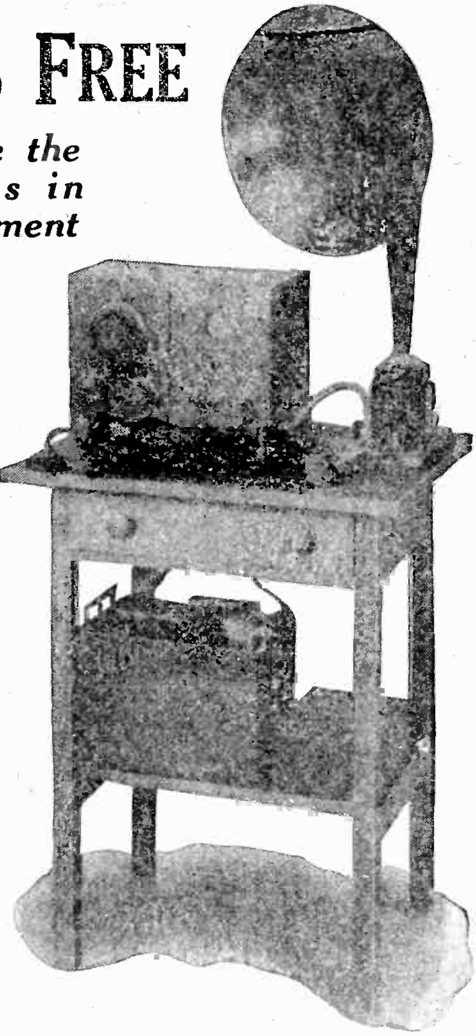
Radio Instructor

10 RADIO SETS FREE

These Sets Embrace the Very Latest Ideas in Radiophone Development



Are You a Radio Fan?

Do you want a complete up-to-the-minute set that is the last word in Radio? You can have such an outfit and it need not cost you one cent. We give not one set but ten of them.

Radio, the wonder of the age! With one of our outfits you can "listen-in" and hear music, song, news, weather reports, and oodles of entertainment from the large cities. All this is free from the air if you only have a Radiophone receiving set. As easy to operate as a phonograph. We will give away 10 complete outfits worth up to $300. each. You can entertain your family and friends every day.

No expert knowledge required to operate our sets, but these sets will appeal to and please the most expert Radio "bug".

Wonderful, new, easy amazing plan. You can get your set free. HOW? Send the coupon and learn all about it. Don't delay. Don't send a penny, just write your name and address and mail the coupon today.

Radio Cook, Mgr., Radio Dept. 3130
141 W. Ohio St. - - - - - - - Chicago, Illinois

Enter My Name for a Free Radio Set

COUPON

Radio Cook, Mgr., Radio Dept., 3130
141 W. Ohio St., Chicago, Ill.

Date ____________ 1922

Please send me full particulars about the free Radio Sets you are giving away.

Name ____________

Post Office ____________ State ____________

R. F. D. No.
Street No. ____________

RADIO INSTRUCTOR

"The Magazine of Radio Instruction"

Editorial and Business Offices

854 N. Clark St. Chicago, Illinois

Vol. 1 July, 1922 No. 3

Published monthly by the Rural Publishing Corporation, 854 North Clark St., Chicago, Ill. Application made for entry as second class matter at the postoffice at Chicago, Ill., Single copy, 20c. Subscription price, $2.00 per year.

Articles dealing with radio in any form solicited. All manuscripts must be accompanied by return carrier. Not responsible for manuscripts lost in the mails.

IMPORTANT NOTICE: Due to a conflict in names which would naturally cause confusion, two publications appearing in this city under the same name: Radio Digest, we decided to adopt the above name and we feel that the cover design of this issue will readily portray to the buyer that this is the third issue of what was formerly Radio Digest. Our policy and aim will continue the same: to give the reader the latest and most authentic information pertaining to the now all-absorbing subject, Radio.

Simple Methods of Making Station Measurements

GEORGE F. PATRICK

It happens quite often that the amateur station owner wishes to know the capacity of his antenna or some other constant of his system but is at a loss to know how to determine it. Two simple methods of obtaining the antenna capacity are described herein which may be used at any station.

In the first method a wave meter is required having a mil-ammeter or current squared meter as an indicator, and a calibration curve of the condenser, also a receiver of the feed back or regenerative type. Setting the receiver into oscillation at some point on the higher wave lengths, couple the wave meter closely to it and locate the resonance point carefully. Make note of this reading at the condenser scale, and then attach to one terminal of the wave meter condenser the antenna lead and to the other terminal the ground lead. It will now be found that the wave meter is detuned due to the added capacity of the antenna, turn the wave meter condenser toward zero until resonance is again found and make note of this reading also, then referring to the calibration curve of the condenser find the capacities at the two points, and the difference between them is the capacity of the antenna. For the first reading the oscillating circuit should be set so that the resonance point will fall along the high part of the condenser curve so that there will be an appreciable difference between its capacity and that of the antenna. For example, let us suppose that the first reading falls at 165 degrees on the condenser scale, and the second at 92 degrees, also that we find by reference to the calibration curve that the capacity at 165 degrees is .0014 M F and at 92 degrees it is .00085 M F, then the antenna capacity would be the difference between the two or .00055 M F. It must be understood that when the first setting is made no change can be made in the driving circuit before the second setting is obtained, the idea being to substitute the capacity of the antenna for a part of the wave meter condenser capacity and find resonance at a constant frequency of driving circuit. If the exciting frequency be changed through any cause between the two settings the measurement will be incorrect. In case the wave meter can not be coupled strongly enough to the receiver to give a sufficiently large reading on the current squared meter, the primary coil of the receiver may be substituted for the inductance coil of the wave meter. If no wave meter is at hand any calibrated variable condenser will be suitable provided its capacity be sufficiently large. If a current squared meter is not available a two volt flashlight lamp will do as an indicator although the resonance points can not be determined as accurately with this as with the meter. Another method is the click method, so called because of the click heard in the telephones attached to an oscillating circuit when another circuit coupled to it, is brought into resonance with it. In this method the telephones are worn and the wave meter is closely coupled to the oscillating circuit. When the wave meter is brought into resonance a click will be heard in the telephones, ordinarily two clicks will be observed a number of degrees apart on the condenser scale, by reducing the feed back coupling on the receiver, and the coupling between the receiver and the wave meter, these two points may be brought closer and closer together until they are merged into one click. When this is accomplished attach the antenna and ground leads to the wave meter condenser as before and find resonance lower down on the scale, then refering to the calibration curve as before the antenna capacity is found. In case it is found to be not possible to manipulate the couplings so as to bring the two clicks together, the middle point between the two may be taken as the point of resonance. If the receiving circuits do not supply enough power to give a good indication a driving circuit as shown in Fig 1 employing the two tubes may be made which will give excellent results. L is a coil of one hundred and fifty turns of number sixteen cotton covered wire four inches in diameter having two variable contacts, C_1 is a .001 M F variable air condenser, C_2 and C_3 are variable air condensers roughly .0003 M F each, X and X_1, are ten to fifteen thousand ohm grid leaks. The amount of plate voltage required will vary with the tubes used, and it is essential that two tubes having approximately the same characteristics be used in order to obtain maximum output. The natural period, the inductance, and the total resistance of the antenna may be obtained easily using this driving circuit. Wrap a few turns of the antenna lead around the driving coil L and connect to ground through a current squared meter, then setting the circuit into oscillation vary the number of turns cut in on the coil L and vary the condenser C_1 until the current squared meter shows resonance, the wave length of the driving circuit as measured with the wave meter will then be the natural period of the antenna. It will be found that the variable contact leading from the positive of the plate battery to the coil L will be quite critical at the lower wave lengths. Having the natural period

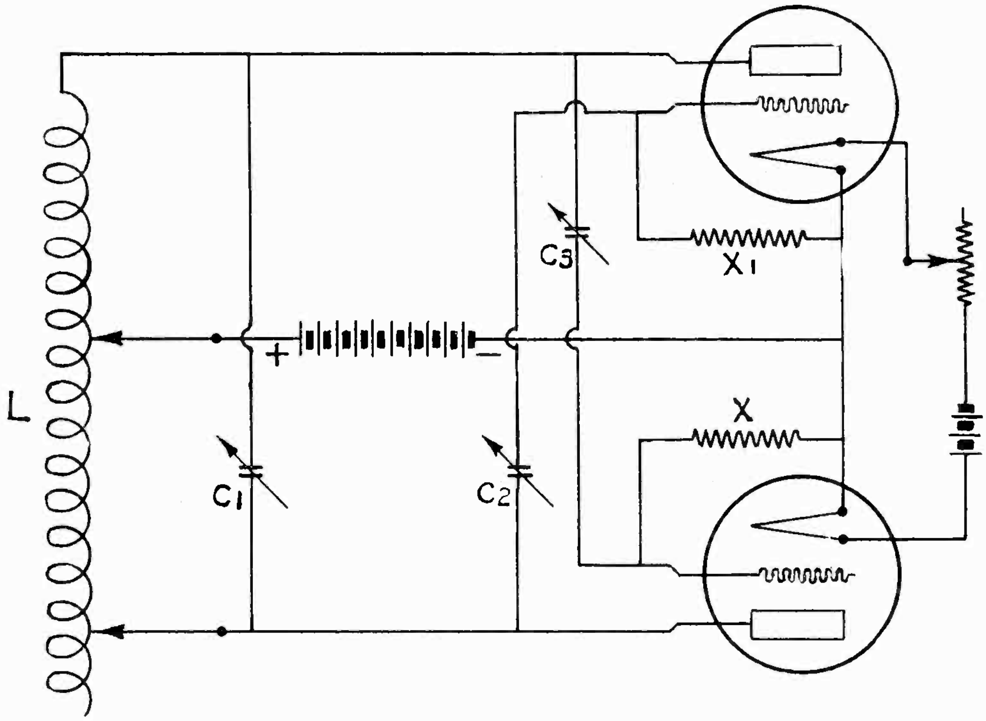


FIG. 1

and the capacity of the antenna the inductance will be equal to $\left(\frac{\text{Wave Length}}{2}\right)^2 \div C$ all in centimeters.

To obtain the resistance make the coupling sufficiently strong so that the current squared meter will register nearly full scale, then insert in series a non-inductive resistance and vary this until the current squared meter reading falls to one half, the value of the non-inductive resistance cut in then will be the resistance of the antenna. An excellent method of calibrating wave meters is one making use of such a driving circuit. Setting the driver into oscillation bring the meter to be calibrated into inductive relation with it and find the resonant point, then remove this meter and substitute a meter known to be correct and determine the wave length the driver is oscillating at. A series of such readings at different points on the scale gives the data on which to construct the wave length curve. Condensers may be accurately calibrated also as follows: Set the driving circuit at a wave length which will measure along the upper range of the wave meter condenser and get an accurate reading, then connect the condenser to be measured in shunt with the wave meter condenser and set it at ten degrees, find resonance with the wave meter again and the difference in the two settings of the wave meter condenser is the capacity of the condenser being calibrated at ten degrees. Proceed similarly at twenty, thirty, forty, etc., degrees and draw the curve from the capacities obtained. The mil-ammeter used should be of the thermo type and have a full scale reading of 100 or 150 mils. Such a meter is not costly and is well worth while having at any station. Placed in the plate or grid circuits it will show the amount of current flowing, and placed in the plate circuit of a telephone transmitter it indicates the degree of modulation taking place.

Radio in France

Nearly everyone has heard of the Eiffel Tower, near Paris, France, and a great many American radio operators have heard the radio signals sent out from the station located at the tower. It was at this station that observers were stationed in 1915 to assist in the conduct of the experiments which were epoch making in radio, for it was these men who heard the human voice transmitted for the first time across the Atlantic Ocean.

The station at the Eiffel Tower is one of the best equipped in the world. Its high state of efficiency must be greatly attributed to General Gustave Ferrie of the French Signal Corps. (The famous eighth regiment of Engineers).

Shortly after Marconi disclosed his finding to the world, it was General, then Captain Ferrie, who suggested the use of the one thousand foot tower to support an aerial for radio work. Probably some of our readers will be surprised to know that the first transmitter at this station was an induction coil operated off a storage battery. This was in 1902. This set was later displaced by an alternator and transformer set which is still in use for certain purposes.

In the early days a two hundred and fifty mile range which was obtained with this set was considered remarkable and when signals were transmitted to the French colony in Africa, nearly thirteen hundred miles, there was a great deal of interest shown in scientific circles.

Experiments were carried out with moving columns of troops, the orders being issued in Paris, transmitted by radio to a station in Africa and then by means of searchlight signals to the troops. So successful were the results of these experiments that it was decided to install a set embodying the latest improvements in radio. The station, which had formerly been housed in three huts in the garden around the tower, was moved to an underground location. Here a 600 cycle spark set with a blower for quenching the gap was installed and for the first time automatic transmitters for time signals were used. The sending of time signals which allowed navigators to check their chronometers was started. This was in 1909, and it has continued every day since.

The pendulum of a clock in the Paris Observatory is equipped with contacts which operate a relay, which in turn closes the circuit of the radio transmitter. It is claimed that a precision of 1/100 of a second is obtained.

During the late war the Eiffel Tower station played the part of an eavesdropper, to a great extent. Receiving sets with amplifiers were installed and radio traffic to and from Germany was intercepted. Enough of this work was done to keep the Intelligence section of the French Army busy, night and day.

One of the methods used by the Germans was to transmit at high speed. In fact at such a high speed that it was impossible to read the signals in the ordinary way. An apparatus was installed in the Tower station which caused phonograph records to revolve at high speed. The radio signals were detected and amplified and registered on the high speed phonograph record. The record was then transferred to a machine which rotated it at ordinary speed and the reading of the messages was easy.

Aside from the "eavesdropper" part, however, the station at Eiffel Tower became and still is a laboratory. It was here that the sensitive receiving sets which are well known to former members of the Signal Corps, United States Army, were developed. Research work is being conducted here at the present time by a staff of French radio engineers.

Suggestions for The Operation of Receiving Stations

BY OTHO CROW

In the days when the best set on the apparatus table of the amateur was the old reliable crystal detector, results depended on the efficient operation of the same. Now if the average amateur does not hear POZ he simply ties a two step on the old set and then wonders why radio is so expensive, this seems to be the idea most amateurs have of making good records.

The result of the observations made in a number of stations and in the writer's station also is this article, which the writer hopes will be of some benefit to the operators of receiving apparatus.

First comes the choice of apparatus. Here the beginner stumbles, as he usually knows little of the game and buys inferior apparatus, which is of unusual design and often inefficient. STICK TO STANDARD DESIGN. You can not go far wrong. The standard apparatus has been tested by the radio field at large and its weak points weeded out.

If you build your own apparatus the following hints may prove helpful:

1. Be sure and solder connections. Some of the awful racket amateurs blame on their tubes is nothing more than loose connections.

2. Use short connecting leads, especially in the grid circuit.

3. If amplifying transformers are used be sure to set them at right angles to each other, to avoid interaction of the magnetic fields and the consequent howling.

4. Eliminate body capacity when regenerative tuning is used. A grounded copper shield behind the panel is the best.

5. The work done on crystal detectors is often overlooked.

They are cheap and for local work as convenient as tubes. After getting the apparatus the next thing to give thought to is the care of it. In this article only the main points will be taken up. First keep your apparatus clean. Keep a number of cloths handy and use them occasionally. Don't use oil or polish on them as it is next to impossible to keep from getting oil on the switch points and the resulting resistance will cause a lot of grief.

Keep dust off the crystal detector especially. Most of the better ones are provided with a glass cover, but covering it with a glass jar is nearly as good. Never handle crystals with the fingers. Use a pair of tweezers. The oil on the fingers will form a film on the crystal and necessitate cleaning it. A crystal may be cleaned with alcohol.

All contacts on a set should be kept clean and bright by the use of fine sandpaper. The plugs on Honey comb coils should fit snugly and be kept bright.

The storage battery of a set should be given proper care. It will pay large dividends in increased service rendered.

When tuning Music Don't try for the loudest reception, but rather for clearness and freedom from distortion.

Have a definite system of operating your set. Don't at one time adjust your fones and light the filaments and at another time light the filaments and then adjust the fones. Adopt one system and stick to it.

Even if you are in a hurry to tune in a station don't go at it as though you were in a race. Time is valuable, but you may have had the desired station tuned in and not known it half dozen times. When the station has been tuned in the filament current may be cut down quite a bit. Don't use amplification unless absolutely necessary. It is a waste of battery current and tube life.

Always ground the antenna when through receiving. An electric storm may play havoc with a set that is not properly grounded.

In conclusion, there is a lot to know about the radio game and one man can't know it all, but may learn something from every amateur, so fellow "hams" get acquainted with the rest of the amateurs in your neighborhood and exchange ideas with them, and you will find that your knowledge of the game will be greatly increased thereby.

Construction and Operation of a Simple Homemade Radio Receiving Outfit

CIRCULAR NO. 120 BUREAU OF STANDARDS

EDITOR'S NOTE:

We have received so many requests to publish data for a receiving set using a crystal dector instead of a vacuum tube, that we are re-printing all the necessary data contained in Circular No. 120 of the Bureau of Standards. This data is the most reliable obtainable and anyone following the description will be well satisfied with the results obtained.

A complete copy of the bulletin may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for five cents.

This circular describes the construction and operation of a very simple and inexpensive radio receiving outfit. The outfit will enable to hear radio code messages or music and voice sent out from medium-power transmitting stations within an area about the size of a large city, and from high-power stations within 50 miles, provided the waves used by the sending stations have wave frequencies between 500 and 1500 kilocycles per second; that is, wave lengths between 600 and 200. This equipment will not receive uninterrupted continuous waves. Occasionally much greater distances can be covered, especially at night. Sets constructed according to these instructions have given clear reception of music transmitted by radiotelephone from stations 300 miles distant. The total cost of the outfit can be kept below $10, or if an especially efficient outfit is desired, the cost may be about $15.

1. Essential Parts of Receiving Station

The five essential parts of the station are the antenna, lightning switch, ground connections, receiving set, and telephone receiver or "phone." The received signals come into the receiving set through the antenna and ground connection. The signals are converted into an electric current in the receiving set and the sound is produced in the phone. Either one telephone receiver or a pair, worn on the head of the listener, is used.

The lightning switch, when closed, protects the receiving set from damage by lightning. It is used to connect the antenna directly to ground when the receiving station is not in use. When the antenna and the connection to the ground are properly made and the lightning switch is closed, the antenna is not a hazard to a building and may act somewhat as a lightning rod to supplement the protection given to a building by lightning rods of standard construction.

The principal part of the station is the "receiving set." In the set described herein it consists of two parts, the "tuning coil" and the "detector," and in more complicated sets still other elements are added.

2. The Antenna, Lightning Switch, and Ground Connection

The antenna is simply a wire suspended between two elevated points. The antenna should not be less than 30 feet above the ground and its length should be about 75 feet (see Fig. 1). This figure indicates a horizontal antenna, but it is not important than the antenna be strictly horizontal. It is in fact desirable to have the end where the pulley is used as high as possible. The "lead-in" wire or drop wire from the antenna itself should run as directly as possible to the lightning switch. If the position of the adjoining building or trees is such that the distance between them is greater than about 85 feet, the antenna can still be held to a 75-foot distance between the insulators by increasing the length of the piece of rope D to which the far end of the antenna is attached. The rope H tying the antenna insulator to the house should not be lengthened to overcome this difficulty, because by so doing the antenna "lead-in" or drop wire J would be lengthened.

(a) Details of Parts. The parts will be mentioned here by reference to the letters appearing in Fig. 1 and 2.

A and I are screw eyes sufficiently strong to anchor the antenna at the ends.

B and H are pieces of rope ¼ or ⅜ inch in diameter, just long enough to allow the antenna to swing clear of the two supports.

D is a piece of ¼ or ⅜ inch rope sufficiently long to make the distance between E and G about 75 feet.

C is a single-block pulley which may be used if readily available. The pulley should not allow the rope to catch.

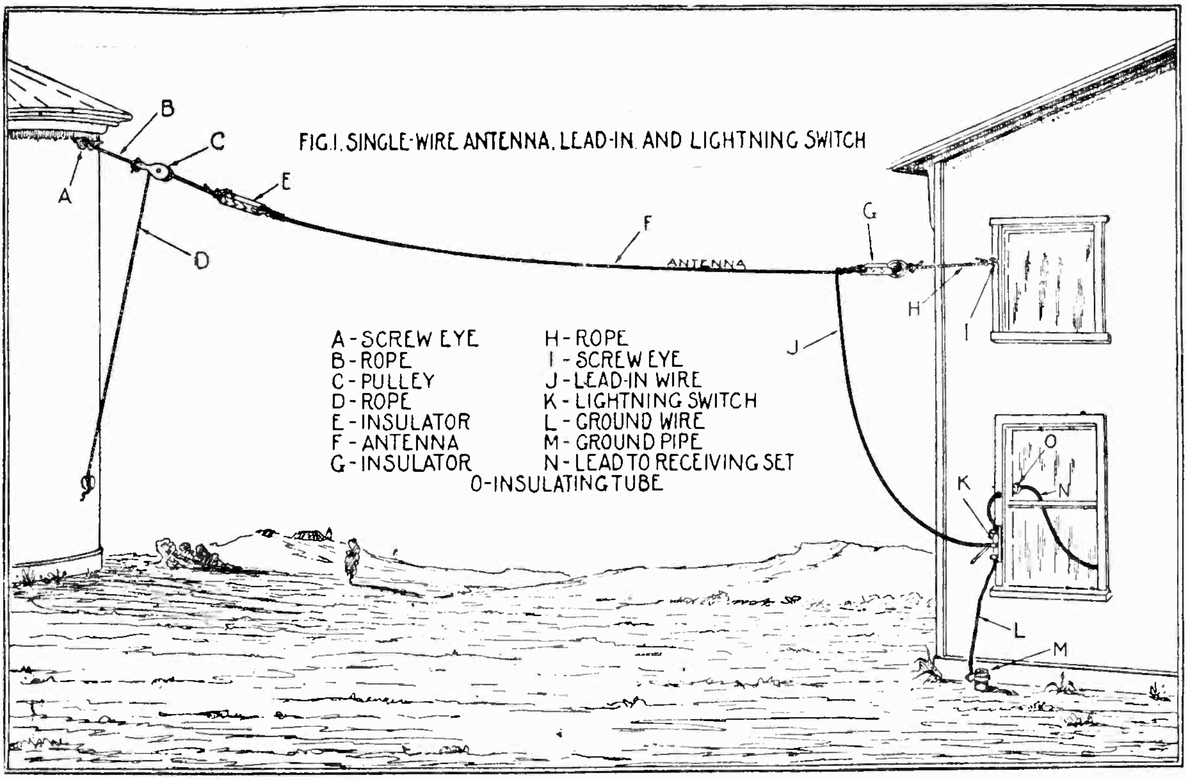


FIG. 1

E and G are two insulators which may be constructed of any dry hardwood of sufficient strength to withstand the strain of the antenna; blocks about ¾ by 1 by 10 inches will serve. The holes should be drilled as shown in Fig. 1, sufficiently far from the ends to give proper strength. If wood is used, the insulators should be boiled in paraffin. Precautions in regard to melting the paraffin are given in the paragraph under "Accessories." If porcelain insulators are available, they may be substituted for the wood insulators. Porcelain cleats can be used. Regular antenna insulators are available on the market, but the two improvised types mentioned will be satisfactory for an amateur receiving antenna.

F is the antenna about 75 feet long between the insulators E and G. The wire may be No. 14 or 16 copper wire either bare or insulated. The end of the antenna farthest from the receiving set may be secured to the insulator E by any satisfactory method, but care should be taken not to kink the wire. Draw the other end of the antenna wire through the insulator G to a point where the two insulators are separated by about 75 feet and twist the insulator G so as to form an anchor, as shown in Fig. 1. The remainder of the antenna wire J, which now constitutes the "lead-in" or drop wire, should be just long enough to reach the lightning switch.

K is the lightning switch. For the purpose of a small antenna this switch may be the ordinary porcelain-base, 30-ampere, single-pole double-throw battery switch. These switches as ordinarily available have a porcelain base about 1½ by 4 inches. The "lead-in" wire J is attached to this switch at the middle point. The switch blade should always be thrown to the lower clip when the receiving set is not actually being used, and to the upper clip when it is desired to receive signals.

In some stations there is no lightning switch outside the building, but instead a lightning arrester is connected to the antenna lead-in just inside the building; that is, as close as possible to the point where the lead-in leaves the porcelain tube. This lightning arrester has two binding posts, one of which is connected to the antenna lead-in, and the other is connected to a suit-

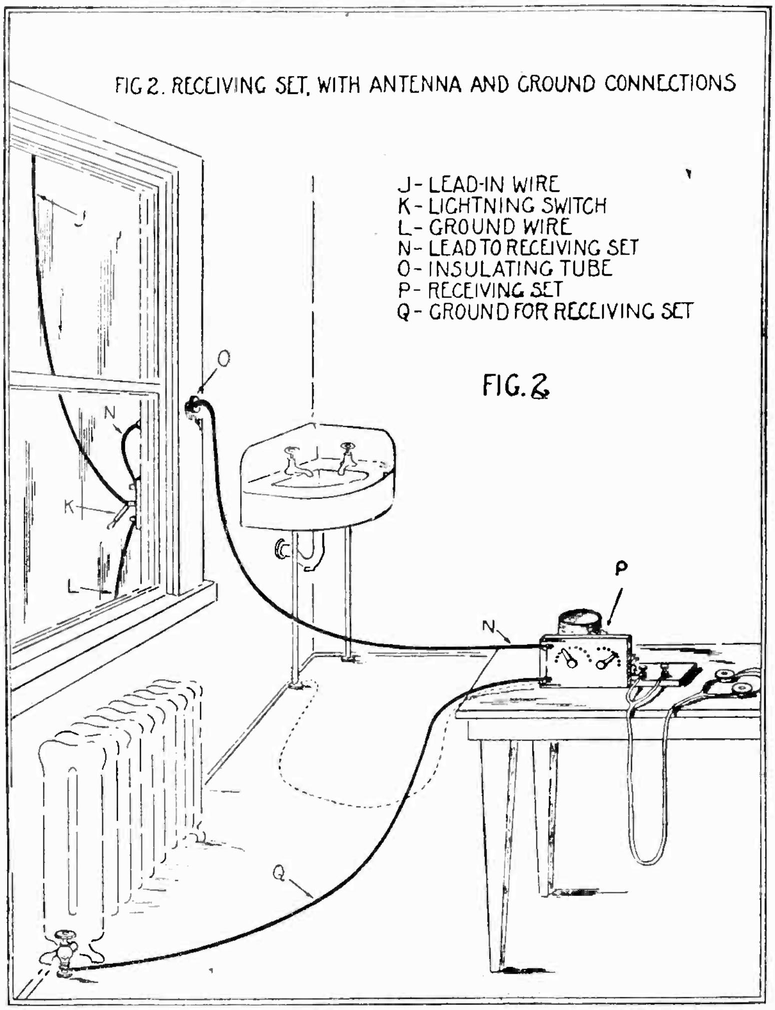


FIG. 2

able ground connection. The type of lightning arrester used should be a protective device approved by the Underwriters' Laboratories, Chicago and New York. Information as to the types of devices which are approved may be obtained from the Underwriters' Laboratories or from local insurance inspection departments. For the ground connection a water pipe or a steam pipe may be used; a gas pipe should not be used. The use of the lightning switch outside the building as above described is perhaps a little preferable to the use of the lightning arrester inside the building.

L is the ground wire for the lightning switch. The ground wire may be a piece of copper wire, No. 14 or larger, and should be of sufficient length to reach from the lower clip of the lightning switch K to the clamp on the ground rod M. The use of a large size of copper wire, such as No. 6, or of copper strap, will give added mechanical strength and minimize the danger of accidental breakage of the ground wire.

M is a piece of iron pipe or rod driven 3 to 6 feet into the ground, preferably where the ground is moist, and extending a sufficient distance above the ground so that the ground clamp may be fastened to it. The pipe should be free from rust or paint. Special care should be taken to see that the pipe is clean and bright where the ground clamp is connected.

N is a wire leading from the upper clip of the lightning switch through the porcelain tube O to the receiving set binding post marked "antenna."

O is a porcelain tube of sufficient length to reach through the window casing or wall. This tube should be mounted in the casing or wall so that it slopes down toward the outside of the building. This is done to keep the rain from following the tube through the wall to the interior.

Fig. 2 shows the radio receiving set installed in some part of the house.

P is the receiving set which is described in detail below.

N is a wire leading from the antenna (upper) binding post of the receiving set through the porcelain tube to the upper clip of the lightning switch. This wire, as well as the wire shown at Q, should be insulated and preferably flexible. Unbraided lamp cord will serve for these two leads.

Q is a flexible wire leading from the receiving set binding post marked "ground" to a water pipe, heating system, or some other metallic conductor to the ground. If there are no water pipes or radiators in the room in which the receiving set is located, the wire should be run out of doors and connected to a special ground below the window. The ground for the lightning switch should not be used for this purpose. It is essential that for the best operation of the receiving set this ground be of the very best type. If the soil near the house is dry, it will be necessary to drive one or more pipes or rods sufficiently deep to encounter moist earth. The distance between the pipes will ordinarily not exceed 6 feet. Where clay soil is encountered the distance may be 3 feet; in sandy soil it may be 10 feet. Some other metallic conductor, such as the casing of a drilled wall, not far from the window will be a satisfactory ground.

3. Tuning Coil, Detector, and Phone.

The phone and certain parts of the apparatus will have to be purchased. The other parts may be obtained at home.

(a) Tuning Coil (R, Fig. 3). This is a length of cardboard tubing with copper wire wound around it. The cardboard tubing may be an oatmeal box. Its construction is described in detail below. A cylinder of wood or other non-metallic substance may also be used.

(b) Crystal Detector (S, Fig. 3). The crystal detector may be of very simple construction. A number of different kinds of crystals are suitable for use as detectors; these are discussed in detail in the book "The Principles Underlying Radio Communication." A galena crystal which will be satisfactory can usually be conveniently secured. Silicon is usually not as sensitive as galena, but is sometimes more easily obtained, and sensitive spots are often more easily located on silicon. It is important that a selected tested crystal be used.

The crystal detector can be made up of the tested crystal, three wood screws, a short piece of No. 16 copper wire or a nail, a piece of fine copper wire such as No. 28 or 30, set-screw type binding post, and a wood knob or cork.

The crystal may be held in place on the wood base by three brass wood screws as shown at 1, Fig. 3. A bare copper wire is wrapped tightly around the three brass screws for connection.

A metal called "Wood's metal," which has so low a melting point that it will melt in boiling water, may be purchased in many stores. If this metal is available, it may be used for mounting the crystal, but a metal of higher melting point, such as ordinary solder, should not be used because it may seriously injure the crystal. A shallow hole of size suitable to hold the crystal and leave most of the crystal projecting may be bored terminate in the hole so that it will be embedded in the Wood's metal. Instead of being mounted in a hole bored in the base, the crystal may be mounted in a small brass cup such as is found on the positive terminal of some kinds of dry batteries.

The binding post may be mounted on the back of the upright panel near its edge, as shown in Fig. 4. It may be found more convenient to mount the binding post on a

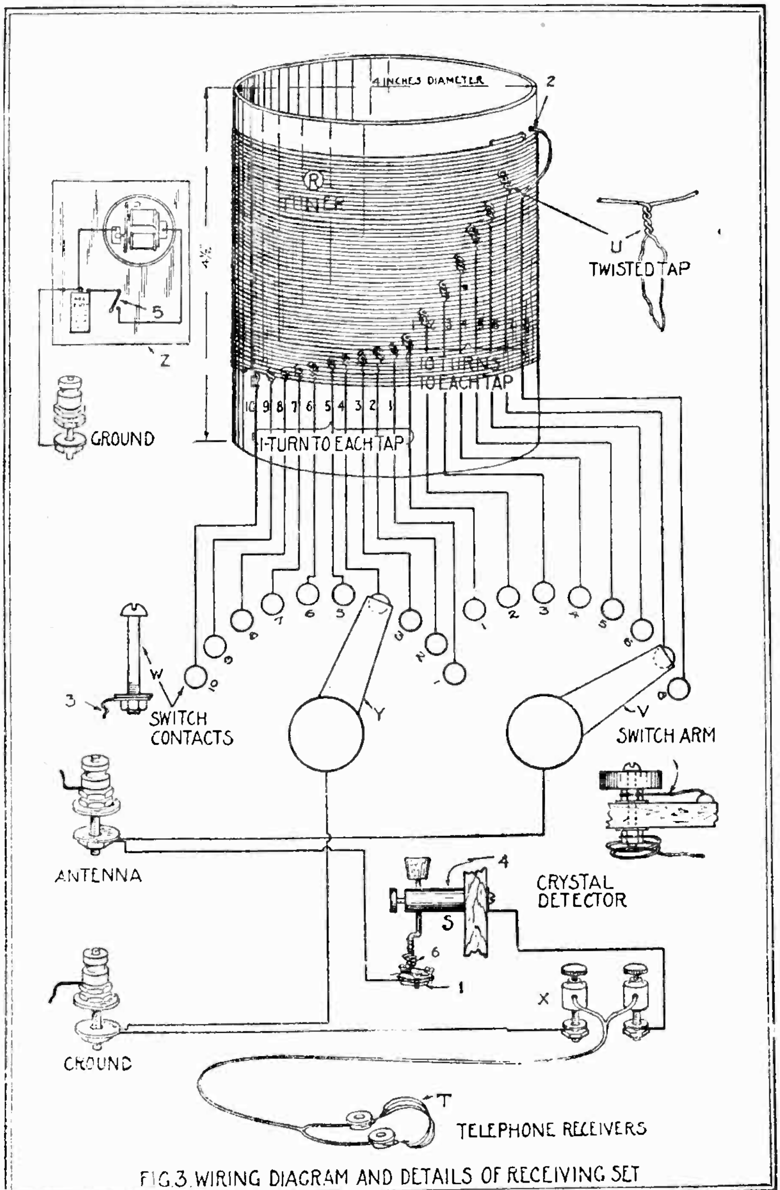


FIG.3 WIRING DIAGRAM AND DETAILS OF RECEIVING SET

FIG. 3

in the wooden base, and melted Wood's metal poured into the hole so that the crystal is held in place. The wire which is to make connection with the crystal should small vertical piece of wood screwed to the base at another point, so that the detector will be more accessible. A long slender nail, or a piece of copper wire of a size such as

No. 16, about 2 inches long, is bent as shown about ½ inch from one end, with an offset depending on the size of the crystal used. Ordinarily the offset may be about ¼ inch. This nail or piece of wire is inserted in the binding post as shown. To the upper end a small cork or wooden knob is attached. To the lower end a short piece of fine copper or brass wire is attached and the free part of the wire is wound into a small spiral of several turns. For this fine wire it will be found best to use No. 26, No. 28, or No. 30. For galena the smaller wire such as No. 30 will usually be found best.

(c) Phone (T, Fig. 3). It is desirable to use a pair of telephone receivers connected by a head band, usually called a double telephone headset. The telephone receivers may be any of the standard commercial makes having a resistance of between 2000 and 3000 ohms. The double telephone receivers may cost more than all the other

(d) Accessories. Un
accessory equipment ma
posts, switch arms, sw
buzzer, dry battery, and
to mount the complete ap
ing posts, switch arms, a
may be purchased from d
such goods or they may be
ed at home. The pieces of
equipment is mounted ma
a dry packing box and cov
to keep out moisture. Car
in melting the paraffin not
For this reason, it is a goo
in a pan set in boiling w
paraffin just begins to sm
proper temperature. Whe
have been drilled and cut to
be soaked in the melted par
affin may be applied quick
brush. When cold, the exce
be carefully scraped off with

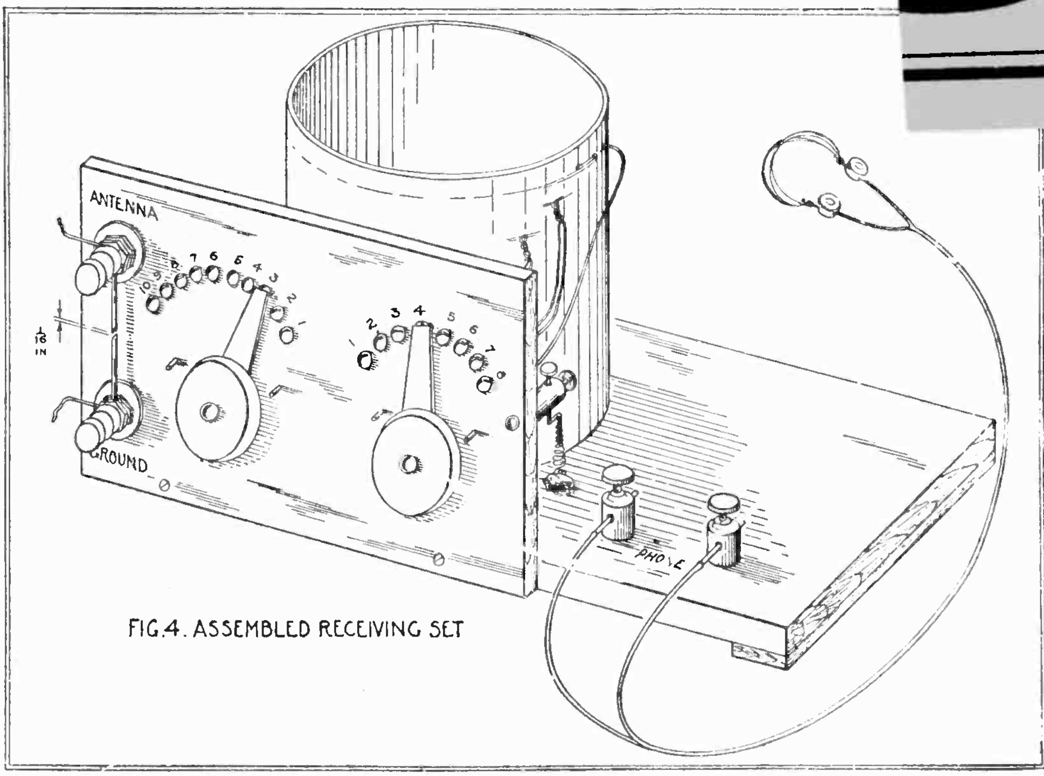


FIG.4. ASSEMBLED RECEIVING SET

FIG. 4

parts of the station combined, but it is desirable to get them, especially if it is planned to improve the receiving set later. A single 1000 ohm telephone receiver with a head band may be used but with less satisfactory results.

of metal such as the brass strip in the edge of a ruler.

4. Details of Construction.

The following is a description of the method of winding the tuning coil and the construction of the wood panels:

(a) Tuning Coil (R, Fig. 3). The cardboard tubing is 4 inches in diameter by 4½ inches long. One end of the tube should have the cardboard cover glued securely to it. About 2 ounces of No. 24 (or No. 26) double cotton-covered copper wire is used for winding the coil. Punch three holes in the tube ½ inch from one end as shown at 2 in Fig. 3. Weave the wire through these holes in such a way that the end of the wire will be firmly anchored, leaving about 12 inches of the wire free for connecting. Start with the remainder of the wire to wind the turns in a single layer about the tube, tightly and closely together. After 10 complete turns have been wound on the tube hold these turns tight and take off a tap. This tap is made by twisting a 6-inch loop of the wire together at such a place that it will be slightly staggered from the first connection. This method of taking off taps is shown clearly at U, Fig. 3. Proceed in this manner until 7 twisted taps have been taken off—one at every 10 turns. After these first 70 turns have been wound on the tube, take off a 6-inch twisted tap for every succeeding single turn until 10 additional turns have been wound on the tube. After winding the last turn of wire, anchor the end by weaving it through two holes punched in the tube as at the start, leaving about 12 inches of wire free for connecting. It is to be understood that each of the 18 taps is slightly staggered from the one just above, so that the taps will not be punched along one line on the cardboard tube (see Fig. 3). It might be advisable, after winding the tuning coil, to dip the tuner in hot paraffin. This will help to exclude moisture. It is important to have the paraffin heated until it just begins to smoke, as previously explained, so that when the tuner is removed it will have only a very thin coat of paraffin.

(b) Upright Panel and Base. Having completed the tuning coil, set it aside and construct the upright panel shown in Fig. 4. This panel may be a piece of wood approximately ½ inch thick, 4½ inches wide, and 8 inches long. This panel can be used with apparatus to be described in another publication. For this reason it is desirable to have the contact an inch from the right end of the panel (see Fig. 4). It is also desirable to have the contact points near the top of the panel. The position of the several holes for the binding posts, switch arms, and switch contacts may first be laid out and drilled. The antenna and ground binding posts may be ordinary 8/32 brass machine screws about 1½ inches long with three nuts and two washers. The first nut binds the bolt to the panel, the second nut holds one of the short pieces of stiff wire, as the case may be. The switch arm with knob shown at V, Fig. 3, may be purchased in the assembled form it may be constructed from a ⅜-inch slice cut from a broom handle and a bolt of sufficient length equipped with four nuts and two washers, together with a strip of thin brass somewhat as shown. The end of the switch arm should be wide enough so that it will not drop between the contact points, but not so wide that it can not be set to tough only a single contact. The switch contacts (W, Fig. 3) may be of the regular type furnished for this purpose, or they may be 6/32 brass machine screws with one nut and one washer each; they may even be nails driven through the panel with the individual tap fastened under the head or soldered to the projection of the nail through the panel. The base is of wood approximately ¾ inch thick, 5½ inches wide, and 10½ inches long.

The telephone binding posts should preferably be of the set-screw type as shown at X, Fig. 3.

5. Instructions for Wiring.

After the several parts mentioned have been constructed and (with the exception of the tuning coil) mounted on the wood base, the wires may be connected to the switch arms and binding posts, and the taps may then be connected to the switch contacts. A wire is connected to the back of the left-hand switch-arm bolt (Y, Fig. 3), twisted into a spiral of one or two turns like a clock spring, and then led to the back of the binding post marked "ground." Connection is made to the binding post by removing the insulation from the wire and clamping between the nut and washer. The same wire is now passed through a small hole and run underneath the base to the left-hand binding post marked "phone." A wire is then run from underneath the right-hand binding post marked "phone" to the binding post 4, Fig. 3, which is part of the crystal detector. The copper wire, which was wrapped tightly about the three brass wood screws that hold the crystal in place, is led underneath the base, up through a small hole, and is then connected to the back of the binding post marked "antenna." Another wire is connected to the back of the right-hand switch-arm bolt (V), twisted into a spiral of one or two turns like a clock spring, and then connected to the back of the same binding post.

The taps leading from the tuner should not be connected to the switch contacts. Scrape the cotton insulation from the loop ends of the 16 twisted taps as well as from the ends of the two single wire taps coming from the first and last turns. Fasten the bare ends of these wires to the proper switch contacts as shown by the corresponding numbers in Fig. 3. Be careful not to cut or break any of the looped taps. The connecting wires may be fastened to the switch contacts by binding them between the washer and the nut as shown at 3, Fig. 3. After all the wires from the tuner have been connected, the tuner should be fastened to the base by two or three small screws passing through the cardboard end. The screws should be provided with washers.

6. Directions for Operating.

After all the parts of this crystal-detector radio receiving set have been constructed and assembled, the first essential operation is to adjust the fine wire so that it rests on a sensitive point on the crystal. This may be accomplished in several ways; one method is to use a buzzer transmitter. Assuming that the most sensitive point on the crystal has been found by the method described in paragraph below, "The Test Buzzer," the rest of the operation is to adjust the radio receiving set to resonance or in tune with the station from which the messages are sent. The tuning of the receiving set is accomplished by adjusting the inductance of the tuner. That is, one or both of the switch arms are rotated until the proper number of turns of wire of the tuner are made a part of the metallic circuit between the antenna and ground, so that together with the capacity of the antenna the receiving circuit is in resonance with the particular transmitting station. It will be remembered that there are 10 turns of wire between adjacent contacts of the 8-point switch and only 1 turn of wire between adjacent contacts of the 10-point switch. The tuning of the receiving set is best accomplished by setting the right-hand switch arm on contact (1) and rotating the left-hand switch arm over all its contacts. If the desired signals are not heard, move the right-hand switch arm to contact (2) and again rotate the left-hand switch arm throughout its range. Proceed in this manner until the desired signals are heard.

It will be advantageous to know the wave frequencies (wave lengths) used by the radio transmitting stations in the immediate vicinity. A lower frequency (greater wave length) requires more turns of the coil.

(a) The Test Buzzer (Z, Fig. 3). As stated, the more sensitive spots on the crystal can be found by using a test buzzer. The test buzzer is used as a miniature local transmitting set. This is shown at z, Fig. 3. The buzzer, dry battery, and switch (5) may be mounted on the table or a separate board. The binding post marked "ground" may be one terminal of the dry cell. The current produced by the buzzer will be converted into sound by the telephone receivers and the crystal, the loudness of the sound depending on what part of the crystal is in contact with the fine wire. To find the most sensitive spot, connect the binding post marked "ground" of the receiving set to the test buzzer binding post marked "ground", close the switch (5, Fig. 3), and if necessary adjust the buzzer so that a clear note is emitted; set the right-switch arm on contact point No. 8 and connect the telephone receivers to the binding posts. Loosen the set screw of the binding post (4) slightly and change the position of the fine wire (6, Fig. 3) to several positions of contact with the crystal until the loudest sound is heard in the phones; then slightly tighten the binding post set screw (4). The single wire connection between the test buzzer and the receiving set is all that is necessary to give a good test signal when the crystal detector is adjusted to a sensitive spot.

After the construction of the set has been completed, a test should be made for broken wires or poor contacts. Connect one terminal of the dry battery to the binding post marked "antenna." Connect the other battery terminal to one terminal of the buzzer, and from the other buzzer terminal run a wire to the binding post marked "ground." Turn the left-hand switch arm to the extreme left and the right-hand switch arm to the extreme right. If the buzzer operates, the metallic circuit of the coil is complete.

To make sure that the cords of the telephone receiver are all right, put the telephone receivers over the ears and touch the two cord tips to the two terminals of the dry battery. If a click is heard in both receivers, the cord is all right.

7. Approximate Cost of Parts

The following list shows the approximate cost of the parts used in the construction of the receiving station. The total cost will depend largely on the kind of apparatus purchased and on the number of parts constructed at home.

Antenna:

Wire, copper, bare or insulated, No. 14 or 16, 100 to 150 feet	$0.75
Rope, ¼ or ⅜ inch, 2 cents per foot.	
2 insulators, porcelain	.20
1 pulley	.15
Lightning switch, 30-ampere battery switch	.30
1 porcelain tube	.10

Ground Connections:

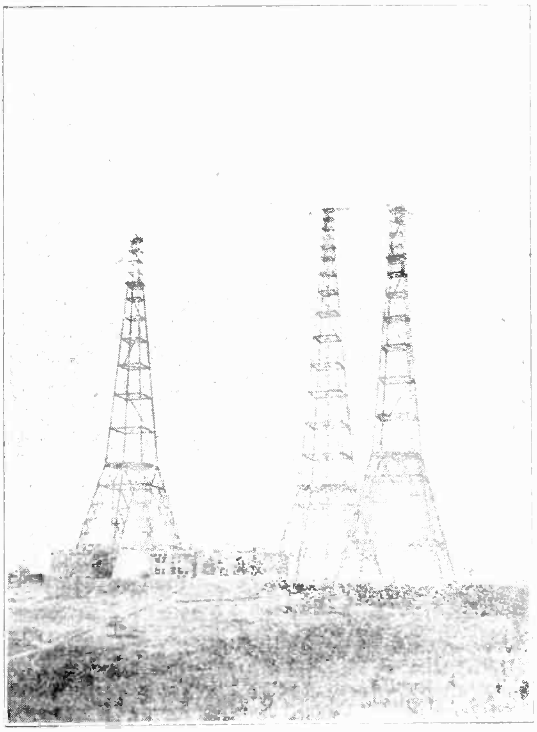
Wire (same kind as antenna wire).	
2 clamps	.30
1 iron pipe or rod	.25

Receiving Set:

3 ounces No. 24 copper wire, double cotton covered	.75
1 round cardboard box	
2 switch knobs and blades complete	1.00
18 switch contacts and nuts	.75
3 binding posts, set screw type	.45
2 binding posts, any type	.30
1 crystal, tested	.25
3 wood screws, brass ¾ inch long	.03
2 wood screws for fastening panel to base	.02
Wood for panels (from packing box)	....
2 pounds paraffin	.30
Lamp cord, 2 to 3 cents per foot.	
Test buzzer	.50
Dry battery	.30
Telephone receivers	4.00
Total	$10.70

If the switches are constructed as directed and a single telephone receiver be used, the cost may be kept well below $10.

If a head set consisting of a pair of telephone receivers instead of a single telephone receiver is used, the cost of this item may be about $8 instead of $4. Still more efficient and expensive telephone receivers are available at prices ranging up to about $20.



International

A Great Radio Station

A view of the giant aerials, by means of which messages are sent through the air. Part of the equipment of the powerful station at Arlington, Va., which is known alike to amateur and professional radio operators. The Arlington station is looked upon as one of the most complete stations in the East.

Baseball fans will become radio fans as the scores and progress of the games will be broadcasted during the season. Henceforth you may sit comfortably in your office or home and "listen in" to the progress of our great national game no matter in what city it is being held.

It is said that Station 9CT located in the Wrigley Building, Chicago, recently established communication by radio telephone with the University of Texas in Austin, more than 1400 miles away.

It is estimated that $5,000,000 is spent weekly by radio fans. The industry is assuming such proportions that it is impossible to foretell how soon it will settle down with an organized business. At this time when the country is just recovering from a severe economic depression it is encouraging to note one industry that is far from suffering from anything by overwork.

The S. S. Leviathan which many of our war veterans will remember, is being rebuilt and every cabin will be equipped with radio receiving apparatus.

Artists who have performed to radiophone audiences say that when they appear following a "hearing" there are many more admirers present who are curious to see the artists whom they have heard.

Radio Telephony

Until the recent wave of broadcasting swept over the United States very few amateurs had devoted any attention to the telephone end of radio, but now that radio telephony is making a bid for supremacy in the radio field many operators are investigating it with a view to adding the necessary equipment so that their stations will be complete. Those operators who have stuck to the spark or damped wave method will find the field a new one entirely, but those operators who have handled C. W. or undamped wave sets will find radio telephony very similar to their old stand-by.

Previous to the very general use of the vacuum tube the methods of obtaining a continuous wave were very expensive and not at all suited for the pocketbook of the average amateur, but the advent of the vacuum tube as a generator has opened up a new field for experimentation. It is the only method at present adaptable to small powers and has other advantages such as comparatively low cost, simplicity, and stability of operation; in short it is ideal for amateur short wave transmission.

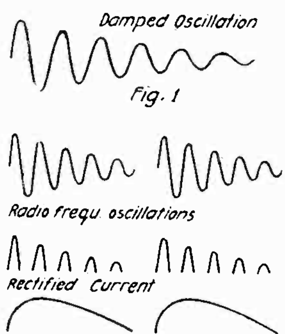


Fig. 2

There is a great similarity between radio telegraphy and radio telephony. One who understands the fundamentals of one field can easily pick up those of the other. There is nothing really hard to master. As a matter of fact, the receiving circuits are identically the same. In transmission, however, it is necessary to employ undamped waves instead of the damped such as are used in spark transmission.

A damped radio frequency wave transmission system cannot be used in the transmission of speech because such a system produces trains of oscillations as shown in Figure 1. These trains arrive at the receiving system and are rectified by the detector, and give impulses of current in the telephone receiver as shown in **Figure 2.**

Now when an undamped radio frequency wave arrives at the receiving station it is rectified by the detector. This rectified current, however, is practically constant and therefore produces a *constant* uninterrupted pull on the diaphragm of the telephone receiver. Therefore no sound is heard.

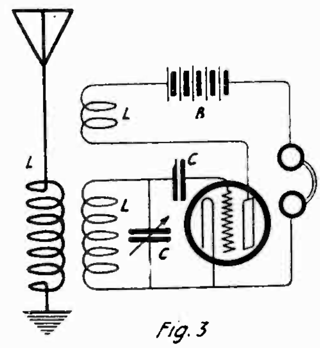


Fig. 3

Voice currents or waves are complex and when we consider how comparatively crude radio telegraphy is, we see the big problem of radio telephony. In the case of telegraph signals all that is necessary is to start and stop the flow of energy by means of a key. In telephony, however, we have to radiate the energy in close approximation to the complex wave forms of speech. When we consider how complicated these wave forms of speech vibrations are, we can readily realize that it is quite a problem.

The solution is to generate an undamped radio frequency wave and modulate it by means of voice or audio frequency waves. That is to say, waves of radio frequency are sent out by antenna, the intensity of which varies with the frequency of the speech waves. Therefore, we need an undamped wave generator and a device to modulate the waves generated.

The following methods may be used to produce the undamped radio frequency wave: First, the high frequency alternator; second, electric arc; third, vacuum tube oscillators.

As the first two methods are complicated and the cost of the equipment is above the average amateur's pocketbook, we will only devote our attention to the vacuum tube oscillators.

The V. T. is in common use as far as amateur receiving systems are concerned, but when it comes to employing it in a transmission system the amateur seems to hesitate. There is nothing really complicated in the basic theory of operation. Let us consider a simple inductive feed-back receiving circuit as shown in Fig. 3. While this is really a receiving circuit, it is also a miniature transmitter. In the plate circuit there is oscillating energy, and if the circuit is coupled to the antenna there will be a small amount of energy radiated. The problem is to get more energy into the antenna. The power is in the B battery. Raise the voltage of this battery by adding cells or employing a DC generator. Be sure the particular tube will not break down with the increased voltage. Also, there is nothing to be gained in using inductive coupling between the plate and antenna. We can get greater power and efficiency by using the circuit shown in Fig. 4.

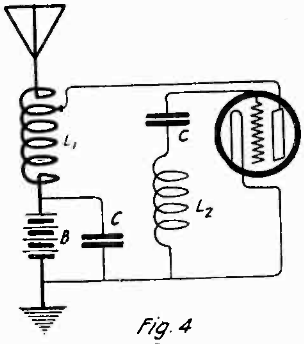


Fig. 4

For use with the circuits of figures 4 and 5 the following data is given:

Wave length—150-300 meters.

L_1=24 turns heavy stranded wire wound on tube 4 inches diameter. Plate connection is tapped on twelfth turn.

L_2=30 turns No. 18 DCC wound on same tube ½ inch from L_1 windings in same direction.

Fig. 5 shows another feed-back circuit.

Wavelength—130-300 meters.

L=24 turns heavy stranded wire wound on tube 4 inches diameter. Tapped on thirteenth turn.

So much for the inductive feed-back circuits.

The common capacity feed-back is shown in Fig. 6.

Substitute the antenna for C and we have the circuit shown in Fig. 7. A modification of this circuit is shown in Fig. 8.

Now that we have a simple means of generating undamped radio frequency waves, we come to the problem of modulation. For this purpose we will connect a telephone transmitter in series with the ground lead in order to modulate the radio frequency wave.

Fig. 9 shows a set employing capacity feedback which has given very good results. It may be constructed from parts found about the average laboratory or workshop.

Wavelength—150-500 meters.

L=100 turns heavy stranded wire wound on tube 4 inches diameter and tapped every 20 turns.

C_1=Variable condenser .0016 mfd. maximum capacity.

C_2=Variable condenser .001 mfd. maximum capacity.

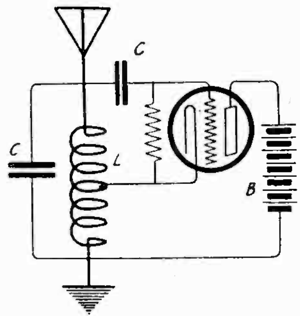


Fig. 5

In order to place the set in operation it is necessary to connect a hot wire ammeter in series with the antenna in order to observe maximum radiation. Adjust the inductance and capacities until the set oscillates on the desired wavelengths. A wavemeter will come in handy when making these adjustments. Then speak into the transmitter. Adjust grid leak for modulation; that is, increase or decrease its resistance. It is a good plan to have some-

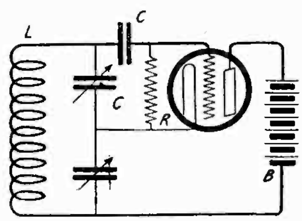


Fig. 6

one listen in on a nearby receiving set to observe the modulation. In adjusting the set remember that you have ALL of the following things to adjust: tuning inductance, tuning condenser, grid condenser, grid leak resistance, filament current and plate voltage. Failure to get the proper values for one of these may cause the set to be a failure.

Fig. 8 is a modification of Fig. 7. In Fig. 9 is shown a circuit employing capacity feedback which has given very good results. Fig.

10 shows the method of connecting iron core inductances on each side of the D. C. supply, as well as a large capacity condenser across the circuit in order to eliminate undesirable ripples.

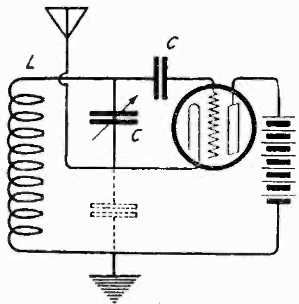


Fig. 7

Know well the vacuum tubes you are using and their operating characteristics. The curves from most tubes in use today may be had from the respective manufacturers. If several tubes are connected in parallel, more power will be radiated. When a DC generator is used, a large capacity should be shunted across it and iron core inductances connected in series, as shown in Fig. 10. The proper values of L and C are determined by the operating characteristics of the machine. The more slots on the commutator the lower the ripples or unevenness of the voltage. Don't raise the voltage above the safety point of the particular tube you are using.

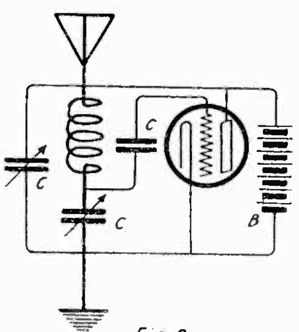


Fig. 8

For greatest efficiency, all inductances should have a very low high-frequency resistance. This may be done by using heavy stranded wire or Litzendrabt. Connections must be as short as possible and soldered properly.

In conclusion, there is nothing really mysterious in the use of V. T. transmitters, but good engineering practice has to be adhered to and if the reader follows the suggestions and uses the data given in this article, success is within his reach. Patience and perseverance are big factors in experimental work. Amateur radio

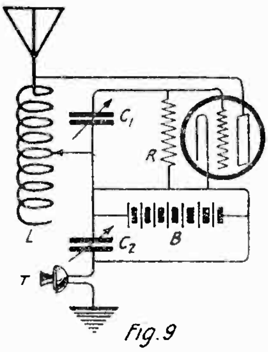


Fig. 9

telephony is the coming thing. It is surprising, when we consider the advantages, why more work isn't being done with it in the amateur field to-day, and the sooner we take it up the better it will be for everyone in general. We are capable of accomplishing big things.

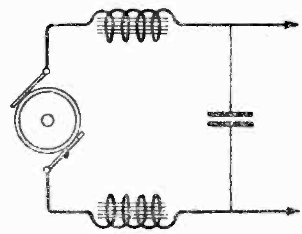


Fig. 10

Why not do it? The one big problem in radio telephony is interference. But it is no larger than those that have been solved already. With all the amateurs working with radiophone, someone is bound to hit upon the proper solution.

Edwin H. Armstrong developed his modification of the accepted three electrode vacuum valve receiving circuit in 1912. Recently his claims have been definitely established by the success of his suit against Lee deForest, inventor of the Audion.

The very successful tests between the S. S. America and New York had evoked the promise of the installation of Radiophones on every ocean going steamer, according to Chairman Lasker of the U. S. Shipping Board, which controls the America.

Fundamental Principles of Radio

(Continued from the June issue.)

Resonance

The principles of resonance can be illustrated by two tuning forks or other pieces of steel which have the same characteristics.

If one tuning fork is caused to vibrate by drawing a violin bow across it, or gently striking it against the palm of the hand, and it is then brought close to the second fork, the second fork will commence to vibrate also. This will occur even though the two forks are not exactly the same. However, if they are exactly alike, the second fork will vibrate very strongly with the first one and give off the same note. When this occurs a condition is set up between the two forks, known as resonance. In other words, they are in tune.

Just so will electrical circuits be in resonance when they are in tune with each other.

A simple way to illustrate this is as follows:

In figure 8 let "l" be an inductance coil consisting of a few turns of wire wound on a Quaker Oats box, "c" a variable condenser and "s" a very small spark gap between the two ends of the circuit which is formed when the apparatus is connected up as shown in the left-hand portion of the figure. Then let "L", "C" and "S" be the elements in another circuit which is connected to some source of alternating current such as a spark coil.

Now if we start the spark coil, oscillations will occur in the circuit LCS, and if we bring our first circuit lcs, close to the circuit LCS, it will be noticed that tiny sparks will occur at the gap "s". If the condenser "c" is varied by turning the handle which changes its capacity or the contact "X" on the coil is changed then it is possible to change the brilliancy of the sparks at the small gap, "S". It will be found that there is a particular adjustment of the inductance "l" and the capacity "c" at which the sparks are brightest. At this point the two circuits are in tune and a condition of resonance has been established.

Electro-Magnetic Induction

When a conductor is moved across a magnetic field so that it cuts the lines of magnetic force, an electro motive force is generated in the conductor. If the conductor is part of a closed electric circuit, a current will flow in it due to this induced electro motive force, or voltage as it is called.

As this induction is due to the cutting of the lines of force by the conductor, it will be greatest at the instant of the highest rate of cutting the lines, since the greatest number of lines are cut at this instant. This

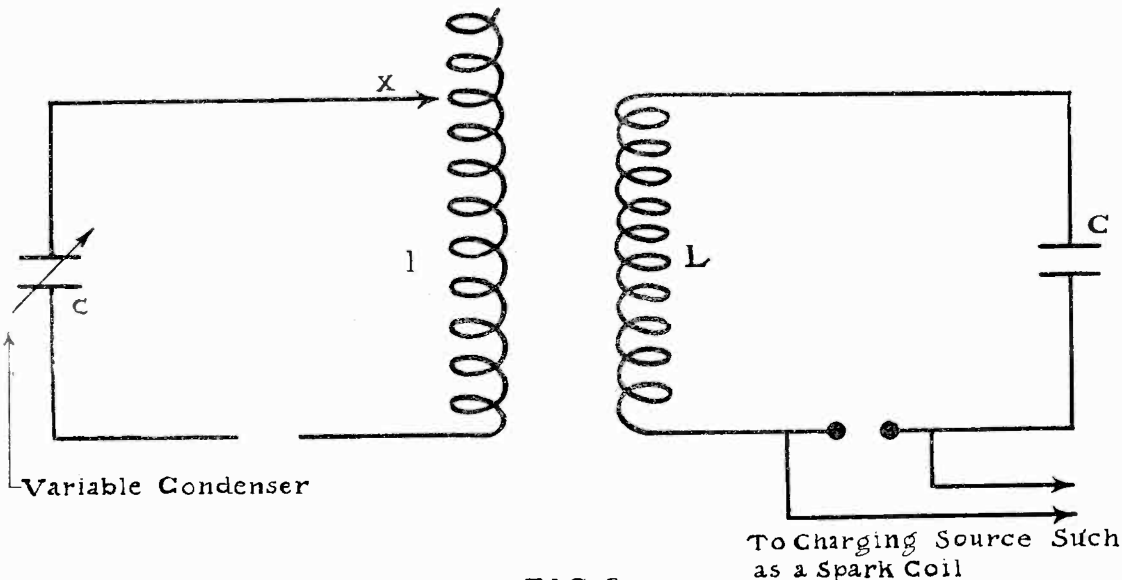


FIG. 8.

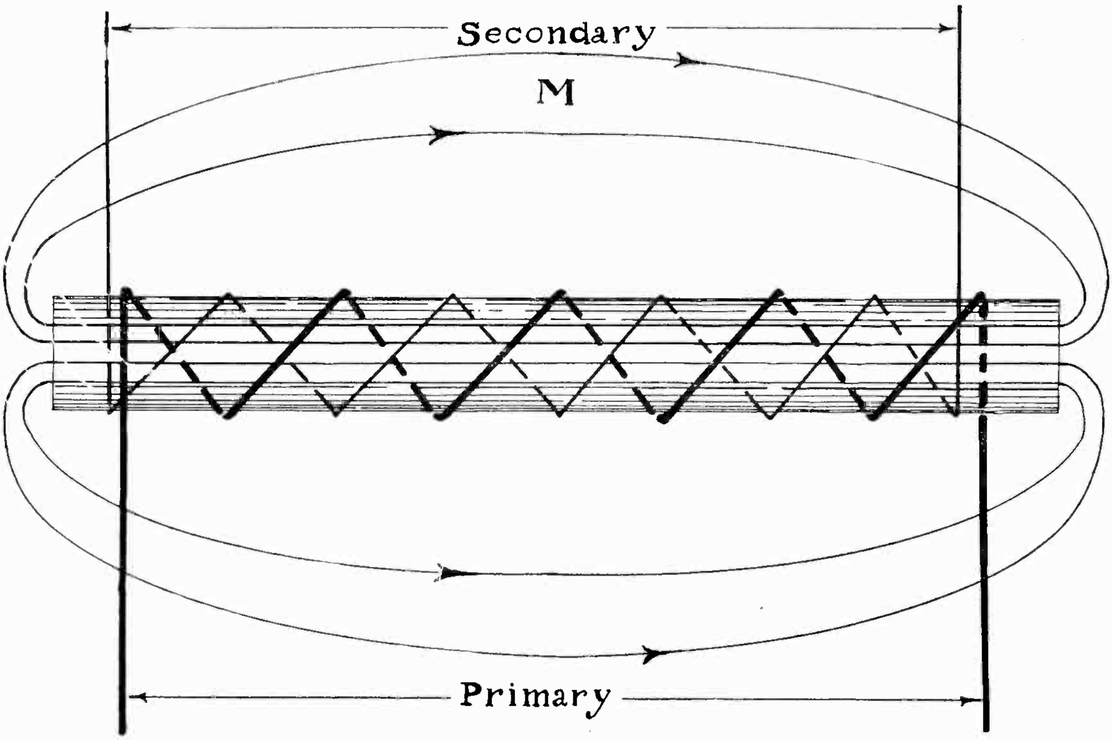


FIG. 9.

effect is known as Electromagnetic Induction and has many practical applications in radio. Some of these will be described.

Power Transformers

It is well at this point to mention the instrument which is instrumental in electrically charging the transmitting antenna circuit and causing it to radiate electromagnetic waves which may be picked up by radio receiving sets. This instrument is called a power transformer and is used to transform the comparatively low voltage obtained from an alternating current generator into a higher voltage.

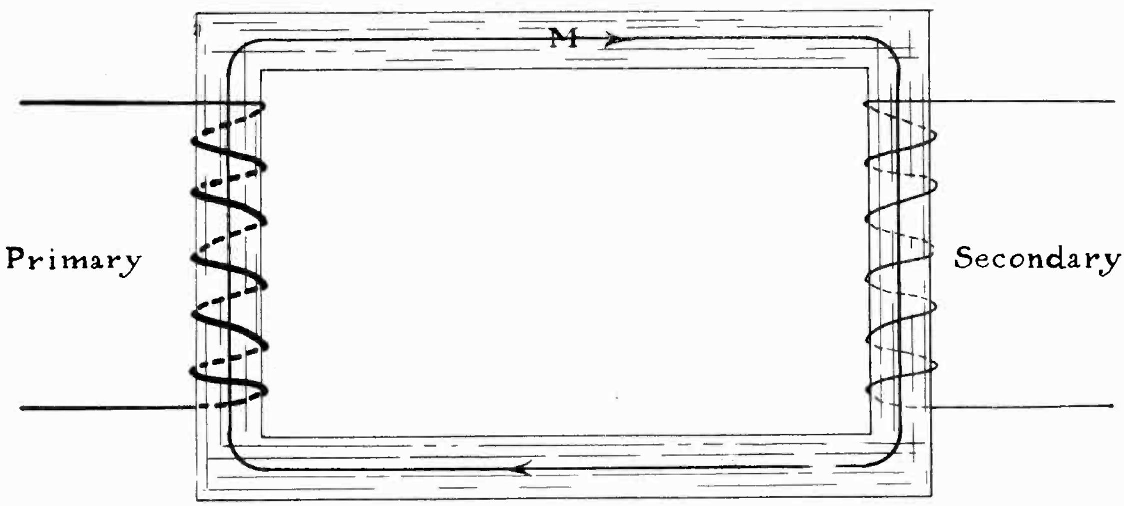


FIG. 10.

Such an instrument is shown diagramatically in Figures 9 and 10.

Briefly, a transformer consists of a primary winding of a comparatively few turns of heavy wire, wound on but insulated from a laminated iron or ironwire core, which carries the current from the alternator; a secondary winding of many turns of finer wire wound in sections and insulated from all other parts of the transformer. It is this secondary winding which delivers the high voltage. In general, it is safe to say that the transformer increases the alternator primary voltage in the same proportion as the number of secondary turns is increased over the primary turns.

Usually 110 or 220 volts is drawn off the generator into the primary and the secondary delivers from 10,000 to 30,000 volts.

Transformers may be divided into two classes, depending upon the style of core used; Open core and closed core transformers.

Figure 9 shows an open core and figure 10 a closed core transformer.

The Alternating Current Generator

Consider a loop of wire connected to an ammeter A as shown in figure 11, and placed near a permanent bar magneto which may be revolved around on an axel a-a. If either the magnet or the loop is moved, a current will be observed to flow through the circuit, indicated by the movement of the ammeter needle, the direction of the current depending upon the direction of motion and the polarity of the magnetic pole. If, then, the loop is held stationary and the magnet rotated around its axis, a-a, the direction of the current will alternate as first the N pole of the magnet passes the loop and then the S pole passes.

The current will be maximum when the number of magnetic lines cutting the wire is greatest. This is when the magnet pole passes directly in front of the loop. As the pole passes the loop the current decreases, and is zero when the magnet is in the position shown by the dotted lines, but increases again in the opposite direction as the other pole of the magnet approaches the loop. One complete revolution of the magnet is termed a cycle. The number of cycles per second is called the frequency.

In practice, instead of only a single magnet being used, a number are mounted on the same shaft, which for a given speed of rotation increases the frequency and voltage.

(To be continued)

All transmitting stations in the United States must operate under a Government license. Most of the commercial stations begin with the letter K or W. The Naval Station calls with N and the amateur with the numeral of their district. Chicago is the 9th district.

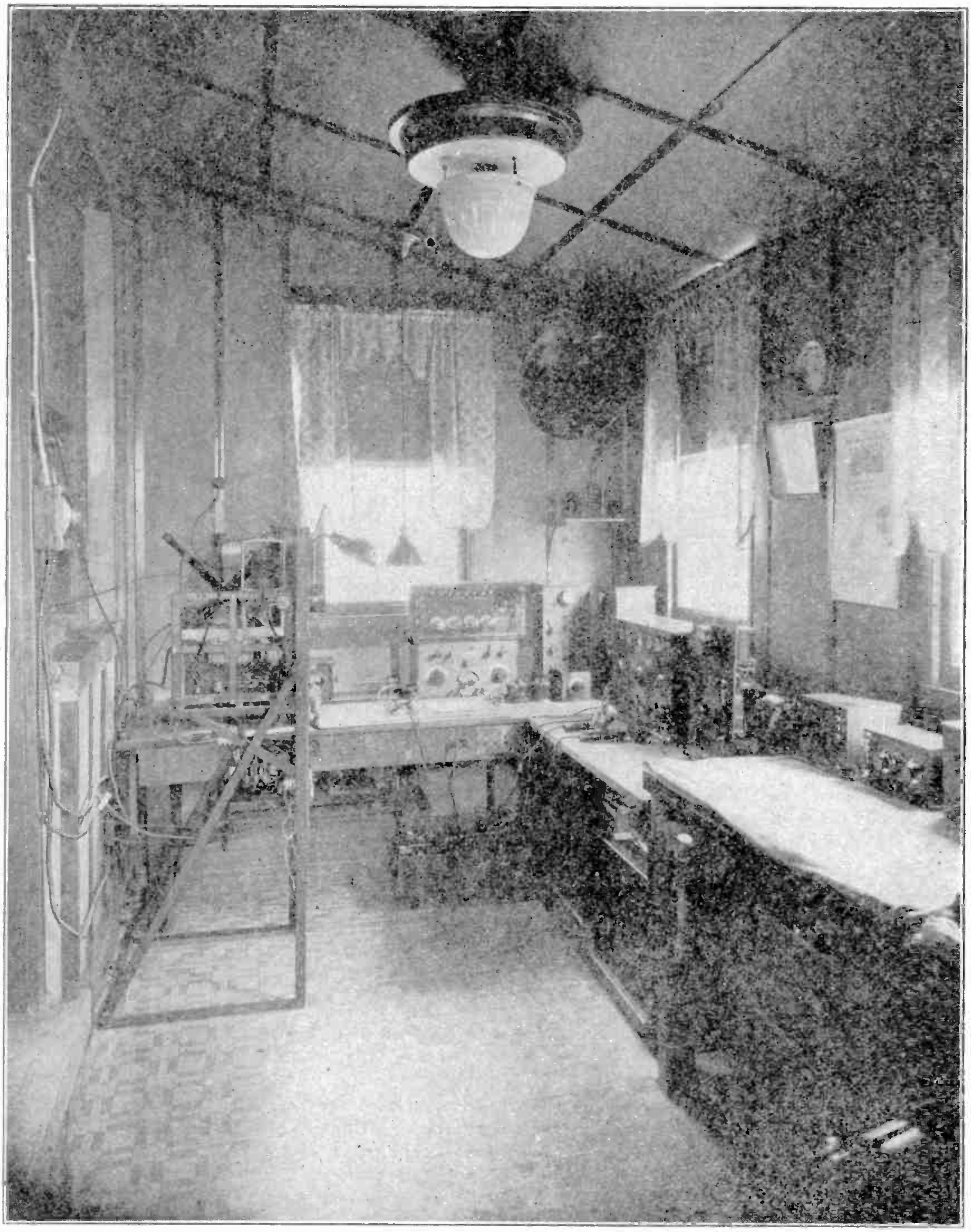
The Radio Corporation of America has recently announced that it has in operation six international circuits for radio communication:—Great Britain opened March 1, 1920; Hawaii and Japan, opened March 1, 1920; Germany, two circuits, opened August 1, 1920 and May 1, 1921; France opened December 14, 1920; Norway opened May 17, 1920.

The Schenectady broadcasting station of the General Electric Company (WGY) has been heard across the Rockies and our correspondents from all parts of the country report that the lectures and program come in with perfect modulation.

Plans are under way for the Radio Exposition to be held in the Leiter Building, Chicago, June 26th to July 1st, inclusive. The Army, Navy, Westinghouse, Radio Corporation of America and technical schools will participate. Contests between amateurs are being arranged and "fans" will have an opportunity to see just what "Uncle Sam" is doing in radio. G. H. Jaspert, in charge of KYW, the Chicago Westinghouse station, announces that his concern will install the official station at the exposition. L. R. Schmitt, inspector for the 9th district and A. Thomas, Jr., district manager for the Radio Corporation, are actively interested. Milo E. Westbrook is general manager of the exposition.

Radio played the part of detective in the search for the jewels of Mme. Amelita Galli-Curci. Description of the suspects was broadcasted from a transmitting station in Los Angeles.

American Legion Post Enters the Broadcasting Field



The band concert given by The Lawndale-Crawford Post, No. 98, The American Legion Wednesday evening, May 3rd, 1922, at Sokol Chicago Hall, 2341-25 S. Kedzie Avenue, was broadcasted by radio. A telegram was received from General John J. Pershing that he listened in. Permission to broadcast from 8 to 10:30 P. M. was secured by the Post from Herbert Hoover, Secretary of Commerce.

The band is led by Edward Freund who was Pershing's Band leader at A. E. F. Headquarters, Chaumont, France. Charles J. Roth, Jr. is chairman of the entertainment committee.

The concert was broadcasted on a 360 meter wave and was heard from coast to coast. Station call is 9APP. The transmitting apparatus used in the broadcasting of this concert is a part of the equipment of the laboratories of the Illinois Radio Engineering Co., Inc., located at 3609 W. 26th Street. The apparatus used making up the transmitting equipment consists of a radio phone using the combination of the Heising Modilator and Colpitts Oscillated Circuits.

A High Meterage Receiving Set

BY BENJ. M. DUGGAR, JR.

It is very hard for most boys to get a good wireless receiving set on account of the cost. I, from long experimenting, have found the hook-up to a very good set that will not over tax the average boy's pocketbook like most sets do.

The set that I am about to tell you of uses a loose coupler. The one which I have at present will tune up to 3000 meters, and I have been able to hear concerts regularly, many radiophone speeches and conversations, and spark sets at all times. But a loose coupler of this meterage is not necessary to be able to hear satisfactorily. A home-made loose coupler will usually do very well.

The tone of this set is clear and sharp, and even the most distant stations come in clearly, but of course a little faint. This set just "Goes right out and gets 'em."

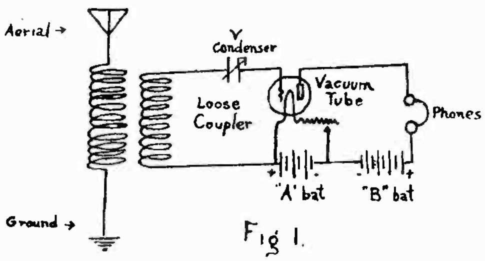


Fig 1.

Figure I shows the hook-up for the set mentioned. It contains:

1 Loose Coupler.
1 Variable Condenser.
1 Vacuum Tube Detector.
1 Vacuum Tube Socket.
1 Six Ohm Rheostat.
1 Pair Phones 2000 ohms or over.
1 22½ Volt "B" Battery.
1 6v. Storage Bat. or d. cells.
50 to 150 ft. No. 14 A wire.

If you can not get a vacuum tube detector figure 2 is a set that will work very nicely. Figure 2 is the hook-up for a loose coupler and crystal detector set. The apparatus required for this set is listed below. Most of these can be made.

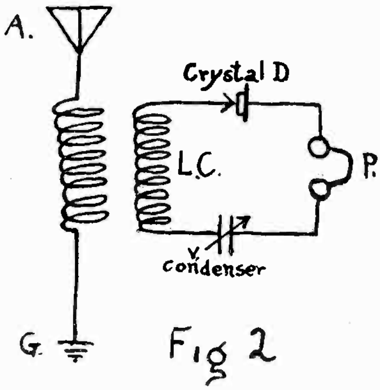


Fig 2

1 Loose coupler.
1 Crystal detector.
1 Variable condenser.
1 pair of phones.
And wire for aerial and ground connections.

A set like this should not at the most exceed $20, which is very reasonable considering its high meterage and receiving power.

Patents

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

1,395,378—Secret Signaling. — Richard H. Wilson of Newark, New Jersey, and John P. Schafer of Richmond Hill, New York. Assigned to the Western Electric Company. This patent describes a radio telephone secret signaling system, which comprises a transmitter circuit with two branch circuits. The microphone is coupled to filter circuits which allow only a limited range of voice frequencies to pass. At the receiving station branch circuits, which combine the different frequencies, are employed. An eavesdropper attempting to intercept a conversation in the ordinary manner would be able to tune to one or the other of the carriers at a time and would receive only unintelligible sounds.

1,395,931—Electric Condenser—Charles E. Smith and William H. Smith, Brooklyn, N. Y. This patent comprises an electric condenser unit of a base or body of thin fiber board around which is wrapped a dielectric and metal foil. The sheets of foil are smaller than the dielectric. The leads are brought out to eyelet terminals on the ends of the board. Any number of units may be used to form a built-up structure by passing bolts through the eyelet terminals.

1,395,987—Radio Signaling Apparatus.—Henry Joseph Round, London, England. Assigned to the Radio Corporation of America. This patent provides means for keeping the wave length of a radio transmitter constant. The open and closed oscillating circuits are combined with a small motor of two windings. One winding is connected in the closed and the other in the open oscillatory circuit. When the open and closed circuits are exactly in tune, there will be no rotating field produced by the two windings at right angles. But if the antenna changes its wave length, a rotating field will be produced; if the wave length is increased this rotating field will be in one direction and if the wave length is decreased the rotating field is in the opposite direction. The shaft of the rotation field motor controls a variometer, a variable condenser or other means for varying the antenna increases its wave length the variometer acts to decrease it until there is no longer a rotating field and vice versa. In this way the antenna wave length is kept constant.

1,396,030 — Variable Condenser — William Dubilier, New York, N. Y. This patent shows a variable condenser comprised of a number of fixed condenser units connected to contacts, a switch for cutting in the units and a variable condenser having a maximum equal to the common difference between the fixed units. Intermediate capacities between the fixed units are thus obtained by means of the variable condenser unit.

1,396,491—Distance Estimating Device—R. L. Williams, Newton, Mass. Patent is for a combination radio submarine sound signal system by means of which a radio transmitter is operated to give a single signal simultaneously with the operation of a submarine sound signal. The operator at the receiving station gets the single instantaneous radio signal and later hears the submarine signal and by measuring the time between the two can estimate the distance from the transmitting station.

1,396,745—Vacuum Tube Circuits.—Arthur Haddock, East Orange, New Jersey. Assigned to the Western Electric Co. This patent covers a multi-stage amplifier in which means are provided for varying the number of effective tubes between the input and output circuit of the amplifier and also for regulating the potential between the incoming line and one of the tubes. With this circuit the amplification can be varied to any desired degree between the input and output circuits.

1,396,786—System for Transmission of Intelligence.—E. O. Scriven, New York, N. Y. Assigned to Western Electric Company. A radio telephone system by means of which signals are transmitted or received by means of a high frequency carrier current, modulated in accordance with the signals. The system comprises a combination of two vacuum tube oscillators which serve as a source of high frequency carrier wave oscillations, the impedance of the combination being varied according to the low frequency signals to be transmitted. The receiver employs a vacuum tube containing two grids, two plates and a common filament. The circuit is suitable for either high frequency carrier wave reception or modulated high frequency wave reception. In the latter case the vacuum tube serves as a homodyne generator, that is, it should produce oscillations of the same frequency as the incoming high frequency oscillations. If the frequency waves are not modulated the tube should become a heterodyne generator.

1,395,390—Oscillation. — Generating System—Lewis M. Clement of Newark, New Jersey. Assigned to the Western Electric Company. This invention provides a vacuum tube transmitter and means for varying the frequency of the oscillator and to simultaneously, automatically provide the feedback for any frequency at which the oscillator may be set to operate. A number of frequencies are made available, means being provided for the operator to switch from one to the other instantly.

1,397,575—Selective Audion Amplifier.—Lee De Forest, New York, N. Y. Assigned to De Forest Radio Telephone and Telegraph Company. This patent covers a vacuum tube amplifier having in its output side a plurality of oscillating circuits, to amplify impressed currents of certain input frequencies to a greater degree than impressed currents of other frequencies.

1,397,093—Radio Repeating System—Lloyd Espenscheid, Hollis, New York. Assigned to the American Telephone and Telegraph Company. This invention relates to radio repeating stations and apparatus for amplifying at intermediate points the signals between two terminal stations.

1,395,454—Radio Signaling System—James Harris Rogers, Hoyattsville, Maryland. This patent provides for an antenna to be used on submarines having a metallic hull. The system comprises conductors extending longitudinally and enclosed by the hull and electrically connected thereto. The signaling system is inductively coupled to the antenna system.

1,397,423—Radio Signaling System.—Chas. V. Logwood, New York, N. Y. Patent relates to a vacuum tube transmitting and receiving apparatus with means for automatically switching from transmitting to receiving.

International

Via Wireless

The Chicago Police Department, under the direction of Chief Charles Fitzmorris, is rapidly becoming the most efficient police force in the United States.

Chicago was the first city to perfect, on a large scale, a system of wireless communication from headquarters to the policeman on his beat.

By means of the latest wireless (police wireless) radio, it is possible for the patrolman or mounted officer to catch from the air the radio messages of his superior officer. This appliance is working wonders in the apprehension of auto bandits.

By means of a small receiving instrument which buzzes when calling, the officer, by placing the receiver to ear, is able to receive orders. He cannot talk back, as there is no means afforded in answering.

Photo shows: Portable sending station, or squad wagon. Can be rapidly moved for sending orders to squads of police covering strikes, riots, etc.

Amplifying-Transformers

For the operator who wishes to build apparatus during the summer months, a simply constructed and at the same time efficient amplifying transformer may be made. This is of the so-called Audio or low frequency type.

A core of soft iron wire is built up three inches long and one-half inch in diameter and thoroughly insulated with a good tape. On top of this wind the primary coil, consisting of 4000 turns of No. 32 B. & S. enameled copper wire. Insulate this winding thoroughly and then wrap a layer of varnished tape over it.

The secondary winding may now be put on and consists of 15,000 turns of the same wire. The secondary should now be protected by winding one or two layers of the tape over it. Bakelite heads or ends may be fitted and the two ends of the primary winding brought out to binding posts on one head, and the two ends of the secondary treated in the same manner at the other end of the coil.

Questions and Answers

Q. Will I be able to hear New York and Pittsburgh if I install the hook up described by C. Y. Davis in his article "Rubbing Aladdin's Lamp," in your May issue?

H. R. Carter, Toronto, Ontario.

A. Yes. This hook up is one that reaches out and brings in the distant stations.

Q. Can dry cells be used for lighting the filament in place of the 6-volt storage battery?

Ferris Dietz, Lake Charles, La.

A. Yes, but dry cells when used for lighting the filament will be exhausted so rapidly that they will not be satisfactory for the purpose.

Q. Will the set described in your magazine receive signals from Chicago in Scranton, Pa.?

H. J. John, Forty Fort, Pa.

A. Yes.

Q. (1) Can you receive telegraph messages over a radio set? (2) Do you have to get a license to send radio messages. (3) Can you attach a receiving and sending set to the same antenna?

Arthur Dobbs, Ft. Worth, Texas.

A. (1) Yes. (2) Yes. (3) Yes.

Q. Why are five connections shown in the variometer used in the hook up of your May issue?

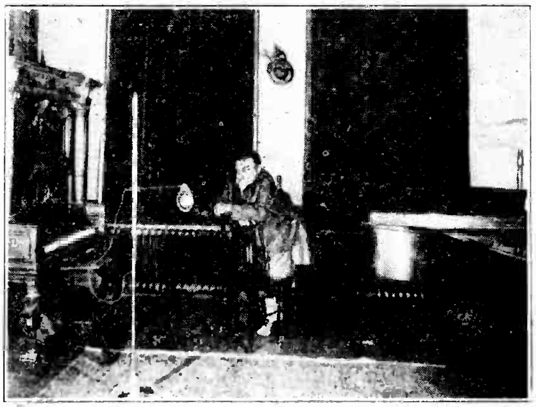
J. F. Burkhart, Johnstown, Pa.

A. The five connections are as follows: The rotor is disconnected from the stator, and a connection made to each end of the rotor. (2) One connection to each end of the stator and one to the center of the stator, total five.

Q. Can a metal bowl be used with a head receiver instead of the wooden bowl shown, for the loud speaker in your May issue?

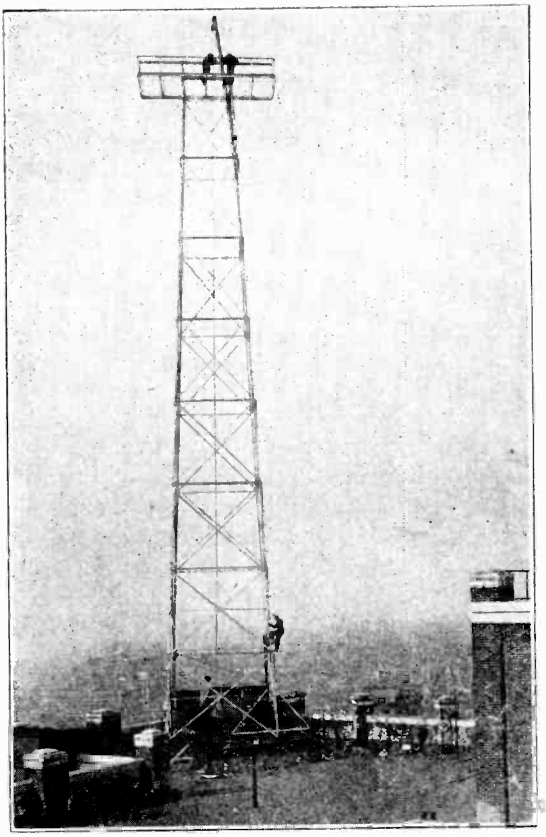
Wm. Holden, Peetz, Colo.

A. Yes, but there will be a "tinny" quality to the tones.



Dr. Steinmetz Explains Lightning by Radio

Dr. Charles P. Steinmetz, chief consulting engineer of the General Electric Company at Schenectady, N. Y., who recently startled the world with the announcement that he had succeeded in making artificial lightning at his laboratories, is here shown speaking via radiophone to a vast army of invisible listeners, to whom he explained the manner in which he evolved the experiment. This is the first time the aged electrical



International

Radiophone Station Opened in New York

Atop the Telephone Building at 24 Walker street is this 80-foot aerial tower, by means of which radiophone conversations may be carried on. The telephone company is inaugurating a system of radio telephony, somewhat along the present telephone system. Regular business may be transacted via the radiophone, the advantage being mainly for long distance work. At the present time transmitted messages are being made only from the main station at the Telephone Building, but it is expected that a regular individual system will be installed.

SOME MISCELLANEOUS NOTES ON RADIO

Tuning

Tuning is the process of obtaining electrical resonance in two circuits.

Now that sounds quite technical but really is not as hard as it sounds and is very well illustrated by the following:

If we stretch a string, say three feet long, between two points and hang from it two other strings, say one foot long, which have small weights attached to them we will have the mechanical equivalent of a coupled radio circuit.

Hang the two strings with the weights about six inches from each other near the center of the long string.

For convenience we will call the long string number one, the short string on the left, P, and the one on the right, S.

Now pull the string P to one side and release it, and note that it swings back and forth in a series of oscillations, each one of which is shorter than the previous one. Also note that string S starts to swing back and forth and soon is oscillating as hard as P, but P is gradually slowing down. However, after having slowed down and practically stopped, P will start oscillating again until it will be oscillating almost as hard as before, but S has stopped.

Thus it is seen that the energy is given to the first string by pulling it to one side is transferred to the other one and then transferred back until it is all used up in friction.

The length of time it takes for these oscillations to die down depends upon the horizontal movement of string number one and the horizontal movement depends upon how tightly the string is stretched.

If the horizontal movement is great there will be a frequent transfer of energy. This corresponds to "close coupling". If the horizontal movement is slight, there will be a less frequent transfer of energy, which corresponds to "loose coupling".

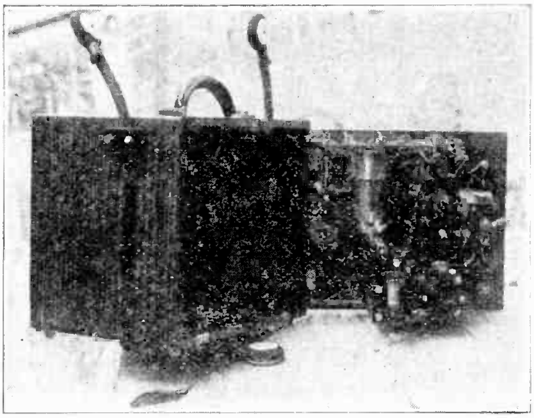
The strings P and S, correspond to the primary and secondary of an oscillation transformer, generally known as a coupler.

Advantage may be, and is, taken in the better stations of "loose coupling" on account of the purity of the wave either sent out or tuned to in the case of a receiving station.

The reason for using loose coupling is this: if we use a receiving set for example, containing a primary and secondary coil, and tune the primary and secondary separately by means of a wave meter to a given wave length or frequency, say 360 meters, and then bring the primary up to the secondary until signals are heard, we find that only stations tuned to the exact wave length to which we tuned our set can be heard. In other words there is only one wave length in the circuit, 360 meters. Let us now move the primary and secondary very close together and we find that stations on 200 meters and probably 600 meters are now heard. Our circuits are now closely coupled, and we are getting interference from undesirable stations. Sometimes we blame those stations for not staying on the wave length they are supposed to, but there are times that readjusting or coupling our own sets looser would avoid the interference.

As a matter of experiment, the writer at one time, using a large receiving loose coupler, carried the primary thirty feet from the secondary and continued to receive signals from the old Sayville station, which indicates that there still was a transfer of energy from one circuit to another.

In very loosely coupled circuits the normal frequency of oscillation or wave length is unchanged. On the other hand where circuits are closely coupled the normal frequency or wave length is changed and more than one wave length is present or rather may be detected in the case of a receiving set and radiated in the case of a transmitting set. Such sets are "broadly tuned".



Aerial Communication Exhibits at Aero Show

An interior view of Type C. G. 1104, radio telephone and telegraph transmitting set, made by the General Electric Company and exhibited at the Aero Show in New York.

Methods of Obtaining Variation of Inductance

There are several ways by means of which a change of inductance may be obtained. Change of coil method, the step method and the variometer method.

The change of coil method requires that one have a number of coils for a given band of wave lengths, for example, one coil for 160 to 215 meters; another for 200 to 350 meters and so on. These coils must be or should be so equipped that they may be taken out or inserted in the circuit with a minimum loss of time.

The step or top method is the one familiar to nearly all who have taken up radio and is the one where we find a single coil of wire wound on a form of suitable size, and from which a short wire extends every few turns to a switch.

In this way any given number of turns of the coil may be cut into the circuit and since the inductance depends upon the number of turns of wire, the inductance may be varied in steps corresponding to the number of turns included in each top.

However, there are limitations to the practical size any coil should be made as it has been found that it is not good practice to make a coil large enough to tune to the longest wave length in use and expect it to function well on the short wave lengths.

The third method for varying inductance is by means of a variometer.

Briefly a variometer consists of two coils of wire wound on suitable forms, and so arranged that one can be rotated inside the other or moved away from each other, one end of the winding on one being connected to one end of the winding on the other.

When these windings are both in the same direction, and current flows through them, the magnetic fields set up assist each other and a maximum inductance value is obtained, but if the windings are opposite, then the magnetic fields oppose each other and a minimum value is obtained. Any degree between minimum and maximum may be obtained by changing the relative positions of the windings.

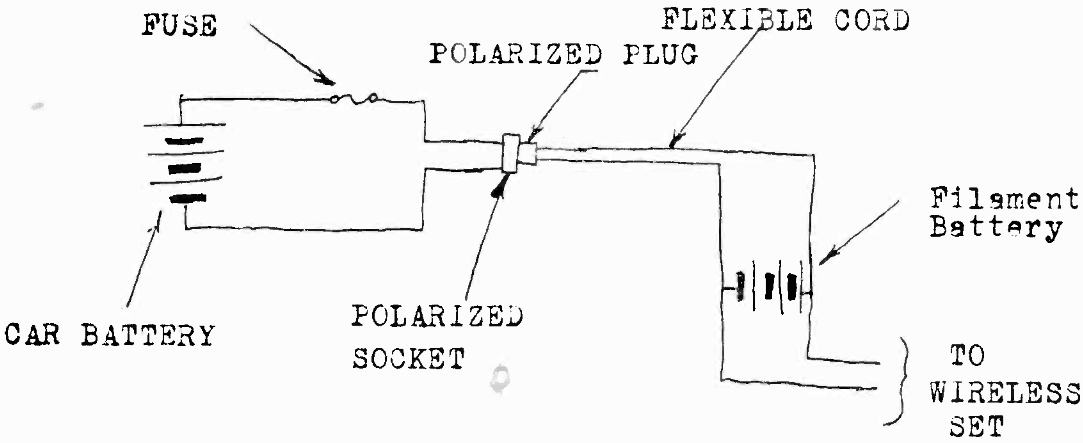
However, there is never a time when the inductance value is zero, because only the mutual inductance of the coils is changed; the self inductance of each coil is still present.

Keeping the Filament Storage Battery Charged Without Trouble

By H. H. SCHNECKLOTH

Experimenters have frequently made use of the automobile storage battery to supply current for heating audion filaments, etc., but have repeatedly abandoned the idea because the car was generally gone when the "juice" was most wanted.

When the car is driven into the garage the polarized plug is placed in the socket. This connects the two batteries in multiple, and, if the voltage of the filament battery has fallen below that of the car battery, the former will be raised, the charge continuing until the two batteries are equal in voltage.



A practical method of allowing the automobile to furnish current for wireless purposes is to connect the automobile storage battery in multiple with the filament battery whenever the car is not in use.

This is readily done by mounting a polarized socket in the car, connecting it to the car battery, and connecting the wireless storage battery to a polarized plug by means of a flexible cord.

The expense and interruption of having the filament battery removed and charged is thus eliminated as the car battery will keep the charge of the filament battery practically constant.

Likewise, the experimental battery can be depended upon to occasionally replenish the voltage of the car battery, should the latter accidentally become discharged.

The rated voltage of the two batteries should be equal.

The International Radio Conference is being continued in London and an effort is being made to bring about a world wide standardization of wireless traffic.

Marshall Joffre, of France, the hero of the Marne now on a visit to this country, delivered a message to radio enthusiasts on April 5th. He spoke in French but an interpreter translated the message.

Jean LaCarne of the Vallot observatory on the summit of Mont Blanc, has perfected a radio apparatus capable of resisting severe atmosphere changes of the high altitudes which break ordinary wireless instruments.

The volume of business in the Wireless Telephony field is unprecedented and a vast amount is being forfeited because of the shortage of supplies and equipment.

North Star Radio Products

For Immediate Shipment

TYPE 1-R "NORTH STAR" SPECIAL REGENERATIVE RECEIVER.

(Licensed under Armstrong U. S. Patent 1,113,149.)

SPECIFICATIONS

Cabinet: Quarter sawed oak, walnut finish. Size: Length 20″; Width 7″; Height 7″.
Panel: Formica, walnut finish.
Variometers: "North Star" Special.
Vario-Coupler: "North Star" Special.
Rheostat: "North Star" Special.
Dials: "North Star" Special, white figures on dark ground.
Coil: Two taps, one for 10 turns; one for 1 turn.
Wave Length: 150 to 600 meters.
Price: Without phones; tube; aerial or batteries—

$57.50

Price: With following equipment: 1 Radiotron UV 200 tube; 1 pair Kellog Headphones; 1 Burgess tapped "B" Battery; 1 Brach Lightning Arrester; 1 complete aerial—

$75.00

Type 1-A "North Star" Special Two Stage Amplifier, designed to match our RECEIVER as above. Size: Length 11 in.; Width 7 in.; Height 7 in. Finished same as TYPE 1-R RECEIVER.

Price: Without tubes or batteries—

$50.00

Radiotron UV No. 201 Amplifying Tubes . . . . $6.50 each net

THE RECEIVING OUTFIT YOU WILL EVENTUALLY BUY

North Star Variometers	$5.00
North Star Vario-Couplers	$4.50
North Star 43 Plate Variable Condensers	$4.50
North Star Rheostats	$1.25
Thoardson Amplifying Transformers	$4.50
Brach Lightning Arresters	$2.50
Burgess "B" Batteries, Tapped 22½ Volt	$3.00

DEALERS DEALERS DEALERS

We Can Offer You Attractive Discounts on Any of the Above Listed Material.
Write or Wire

Minnesota Radio Sales Corp.

208-220 Palace Building, MINNEAPOLIS, MINNESOTA