850,000 cycles, it is readily seen the wide usefulness of the set about to be described.

List of Material

- 1—Panel 7"x12"x $\frac{1}{8}$ " (hard rubber or bakelite or formica).
- 1—Tube—Formica or firm cardboard 4" diameter, 6" long.
- 1—Variable condenser—preferably 43 plates but may be of a smaller number of plates.
- 1—Grid and grid leak condenser (a description of how to make one will be included in this article).
- 12—Switch points (brass screws may be used).
- 1—Lb. of No. 22 Double Cotton covered (D. C. wire).
- 1—Vacuum tube socket—This may be purchased or may be made by following the instructions given in this article.
- 1—Rheostat for control of filament battery.
- 1—Switch lever with handle. (This can be made.)
- 1—Vacuum detector tube.
- 1—Unit of 22½-volt dry battery or five of the small flat 4½-volt flashlight batteries may be used.
- 1—Pair of Radio receivers complete with cord and head band. These may be 2000 ohms or 3000 ohms.
- 1—6-volt storage battery to light the filament of the vacuum tube.
- 6—Binding posts.
A few small screws and nuts.
- 1—Foot of sheet brass 1-16" thick, $\frac{1}{2}$ " wide.

Method of Procedure

The first problem that confronts the constructor is the coil which is necessary to allow "tuning" to the station desired.

The Tuning Coil

Take the specified tube and drill or punch two holes one-half inch apart and one inch from each end. These are for fastening the wire at the beginning and the end. One-half inch from each end drill a hole large enough to allow a 6/32" machine screw to pass through. These holes are for fastening two brackets used to support the completed coil. Pass one end of the No. 22 D. C. C. wire down through one and up through the other of the two holes which were drilled one inch from one end, and holding the tube firmly in the hands turn it so that the wire is wound on smooth and even until the two holes which are a half inch apart near the other end of the tube are reached. Cut the wire from the spool allowing six or eight inches to hang from the tube. Pass this end down through one and up through the other hole which was drilled and the coil will be completely wound and will not lose its shape. The tube will now have approximately one hundred and ten turns of wire wound on it.

Tapping the Coil

The next operation is to provide some means of varying the number of turns in the circuit at any one time so that stations of various frequencies or wave length may be "tuned in" or "out". This is accomplished by means of "taps". Begin at one end of the coil and count ten turns. Using the point of a needle or knife lift the tenth turn a little from the tube and insert a short piece of a toothpick under the wire at that point. This will raise the wire a trifle above the adjacent wires. Count ten more turns and repeat the operations, repeating this at the 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th, and 100th turn. All is in readiness to "tap" the coil.

From the spool of wire cut eleven pieces ten inches long. Scrape the insulation for one inch from the ends of each piece. Now at the places on the tube where the wire crosses over the toothpick scrape the insulation from the wire for one-quarter of an inch and solder one end of each ten-inch length of wire which has been prepared. This gives a total of thirteen loose ends of wire and the hard work on the coil is complete.

The brackets for supporting the coil are made by cutting off two lengths from the brass strip and bending the ends over at right angles and drilling a hole at each end to fasten to the coil and the panel. The exact dimensions of the brackets are

left to the constructor as each individual will have his own idea on this and it is not a matter of grave importance.

The Grid Condenser and Grid Leak

These may be purchased ready to be used or may be made as follows: Obtain two strips of thin copper, one and one-quarter inches long and three-quarters of an inch wide, and three pieces of thin mica or hard rubber of the same size. Lay a piece of the mica on the table and on top of it a piece of the copper then another piece of mica and then the second piece of copper and last the third piece of mica. Slide the second piece of copper between the mica so that the ends of the two copper strips are not even but are past each other one-half inch. Punch a hole one-quarter inch in from each end and insert a screw with a nut on it in each hole making certain that the screw at one end touches one strip of copper and the screw at the other end touches the other copper sheet, but be very careful that the two strips of copper do not touch each other nor must either screw touch both strips of copper. The condenser is now complete and all that is necessary to make the leak is to run a strip of paper from one screw to the other and draw pencil lines on the paper from one screw to the other, the number of lines depending on the character of the particular vacuum tube which is used. This will be determined by using the tube, erasing some lines if it is found there are too many and drawing more if there are not enough.

The Vacuum Tube Socket

It is best to purchase this from a supply house

but it may be made as follows:

From a piece of two by four or a board an inch and a half thick, which is dry, cut a block two and one-quarter inches square and drill a hole in the center one and three-eighths inches in diameter. Cut four strips of brass one-quarter inch wide and one and three-quarters inches long and screw one to the wooden block at each corner so that the four project in toward the center of the hole, being careful that they do not touch each other. These form the four contact springs for the terminals of the vacuum tube.

The Rheostat

The rheostat is best purchased. This is used for controlling the amount of current which flows from the six volt storage battery through the filament of the vacuum tube.

The Switch Lever

This will be purchased, its cost being in the neighborhood of twenty-five cents.

The storage battery, binding posts, screws, etc., will probably have to be purchased. The cost of all the material not including the storage battery will probably be about fifteen dollars if the items, the construction of which has been described, are made at home, and not over twenty dollars if everything is purchased at a supply house. The price of a storage battery will vary from eight to thirty dollars depending on the quality and size which one wishes to invest in.

The assembly of the equipment and the circuit wiring will be described next month.

(To be continued.)

BATTERIES

Batteries are divided into two classes: primary batteries and secondary batteries.

Primary batteries are those which convert chemical energy into electrical energy by the gradual eating away of certain elements in the battery and a change in the physical composition. The ordinary dry battery is an example of a primary battery.

Secondary batteries are those which require electrical energy put into them this causing a chemical change in the battery and then are cap-

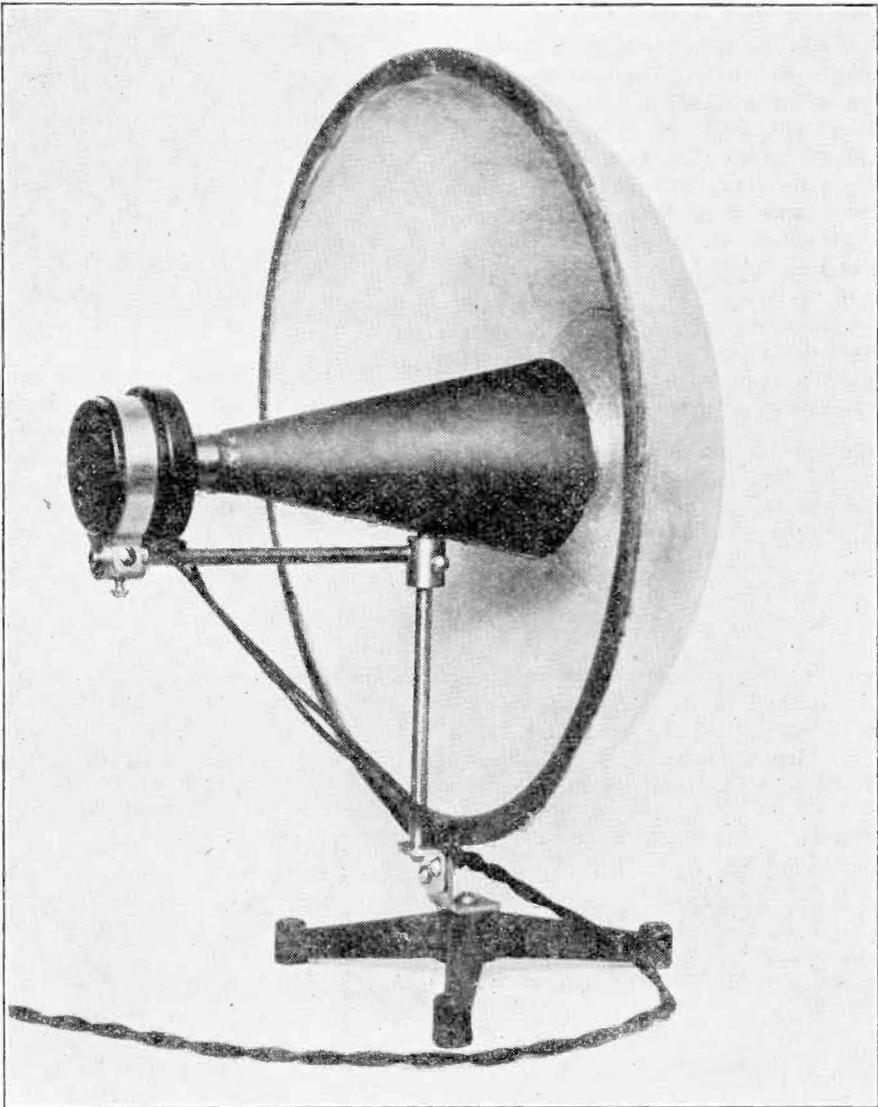
able of a chemical re-action which converts chemical energy into electric energy. The storage battery is an example of the secondary battery.

The advantage of the secondary or storage battery over the primary battery is that when the chemical reaction has progressed to a point where the battery is nearly exhausted it may be rejuvenated by connecting it to a source of direct current. When it is in an exhausted condition it is said to be discharged and when it is restored it is said to be charged.

ELECTRICAL UNITS

Just as we have a unit of money such as one dollar, a unit of length, one inch, a unit of weight, one pound or one ounce, a unit of time, one second, etc., so in electricity we have units for various things.

The unit of resistance is one ohm; the unit of potential is one volt; the unit for the rate of flow of a current is one ampere; the unit of capacity is one farad and the unit of inductance is one Henry. These are the most common units with which we deal in radio and are internationally the same.



A REAL LOUD SPEAKER

By L. SURKAMER

The loud speaker shown on this page can be built by anyone having a few tools and a few hours of spare time.

The outstanding features are that it is easily made, is small and compact and amplifies without distortion or change of pitch.

The reflector is made from a wooden chopping bowl. In the center of this bowl is the deflector. Fig. 1 which is made of wood turned to shape on a lathe. If a lathe is not convenient, this could be made of putty and shaped by hand.

The tripod base can be purchased from any dealer handling laboratory supplies and should have legs about four inches long.

The support ("A", Fig. 2) for holding the bowl is made of brass $\frac{1}{8}$ " thick by 1" wide with one end bent at a right angle and the upper part bent to fit the curved back of the bowl to which it is fastened with two short round-head wood screws.

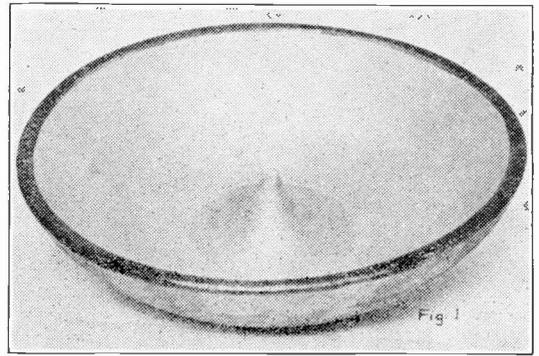
Two $\frac{1}{8}$ " brass rods for the receiver support will be needed. The length of these will be determined by the size of the bowl. One end of

these rods should be finished as in Fig. 3 which also shows the bracket ("A") for holding them.

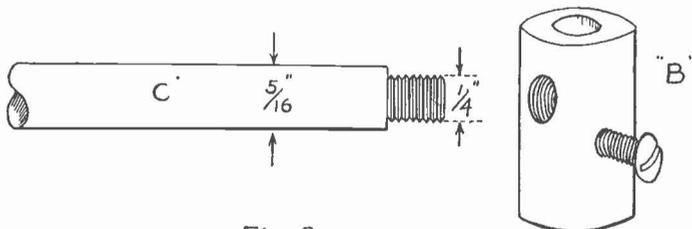
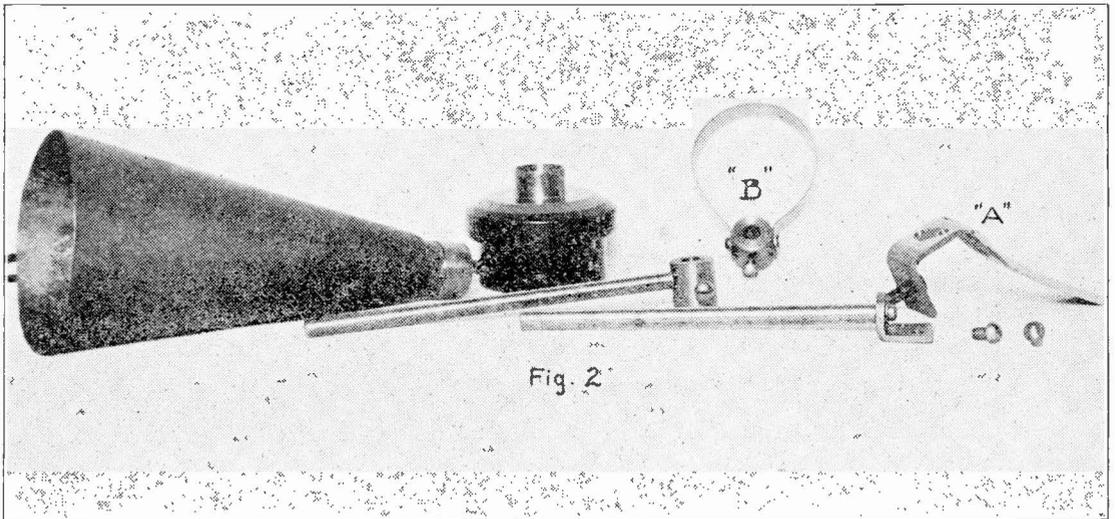
This bracket is made of $\frac{1}{8}$ "x1" brass bent at right angles and is screwed to the front of the bowl support. The sliders should be made of brass $\frac{3}{4}$ " in diameter with a $\frac{5}{16}$ " hole drilled through the center. Each slider should be drilled and threaded for a set screw. One slider ("B", Fig. 3) is drilled and threaded for the slider rod ("C", Fig. 3) to which the receiver is attached.

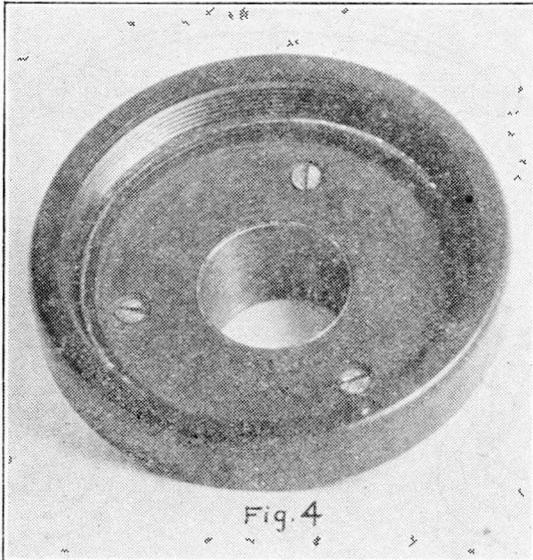
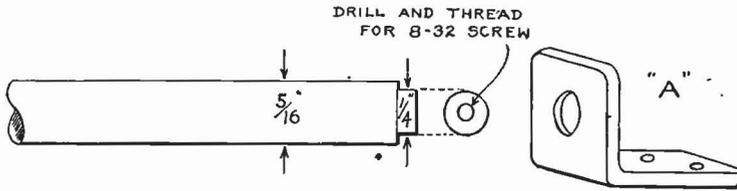
To attach the receiver drill two holes in the side of the slider ("B", Fig. 2) and put a band of thin brass about $\frac{1}{32}$ " thick around the receiver shell. This should be a snug fit when the screws are just started so that when they are screwed home the band will draw tight.

Now for the hardest job of all. If you have access to a small lathe, everything will be easy. Chuck the receiver cap in the lathe and turn off the face until it is flat. Then turn out a flat piece



of brass $\frac{1}{8}$ " thick and cut out the center to take a tube which should be about the same size inside as the hole in the receiver cap, and either thread it or else sweat it into the brass plate. Now drill three holes through the front of the receiver cap and the brass plate, and thread the holes in the brass for 2-56 flat-head screws and then counter-





sink the screw holes in the back of the receiver-cap so that when the two are screwed together the screw heads will be flush with the cap (Fig. 4). If you are unable to make this cap, there is a cap on the market made for attaching a receiver to a phonograph that sells for a reasonable price.

The horn can be made of paper but copper makes a much better job and kicks out more noise and besides is easy to work.

Now, as to the best receiver to use. Any receiver will work, but some are much better than others, and the writer prefers the Baldwin, as the reproduction is much better and much louder than any other type he has used. In fact with the two step amplifier that the writer uses, with 100 volts on the plate, the volume is so great at full amplification on broadcasting stations nearby as to be absolutely unbearable in an ordinary room, and distant stations such as WWJ, KDKA, WGY, and WJZ can be distinctly heard in the basement of his home with the loud speaker on the second floor.

CONDUCTORS AND INSULATOR

All substances will allow electricity to flow through them or on their surface but there is a vast difference in the ease with which this is done.

Those substances which allow a current of electricity to pass readily are called "conductors" and those which obstruct the flow of electricity are called "insulators".

The following are good conductors: Silver, copper, gold, aluminum, zinc, platinum, iron, nickel, tin, lead, antimony, mercury and bismuth.

A number of fair conductors are: Charcoal, carbon, plumbago, acid solutions, salt water, metallic ores, living vegetation and moist earth. Partial conductors are water, the human body, dry wood and marble. Insulators: slate, oils, porcelain, dry leather, paper, wool, sealing wax, sulphur, resin, gutta percha, shellac, ebonite, mica, amber, paraffine wax, glass and dry air.

The opposition which a substance offers to the flow of an electric current is called "the resistance of the substance".

ELECTRIC CURRENT

Electric current is divided into two classes, direct current and alternating current.

Direct current is usually abbreviated D. C. and alternating current is abbreviated A. C.

Direct current is caused by the charges of electricity moving along a wire always in the same direction, while alternating current is caused by a periodic change in either the character of the charges or in the direction of flow.

Alternating current is always one of the following—low frequency, moderately high frequency or high frequency.

Low frequency alternating current is usually considered as that current which changes its

character or direction of flow, from twenty to one hundred times per second; it is used for power and lighting work, to drive the street cars, run factory motors or light the homes.

Moderately high frequency current is current which undergoes the same changes as low frequency at a more frequent interval, from one hundred times to twenty thousand times per second. Its most common use is found in the field of wire telephony.

High frequency current is current which changes its character or direction of flow twenty thousand to two or three million times per second—a bit fickle, I should say.

Its greatest use is probably found in radio.

Fundamental Principles of Radio

No attempt will be made here to completely cover the field of Radio Communication but to thoroughly enjoy any subject it is well to know something of the fundamental principles of that subject.

Principles Pertinent to Radio

There are two general classes of electrical phenomena—static electricity or electricity at rest and current or dynamic electricity, electricity in motion.

Electro-Static Electricity (The Charge)

We have all noticed that when we use a rubber comb on our hair, especially during cold clear weather, difficulty is experienced in causing the hair to "stay put". The same effect may be produced by rubbing a glass tube with silk and tearing paper into small pieces and bringing the glass tube near them—they are attracted to the tube.

When the comb or the glass tube has acquired these properties of attracting light bodies, we say they are "electrically charged". The "charge" on a body is either negative (—) or positive (+).

This effect of bodies attracting other bodies indicates that a force of some kind exists in the space surrounding them, and it is said that there is an electrostatic or static field about them. We think and speak of this static field as being composed of a great number of "lines of static force". These lines cannot be seen but only their effects observed.

Figure 1 shows the static field of force which exists between a body with a positive charge on it and another with a negative charge on it.

It will be noted that the lines of force are crowded together between the two bodies and are further apart in the space away from the bodies indicating an intense field directly between them with a falling off of intensity as the distance away is increased.

Figure 2 shows the field surrounding two bodies each of which has a positive charge. Here it will be noted that the lines repel each other or are driven apart. However, electrically charged bodies do not always attract each other, but sometimes repel. This is demonstrated by the following:

If we rub a piece of sealing wax with fur and touch some small pieces of paper, we convey a portion of the "charge" from the sealing wax to the paper so that the paper is also "charged"; now if the glass rod which has been rubbed with silk touches any of the particles of paper the same

thing occurs and we will find that the particles touched by the sealing wax will be attracted by the particles touched by the glass rod, but one particle touched by the glass rod will repel another particle which has been touched by the



FIG. 1

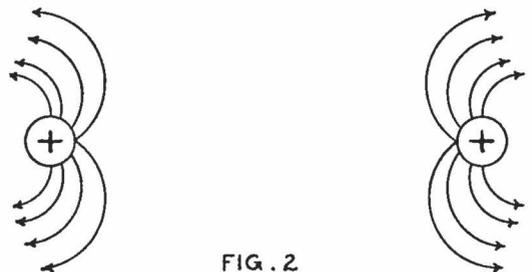


FIG. 2

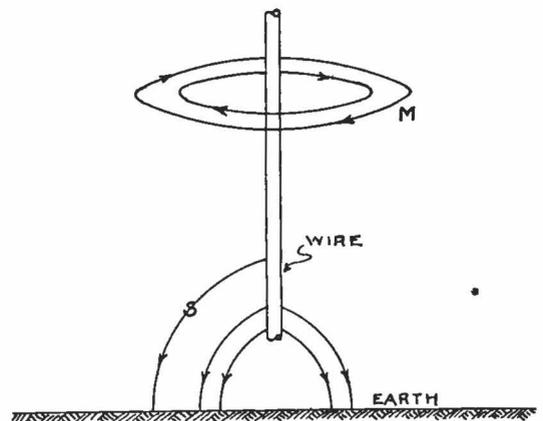


FIG. 3

glass rod, which establishes for us the principle that:

Charges which are alike repel each other and charges which are unlike attract each other.

This effect may be produced in a number of different ways. In the case cited the glass was charged positive (+) and the sealing wax charged negative (—).

The static forces are, in general, perpendicular to the surfaces of the charged bodies.

The amount of electric charge which may be conveyed to a body with the method described is small so that in practice other means must be used when it is desired to produce a large electrical charge.

The following methods are used to create charges of electricity which are large enough to have practical value—spark coils operated by batteries, transformers operated by the lighting current in our homes and electrical machines called dynamos.

Radio depends upon this principle of charged bodies, as it is the alternate placing of an electric charge on and removing it from the wire which we usually place in the air for use as an antenna, which enables us to send signals from one place to another without the use of wires connecting the two or more places.

Dynamic Electricity—Electricity in Motion—Current

We may transfer the charge of electricity which is on one body to another if the charges are of different kinds, without causing the bodies to touch each other if we connect the two by means of a wire and we may connect with a wire one body which has a charge on it to one which has no charge and thus charge the second.

When a connection of this kind is made the static charge on one flows through the wire to the other body, and this movement of the charge of electricity becomes what is known as a current.

The current will flow along the wire from the positively charged body to the negatively charged one or from the positively charged to the uncharged body.

This is what happens when we press the button to ring the door bell at home—we have a battery made up of a positive element and a negative element which we connect by pressing the button and cause electricity to flow through the wires which run between the battery, the button and the bell. The electricity was at rest until we caused it to move by pressing the button.

If the charge which we cause to flow along a wire is always a positive charge or if it is always a negative charge, we obtain what is known as a direct current (D. C.), but if we cause first a positive charge to flow along the wire and then a negative charge, we obtain what is known as an alternating current (A. C.).

The Magnetic Field of Force

If we connect the positive terminal of a battery with the negative terminal by means of a wire thus causing a movement of the electric charges and a current to flow along the wire, and bring a compass needle close to the wire, we will ob-

serve that the compass needle is disturbed by some force which we cannot see. When the compass is removed from the vicinity of the wire the needle is no longer disturbed. This indicates that there is some force close to the wire which has an influence on the needle. This force is known as magnetic force and the space immediately surrounding a wire through which a current of electricity is flowing is called a magnetic field.

We think of this magnetic field as being made up of a great number of lines of magnetic force. These lines assume the shape of circles around the wire they are associated with. Thus we see there are two kinds of forces surrounding any wire which has an electric current in it, first the static force due to the electric charge on the wire, and second the magnetic force due to the current flowing in it. These two forces are the great underlying ones upon which radio depends, since what we actually do in transmitting a radio message is to cause an electric current to flow along the antenna, thus establishing an electrostatic field and a magnetic field about the wires which comprise the antenna.

Figure 3 shows the two fields which are acting about a wire if it is placed vertically with respect to the earth and a current is caused to flow in the wire, the circles around the wire indicating the magnetic lines of force and the lines running from the wire to the earth representing the electrostatic lines of force.

In our next issue we will show how these two fields (electrostatic and electromagnetic) cause the disturbance in the surrounding medium which enables us to transmit signals between two or more distant points without the use of intervening wires.

(To be continued.)

Wired Wireless

Major General George O. Squier, chief signal officer of the United States Army, recently gave an interesting demonstration of what he terms "wired wireless".

By a means of a device which he has invented it is possible to receive broadcasted speech and news by merely screwing an attachment into the socket of an ordinary electric light fixture just as one would attach an electric flatiron or fan. The broadcasting station, of course, would have to be connected to the electric lighting system. Such a method would tend to eliminate antenna of any kind.

An Army Airplane Radio Telephone Set

By Daniel E. Moore*

Former Major, Signal Corps United States Army.

The set about to be described was developed during the World War and combines a transmitting and receiving unit in one set. By throwing over a switch the pilot can either talk to or receive messages from another airplane similarly equipped.

During the war this was known as the S.C.R.-68 set. It included an interphone set (S.C.R.-57) which enabled the observer and pilot to converse during flight.

Only the radio portion of the set will be described. A schematic wiring diagram of the S.C.R.-68 Radio set is shown.

Generator—The generator is fan driven, self excited and has a differential compound field winding and two separate armature windings. One of these supplies a 25 volt direct current for lighting the tube filaments and the other a 275 volt direct current for the plate potentials.

A feature of this generator is the use of a special two electrode tube which is mounted as part of the generator and regulate the output voltage of the generator through wide variations of speed.

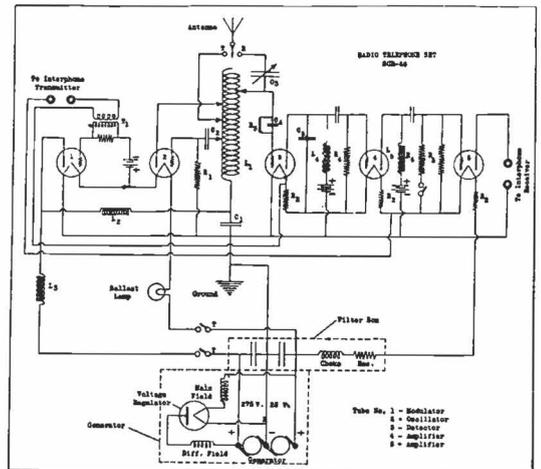
The Filter Box—The filter box contains two condensers, a choke coil and resistor and is inserted in the output circuits of the generator.

Radio Telephone Set Box—The transmitting and receiving circuits are mounted in a single box and arranged so that the operator may send or receive by throwing a switch. There are five three-electrode tubes and a ballast lamp, two of the tubes being V T-2 power tubes and three of them V T-1 tubes. The ballast lamp is in series with the filaments of the V T-2 tubes and functions as an additional regulator. It has a single hairpin filament and its characteristics are such that it has a very steep rise in resistance as the current increases, thus holding the filament circuit current constant as the generator speed varies.

A large oval shaped antenna inductance coil is so installed that it encloses the transmitting tubes. It is provided with a number of taps. This antenna coil is used in both the radio transmitting and receiving circuits and forms the electromagnetic coupling between the grid and plate circuits

of the oscillator tube. A variable condenser is connected in series with the antenna coil.

Transmitting Circuit—It is convenient to consider the transmitter as comprised of two circuit. One of the power tubes is connected in the oscillator circuit and produces high frequency current which may be termed the "carrier" current, and the other tube is in the modulator circuit and acts to vary the amplitude of the current generated by the oscillator circuit.



A switch varies the voltage across the condenser C_2 thus controlling the A. C. voltage on the grid, causing the tube to oscillate.

The range of wave lengths is from 215 meters to 450 meters.

Receiving Circuit—In receiving, the main switch is placed in the "receive" position. The plates of the variable condenser C_3 , are locked in any position by tightening a screw provided for the purpose.

Two stages of amplification are provided.

The resistor R_6 , shunted across the grid circuit of the second amplifier tube and in parallel with the resistor R_5 , may be cut in or out of the circuit to increase or decrease the amount of amplification.

*Associate Institute of Radio Engineers.

Rubbing Aladdin's Lamp

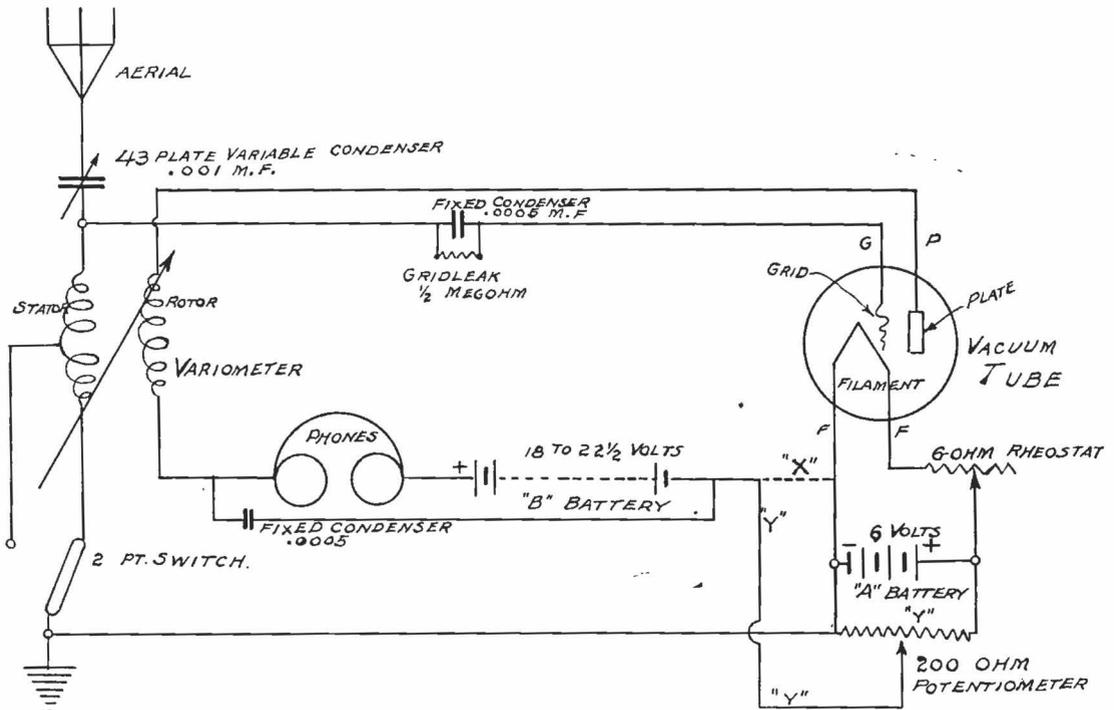
By C. Y. Davis

About the middle of January the local newspapers contained short articles of probably 25 or 30 words which told of the successful broadcasting of the Chicago Grand Opera performances by wireless telephone. To most of us "wireless" meant a very complex system of dots and dashes but upon inquiry I found that transmission of voice was being successfully accomplished and over considerable distances and was being received by means of simple apparatus.

Further inquiry brought descriptions of simple hook-ups and a list of some of the essential pieces of apparatus. From this information the circuit shown was built and a test was made to see if

the Opera could be heard. Clear and loud came the music from "Madam Butterfly" broadcasted from Station K.Y.W. The try-out was a success. Each night thereafter until the close of the season "Grand Opera" was brought right into the home.

At the close of the opera season K.Y.W.'s nightly concerts were enjoyed, and one night I discovered that by close adjustment of the filament battery and by very close tuning, K.D.K.A. at Pittsburgh and W. B. I. at Detroit could be heard very clearly but not very loud. This opened up a new line of investigation and since that time the following distant radiophone stations have been heard:



- Springfield, Mass.—W. B. Z.
- Deal Beach, N. J.—2 X. J.
- Schnectady, N. Y.—W. G. Y.
- Anacostia Navy Yard, D. C.—N. S. F.
- East Pittsburgh, Pa.—K.D.K.A.
- Detroit, Mich.—W. B. L. (Now W. W. J.)
- Cincinnati, Ohio—(Call not obtained).
- Denver, Colo.—(Call not obtained).

Considering the fact that no amplifiers are being used, these results seem almost as remarkable as the old story of "Alladin's Lamp" and I can heartily recommend the use of this hook-up for all amateurs who want a simple inexpensive receiving set. It is not very selective and you may be bothered some by spark sets, but it sure does reach out and get the radiophone stations.

(Continued on page 10)

APPARATUS REQUIRED

- 1—43 Plate Variable Condenser.
- 1—Standard make Variometer.
- 1—.0006 M. F. fixed condenser with $\frac{1}{2}$ megohm leak.
- 1—.0005 M. F. fixed condenser without leak. (Not essential).
- 1—6 Ohm Rheostat (with vernier preferable).
- 1—Pr. high resistance phones.
- 1—Detector Vacuum Tube.
- 1—Vacuum Tube Socket.
- 1—200 Ohm Potentiometer (may be omitted,

in which case substitute X wiring for Y_wiring).

1—2 Pt. switch (may be omitted, in which case connect grd, to point on which switch now stands)

1—22½ Volt "B" Battery (tapped battery preferable, may be made up from flat flash light batteries).

1—6 Volt storage battery.

50 to 100 feet of No. 14 aerial wire.

Enough insulated No. 14 wire to reach from aerial to set.

Radio—A Permanent Utility

Probably no scientific development ever took such a hold on the public as radio has. In the past ten months the number of stations which have been installed has increased by leaps and bounds until now the only thing which limits the number seems to be the inability to obtain the required apparatus and material.

The Government radio inspectors are flooded with applications for licenses for transmitting stations and receiving stations which, of course, require no license, are growing like mushrooms. The supply houses cannot get the material inside their doors fast enough. As an example, one of our contributors told me that last week he scurried around to fifteen large supply houses, whose service has heretofore been all that one could desire and was compelled to be satisfied with forty per cent of the material he wanted to purchase. One manufacturer who concentrates on two items, one of which is vacuum tube sockets, informed me yesterday that the machines in which these sockets are moulded have not been cooled at any time in the last forty-five days, and that even with the enormous output which his plant has, his service department is swamped with telegrams and mail from distributing houses, begging him for supplies.

The practical application of radio is just beginning to be utilized. The farmer no longer has to wait for the next morning's paper to see how the produce market is going. After the "chores" are cleared up for the day all he has to do is step to a corner of the house, put on a pair of head receivers, turn a switch and get the latest selling and bid prices for live stock, grain and other commodities. No longer is it necessary for a public speaker to travel from town to town in order to address a few thousand people during a

period of several days. In one evening he can address hundreds of thousands, thus allowing him more time to prepare his work and consequently his audiences benefit thereby.

During the past year, thousands of people in the United States enjoyed grand opera, who probably would have waited years before they had the opportunity.

During the last week of April, President Harding's voice was heard practically all over the United States by radio telephone.

For years the telephone and telegraph companies have been leasing certain of their wires to the newspapers, banks, stock brokers and anyone who wished them. Now the installation of radio transmitting equipment is under way for the same purpose.

But think of the larger possibilities in the dissemination of information by radio.

Elsewhere in this issue is a description of what one of the larger companies who furnish communication service, is doing in radio.

The Wisconsin State Health Board states that a sixteen-year-old pupil at the State School for the Blind at Janesville, Wis., can "hear" telephone conversations through her finger tips.

This girl is totally blind and deaf but has a nervous sensitiveness so highly developed that she "sees" by the sense of smell and "hears" by the sense of touch. By using an ordinary telephone receiver and placing her finger tips on the diaphragm she recently astounded physicians and psychologists when she accurately repeated a telephone conversation. She is able to carry on a conversation by placing a wooden rod on the head of the person with whom she is speaking and picking up the vibrations of the rod.

Q.R.M.

Despite the efforts of the local and national organizations as well as the existing radio laws, a great many stations persist in disregarding the other fellow by turning on all the power there is in the station whenever the thought occurs to them and let the meter tick around, helping pay the electric light and power companies dividends, but bringing down on their unthinking heads maledictions loud and damning. This interference is not confined to so-called "Hams", but some of our "best families" in a radio sense at least, being the most flagrant offenders. Operators, long in the radio game, are prone to kick over the traces every once in awhile and fling a book or a hammer or something just as heavy onto the key, starting out on its fickle career a stream of disturbance that would cause Confucius to get riled.

The queer part about the whole thing is that some of the worst cases of interferences are caused by men who know better and are entrusted with the enforcement of certain rules, which they utterly disregard. This condition is not a new one but is being brought home more forcibly to the public in general since the broadcasting programs have been entered upon.

The radio laws are not above reproach either.

Consider for a moment if you will, two people seated at two pianos in opposite ends of a room. The pianos are pitched exactly alike. The performers both strike middle "C" at exactly the same time. You, Mr. or Mrs. or Miss Observer, are seated between and equi-distant from the pianos. How can you pick out one piano tone from the other?

Well, that is exactly the condition we have today among the broadcasting stations.

The license issued to broadcasting stations direct that they transmit on a so-called three hundred and sixty meter wave, in other words, use an alternating current which will change its character or direction or flow approximately 850,000 times per second. Assume that the stations observe the regulations. How is it possible to time either of two stations out with a receiving set located at equal distances from the two transmitting stations if they both have the same power?

That is bad enough but just about the time that one of the broadcasting station's schedule time is up and the music or lecture from the other one

is coming right enough to give one something to be thankful for, along comes an amateur who is allowed to operate a transmitting station through the kindness and generosity of a government which says to him, "My boy, you bet you can legally operate that station since you have demonstrated to me that you can punch a key and tell what some one else is saying by means of a key if he doesn't go too fast, and you know a few fundamentals of electricity. But at any time that you want to transmit radio signals from that station you will first "listen in" and make sure that you are not going to interfere with any one else who may be transmitting; you will not transmit a longer wave than two hundred meters; your decrement must not exceed .Z; and observe a few other little things that no reasonable person would think of not observing"—and what does Mr. Amateur do? He sends out a wave that hovers between two hundred and sixty-five meters and four hundred meters; his decrement cannot be measured by any approved method and does he listen in first? He does—not, with the result that the particular number on the program that night that you had hoped to be able to enjoy is all lost due to the jamming that he causes.

Now that sort of thing was gotten away with in the old days, but a new order of things is here. There are people in the radio game to-day as amateurs, just like you and me, who are responsible for the making of laws, rules and regulations which have as their basis the beneficial interests of the majority of the people. These men are going to take a hand one of these days after they have become disgusted with the actions of the fellows who don't play the game square, and then we will all be sorry.

There will be no more five hundred and one thousand watt transmitting sets in amateur stations of any type; the amateur will be compelled to stay on some outlandish wave length that will prevent him from sending even into the next country at least for some years and a lot of other restrictions that are going to leave a bad taste in our mouths.

You know it was pretty hard to find anyone, right up until the last, who would admit that the Eighteenth Amendment could be passed in this country, let alone would be passed.

But do you know there are places pretty arid right here?

Distribution of Call Letters

The Service Regulations of the International Radiotelegraphic Conventions provide that the call letters of stations in the international system must each be formed of a group of three letters which shall be distinguishable from one another. These have been modified and added to from time to time.

The call letters assigned to Public Service stations of the United States are all three and four letter combinations beginning with the letter N, and all beginning with the letter W, and all combinations from KDA to KZZ, inclusive. The international call letters assigned to the United States are reserved for Government stations and stations open to public and limited commercial service.

All combinations beginning with the letter N are reserved for Government stations and, in addition, the combinations from WUA to WVZ and WXA to WZZ are reserved for stations of the United States Army. (From the Commercial and Government Radio Stations of the United States.)

We shall, from time to time, publish the call letters of Amateur, Commercial and Government Radio Stations, but anyone who wishes may secure a complete copy of each list by addressing a communication to the Superintendent of Documents, Government Printing Office, Washington, D. C., and forwarding fifteen cents for each copy desired.



INTERNATIONAL

Paper Has "Listing" Circulation of 30,000

Miss Bernie Smith of the Atlantic-Pacific Radio Supplies Company, San Francisco, checks up on the news of the day sent out by radio from an afternoon paper which has a "listing-in" circulation of 30,000, which is growing at the rate of 5,000 a month. From Rock-ridge broadcasting station in Oakland, News reports, dance music, sermons, and all sorts of aerial information is sent all up and down the Pacific Coast and to ships at sea.



INTERNATIONAL

They Even Make Love Over the Radio Phone

At the Annual Radio Show held at the Hotel Pennsylvania, Miss Gladys Wyville utilized the radiophone to send a kiss to her sweetheart in Pittsburgh, and he replied, "What could be sweeter, honey?"

Hotels throughout the country are now installing receiving stations by means of which their guests are able to enjoy the programs of radio broadcasting stations.

Questions and Answers

Question: Is it possible to transmit by telephone with a receiving set? J. T. W., New Jersey.

Answer: It is quite possible to transmit for comparatively short distance with a receiving set if the set is of the vacuum tube type. This may be accomplished in several ways, among which are the following:

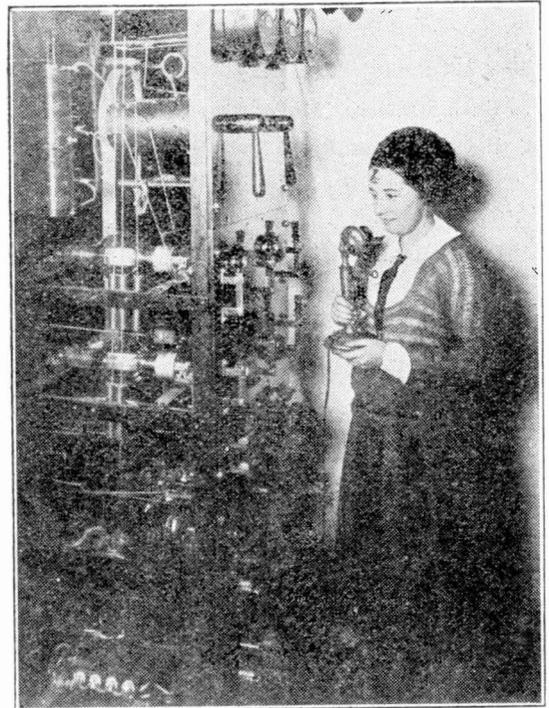
- (1) If the set is a so-called single circuit tuner set, simply connect an ordinary microphone transmitter in series in the ground lead.
- (2) If the set is of the loose or vario-coupled type, cut an induction coil secondary in series with the plate circuit in place of the head receivers and connect the primary of the induction coil, a microphone transmitter and a few volt of battery in series and talk.

Question: Does the number of stations listening in, have any effect on signals? C. D. H., Cleveland, O.

Answer: This question is in the minds of many scientists at present, but we know of no answer to it. We know that a given transmitting station radiates a certain amount of energy and that it requires a certain amount to cause any effect at each receiving station, so that it would seem that a point could be reached where all of the available energy was used and when the next station listened in, it would be left out in the cold—like standing in line for tickets to be confronted with the “tickets all sold” sign when you reached the window. However, there is one thing which occurs when one or more receiving stations are listening in if they are equipped with vacuum tubes. When the tubes are in a so-called oscillating condition there is a transfer of energy from the set to the antenna and the station becomes to all intents and purposes a transmitting station. Now multiply that by several thousand and it is easy to understand that even receiving stations can cause disturbances.

Question: What is a good kind of antenna to use for receiving the music which is being broadcasted? T. B. W., California.

Answer: Almost any kind of an antenna is good for this work provided it is not over two hundred feet in length, because if it is longer than this the fundamental wave length of the antenna system will be such that you cannot tune to three hundred and sixty meters, the wave length usually used. Better that the antenna be one hundred and twenty-five feet long and thirty to forty feet high unless you are closed in by trees or other obstacles. The length may be either horizontal or vertical. The high antenna is subject to more static disturbances than the long low one.



INTERNATIONAL

A Radiophone That Carries 2,000 Miles

This powerful radio telephone set, in the Thomas G. Plant Shoe Factory at Jamaica Plains, Boston, is able to clearly carry a radio message for a distance of 2,000 miles, probably one of the most powerful of its kind in the country. This transmission is said to be a record for the new method of telephony.

Patents

The purpose of this section is to enable those interested to keep abreast of the developments in radio. It is hoped that engineers and others will avail themselves of our records and possibly save time and effort thereby.

Copies of the patents listed may be secured from the Commissioner of Patents, Washington, D. C., for ten cents each.

- 1,388,793—Vacuum Tube Converter—Wilfred T. Birdsall, Montclair, N. J. Assigned to the Westinghouse Lamp Company.
- 1,388,936—Radio Telegraphic and Telephone Apparatus—Portable—Horace St. John de Aula Donistrophe, London, England.
- 1,389,026—Radio Receiving System—Vannevar Bush, Chelsea, Massachusetts. Assigned to the American Radio and Research Corporation.
- 1,389,351—Means for Supporting the Elements in Vacuum Tubes—Charles Howard Harvey, London, England. Assigned to the General Electric Company, Ltd., London, England.
- 1,389,800—Radio Signalling Apparatus using several antenna, means being provided for the elimination of static disturbances—Roy Alexander Weagant, New York City, N. Y.—Assigned to the Radio Corporation of America.
- 1,390,288—System for Controlling Moving Body by Radio—John Hays Hammond, Jr., Gloucester, Massachusetts.
- 1,391,671—Thermonic Tube for Use in Radio Telegraphy and Telephony—Horace St. John de Aula Donistrophe, London, England.
- 1,391,855—Radio Transmitting System Employing a Vacuum Tube and a Loop Antenna—Henry K. Sandell, Chicago, Illinois. Assigned to Herbert S. Mills, Chicago.
- 1,393,077—Electrical Condenser—William C. Brinton, Jr., Kennett Square, Pennsylvania. Assigned to Philbrin Corporation.
- 1,394,056—Radio Signaling System, using a vacuum tube. William C. White of Schenectady, New York. Assigned to the General Electric Company.



INTERNATIONAL

Order Theatre Reservations Now By Wireless

Have you decided to take your girlie to the movies or theater? Well, you won't have to worry about getting choice seats if you have a wireless set in your home. Now, if you should happen to live in the Bronx, which is a part of New York City, all you have to do is get Miss Theresa Harding, operator of Keith's Royal Theater, who is seen here at the receiving station recently installed by the theater management and reserve your seats. Mr. Alfred T. Albee, who manages the Keith Circuit of theaters throughout the country, is inaugurating a wireless system in all his theaters and can keep in close touch with them from his home in Larchmont.

A Survey of the Field of Radio Communication.

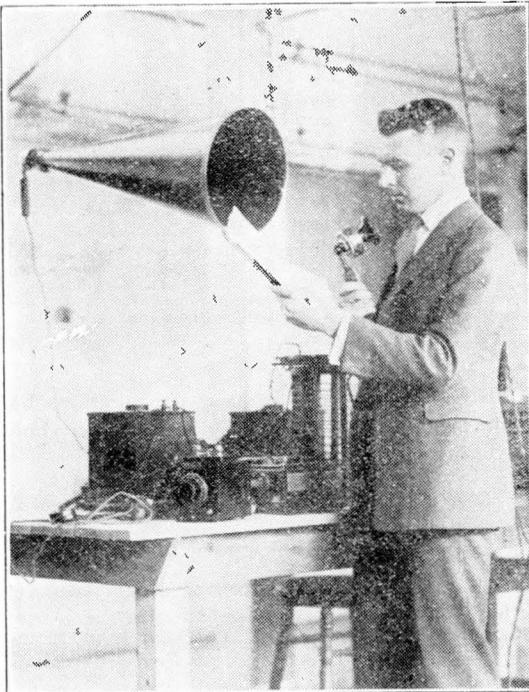
The transmission of signals by means of unguided electric waves was introduced in 1896 by Guglielmo Marconi. Three years later signals were successfully transmitted without wires between Dover, England, and Boulogne, France—a distance of thirty-two miles. Rapid strides have been made since that time until, to-day, it is entirely practicable to establish communication between New York and Honolulu, Paris, Tokyo, and any place on the earth which is inhabited and equipped with the proper instruments, without the use of wires between the points.

At first the efforts of scientists were confined to signaling by means of the dot and dash method, but gradually progress was made in the science which enabled people to talk with each other the same as they could on an ordinary telephone,

in fact one thing has been accomplished by means of the radio telephone which finds no counterpart in wire telephony, namely, the human voice has been heard around the world, the American Telephone and Telegraph Company having succeeded in 1915 in transmitting a message from Arlington, Va., to Honolulu and Paris by means of the radio telephone.

Previous to the World War, interest in radio was confined largely to scientists and a small number of experimenters who installed apparatus to carry on communication with each other; to the Army and Navy and a few commercial companies. Much of the work of the aforementioned was confined entirely to the dot and dash method of communication, called radio telegraphy.

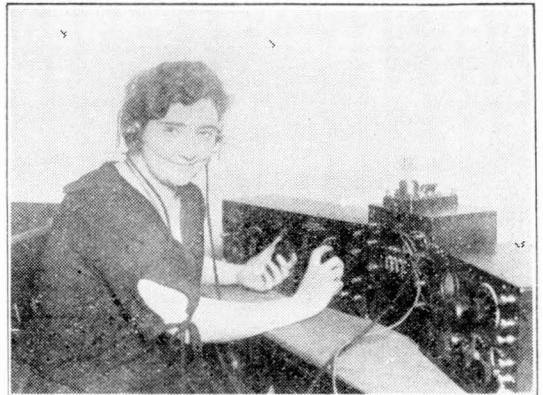
During the war and since, a rapid development in radio telephony has occurred until now it is possible for one to sit at home with a receiving set and listen to the best musical artists, well known public speakers, government officials and others; to hear church services, addresses on Public Health, Fire Prevention and in fact no end of topics, by turning a small switch and with a small outlay in money.



INTERNATIONAL

Reporting News By Radio

L. D. Trefry is shown reporting news to the newspapers, as the latest innovation in radio. At this same station at Medford Hillside, Mass., the Boston American broadcasts its news every evening, and is believed to be the first newspaper to do this.



INTERNATIONAL

Meet Your Radio Teacher

The Cook County Board of Education has inaugurated a course in radio in many of Chicago's high schools, in the belief that the commercial future of the radio is such that it becomes as much a part of the education of the coming generation as commercial law, or any other of the accepted high school courses of studying.

Photo shows Miss Elizabeth A. Bergner, radio instructor at the Lane Technical High School, Chicago.



INTERNATIONAL

First Landlord to Furnish Radio Equipment

The father holding the baby is A. I. Weinberger, who was called "The Boy Wonder" by the newspapers back in 1910, when he demonstrated his wireless controlled boat in Jackson Park, Chicago, as well as his portable wireless set which he used with the aid of an aerial suspended by kites. At the extreme right is his friend, A. E. Gundelach, who treats his friends to "radio" concerts every evening. Mr. Gundelach boasts of being the first, if not the only, landlord to supply a complete radio equipment with each of his flats without any additional charge.

Medical Aid by Radio

Ships at sea which do not have a physician as a member of the crew are now able to get medical advice by radio. This service is rendered through the coastal stations by the Radio Corporation of America working in conjunction with the Public Health Service.

Surgeon General Cummings has issued the following order to the senior surgeon at the Hudson Street Hospital of New York:

"You are directed to furnish promptly whatever advice seems indicated, couched in language intelligible to the layman."

This service is obtained by sending a radio message from the ship to any of the listed coastal stations, the reply being radioed also. Although this service was primarily intended for ships

which had no physician aboard, consultations between a physician on the ship and one on shore can be accomplished.

Stations in the United States

It is estimated that there are more than one million radiophone sets in operation in the United States, a growth of twelve hundred per cent in one year.

Steamship America Is Heard in Chicago

On the night of March 3, amateurs in Chicago heard K. D. O. W., the steamship America, talk to station 2 X. J. at Deal Beach, N. J. The ship was one thousand miles out at sea.

China Leads the World

The longest combined radio-telephone circuit in the world was recently put into service in China.

Great difficulty has been experienced in the past with the maintenance of lines between Peking and Tientsin because of the devastation by robber bands of the copper wire leads.

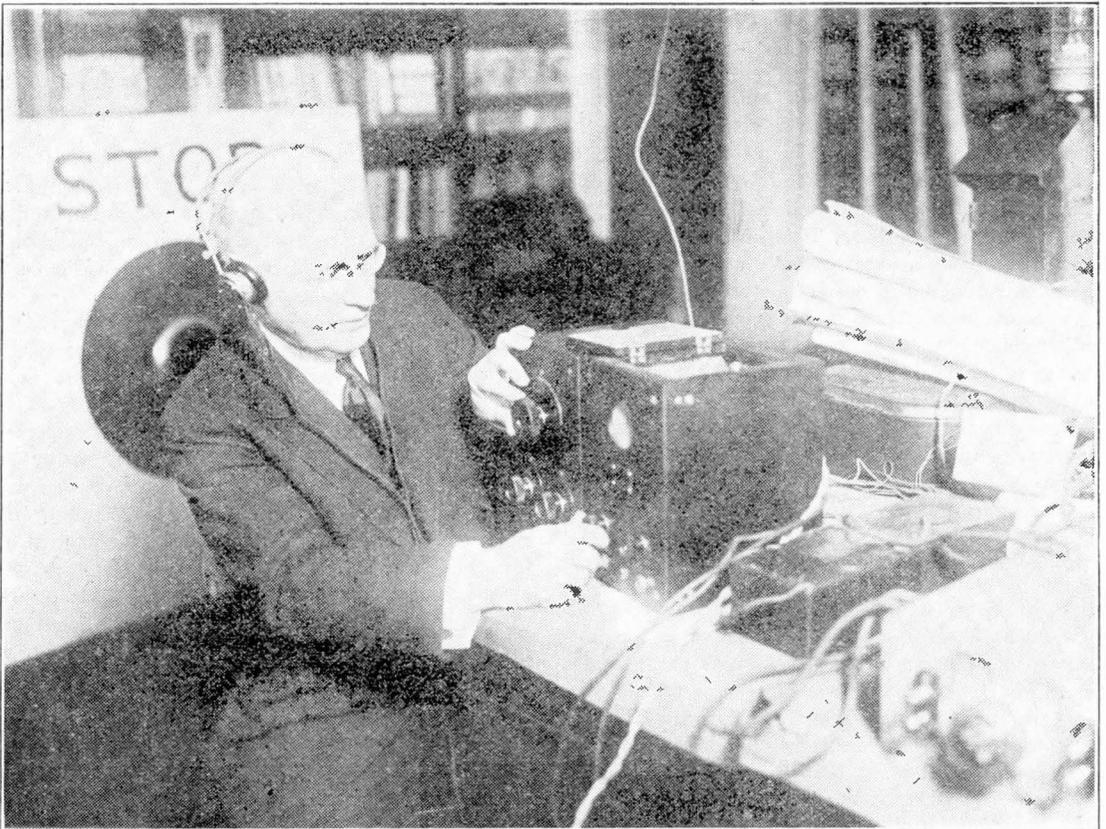
The apparatus was manufactured by the Western Electric Company and includes certain features to insure the greatest possible freedom from interference due to atmospheric and other causes. The normal range is one hundred miles under reasonably severe conditions and considerably farther under good conditions, as was demonstrated during the tests of the installation when the signals were at times heard one thousand miles away.

An Aid to Housewives

By "listening in" to the information broadcasted each day, the housewives throughout the country are able to keep a check on foodstuff prices.

City of Chicago Installs Broadcasting Station

The City of Chicago has installed a broadcasting station on the roof of the City Hall, Chicago, for the purpose of disseminating information on the conduct of city affairs by the city officials. In this way, the citizens are able to keep in close touch with civic affairs. A recent fire which caused a loss of fifteen million dollars offered an excellent opportunity for the fire commissioner to take up directly with the people the need of the city for an increase in fire-fighting apparatus.



INTERNATIONAL

The Future of Wireless

Chief James F. McLaughlin of the Philadelphia Electricity Bureau, whose prediction of the bright future of wireless has been hailed with promise and joy by lovers of the radiophone. Mr. McLaughlin says that no one, no matter how thoroughly they may be versed in the ways of radio, is in a position to say just what the possibilities of the radio idea may reach to. No limits are placed on achievement, no bounds of confinement. Philadelphia, he says, is constantly experimenting and will be the first city in the Union to properly adapt the municipal facilities to practical use of radio and wireless.

Single Vacuum Tube Circuits for Transmission and Reception on Short Waves.

By G. W. Hale

It often happens that amateurs who have single valve receivers are not satisfied with the results they obtain, and in consequence having done all they can to improve reception, decide that the only remedy is to use additional valves. If one can be sure that the maximum of efficiency is obtained on the first valve, there can be no objection to adding extra valves for the purpose of signal magnification. In many cases, however, the highest degree of efficiency is not reached in the first valve circuit, and no amount of signal amplification will bring in signals of a suitable strength for reception unless they are already audible when the phones are used with the first valve alone.

The majority of wireless amateurs evidently favor the simple regenerative circuit, where the grid is connected through a grid condenser to the aerial and a reaction* coil is used for regenerative amplification and self oscillation for continuous wave reception. This circuit is certainly a good one with which to make a start, as it can be quickly tuned and easily operated, but in point of sensitiveness it falls a long way short of the inductively coupled, or two-circuit receiver. The tuning is naturally more complicated than is the case with a single circuit receiver, which only requires one variable condenser, one tuning inductance and a reaction coil. The adjustments of these three are the only ones really essential for the operation of a single circuit receiver.

It is with the shorter wave lengths from 180 up to 3000 meters that the two circuit receiver is most efficient, while for the long waves up to 20,000 meters, a single circuit receiver is perhaps to be preferred, as it enables signals to be easily found and tuned in. At the same time an increase of signal strength and selectivity is noticeable on the long as on the short waves when coupled circuits are used.

In a receiver where a reaction coil is used, it should be coupled to the filament end of the tuning inductance and not at the end where the grid is connected. The reason for this is to prevent, or avoid, upsetting the tuning of the circuit when the reaction coil is moved. This, of course, refers mainly to the cylindrical coils used for

short waves. Where the honeycomb or pancake coils are used, the filament is preferably joined to the outside of the winding, and the grid to the inside. The parts of a circuit directly connected to the grid or grid-condenser are at a relatively high potential with regard to the objects connected to earth, and the movements of any conductors near this part of the circuit will disturb the tuning. This effect can always be noticed if the hand is moved about the high potential parts of the circuit, the heterodyne of C. W. signals rising and falling with each movement as the capacity of the circuit is altered. The movement of a reaction coil has a similar effect and frequently gives a great deal of trouble when tuning telephony from distant stations such as The Hague, which transmits the Sunday concerts.

*Tickler.

The slightest change from the correct tuning position is sufficient to prevent reception, and it is quite easy to see that the reaction coil should be used where it will give the least disturbance to tuning. When designing a reaction coil for use over a wide range of wave lengths, it should be wound with as few turns of wires as possible if trouble is to be avoided on short waves from resonance effects. If the reaction coil circuit, or plate circuit happens to have a natural frequency near to that of the grid circuit on any particular tuning adjustment, the set will commence to oscillate whether required to or not. Winding the reaction coil with as few turns of wire as will allow the set to oscillate on the longest wave length of the inductance used, will help to give a uniform control throughout the whole range of adjustment. In all cases the reaction coil should be used in conjunction with a by-pass condenser having a large capacity, although if this condenser is too big it will spoil the tone of the signals. With high resistance receivers connected directly in the plate circuit of the valve, a by-pass condenser of greater capacity than .003 mfd. will usually give the signals a dull or drum like tone, and telephone speech will have a muffled sound. There is one method of controlling the reaction in this circuit which avoids the necessity for any mechanical movement of the reaction coil with regard to the tuning inductance.

if the initial voltage of the signals can be doubled by the use of coupled circuits, the resulting signal strength will be four times that available when the grid is connected to the aerial circuit.

It is important to keep all connecting leads well separated if their self-capacity is to be kept low. I once saw a coupled tuner connected by about three feet of twin flexible to the terminals of a valve panel. The two leads of the flexible behaved like the plates of a fixed condenser, and consequently the range of adjustment was limited, the signals were not what they might have been. Quite a serviceable grid-condenser can be made with a foot or two of thin lighting flex, by connecting each wire at one end to the terminals and leaving the other ends insulated. The capacity can be adjusted by cutting off pieces from the loose end. Unfortunately one can only reduce the capacity in this way. Another way is to arrange a piece of flex so that it can be twisted or untwisted by turning a handle and so changing the capacity.

To receive the very short waves of 180 or 200 meters on the ordinary postoffice aerial, very little inductance is needed for tuning. On this wave length only about twelve three inch diameter turns of inductance are required. The oscillatory voltage across so small an inductance is very small, and when this is applied direct to the grid of a valve, the signals are weak. This can be remedied to a certain extent by a series tuning condenser. The series condenser between the aerial and the inductance will lower the wave length of the aerial circuit, and so permit the inductance to be increased, thereby giving a higher voltage on the grid and, improved signals.

If the capacity of the series condenser is reduced below a certain limit, no further improvement of signals is noticed; in fact, the signals will again become weaker. Greatly increasing the inductance and at the same time reducing the series capacity has the effect of stiffening the circuit, or, in other words, its electrical inertia is increased, so that it becomes only weakly responsive to passing electro-magnetic waves.

The coupled circuits, on the other hand, on these short wave lengths need a few turns only of inductance in the aerial circuit to give all the coupling necessary. The degree of coupling required to obtain the highest efficiency is exceedingly small and can seldom be made sufficiently loose with the ordinary type of loose coupler unless provision is made to separate the primary from the secondary to a distance of three or four inches. The looser the coupling of the two circuits, the more effective does a receiver become,

and, in addition, the reactive amplification of weak but sharply tuned spark signals and telephony is much greater. It is possible when receiving telephony to use a coupling so loose that spark signals cause practically no interference unless on the same wave length.

A receiving set when installed at any height above ground level, must necessarily have a long lead to earth. Consequently, the point where the earth lead connects to the apparatus is at a higher potential than earth when signals are being received, and this often results in electro-static coupling of the two circuits if the earth lead runs near the low tension (A) or high tension (B) batteries of the valve connected to the secondary inductance. This effect can be cancelled by so inductively coupling the circuits that, when the primary is moved nearer the secondary, a point is reached where all signals disappear. Where a totating coupling is used, as in many cabinet sets, this point should correspond to zero on the indicating dial.

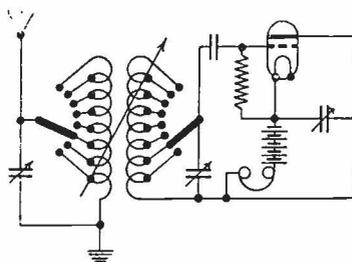


Fig. 2.

There are several circuits that do not depend on the use of a reaction coil for oscillation control. One of these is the De Forrest "ultra-audion" circuit which is used quite a lot in America. Fig. 2. This circuit depends for its action on capacity reaction. The lower end of the secondary, instead of being connected to the filament, is connected to the plate. A variable condenser of about .001 mfd. capacity is connected directly between the plate and filament, and also across telephones, and H.T. battery. Although the lower end of the secondary is joined to the plate it can also be considered as being connected to the filament through the condenser. The condenser is, therefore, in a position where it is common to both grid and plate circuits, and so any difference of potential across the plates of the condenser arising from amplified signals, or oscillations in the plate circuit, will serve to feed back a certain amount of energy into the grid circuit. When the capacity of the reaction condenser is lowered, the difference of potential across the plates becomes greater and the reaction stronger.

The capacity reaction circuit can be used direct in the aerial circuit (A, Fig. 3), and this, I think, forms one of the simplest circuits for long wave C.W. reception, but is not so suitable for short waves.

There is one disadvantage which can be got over in a simple way. It will be noticed that the variable condenser which serves to give reaction is common to both the aerial and the plate circuits, and consequently when the capacity of the condenser is altered to control the reaction, the tuning of the circuit is altered at the same time. To overcome this, three or four fixed condensers can be employed instead of the reaction condenser and the variable one can now be used in parallel with the tuning inductance. (B, Fig. 3). These fixed condensers should have capacities varying from .0003 mfd. up to .001 mfd. One side of each of the condensers is connected to a stud of a four-way switch, while all the others are connected together to the filament and earth. The usual variable condenser is used in parallel with the inductance.

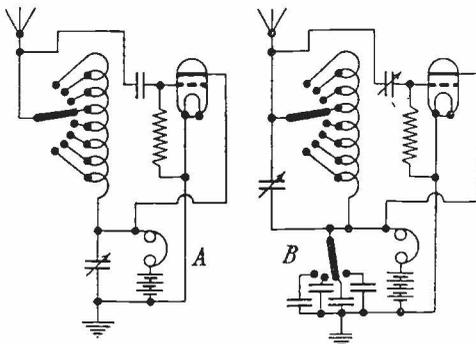


Fig. 3.

To use this circuit, the blade of the four-way switch is moved from stud to stud until a loud click denotes that the circuit has begun to oscillate. The tuning condenser and inductance are now adjusted until tuned to the wave-length of the signals to be received. For spark signals or telephony, oscillation can be finely controlled by the filament rheostat or with a variable grid condenser. The advantage of using the filament rheostat for control is that the tuning is not affected as when the reaction condenser is used for a fine adjustment. By using cylindrical inductances for wave lengths below 1,000 meters, and slab or honeycomb coils for the long waves, it is possible to cover the whole range of wave lengths with this circuit, but for any wave lengths below 1,000 meters, or thereabouts, the coupled two-circuit receiver is to be preferred.

The next diagram is of the resonance or Armstrong "regenerative" circuit (Fig. 4a). No special means at all are used to feed back energy from the plate circuit to the grid circuit in this arrangement, although the working of the circuit

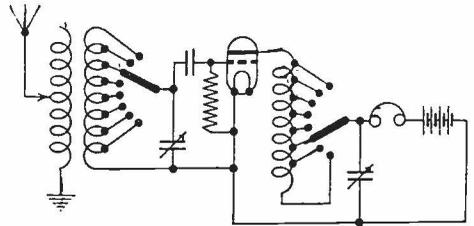


Fig. 4a.

can be more easily controlled when a reaction coil is used. In this diagram I have not included a reaction coil as it is not really necessary. The circuit, it will be seen, consists of an aerial circuit coupled to a tuned grid circuit and connected to the plate is a third tuned circuit. It will be found when using this circuit that where the aerial and grid circuits are set to a given wave-length and the plate tuning is varied, a point will be reached where the usual effects of amplification which precedes self-oscillation are noticeable. If the tuning of the plate circuit is adjusted so that it comes nearly into resonance with the grid circuit, the set will begin to oscillate automatically. Oscillation will only be set up when the plate circuit is near the point of resonance with the grid circuit. Sometimes the oscillations are so violent that the valve begins to howl as the grid leak becomes incapable of dissipating the enormous negative grid charges which accumulate. These charges reach so high a value that they are capable of shutting off the current flowing between the plate and filament, thereby stopping the oscillations. When this occurs the accumulated grid charge now has an opportunity of escaping through the grid lead until the grid becomes near enough to normal to allow the plate current and also the oscillations to recommence. A click is produced in the phones every time this occurs and if this should happen at, say, 1,000 times per second a howl of that frequency is heard. On a single valve receiver the howl nearly always indicates excessive reaction or insufficient grid leakage.

A very common form of Armstrong's circuit uses a variometer for tuning both grid and plate circuits (Fig. 4b); and some of the American short wave receivers advertised are sets of this type. Some wonderful results are claimed by

American amateurs using the Armstrong circuit for 2000 meter reception. Distances of 1500 and 2000 miles are covered by amateur stations, but it must be remembered they are not limited to 10 watts over there but may use anything up to 1 kilowatt for transmission. A single valve reaction receiver when used under proper conditions is far more selective and practically as sensitive as a three valve H.F. transformer-coupled amplifier

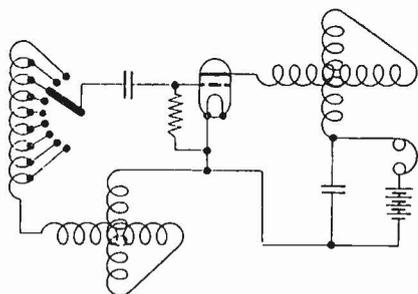


Fig. 4b.

and those short wave lengths. The effect of reaction is to reduce the damping of the set to nearly zero for the wave length to which it is tuned and to leave the damping unaffected on other wave lengths. This has the effect of making the set very sensitive to just the wave length required and comparatively insensitive to all others. A few months ago I had the opportunity of listening to the 900 metre wave telephony received on a six valve resistance and capacity coupled amplifier used with a 70 ft. high loop aerial. All tuning was done with a single variable condenser and although the speech was very loud, there seemed to be a great deal of interference from 600 metre and other stations, and, in fact, the tuning seemed to be decidedly flat compared with that of a reaction receiver with an open aerial.

There is another form of reaction circuit which utilizes a two slide inductance, or autotransformer

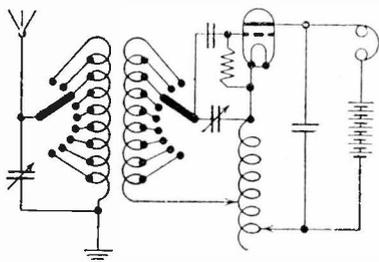


Fig. 5.

to couple the grid and plate circuits (Fig. 5). This inductance which is connected at one end to

the filament, has two sliding contacts. The right hand slider connects through the by-pass condenser to the plate and the other slider leads to the lower end of the grid circuit. The high frequency currents from the plate, in passing through this inductance set up an oscillating difference of potential between the grid circuit slider and the filament. The effect of this is to feed back a certain amount of high frequency energy into the grid circuit. By varying the position of the right hand slider the set can be made to reactively amplify or to oscillate for autodyne C.W. reception. The ordinary two slide tuning inductances that formerly were used for crystal reception can be pressed into service for a circuit of this type.

Figure 6 shows a useful circuit which is often used for oscillating wave meters and can quite easily be adopted for use in receiving sets. The ends of the oscillating circuit are connected to the grid, and through the H. T. battery to the plate.

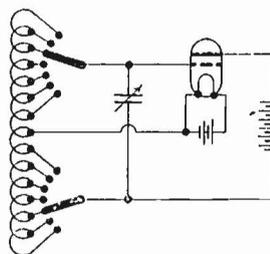


Fig. 6.

A by-pass condenser is often connected across the H. T. battery to make the passage of high frequency currents easier than through the H. T. battery which may have a fairly high internal resistance. A tapping is taken from a point near the center of the inductance to the negative side of the filament. Actually the grid and plate circuits are here combined into one oscillatory circuit. It is possible to make this circuit oscillate without any H. T. battery at all by connecting the lead from the center of the inductance to the positive side of the filament battery, and a small resistance between the filament and the positive terminal of the battery, so that the plate will be raised to a potential slightly more positive than any part of the filament. A grid condenser and leak are required, the leak being connected to the negative side of the filament. For this arrangement I have to thank Mr. R. E. H. Carpenter, who has used this circuit and found it effective.

To employ this circuit for reception a certain amount of modification is necessary, as in Fig. 7. The phones and H.T. battery are here connected between a center tapping of the inductance and the filament, and shunted by a variable by-pass

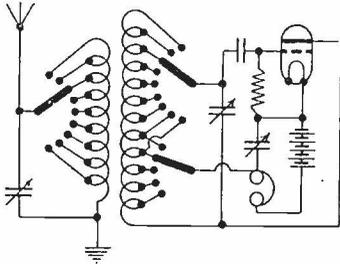


Fig. 7.

condenser to control reaction. Two sets of tapings should be taken from the tuning inductance, which for short waves should be of the cylindrical type. The tapplings should be taken to the studs of a pair of rotary switches. One switch is for the purpose of selecting the amount of inductance for tuning, and the other to vary the amount of inductance for reaction. For the tuning switch, tapping will have to be taken from points along the whole length of the coil, while only about a quarter of the length of the coil will need to be tapped for the reaction switch. The variable by-pass condenser gives a critical reaction control after the reaction has been roughly adjusted by the switch. With the by-pass condenser set to a small value, the reaction is weak and becomes stronger as the capacity is increased. This type of circuit gives excellent results, and also has the advantage of not requiring any mechanical arrangement for moving the reaction coil, as in this circuit it is actually a part of the tuning inductance.

I should like to say a few words about using a reaction so as to obtain the highest efficiency. In the first place we will assume that the telephony from The Hague is to be received. The primary and secondary circuits are first coupled fairly tightly. It is never necessary to couple coils so closely that the secondary disappears somewhere inside the primary. The tightest coupling that is ever likely to be necessary is where the ends of the coils are facing each other, but not overlapping at all. The reaction of the secondary, or grid, circuit is now increased until a click is heard where oscillation begins. The secondary tuning switch is then adjusted to the stud which will give approximately the wave-length of 1.070 meters. The secondary tuning condenser, or variometer

if one is used, is slowly moved backwards and forwards, until the carrier wave of the telephony is heard faintly. When this is done, the primary switch is varied from stud to stud until the clicks which are heard as the switch makes contact with each stud are very loud and then become weaker again when the switch is moved further. The primary tuning condenser is now adjusted, and it will be noticed that when the primary circuit is tuned exactly to the same wave length as that of the secondary the oscillations will stop. The coupling should now be loosened until the oscillations again start, and both circuits tuned together until the carrier wave is fairly loud on the lowest audible beat note. If reaction is now reduced until the oscillations stop, the telephony should be heard fairly well. Every time the coupling is altered the tuning will be affected. Loosening the coupling will raise the wave-length, while tightening will have the opposite effect; and so it is always necessary, after altering the coupling, to re-set the tuning condensers.

Unless the tuning of coupled circuits is done systematically, the results are quite likely to be little better than those obtained from a single circuit, and a great deal of trouble is likely to be caused from hetrodyning. When once the correct position is found for tuning in any one station it is quite easy, by moving the primary and secondary condensers in step, to search for each signals throughout the whole range of their adjustment, at the same time keeping the reaction just below the oscillating point. With the short wave set which I have here this evening the Dutch telephony comes in very well on a single valve and the conversation is easily understood when spoken in English.

The reception of C.W. signals with an autodyne receiver, while allowing the use of very simple apparatus, does not bring in the weaker signals very well. It is much better to use a separate heterodyne oscillator, and to use the ordinary reaction receiver to receive the signals on their exact wave length. With the autodyne receiver it is necessary to receive signals out of time if the best tone is to be reproduced, and this method, besides giving weak signals from distant stations, does not give much selectivity and freedom from interference by other stations.

The usual objections to the use of a separate heterodyne oscillator is that an extra valve is wanted, and this means additional filament current and H.T. consumption which form a very serious item with the majority of amateurs. It is quite common for an amateur to use a single

valve as a detector, and oscillator, and to use another valve for note magnification. An arrangement where the second valve is used as a heterodyne oscillator as well as a note magnifier will be of interest to those who like to get the utmost out of every valve they use. I am using this arrangement on my own receiver, and I am very pleased with the results obtained. When using a separate heterodyne the ordinary reaction receiver is used for reception and the C.W. signals can be amplified by reaction in exactly the same way as spark signals and telephony, but the set must not oscillate as is the case when autodyne reception is used. Figure 8 gives a diagram of the com-

from Annapolis are easily heard at a distance of four feet from the loud speaker which is made from a pair of ordinary low-resistance telephone receivers.

There is a peculiar effect noticeable where a separate oscillator is used that is not evident with an autodyne receiver. The atmospherics which are nearly always to be heard on the long wave lengths are heterodyned and are heard as short musical notes instead of the usual crackling noises. With an autodyne receiver all atmospherics set up oscillations at a frequency to which the aerial is tuned, and as the aerial also oscillates at this fre-

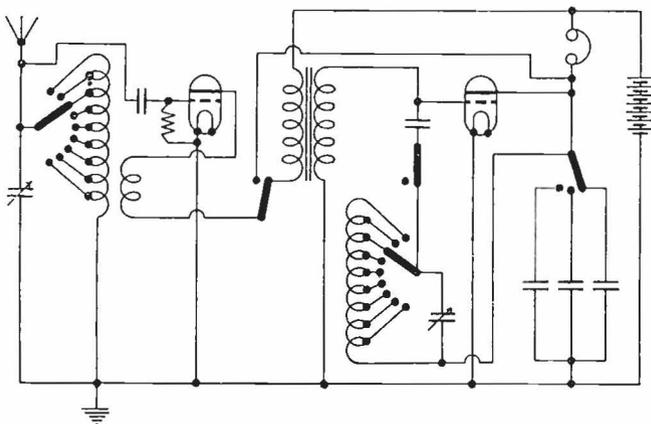


Fig. 8.

bined note-magnifier and oscillator. The low-frequency inter-valve transformer is connected to the second valve in the usual way. A small fixed condenser of about .0001 mfd. capacity is joined to the grid and to one end of the oscillatory circuit which tunes from 1000 meters up to 17,000 meters. The other side of the oscillatory circuit is connected to the plate. Between the grid and filament is a condenser, which should be adjustable in three or four stages of capacity, the largest being about .001 mfd. The circuit is actually a DeForest ultra-audion oscillator superimposed on to an ordinary note magnifier. The secondary of the inter-valve transformer in addition to being used for stepping up the voltage of the rectified signals also behaves as a grid leak and so prevents the accumulation of negative grid charges. The working of the second valve does not appear to be any less efficient as a note magnifier when serving two purposes. With the new double grid four electrode valves that were described by Mr. Scott Taggart in *The Electrician* some months ago, it may be possible to do all this with one valve only, but I am afraid the circuit would then become somewhat complicated. The time signals

frequency, it is, of course, impossible to produce a beat note. On the other hand, where a separate oscillator is used it is set to oscillate at a frequency different to that of the aerial, and consequently, both signals and atmospherics give a beat note, both signals and atmospherics are heterodyned together. When both signals and atmospherics give a beat note of the same pitch, it serves as an indication that the aerial is tuned to exactly the frequency of the incoming signals.

Before concluding this paper, I should like to give a short description of the telephone transmitter which I am using at my station. The wave length radiated by this set is 180 meters. Only one valve is used and a 200 volt set of dry cells provides the H.T. supply. An Osram R-4 valve is used and is suitable for both low power transmission and reception. The filament current is 1.2 amp., which is rather heavy when a valve of this type is used for reception. An oscillating circuit is employed of the type I have previously described, i. e., where both the plate and grid circuits are combined. The center of the inductance

which is of the cylindrical type is connected through a condenser of .002 mfd. capacity to the filament and earth. The inductance consists of 100 turns of No. 14 D.C.C. wire wound on a tube 5 inches diameter and 5 inches long. Tappings are taken from the coil at every 10 turns, and at every 5 turns near the center. The leads from other parts of the set are fixed directly to the tappings. On this short wave length I have not been

able to telephone over a distance of 20 miles. For several evenings per week for the past four months the set has been used over a distance of 8 miles which is the distance between the station 2 K. Z. at Purley and my own station at Malden. A single valve two circuit receiver is used at Purley, and there is no need for further application; in fact, at times, the speech has been understood 6 inches from the phones. The modulation

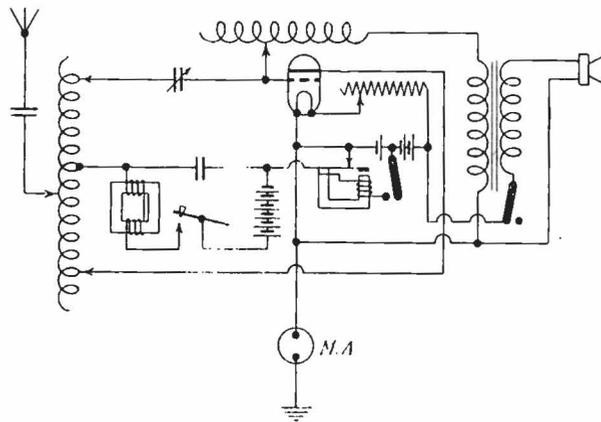


Fig. 9.

able to get such a good deflection on the hot wire ammeter connected in the earth lead with any other type of reaction circuit that has been tried. Ten turns of inductance near the center of the coil are used for coupling the aerial to the oscillatory circuit. I have an .001 mfd. condenser in series with the aerial and this can be adjusted by steps for other wave lengths near 180 meters if necessary. It is possible by adjusting the capacity of the condenser to use varying amounts of inductance to couple the aerial to the oscillatory circuit without changing wave-length, and in this way the best coupling is obtained. If the series condenser is cut out altogether, only 5 turns of inductance are required for 180 meters, but the greatest output is where 10 turns are used. The aerial current is only .17 ampere when 5 turns are used, whereas with 10 turns I can get a normal output of .2 ampere. By raising the filament temperature somewhat, the aerial current will rise to .26 ampere. Apparently the highest efficiency is reached at a wave-length of 250 meters, as at this range the current reaches .32 ampere, and will light a flash lamp bulb to full brightness when it is connected in series with the aerial. This output is obtained with a plate current consumption of 15 milliamperes at 200 volts, which is 3 watts. When consuming a power of 2.4 watts, which requires a plate current of 12 milliamperes, I have been

control arrangement is, I think, somewhat unusual, as both grid and choke coil systems are combined in a single valve circuit, instead of using two valves as is usually the case where choke control is used. The H.T. supply is taken through a low frequency iron core choke in series with the 200 volt dry cell battery. Across the choke and H.T. battery is a condenser of about .002 mfd. The ordinary grid control system of modulation where transformed vibrations in the microphone current are applied to the grid usually gives a great deal of distortion if anything more than about 10 per cent of the output is modulated. This is partly because it is necessary to work the valve at the lower end of the characteristic curve, and this has the effect of rectifying the speech current. When rectification occurs it has the effect of giving unequal control with alternate positive and negative currents from the secondary of the microphone transformer, and this causes distortion and poor articulation. Rectification can be prevented by using a tuned high frequency choke instead of a grid leak, as this will not allow any accumulation of a negative charge on the grid. This choke will offer practically no impedance to the low frequency voice currents, but will have an impedance equal to several million ohms resistance to the radio frequency voltage on the grid when it is tuned to the same frequency. When the

microphone is spoken into, the voice vibrations cause variations of the resistance and the current through the primary of the modulation transformer will change in strength at the frequency of the voice. The transformer has a resistance of 2 ohms in the primary and 1000 ohms in the secondary. Alternating currents at the voice frequency are set up in the secondary winding at a much higher voltage than that in the microphone circuit, and these are conveyed through the high frequency choke to the grid. Each positive alternation on the grid will increase the plate current, while the negative alterations will decrease the plate current. The H. T. supply current having to pass through the iron core choke, will not be able to respond instantly to the varying demands of the valve, and consequently the reservoir condenser, which can only be kept charged at a practically constant rate through the choke, is subject to great variations of voltage at the voice frequency. The immediate effect of this is to control the amplitude of the oscillations generated by the valve, which is largely dependent on the plate voltage. In this way the high frequency aerial current changes in strength at the frequency of the voice vibrations. This is actually a choke con-

trol system, although one valve is used for both purposes, instead of a separate valve for each of power and modulation.

A key switch such as is used on telephone switchboards is used to interrupt the H.T. current for plain C. W. signalling, and it also serves to change over from send to receive and to switch on the filament and microphone currents of the transmitter. In addition to plain C. W. for signalling a high note buzzer can be used for interrupting the aerial current. The buzzer runs continuously when switched on, and signalling is done as for plain C. W. by keying the H. T. supply current. A very high-pitched note of great purity is produced in this way, and the tuning is much sharper than in the case of a spark transmitter. The interrupted C. W. signals can be received on a crystal detector as well as on a valve, owing to there being no necessity to heterodyne them. On this form of transmission the strength of received signals, when using 2 watts, is greater than that from a spark using 10 watts.

From the Model Engineer and Electrician—London.

Amateurs Can Obtain Time Signals

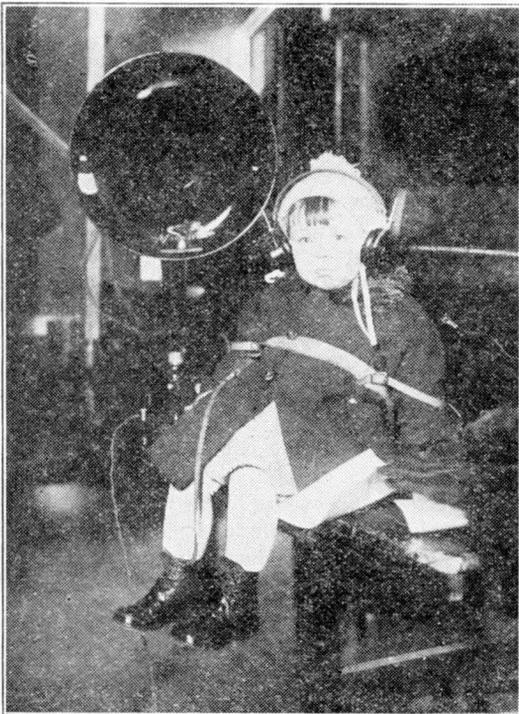
Those amateurs who have apparatus capable of tuning to the wave length used by most of the broadcasting stations, namely, three hundred and sixty meters, but who cannot tune to Arlington (2500) can check their time pieces by tuning into the Westinghouse Station at Pittsburgh, K.D.K.A., which now receives Arlington signals and relays them by radiophone on three hundred and sixty meters.

Warning to Radio Station Owners

It is well for the owner of a radio station to observe the Underwriters' rules relative to the installation of a switch which will allow the aerial to be connected to ground at all times when the station is not in use and during electrical storms. This precaution will prevent many fires and applies to all receiving stations as well as transmitting stations where an outside aerial is installed.

W. J. Bryan Talks by Radio

All radio fans were given a chance to hear William Jennings Bryan deliver a sermon, March 8, in Pittsburgh, where he talked before a large congregation. His sermon was on the world "All"



INTERNATIONAL

Radio Show Attracts Throngs to Penn. Hotel
Baby Helen Nairns of 344 Summit Avenue, Jersey City, with her mother, took great interest in a radio set.

Antennae-Aerials

One of the problems confronting the prospective experimenter in radio especially if he is a resident of any one of our largest cities, is the question of an antenna.

To the man who lives outside of the densely populated areas, this is easily solved usually. His property is usually of sufficient depth to allow him to erect the necessary towers or masts without encroaching on the property of some one else, but in those cases where more space is necessary he usually has no difficulty in obtaining permission to go ahead with his work, due in a great many instances to the very novelty of the thing. However, such is not the case with the city man, a great many of whom reside in modern apartments hemmed in on all sides with other buildings, with the electric light wires and the telephone wires entering the building underground. In a great many such cases the landlord refuses to grant permission to string a wire across the roof or an area way as he does not want his premises "cluttered up" with what to him are unsightly wires. But even under such conditions the city man need not lose heart as the day is here when for all ordinary purposes of receiving radio signals at least, no outside wire is necessary. Some of the best long distance receiving of the musical programs which are being broadcasted by the various companies, is accomplished on indoor aerials.

To cite a few examples:

Nearly every house has some picture moulding which is usually of such shape that a wire can be concealed behind it. The wire should be insulated although in normally dry places this is not altogether necessary. The best result is usually obtained by installing a single wire in long, straight run, but where conditions compel one to go around corners it can be done and satisfactory results obtained. A wire of number sixteen to twenty-two gauge is satisfactory and is easily handled as well as being readily concealed.

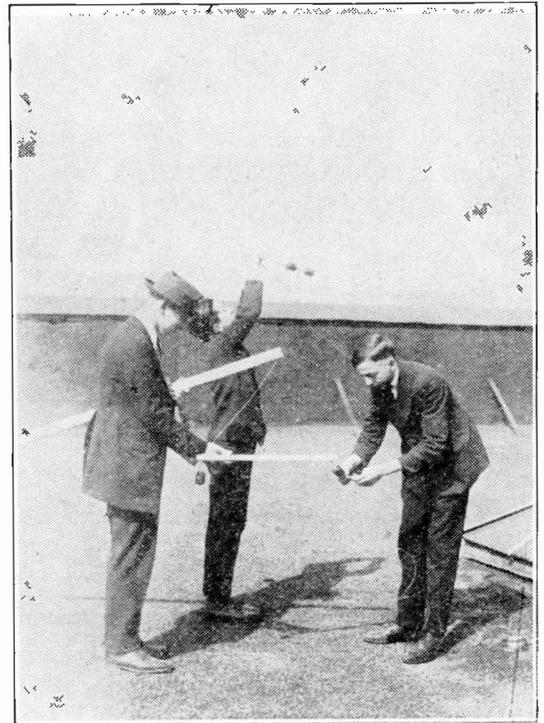
Start at a convenient point in one room and fasten the end of the wire so that it will not be pulled down, and lay it up out of sight along the moulding until as long a run or stretch of wire as possible up to one hundred feet or one hundred

and twenty-five feet is up. Then bring the other end of the wire into the receiving apparatus. A ground wire will also have to be run under the average conditions. This is simply a wire from the receiving set to a convenient water pipe and a good connection made thereto.

In this city (Chicago) there are many stations picking up the concerts from Pittsburgh and Detroit on indoor antenna and several stations are regularly listening in to the Westinghouse Electric and Manufacturing Company's station at Schenectady, N. Y., and the Western Electric station at Deal Beach, N. J.

The writer has heard the station at the University of Wisconsin (9 XM) Madison, Wis., on a small loop aerial constructed as follows:

A square wooden frame thirty inches on each side has forty-two turns of No. 22 D. C. C. wire

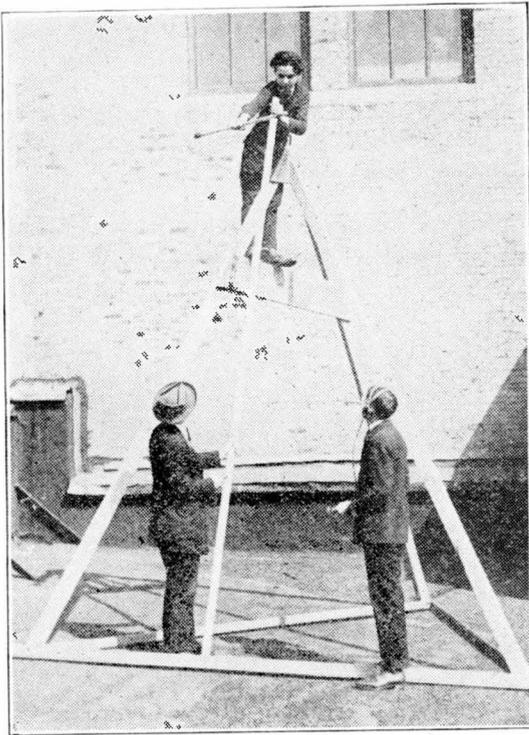


INTERNATIONAL

The Radio Fans Get Busy. No. 1

Sonny and his pals stringing the wires for the aerial on top of the roof of their home

wound on it. This is hung from the hook that holds, or rather held the bird cage at one time and is free to swing in any desired direction. By swinging this around stations may be tuned in or out to a considerable degree due to the so-called directional effects. One friend of mine uses the metal portion on "In-a-Dor" bed for an antenna. His apartment is on the third floor of a building in a rather densely populated section of the city, still he hears the concerts nightly. So there is no reason to keep away from radio because you cannot put up an outdoor antenna—even you—Mr. Cliffdweller.



INTERNATIONAL

The Radio Fans Get Busy. No. 2

Sonny and his pals built this platform to string the aerial wires

Amateur, Using Five Watts, Bridges the Atlantic

The time was when it was considered necessary to use an enormous amount of electric power to transmit signals any great distance, but an amateur in Massachusetts succeeded in radioing across the Atlantic Ocean to Scotland during an official test recently with a power consumption of five watts. This is not enough "juice" to light an ordinary incandescent lamp.

The American Telephone and Telegraph Company Enters The Field

One of the greatest steps in the radio field has been taken with the entrance of the Bell System into the radio field.

A permit was recently granted for the installation of a radio station by the American Telephone and Telegraph Company on one of its New York buildings.

This station is intended for a broadcasting station but will be the only one of its kind in use, as the American Telephone and Telegraph will provide no program of its own but will provide the means whereby anyone who makes a contract with it can send out their own programs.

The requests for such a service have come from entertainment agencies, newspapers, department stores, and a variety of business houses who wish to utilize this medium for distribution and advertisement of their particular commodity.

The new station is designed to effectually cover an area of one hundred and fifty miles surrounding New York. In this area there are over eleven million people, so it is readily seen what a large audience this station will have. It is said that as circumstances warrant, other stations of this kind will be installed by the Bell System at the important centers.

Once the system is in operation it will be possible to connect the various stations by means of the toll and long distance wires of the American Telephone and Telegraph Company so that the music, lecture or news from one "Central" may be transmitted simultaneously to all parts of the country.

The report is, that by using recent inventions, several different programs may be sent out at the same time with no interference, so that when one tires of listening to a lecture on psychoanalysis, all that is necessary is to tune it out, go in on another wave and hear a "peppy" yarn or good music, as one fancies.

What next in radio?

News

The High School of Williamsport, Indiana, is installing a radio telephone receiving station.

Commodore Taylor and Lt. C. D. Palmer of the Anacostia Air Station Radio Laboratory, have done much work in the development of the emergency transmitting equipment now carried on machines which permits the sending of messages when a plane has made a forced landing. Formerly a radio set was only efficient while the plane was in flight. The equipment weighs only a few pounds. A kite is used to support the antenna which is of unusually light wire. A wind driven generator is used to develop the necessary electric current. A plane equipped with this apparatus enhances its chances of receiving timely aid in case of accident.

Radio has lengthened the arm of the law, and the rum runner will at last find his Nemesis when the station at Negaunee, Gaylord and Grand Rapids, Michigan, are installed and in operation. Radio is one thing which can outleg the bootlegger and will enable the authorities to keep in touch with the activities of lawbreakers.

Supt. Potts of the Detroit Police Department, is the inventor of a small radio receiving apparatus with which it is proposed to equip every Detroit policeman enabling the officials to keep in touch with the patrolman. Although the set weighs two pounds it is thought that this weight can be reduced considerably. One of the police stations in Detroit is already equipped with sending and receiving apparatus and it is said that preparations are under way to equip all patrol wagons with receiving apparatus.

The great loss of life which has occurred in some mine disasters in this country has caused mining authorities to investigate the possibility of the use of radio as first aid. With a scheme proposed by Radio Engineers each miner would be equipped with a small transmitter by means of which he could send special danger signals to the mouth of the mine where a receiving set would be installed, this set being of such a design that the exact location of the transmitter could be readily determined.

The French railway authorities have been conducting experiments with radio telephony on moving trains with a view to transmitting orders between trains and dispatch stations. The results have been very satisfactory as the messages were

heard for a distance of ten miles although the train was run at various speeds.

Plans are under way for the installation of a broadcasting station by the Matthews Electric Supply Co., on their premises in Birmingham, Ala. It is proposed to use this station for the distribution of news, weather and market reports as well as furnishing two programs daily. The station equipment will be powerful enough to reach practically all sections of the south under normal weather conditions. It is reported that the station will be in charge of Mr. Donald Beatty who was in the United States Naval Aviation service during the war.

Great interest is manifested in the receipt of music and speeches by radio in Madison, Wisconsin. Plans are now under way to form a Radio association which will aid in the development of the science.

Radio ghosts are becoming popular. Benjamin Wolf, of Falmouth, Ky., claims that one or more of them disturb his rest. Tune in your bed spring, Mr. Wolf, and hear the bedtime stories.

M. Rich and Bros., of Atlanta, Ga., are contemplating the installation of a receiving set in their store for the entertainment of their patrons. The Journal of Atlanta, has a large broadcasting station on their building. Their call is USB.

Some amateurs are applying stunts learned in the army for their own use. It is possible to get unusual stunts by using a crystal detector instead of a vacuum tube and amplifier receiving set and hitching an aerial to a kite.

Capt. Roald Amundsen, discoverer of the South Pole, is now preparing to sail for the North Pole on June 1st. Contrary to previous expeditions, the Amundsen party will not be isolated from civilization but expects to talk with Washington every day by Radio. He has been conferring with John M. Larsen, a Governor of the Aeronautical Chamber of Commerce of America.

Pine Bluff, Ark., has been bitten by the radio bug. The Arkansas Light and Power Company have a large broadcasting station (W.O.K.) and are furnishing music, news service, etc. It is primarily to advertise Pine Bluff and Arkansas messages from people throughout the central west, acknowledging the receipt of their messages and entertainment have been received.

Vaudeville

Cheap At Any Price

He—Oh, come on; please do.

She—I'm not that kind of a girl.

He—Sal, I know a trick. Bet you I can kiss you without touching you.

She—Don't be absurd.

He—Fact. It's a trick. An awful cute trick. But you have to stand perfectly still.

She—It can't be done.

He—Can, too. I bet you a nickel I can kiss you without touching you. It's a swell trick.

She—All right. Show me.

He—Well, stand absolutely still or it won't work. And you don't want me to lose that nickel, do you?

She—I won't move.

He—(Kissing her square on the mouth.)

She (indignantly)—Why, you did too touch me!

He—Jove, I did. Well, I lose the nickel.

"No, I don't want to buy that horse. He looks as tho' he had a mean disposition."

"Dat ain' nothin', boss. He jus' got dat look runnin' sulky races."

Parson—My good man is there anything you would like to say to me?

Parishioner (just placed in jail for drinking)—I would (hic') like to ask you one question (hic'). Did Paul ever get an answer to that letter he wrote the Ephesians?

"I'll bring my violin the next time I call. You like music, don't you, Miss Thorpe?"

"Yes, I do. But come just the same."

It Is More Blessed to Give—

Charity—Will you donate something to the Old Ladies' Home?

Generosity—With pleasure. Help yourself to my mother-in-law.

The Girl—My family is traced back to William the Conqueror...and even further—to the kings of Jerusalem. Edmund Ironsides is an ancestor of mine and Oliver Cromwell, and Pocahontas—

The Cat—Your family is like the potato vine, isn't it?

The Girl—How do you mean, potato vine?

The Cat—The best part underground.

Money Mad

John—Just burned up a \$100 bill.

Demijohn—You must be a millionaire.

John—Well, it's easier to burn them than pay them.

"Marjie, have you been smoking?"

"No, mother."

"But your breath smells of tobacco."

"Father kissed me good-bye."

"But father doesn't smoke."

"I know it, mother, but his stenographer does."

Customer—What are the least expensive calling cards you have?

Stationery Clerk—A royal flush, madam.

Big Earl—"Haven't seen you in the cafeteria lately."

Simple Felo—"Nope! I stepped on my meal ticket last week with my hob nails."

Chauncey Reginald Archibalt Asherton, to prospective father-in-law: "Youah daughtah has promised to mawy me and eh—ah—I'd like to know if there is any insanity in yuoah family?"

Crusty Old Papa, looking him over: "There must be."

Bank Teller: "I've left my combination at home."

New Steno: "Heavens! I'd think you'd be frozen without it."

Ash: "How'djt get that cut on your face?"

Can: "A guy called me a low down, good-for-nothing, lazy, worthless, sawed-off, bow-legged, cross-eyed loafer, and I cleaned him up."

Ash: "He shouldn't have called you that."

Can: "No, of course not."

Ash: "Why, everybody knows you're not cross-eyed."

He: "What do you do in dramatics?"

She: "Oh, I'm the new stage coach. What do you do?"

He: "Oh, I'm the fast male."

Baggs—"I'm worried. My girl is running around with that new doctor in town."

Jaggs—"Feed her an apple a day."

"I'm cutting quite a figure," said the chorus girl as she sat on the broken bottle.

Via Wireless

She: You have got a low mind—
 He: Do you believe in wireless telepathy?
 She: Yes.
 He: Well, that's what makes it so low just now!

Sunday School Teacher: "Will one of the little boys tell me who led the children of Israel into Canaan?"

No reply.
 Teacher (sternly): Little boy on the aisle seat, who led the children of Israel into Canaan?"
 Frightened Boy: It wasn't me, teacher. I just joined this Sunday.

Lord Babbington was instructing the new colored servant in his duties, adding, "Now, Zeke, when I ring for you, you must answer me by saying, 'My lord, what will you have?'"

A few hours afterwards, having occasion to summon the servant, his lordship was astonished with the following:
 "My Gawd, what does you want now?"

"More throat trouble in the south."
 "How's that?"
 "They just hung another coon."

Famous Woods

Iron ———.
 ——— bury's Soap.
 Holly wood.
 Sandle ———.
 ——— row Wilson.
 Belleau ———.
 ——— alcohol.
 Drift ———.
 Mahogany ———.
 Kindling ———.
 Gen. Leonard ———.
 ——— you?
 I ———!

"Now give an example of how 'circumstances alter cases.'"
 "Well, Milwaukee isn't famous any more."

Salesman: Pardon me, sir, I have an attachment for your typewriter.
 Manager: Well, don't bother her during working hours.

"Rastus, is my bawth warm?"
 "Yassir, the wahmest Ah wa' evah in."

"Say, waiter, is this an incubator chicken. It tastes like it."
 "I don't know, sir."
 "It must be. Any chicken that has a mother could never be as tough as this one."

Obliging

Wife—Drunk again, Harry? You have broken the promise you made me.
 Hubby—Hic, n'ver mind, dear, 'sall ri'. I'll hic, make you 'nother one.

Miss Anne Morgan, daughter of the late J. Pierpont Morgan, addressed the radio public and through it the United States, on Sunday night, March twenty-sixth, from the Westinghouse Electric station in Chicago.

Miss Morgan made an earnest appeal for funds for the devastated regions in France. This is the first time that radio has been used for an appeal of this kind.

Relative to the wrecking of the seaplane Miss Miami with the loss of five lives off the coast of Florida March 23, Rear Admiral Moffett is urging the passage of a law requiring the use of radio in passenger planes.

Railroads are installing radio on their limited trains. The Pioneer Limited of the Chicago, Milwaukee and St. Paul Ry., is equipped with a wireless set.

Radio Log

A log designed for the use of Amateur Radio Operators, to keep a record of all calls heard; messages sent and received. Also to note the conditions involved. Records may be graphically recorded on the charts on last pages in book. These records will be found not only interesting but valuable for a comparative study. 100 pages, well bound, postpaid for \$1.00. RAVENSWOOD RADIO CO., 2044 Waveland Ave., Chicago, Ill.

Wave Length

is not necessary to enjoy the entertainment offered you by 1000 college artists and humorists. The amateur humorist is the real humorist. COLLEGE HUMOR is a collection of 128 pages of real live humor. Over 150 genuinely funny illustrations. Handsomely bound in four colored cover. Mailed postpaid for 60c. At all news stands. The Collegiate World, 111 N. Market St., Chicago, Ill.



Have You a Radio Garter, Girls?

Here's the latest radiophone set, in the manner of a garter, the invention of Walter E. Miller of the Seattle, Wash., Post Intelligencer. Miss Julia Elmendorf, of the same paper, is wearing the radiophone on her knee, and is able, while at her desk, to pick up radionews.

ELECTRICAL POSITIVE AND NEGATIVE POTENTIAL

It is now assumed that the thing which we call electricity is composed of small particles which are called electrons.

In order to have a flow of electricity in a conductor there must be more electrons in one portion of the conductor than there is in another.

The earth is considered to be at what is called zero potential as it has an average concentration of these electrons all over its surface.

Electrons have been found to have a negative charge, hence a body which has a greater concentration of electrons than the earth, is more negative than the earth and is said to have a negative electric potential. If the body has a concentration of electrons which is less than that of the earth then it is less negative than the earth and has a positive electric potential.

If two objects having an unequal concentration of electrons are connected together by a wire, the electrons will flow along the wire to balance up the concentration and when the concentration is equalized the electrons will cease to flow and there is no current.

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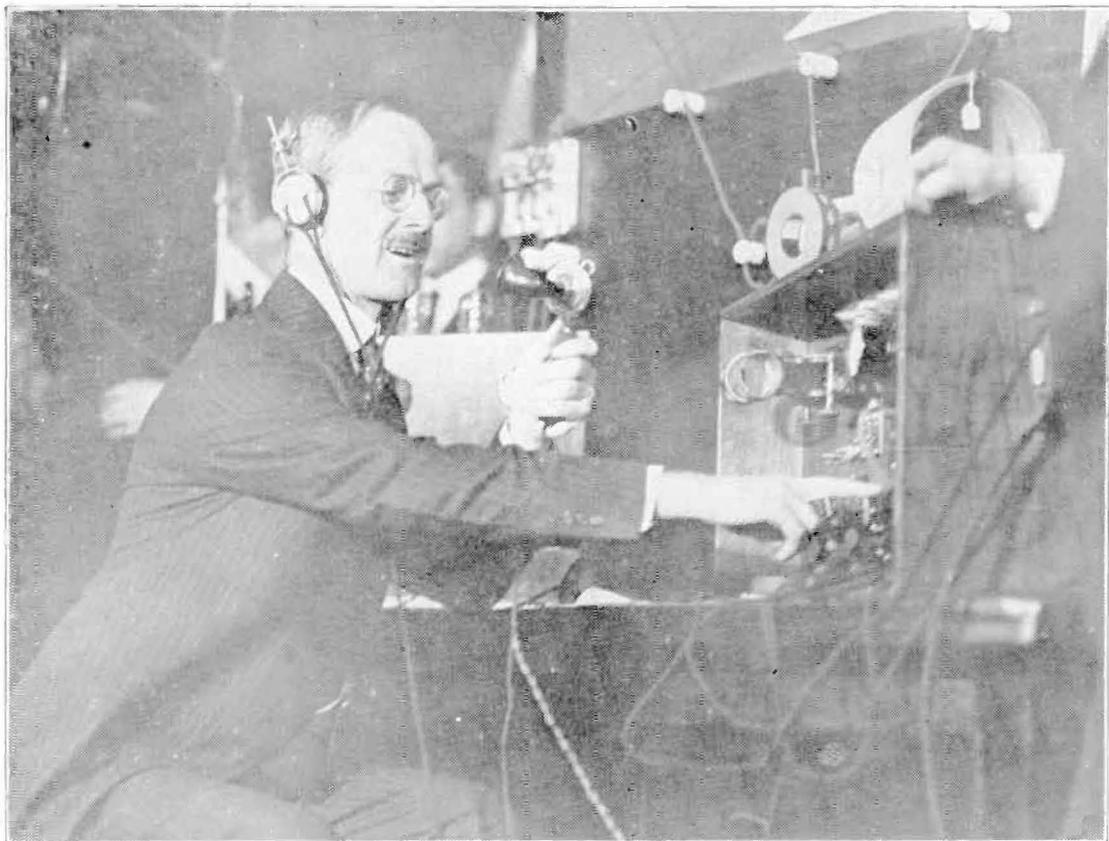
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INTERNATIONAL

Mayor of Philadelphia Booms His City Via Radiophone

Mayor Moore of Philadelphia claims that Philadelphia is never behind in any modern improvement and therefore takes advantage of the radiophone to talk with his constituents and listeners in as far away as Boston and Chicago and impresses upon them all the advantages that Philadelphia is possessed of.



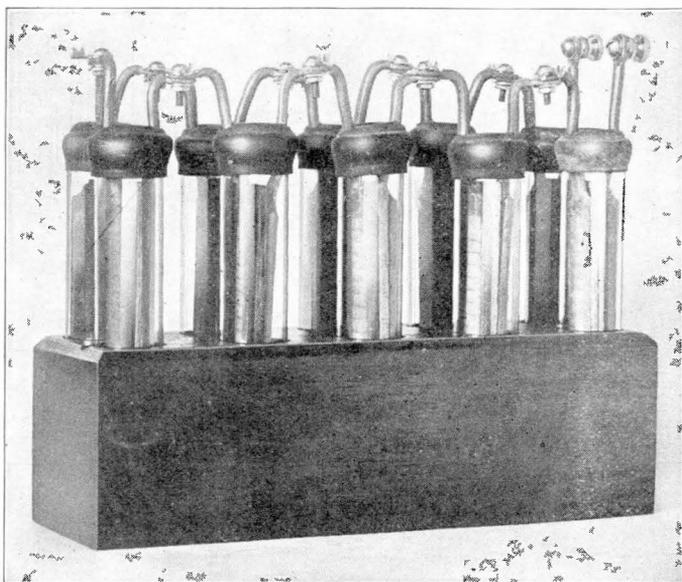
INTERNATIONAL

Wireless Telephone to Link Hotel Chain

Perhaps you've a friend at Buenos Aires, France, Spain, England, Rome or Switzerland. If you have, it will be a comparatively easy matter for you to talk to them over the radio telephone. Here is shown the first station atop the new Ritz Carlton in Atlantic City, where concerts are heard daily from every section of the country. The skyline of "the Nation's playground" can be seen through the window showing the boardwalk and the ocean piers

"Chi-Rad" Storage "B" Battery

THE hit of the season—a real Storage "B" Battery with pasted plates which can be re-charged as easily as your "A" Battery. Ideal for Laboratory and Experimental use as well as all Radio Equipment employing Vacuum Tubes. Equally desirable on detecting amplifying or transmitting tubes as source of plate voltage.



PRICES

22 Volt Battery as shown, \$6.00. (Add. PP on 8 lbs.) Single Cells, \$0.50 (Add. PP on $\frac{1}{2}$ lb.). Wood Base, \$1.00 (Add. PP on 1 lb.).

SPECIFICATIONS

Block size, $2\frac{3}{4}$ " \times 9".
Tubes, 1" Diam. 5" high.
Voltage per cell, 2 volts.

Shipped dry with simple directions for setting up and charging.
Capacity 2 Amp. Hours—will operate 1 tube 1000 hours on one charge.

Dealers:—Chi-Rad Storage Batteries will be widely imitated but never excelled—why not sell your customers the 100%, ORIGINAL Battery backed up by our guarantee? It will mean dollars in your pocket in the end. Send us your orders now!

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Don't forget we are now located in our new Ground Floor Salesroom at 415 South Dearborn St. Come and see us soon—we will carry the most complete stock of High Grade Radio Supplies in the Middle West.

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