RADIO AGE

The Magazine of the Hour

October, 1922

Price 25 cents

How To Make a Tube Unit for $23—In This Number

RADIO AGE INSTITUTE

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The Magazine of the Hour

Volume 1 *Number 5*

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RADIO AGE is published monthly by
RADIO AGE, INC.

Publication office, Mount Morris, Ill.
Chicago Office, Garrick Building, 64 W. Randolph St.

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Advertising Forms Close on 19th of the Month Preceding Date of Issue.

Issued monthly. Vol. I, No. 5. Subscription price $2.50 a year.
Entered as second-class matter September 15, 1922, at the post office at Mount Morris, Illinois, under the Act of March 3, 1879.

Pardon Our Loud Speaker

One day we visited a Radio Show in the Central West. Several exhibitors had loud speakers installed in their booths and each one, apparently fearing the other fellow would get the most attention, turned on the noise to the limit. Friends, it was awful. The bedlam gave us such an unfortunate impression of Radio entertainment?? that we put our own loud speaker away in the kitchen cabinet when we arrived back home.

We are bringing it out again because we have something which calls for a bit of noise and we want to broadcast it.

Radio magazines are not newspapers. However, some Radio magazines publish articles about the progress of wireless developments that are real news stories. With becoming modesty we call attention to the fact that RADIO AGE has been printing Radio News first. And Radio News which is not printed first is not news at all.

In our August issue we published articles on "Radio Equipment at KDKA", and on "Development of Radiophone Broadcasting" both by eminent experts. We are not betraying any confidences when we tell our readers that we observed the same articles in the September issue of other magazines. Also in the August number we published an article on "How Radio Photographs Crossed the Atlantic in 40 Minutes". This article was accompanied by an illustration on our first page. Imagine our satisfaction in having our selectivity endorsed by no less a periodical than the Litry Digest in the following September. The Digest folks not only used a story about the same Radio achievement but they printed the same illustration.

In the September number of RADIO AGE we printed an article on "The Problem of Radio Power Transmission". We find the same article in the October number of another Radio monthly.

In this number of RADIO AGE we are publishing in full a Bureau of Standards Official article on How to Build a Tube Unit accompanied by seven illustrations. We note that at least two other Radio periodicals are advertising that they will publish this same Bureau of Standards article *next month.*

Before turning off the Loud Speaker let us broadcast the News that some of the best judges of Radio writing in the United states have been telling us by letter, unsolicited, that Mr. Pearne's September article on the Reinartz Unit was the bulliest thing in type anywhere on this subject.

Read RADIO AGE if you want Radio News.

Tuning In For Grandma

William McClintock, 108 West Madison street, Chicago, not only built this receiving outfit with which he hears broadcasting stations within a radius of more than 1,000 miles, but he is the father of the little radio fan in the big chair. And Mr. McClintock took the photograph. Seems like Bill has lots of reasons to be proud of himself.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH
PUBLISHER
PUBLISHED MONTHLY GARRICK BLDG CHGO.
FREDERICK SMITH
EDITOR

How to Make a Tube Unit for $23 to $37, with Radius of 75 Miles

Beginners Told by Uncle Sam's Experts How to Take the Next Step Beyond the Crystal Set

USE of an electron tube detector will increase the receiving radius of the receiving set so that it will be possible to hear high power transmitting stations at a distance of about seventy-five miles. Under good atmospheric conditions signals from greater distances may be heard, especially at night.

The electron tube detector may be substituted for the crystal detector, that is, its function is the same as the crystal detector, which is to make the signals from the transmitting station audible in the telephone receivers when the radio receiving set is tuned to the proper wave frequency (wave length).

This article brings the amateur one step forward in understanding the more complex and sensitive apparatus. If the reader has a crystal set the article will enable him to use this more efficient detector. A later article will describe how to use amplifiers. It should be remembered that the electron tube detector will not make "continuous wave" signals audible.

The following description of the electron tube detector, with the illustrations, were supplied to Radio Age by the Bureau of Standards, United States Department of Commerce and is published with permission of the Government. Readers, therefore, will be assured that they are following instructions given by foremost experts in radio.

If any reader meets difficulty in making this unit, he may send self-addressed and stamped envelope to Frank D. Pearne, Technical Editor of Radio Age, 64 West Randolph Street, Chicago, and a prompt reply will be sent back. This is only a

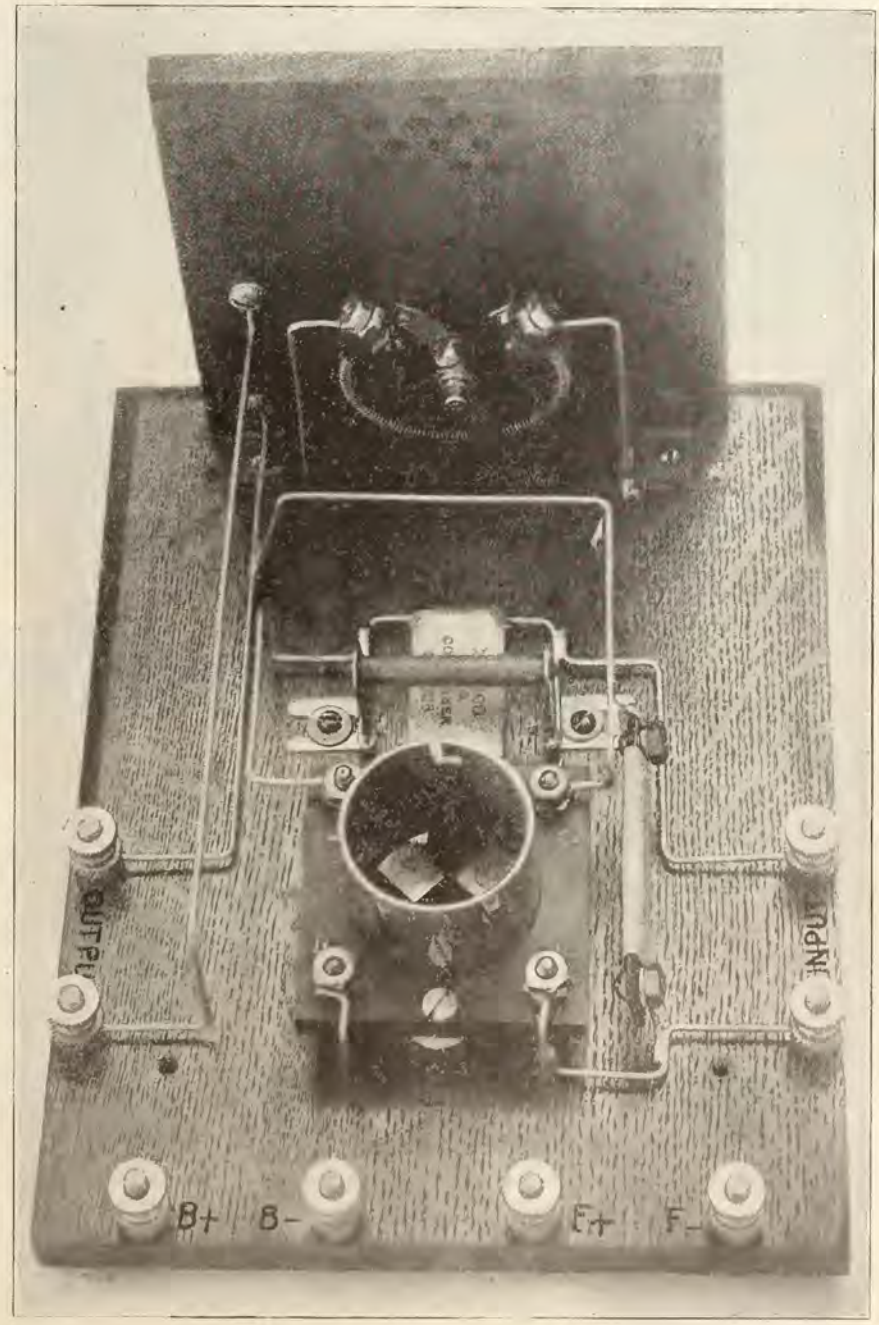


FIG. 2.

part of the service department which this magazine has established for the assistance and convenience of its readers.

The cost of an electron tube detector unit, complete with the necessary batteries will be between $23.00 and $37.00. Additional electron tube amplifiers described in subsequent articles, which will greatly increase the sensitivity and hence the receiving radius of the receiving set, will not require additional storage batteries. This will make the added cost of the amplifiers small.

This article describes simple apparatus of satisfactory performance without reference to the possible existence of any patents which might cover parts of the apparatus. Apparatus in general similar to that described can be purchased from responsible manufacturers.

Essential Parts

The complete radio receiving equipment may be divided as follows: Antenna, lightning switch, ground connections and telephone receivers. These are completely described in Bureau of Standards Circular, No. 120, published in the May issue of Radio Age.

The Tuning Device.—This may be the tuning coil described in Circular No. 120 or it may be a two-circuit coupler and variable condenser. While the two-circuit tuner will be somewhat more selective than the single-circuit tuner, its use is not absolutely essential. The two-circuit tuner is also more difficult to operate than the single-circuit tuner.

Electron Tube Detector Unit. (Figs. 1, 2, and 7).—The electron tube detector unit is composed of a baseboard B and an upright panel A. On the baseboard B is mounted an electron tube E, (shown only in Fig. 7), an electron tube socket S, a resistor (grid leak) R, a grid condenser C, a by-pass condenser C′, and eight binding posts. On the upright panel A is mounted a filament rheostat R′, (the adjusting knob J is shown in Fig. 7), and two telephone receiver binding posts L and M. The parts S, R, C and C′ are also shown in Fig. 3. This circular tells how the various parts are assembled on the baseboard and the panel. No description is given of how the parts E, S and R′ are made because these are all commercial articles. It is, of course, possible for one to make parts such as the electron tube socket S and the filament rheostat R′.

Accessories.—Under the heading of accessories may be listed a six-volt battery, used for lighting the filament, often called the "A" battery, having an ampere-hour capacity of about 60, a 22 1-2 to 45-volt dry battery ("B" Battery) binding posts, stiff copper wire, wood boards for the baseboard and upright panel, and two brass angle braces for supporting the panel. The "A" and "B" batteries are shown in Fig. 7. The "A" battery will usually be placed on the floor beneath the table upon which the other parts of the equipment are mounted. Its comparative size is much reduced in the drawing. An insulating material panel may be substituted for the wood if desired. The electron tube detector may also be entirely enclosed in a wood cabinet with a hinged cover, if desired.

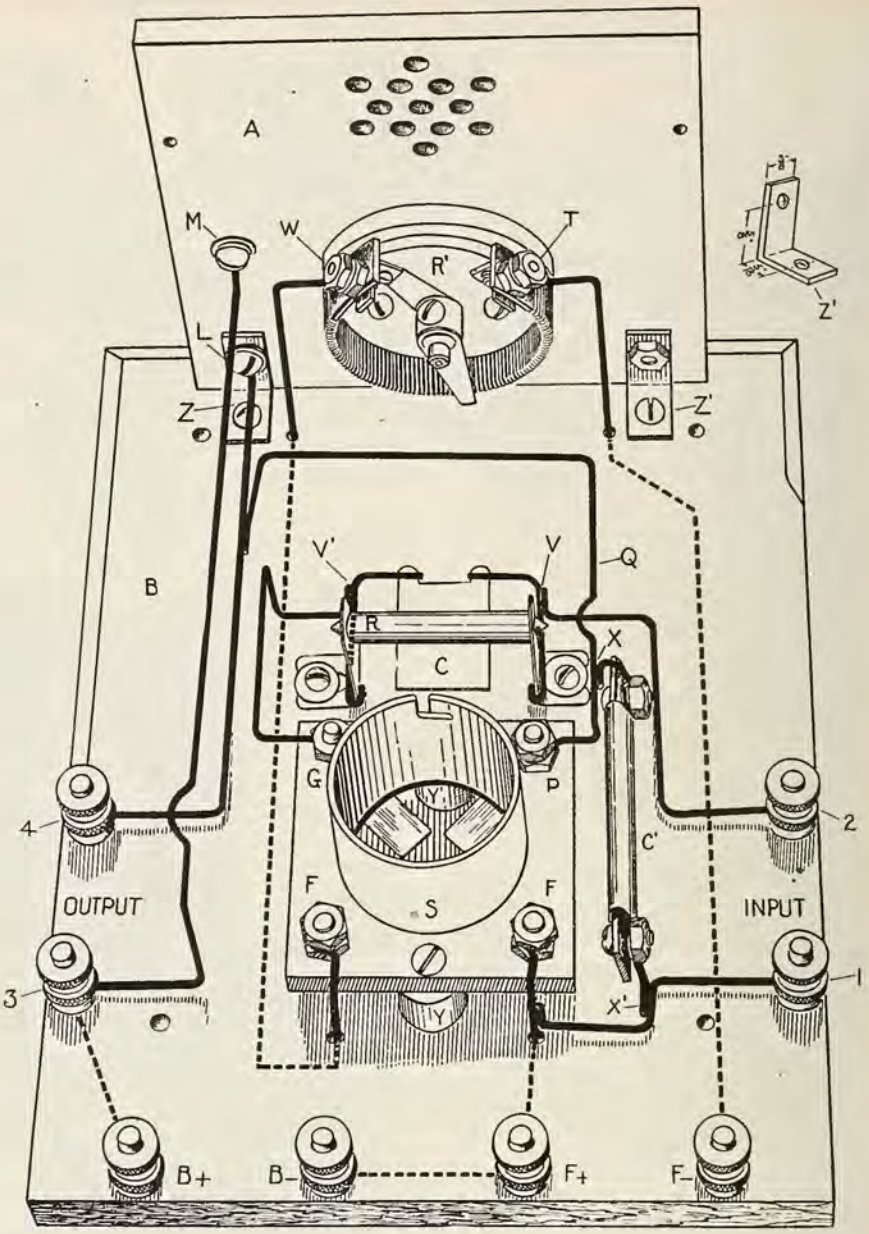


FIG. 1.

Details of Construction

Baseboard. (B Figs. 1 and 3).—The base B is any kind of dry wood about 6 1/4 inches by 8 1/4 inches by 3/4 inch thick. Eight holes are drilled through the base in which the binding posts are fastened. Spacing of these holes is shown in Fig. 3. By the addition of two more binding posts properly connected, this detector may be used in a "regenerative" circuit when the binding posts are externally connected to a "tickler" coil coupled to the tuner. These binding posts are added to the detector baseboard B in line with the "input" binding posts Nos. 1 and 2 (see Fig. 1). They are 7/32 of an inch from the edge of the baseboard, and the four binding posts are arranged in such a manner that

they are equally spaced, 1 1/2 inches between centers. Referring to Fig. 1, the wire which leads from the terminal P of the electron tube socket is cut at some convenient place Q and the two ends thus formed connected to the extra binding posts. The method followed in making these connections does, of course, correspond with the style of wiring used in the complete electron tube detector unit. The connection X, from one terminal of the condenser C′, is also removed and a longer wire connected from this terminal to the other side of the point Q where the wire was cut. The base is arranged so that the three remaining sides and a hinged cover may be added without changing the relative positions of the binding posts. Under each of the four corners of the base B, rubber or wood feet (risers) are fastened in order that the binding post heads and wiring will be protected on the under side of the base.

Upright Panel, (A Figs. 1 and 4).—The panel A is any kind of wood about 4 1/2 inches by 5 inches by 3/8 inch thick. In Fig. 4 a back view of the panel is shown which brings the two holes for the telephone receiver binding posts in the lower left-hand corner. If the panel is viewed from the front these two holes will be at the lower right-hand corner. It seems quite desirable that this board present a good appearance, it being the front panel. Four holes are drilled in the panel A, one for the bolt which fastens the panel to the brace, (See L, Fig. 1) two for the telephone receiver binding posts L and M (Figs. 1 and 7) and one for the shaft of the filament rheostat R′ (See Fig. 1.)

The exact location of the hole for the rheostat shaft is determined from the rheostat itself. It is drilled so that the rheostat will occupy as low a position as possible, allowing room enough to do the necessary wiring.

Electron Tube (E, Fig. 7).—The electron detector tube is a commercially available type. The several parts of an electron tube (sometimes called a vacuum tube) are sufficiently described in "The Principles Underlying Radio Communication."

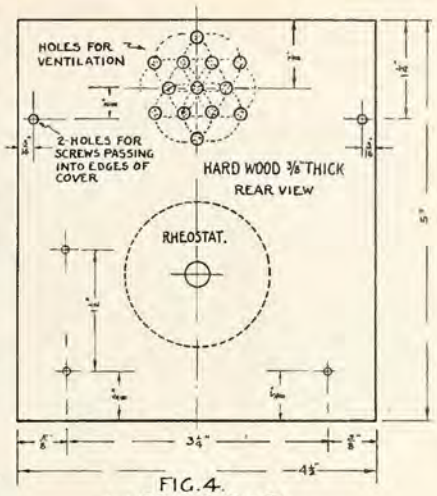


FIG. 4.
A-UPRIGHT PANEL

2-BOARDS FOR SIDES	7¼"×5"×½"
1-BOARD FOR BACK	5"×3¾"×½"
1-BOARD FOR TOP	7¾"×5¼"×½"
2-HINGES, BUTT	¾"

Electron Tube Socket. (S, Figs. 1, 2 and 7).—The electron tube socket is of commercial design. No suggestions are offered as to the particular kind of socket to use. There are many types available and the majority of them will be found satisfactory for this purpose.

Grid Leak and Grid Condenser (R and C, Figs. 1, 2 and 7).—The grid leak and grid condenser may be purchased together or separately or they may be constructed. If one expects to use a detector type of electron tube (sometimes called "soft" or "gas" tube) it is recommended that these two parts be purchased with the tube, care being taken to select the proper values of resistance and capacity for the grid leak and the grid condenser, as specified by the manufacturer of the tube purchased. The resistance of the grid leak will usually be between 1 and 5 megohms (1,000,000 and 5,000,000 ohms) and the capacity of the grid condenser will be about 0.0003 of a microfarad (300 micromicrofarads). If an amplifier type of electron tube (sometimes called a "hard" tube) is used, the resistance of the grid leak may generally be anywhere within the resistance limits specified above and the same size of grid condenser used as mentioned above. Experimental grid leaks may be made for such electron tube detectors. This is only suggested for its educational feature. If the two-stage audio-frequency amplifier is used also, it will be quite difficult to make a grid leak that will work satisfactorily. Such an experimental grid leak may be made from a piece of fiber about 3/8 inch wide, 1 1/2 inches long and from 1/32 to 1/8

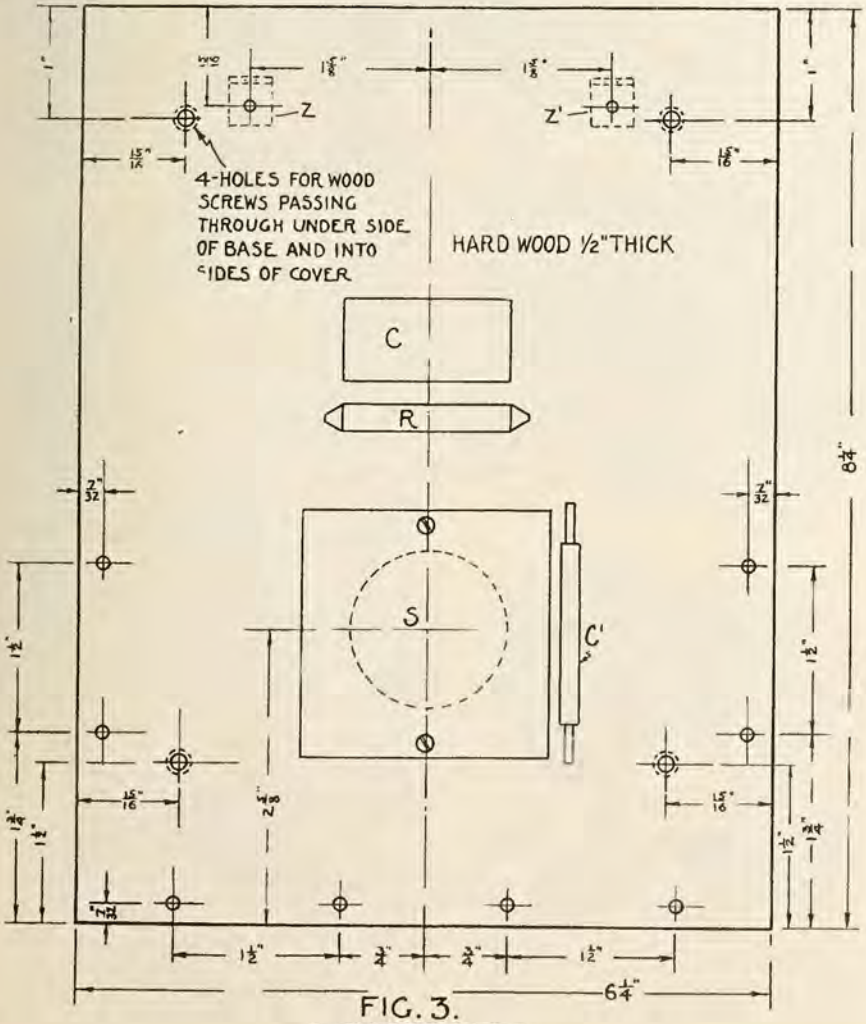


FIG. 3.
B-BASEBOARD.

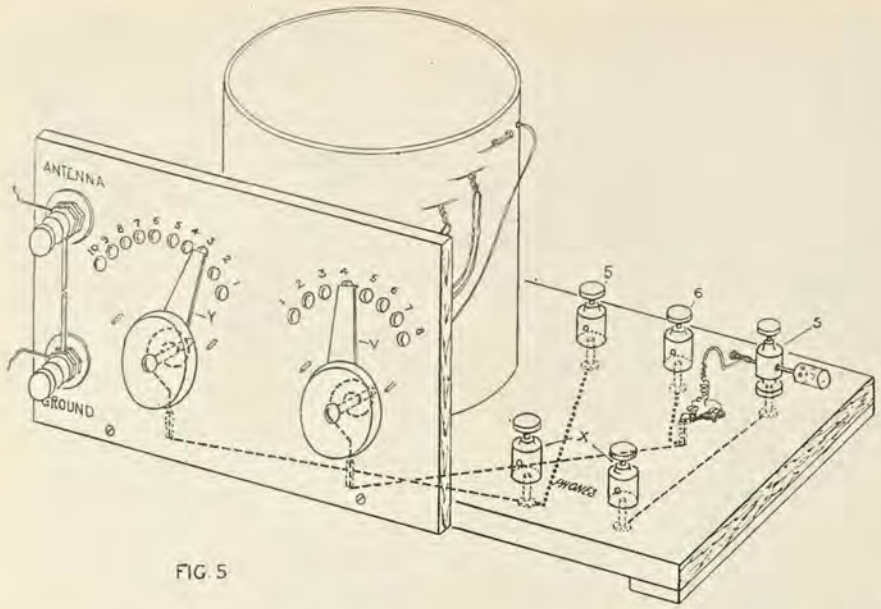


FIG. 5

inch thick. Two 1/8-inch holes are drilled along the center line of the piece, about 1 inch apart. A line is drawn between the two holes, using india or drawing ink. Contack with the ink line may be made by the use of two brass (6-32 or 8-32) machine screws about 1/2 inch long and each equipped with one nut and two washers. The machine screws are put through the holes in the ends of the fiber strip with one washer on each side of the fiber strip. A small piece of tinfoil may be rolled up and wound around each machine screw between the fiber and the washer so that the tin-foil pad will make contact with the ink line. When the nuts are tightened down, the tin-foil pads will flatten out and form a contact between the brass washers and the ends of the ink line. Since the ink line makes a partial electrical conductor of high resistance, the thickness and width of the ink line will determine the resistance of the grid leak to a great extent. The value of resistance may be decreased by inking the line over several times, until the electron tube detector works best. A suitable condenser may be made from tin-foil and paraffined paper after the manner described in Bureau of Standards Letter Circular No. 46, the shape of the condenser being modified to suit the present space requirements, and the total area of each of the tin-foil sheets reduced to six square inches.

By-Pass Condenser (C′ Figs. 1, 2 and 7).—This is any small-sized fixed condenser having a capacity of from 0.0003 to 0.0015 of a microfarad (300 to 1500 micromicrofarads) which may be purchased or made according to the description given in Bureau of Standards Letter Circular No. 46. While this condenser is not absolutely necessary, its use is advisable.

Binding Posts (Figs. 1 and 2).—The binding posts used on the base may be 6-32 or 8-32 brass machine screws each equipped with two nuts and two washers, if regular binding posts are not available. The telephone receiver binding posts L and M, (Figs. 1 and 7) should be of the set-screw type to admit the tips of the telephone receiver cords.

Filament Rheostat (R′ Fig. 1).—As has been previously stated, the filament rheostat may be constructed but no details are furnished. If the rheostat is purchased, it is desirable to select one designed for panel mounting as well as one having a neat appearing knob and pointer. The rheostat should have a resistance of about seven ohms and a current-carrying capacity of about 1 1/2 amperes.

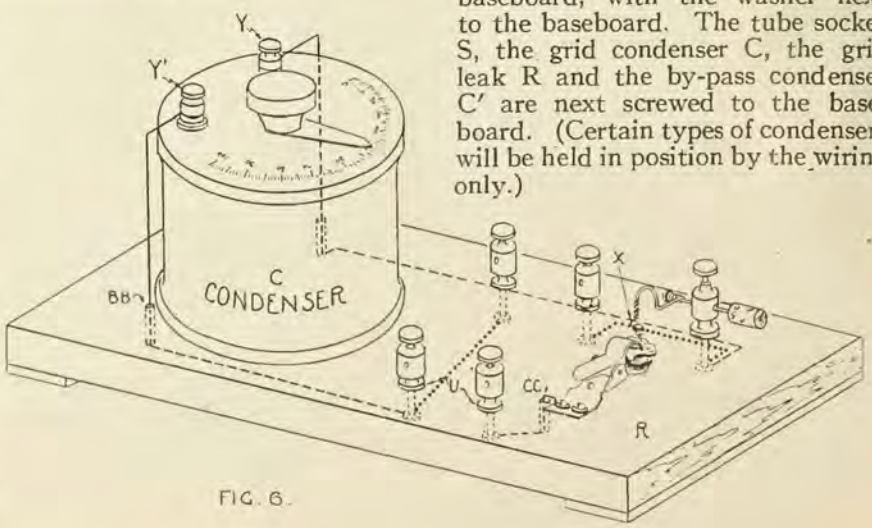


FIG. 6

Accessories.—The accessory batteries are commercial articles. The purchaser of a storage battery for lighting the filaments should get full instructions from the dealer for testing and re-charging the battery. The dry battery ("B" battery) usually used for the plate circuit can not be re-charged. The normal life of a battery of reliable manufacture is about six months. Storage batteries for use as "B" batteries are available. Their first cost is greater than that of dry batteries but they may be re-charged.

Assembling and Wiring

Wood Finish.—It is essential in electron tube sets that the wood be protected from moisture. While the wood base and panel may be treated with paraffin as suggested in Circular No. 120, it was found more satisfactory to first dry the wood and then stain and varnish it, using a good varnish, preferably insulating varnish. Shellac is not recommended. It is rather difficult to give definite suggestions concerning drying and staining of wood. Wood may be put in a warm oven for an hour or so to insure more or less complete drying. A lamp-black or carbon pigment stain is not used ordinarily on such radio parts and it would be well to avoid the use of such. The stain and varnish are thoroughly dried before the apparatus is mounted on the wood baseboard and panel.

Baseboard (B, Figs. 1 and 7).—The eight brass machine screws or binding posts are put in the holes already drilled in the baseboard. If machine screws were to be used the heads would be put on the under side of the baseboard with a brass washer between the head and the baseboard. A brass washer and two nuts are then fastened to each screw, on the upper side of the baseboard, with the washer next to the baseboard. The tube socket S, the grid condenser C, the grid leak R and the by-pass condenser C′ are next screwed to the baseboard. (Certain types of condensers will be held in position by the wiring only.)

The exact location of these parts can not be stated because the several types of parts commercially available will vary somewhat in dimensions. One can get a very good idea of the relative positions of the several parts from Figs. 1, 2 and 7. The tube socket S is mounted so that the two terminals marked G and P (Fig. 1) are nearest the upright panel. Blocks Y and Y′ are put under the socket S so that the four terminals of the socket do not touch the wood baseboard. This is done by cutting solidly and pulling on the other end just hard enough to stretch the wire slightly. It is also a good plan in wiring such sets to have all wires run as directly as possible, neatly, and all bends made at right angles. When a wire is attached to a binding post, a loop or eye is formed on the end of the wire and the wire at the eye flattened with a hammer. This gives more contact surface. Special lugs may also be soldered to the ends of the wire before the connection is made. A small hole is drilled through the baseboard are shown by dotted lines. A short piece of wire is soldered to the wire leading from the right-hand socket terminal marked F, just above the baseboard and led to the "input" binding post No. 1, and fastened between the washer and the first nut.

This wire is shown as a solid line which means it is on the upper side of the baseboard. The wires do not touch the wood boards except at the terminals and where the wires pass through holes in the baseboard. The wires may be

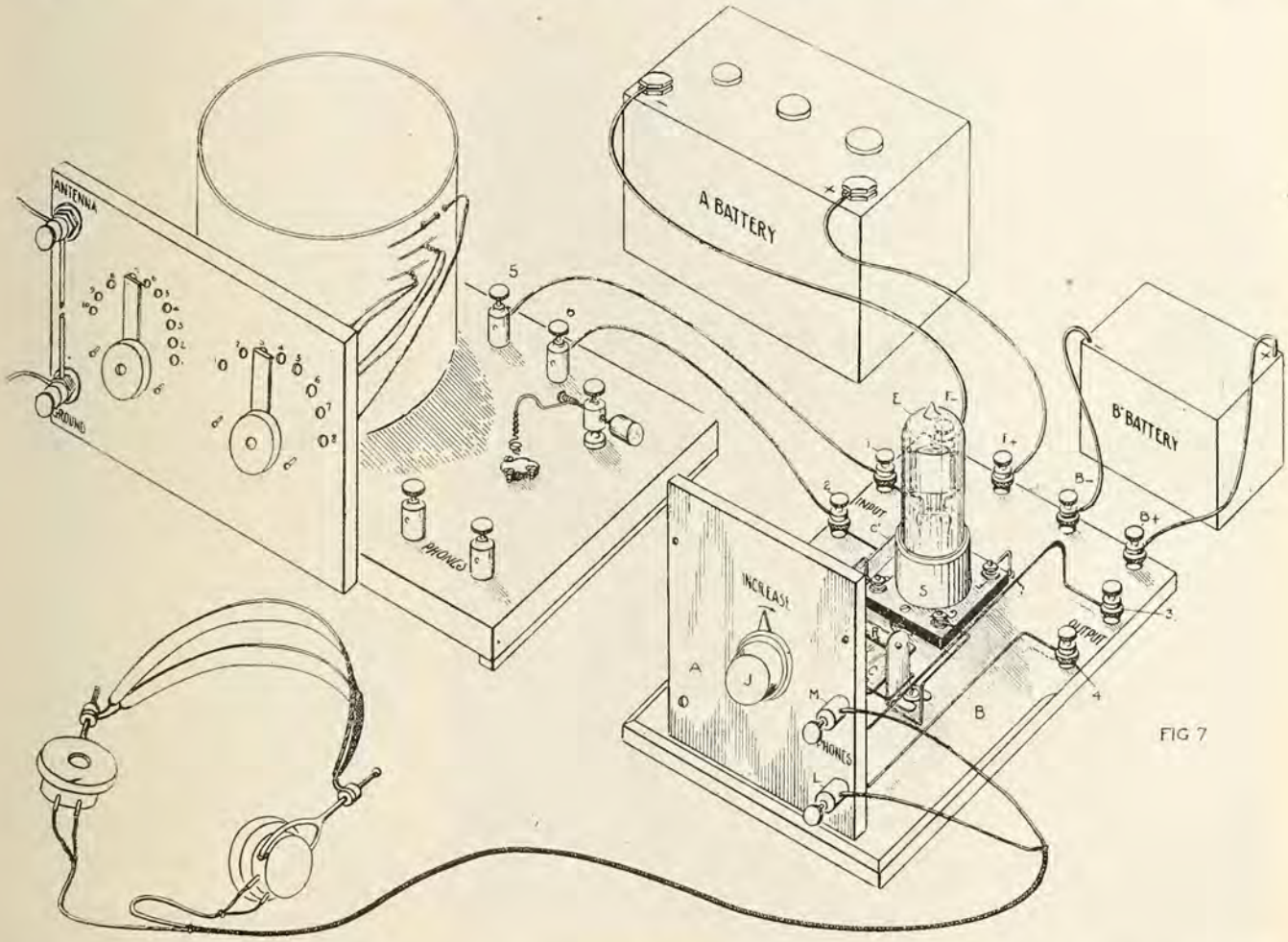


FIG 7

off two round wood blocks just long enough to raise the socket terminals clear of the base, and mounting them so that the screws which hold the socket to the baseboard will pass through holes in the centers of the blocks. After the socket, S, grid condenser C, grid leak R and by-pass condenser C′ are mounted the parts are wired up.

Number 14 bare tinned copper wire is used in wiring. This makes the connections stiff and self-supporting. This wire is ordinarily furnished in rolls. The wire should be straightened before it is used. It can be straightened by clamping or otherwise fastening one end

baseboard just back of each of the tube socket terminals marked F (See Fig. 1). A short piece of wire is fastened to the right-hand socket terminal marked F and is then led through the small hole in the baseboard to the under side of the baseboard.

The same wire is led to the binding post F and fastened between the machine screw head and washer underneath the baseboard. The same wire is further led to the binding post marked B.... and fastened between the machine screw head and washer underneath the baseboard. All wires which are run on the under-side of the base-

raised more or less to accomplish this. The two terminals of the grid condenser C are connected to the two terminals of the grid leak R as shown in Fig. 1. A wire is soldered at V and led to the input binding post No. 2. This wire is kept quite close to the baseboard. Another wire is soldered at V′ and led to the tube socket terminal marked G. The remainder of the wiring is left until the upright panel is assembled and fastened to the baseboard. Notes on soldering are given later.

Upright Panel (A Figs 1, 2 and 7).—The filament rheostat R′ is mounted on the upright panel A

so that the two terminals will be in a convenient position for wiring. Two binding posts of set-screw type, L and M, (Figs. 1 and 7). are inserted in their proper holes, and the upright panel mounted in position by bolting it to the two brass angle pieces (Z and Z′) shown in Figs. 1, 2 and 3. One of the telephone receiver binding posts L serves as a bolt. Two small holes are drilled through the baseboard near the two terminals of the filament rheostat R′. A wire is run from the "output" binding post marked 4 (Fig. 1) along the upper side of the baseboard to the back of the telephone receiver binding post marked L. A wire is fastened to the tube socket binding post marked P and from thence led to the back of the telephone receiver binding post marked L, or else soldered to a convenient place on the wire leading from binding post L. These wires are shown in Fig. 1. A wire is run from the binding post marked 3 to the back of the telephone receiver binding post marked M and also a wire from B× to binding post No. 3, underneath the baseboard. One of the terminals of the by-pass condenser C′ is connected at the point X and the other terminal of the condenser is connected at the point X′. The method of making these connections depends to some extent on the particular type of fixed condenser which is used. If the condenser be provided with flexible leads one of them is soldered at the point X and the other is likewise connected at the point X′. If the condenser is provided with lugs, connections are made by bending the wires into the proper shape and soldering thereto. A wire is run from the filament rheostat binding post marked T through the hole in the baseboard and thence along the under-side of the baseboard to the binding post marked F−. This wire is shown in Fig. 1 by a dotted line. Likewise a wire is run from the rheostat binding post W underneath the baseboard and up through the left-hand hole in the baseboard at the rear of the electron tube socket S and connected to the left-hand binding post marked F. This completes the assembling and wiring of the electron tube detector unit.

Directions for Operating

Connections.—It has already been stated that better results are obtained if the two-circuit tuner described in Bureau of Standards Circular No. 121 is used with the electron tube detector. However, the single-circuit tuner described in Circular No. 120 may be used or the electron tube detector may be connected to any tuner not already supplied with an electron tube detector.

If the single-circuit tuner is used with this electron tube detector the several parts are arranged somewhat as shown in Fig. 7. The single-circuit tuner (shown at extreme left) is fully described in Circular No. 120. Two more binding posts are added in the back right-hand corner and wired as shown in Fig. 5. The greater portion of the wiring is beneath the baseboard. The wires shown as - - - - are those already described in Circular No. 120. The wires shown as..... are the new wires added. Such wiring will not disturb the set for use as a crystal detector receiving set. The second unit to the right is the electron tube detector described in this circular. Accessory parts such as telephone receivers, "B" battery and "A" storage battery are also shown in Fig. 7. As previously mentioned, the "A" battery is shown here reduced in size, and it is usually placed under the table upon which the rest of the apparatus is mounted.

If the two-circuit tuner is used with this electron tube detector the arrangement of the parts is similar to that shown in Fig. 7, except that the two units consisting of the coupler, and the variable condenser with crystal detector, replace the single-circuit receiving set shown at the left. Connections between the secondary of the coupler and the terminals of the variable condenser are the same as described in Circular No. 121. Two more binding posts are added at the rear edge of the baseboard supporting the variable condenser and crystal detector (see Fig. 6.) The dotted lines clearly indicate the new wiring connections as described for the single-circuit receiving set.

The antenna and ground wires are connected as described in Circular No. 120 and as shown in Fig. 7. Binding post No. 5 (Fig. 7) is connected to binding post No. 1 and binding post No. 6, is connected to binding post No. 2. The telephone receivers are connected to the binding posts L and M as shown in Fig. 7. The red (positive,+) wire of the "B" battery is attached to the electron tube detector binding post marked B+ and the black (negative,−) wire to the binding post marked B−. An insulated flexible copper wire is run from the red (positive,+) terminal of the 6-volt "A" storage battery to binding post marked F+ (Fig. 7) and a similar wire from the black (negative,−) terminal of the "A" battery to the binding post marked F−.

Operation.—The filament rheostat knob J (Fig. 7) is turned to the extreme left and the electron tube E inserted in the electron tube socket S. The filament rheostat knob is then turned to the right until the electron tube filament becomes lighted, the brilliancy depending upon the type of electron tube used. When one of the telephone receiver terminals is removed from its binding post and again touched to the post, a sharp "click" in the telephone receivers will be an approximate indication that the circuit is in working condition. If the test buzzer as described in Circular No. 120 is available, it may be attached (as described) to the tuner binding post marked ground" and then the rheostat adjusted until the sound in the telephone receivers is the loudest. The reader should bear in mind that the electron tube detector unit is merely substituted for the crystal detector and the tuning of the receiving circuit is the same as described in Circulars Nos. 120 or 121. When signals from a desired transmitting station are heard as loud as possible by tuning, the intensity may sometimes be improved by adjusting the knob on the filament rheostat so as to increase or decrease the filament current (current from the "A" battery). The knob is kept in the position of minimum filament current without reducing the strength of the incoming signals.

If a detector type of electron tube be used, the voltage of the "B" battery is changed until the greatest signal intensity is obtained. This necessitates the use of a tapped "B" battery.

The operator must not expect too much of the apparatus at the first trial, and even assuming that he has had experience with crystal detectors, some difficulty may be experienced in getting the electron tube to operate. In this case he should first ascertain if the various parts of the complete receiving equipment are properly connected; or again, it may be found that some of the connections to the electron tube detector unit are improperly made. Special care should be taken to see that the "A" and "B" batteries are connected to the proper terminals of the electron tube detector unit. After a little experience the operator will find the electron

(Continued on page 18.)

World's Greatest Electrical Station Has Its Own Radio School

It Revolutionized Broadcasting Programs and Was the Pioneer in Wired Wireless

THE Commonwealth Edison company, as befitting the largest central station electric company in the world, conducting the world's largest electrical appliance store, has been a potent factor in the progress and expansion of the latest marvel of electrical development—radio.

The recent pioneer experiments, made by E. W. Grover, and E. H. Gager, Edison engineers, under the direction of Ernest F. Smith, Superintendent of Sub-Stations, in so-called "wired wireless" (an account of which is given in later paragraphs) have attracted wide editorial attention and provoked much comment among radio experts throughout the country

But aside from the purely commercial aspects, the Edison company has been particularly concerned with the broad, constructive side of radio expansion and development; in promoting the educational and entertainment features, which have come to be used for the benefit of the general public.

One of the outstanding results of the Edison company's policy in this respect, is the broadcasting of grand opera during the winter months from station KYW, one of the finest radiophone broadcasting outfits in the country, which is operated by the Westinghouse Electric and Manufacturing Company, from the roof of the Edison building, 72 West Adams street, Chicago. This was the first radiophone station in history to broadcast grand opera, and the only radiophone station to ever broadcast the complete programs of an entire operatic season, as it did here, last year

Because all radio fans appreciate good music, and the radio receiving set, as the most up-to-date and novel means of having it in the home, the inside story of how opera broadcasting was launched by the Commonwealth Edison Company will be of interest here.

A little more than a year ago, George B. Foster, Assistant to Vice-President John F. Gilchrist, of the Edison company, an early radio enthusiast, installed a receiving set in his home, and, as he

(Continued on page 10.)

M. R. Brennan, Superintendent of New York City Police Telegraph, operating the new radio broadcasting station of the New York Police Department, known as W L A W. It will not be long before the radio transmitter will enjoy the position of being the criminal's greatest peril.

Sad News for the Crooks

THE first radio broadcasting telephone station to be exclusively for police purposes is installed at the New York headquarters. After a test, Joseph A. Faurot, deputy commissioner, estimated that an area of at least 30,000 square miles could be covered with it.

"This should prove a great aid," said Faurot, "in finding stolen automobiles and missing persons, in spreading alarms and in other work where secrecy is not essential. Every amateur receiving station within a radius of 100 miles will become a sort of police outpost, enabling us to spread emergency information quickly.

"Later, as our men gain experience, we may even use the ether to spread confidential reports by special code."

Secretary of Commerce Hoover has given permission to Commis-

(Continued on page 18.)

(Continued from page 9.)

afterwards put it, "was engrossed for a while but soon became bored with hearing some one yell in stentorian tones, 'one, two, three, four—I am testing—one, two, three, etc.' This was followed by a bevy of amateur wireless telegraph operators dashing out the Morse, A B C, and other 'uncharted' codes, of their own invention, with palsied hands. One night, however, Mr. Foster was thrilled at picking up the music of a phonograph. He quickly summoned his wife, who listened a few moments without much enthusiasm.

"We've got the same record for our own phonograph," said Mrs. Foster, "which is closer at hand."

"Well, my dear," answered Mr. Foster, "I expect I'll have to get grand opera for you." He spoke jokingly, but the crux of the idea was there; the vision of sending the voices of the world's greatest singers from the stage of the Auditorium Theater in Chicago to the radio fans within a radius of 1,000 miles or more, by means of a huge broadcasting station. This was the beginning of the idea, which proved the outstanding event in the radio world during the period of last year.

Imbued with the possibilities for educational work, and the entertainment features which could be obtained from a huge radiophone transmitting station, Mr. Foster and other officials of the Edison company set about to erect the basic foundation of their vision and accordingly negotiated with the old Chicago Opera Association (which has since become the Chicago Civic Opera Company, with Samuel Insull, as president) for the broadcasting of opera nightly during the 1921-22 season.

The next step necessary in the fulfillment of the plans of the Edison Company, was a powerful transmitting station. Negotiations were opened with several prominent radio apparatus manufacturers, which eventually resulted in the plan of the Westinghouse Electric and Manufacturing Company to operate Chicago's famous radiophone station. (Incidentally, the Westinghouse organization stands out as one of the real pioneers in radio development as Harry Phillips Davis, Vice President of the company, is known as the "father of broadcasting," and is credited with being the first to see the popular appeal of radio.)

Thus, it came about that the Edison company erected the towers, which now rise 125 feet from the roof of its general office building (and 400 feet from the street level) and set aside space in its general office building for the radio studio and station, which the Westinghouse company had arranged to install and operate.

From start to finish, the whole scheme of opera broadcasting was one of splendid cooperation from all concerned—the opera company and its artists and musicians, the Westinghouse company, and its officials and engineers, the Illinois Bell Telephone Company, and the Chicago newspapers.

The final steps for the completion of the plan came early in November of last year, when the Westinghouse organization installed the microphones in the footlights of the Auditorium stage, and the Illinois Bell Telephone company ran wires from the theater to the radiophone station, where the voices of the singers were amplified and broadcasted and received by surprised radio fans in thousands and thousands of homes in the Middle West.

The formal announcement of the history-making event and the first grand opera sent over the radiophone took place on Armistice Day, November 11, of last year. Miss Mary Garden, then director of the old Chicago Opera Association, made the dedication address, announcing the innovation to the radio world. Miss Edith Mason, prima donna, sang the aria from "Madame Butterfly," and the instrumental numbers were given by the Chicago Opera orchestra, under the direction of Giorgio Palacco, now First Conductor and Musical Director of the Chicago Civic Opera Company. The same day, telephone calls flooded the offices of the chicago newspapers, and for the next few days letters and telegrams from such distant points as Georgia, Florida, Texas, and Maine were received by the opera company officials and the Edison company telling of the surprising clearness of the singer's voice and the notes of the musicians.

On the technical and commercial sides, the Commonwealth Edison Company has enjoyed a unique position, in the realm of radio. The Edison company, it is believed, was the first central station electric company to successfully demonstrate the feasibility of speech transmission over underground electric cables, without interfering with their normal function (of supplying customers with light and power.) The pioneer tests made by Edison engineers, under the direction of Superintendent of Sub-Stations Smith—without going into a highly technical explanation—have shown that it is possible to talk from one central station to another, or from one sub-station to another, by means of the "wired-wireless," using the underground cable systems for carrying high frequency currents.

Using a radio telephone set, designed by Mr. Gager, the output of which was coupled to the high tension bus, instead of to an antenna, speech was transmitted a distance of several miles over an underground cable carrying 12,000 volts, in the Edison company's system, which was "alive" and carrying "load" at the time, and which was connected to approximately 375 miles of similar cable. The low voltage (110-220 volt) direct current system of the Edison company consists of about 230

(Continued on page 12.)

Do Your Employes Really Know Radio?

HERE is an up-and-coming article about what the world's largest electrical appliance store has done and is doing for the promotion of its own business and for the extension of radio service generally.

This great store has its own electrical institute with a twenty-lesson course for the company's rank and file!

This company first introduced grand opera as a broadcasting feature, there-by setting the country afire with interest in home radio.

This article tells about the men who first sent spoken messages over underground electric light service cables, astonishing the electrical world with the first "wired wireless!"

Read the story and get an inspiration out of it, just as we did.—The Editor.

How to Make an Audio Frequency Amplifying Transformer

By F. D. PEARNE

Chief Instructor in Electricity at Lane Technical High School and Technical Editor of Radio Age

MANY amateurs are not aware of the fact that an amplifying transformer is a comparatively easy thing to make, if one is mechanically or electrically inclined. The following instructions, if carefully adhered to, will produce a transformer designed to do all and more than some of the amplifying transformers now on the market. It may not be so handsome as some, but it will be found to produce good results.

The core is constructed of silicon sheet steel, .018 of an inch in thickness, or, if this cannot be procured, electrical sheet-iron of the same thickness may be used. Enough pieces or the shape and size shown in Figure 1 to make a stack one-half inch high, when pressed tightly together, should first be cut from the sheet. Four extra pieces of the same size and shape should also be cut out, to be used in finishing out the core when it is assembled. These can be partly cut out with a pair of tinners' shears and the balance cut out with a sharp cold-chisel.

When these are finished cut out enough of the pieces shown in Figure 2 to stack up one-fourth inch high and the same number of pieces shown in Figure 3 should also be made. Next, cut out the pieces shown in Figure 4. Enough of these to make a stack one-half inch high will be required. This completes the cutting of the steel or iron.

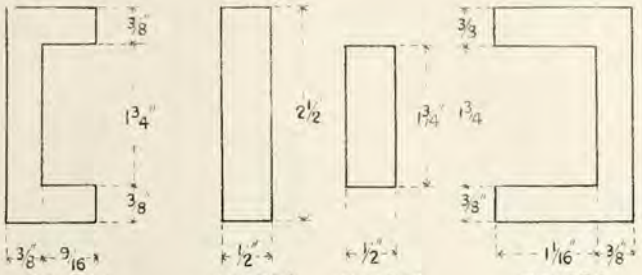



FIGURE 5

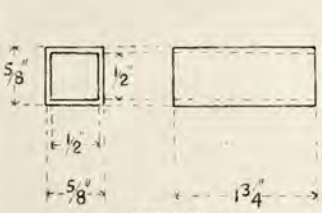


FIGURE 6

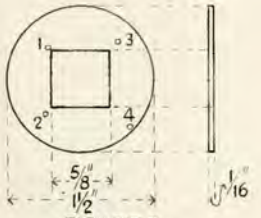


FIGURE 7

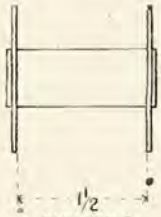


FIGURE 8

A paper tube is next constructed as shown in Figure 6. This consists of a strip of good, heavy paper one and three-fourths inches wide and about seven inches long, covered on one side with shellac varnish. Before the varnish becomes dry, wind it up into the form of a tube, on a piece of square metal rod one-half inch square, or on a square block of wood of the same size. Be sure that none of the shellac gets onto the rod, as this would cause the tube to stick to it, making it impossible to remove the form after the shellac becomes hard. When the paper is all wound on, it should make a tube one-sixteenth of an inch thick. The outside should be five-eighths of an inch square.

Now procure a piece of sheet-fiber one-sixteenth of an inch thick and cut out the two coil ends as shown in Figure 7. Four holes are drilled in one of the coil ends as shown. Hole Number 1 is drilled as close to one corner of the square as possible without breaking through. Hole Number 2 is drilled one-fourth of the distance out from the next corner. Number 3 is also one-fourth of the distance out from the next corner as shown, and hole Number 4 is drilled as close to the outside edge as possible, without breaking through. These holes are drilled in one end only, as all the terminals of the coils are to come out one end.

After the ends are completed, they are forced on the ends of the tube to the position shown in Figure 8. Be sure that these ends are put on nice and straight and that the distance between them is one and one-half inches as shown on the drawing. When this is done, the spool is ready for winding. Because of the small winding space and the fact that it is impossible to do layer winding with wire of the

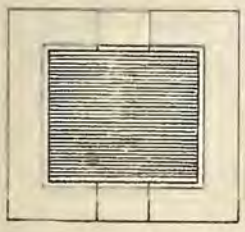


FIGURE 9

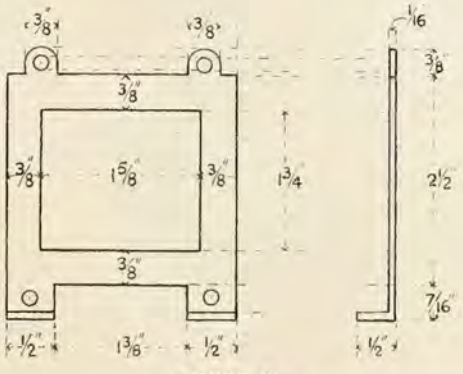


FIGURE 10

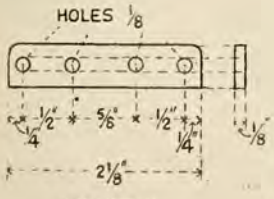


FIGURE 11

FIGURE 12

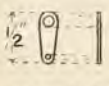


FIGURE 13

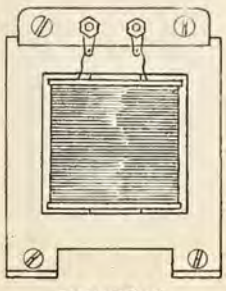


FIGURE 14

size used, it is necessary to use No. 39 enamel insulated copper wire. The winding can be done better in a lathe, if no winding machine is available, but some means for counting the number of turns put on must be supplied. The spool can be slipped onto the original block or rod upon which the tube was made and the end held in the chuck of the lathe, with the end of the spool in which the holes were drilled to the left. Put about six inches of the wire through hole Number 1, to be used for connecting, and begin to wind. The wire should be kept nice and even and should be wound as nearly as possible in layers.

Wind 4,000 turns and then break the wire, putting the end through hole Number 2, which will complete the primary winding. Fit one or two layers of paper over this coil and start to wind the secondary. Lead an end out through hole Number 3 for terminal connection, and wind 16,000 turns in the same direction as the other coil. This should just fill the spool and the final end is brought out through hole Number 4. Now cover the outside of the coil with two or three layers of paper, for protection, and then fit a piece of black binders' cloth neatly between the ends to make the final covering.

The core is now assembled. Figure 5 shows how the pieces of iron are alternated and placed inside the tube. First insert one of the pieces, Figure 2, and then one of Figure 3, etc., until as many pieces as can possibly be squeezed in are in place. The two outside pieces should be those shown in Figure 2.

The outside core is assembled next. First, take one of the pieces shown in Figure 4, and slip the two ends between the bottom piece of the core and the next one to it. Then put another piece, Figure 4, in place on the other side of the coil, slipping the ends between the two pieces of the core, which are next in order for those used for the piece on the other side. Now, put in one of the pieces shown in Figure 1. This will not go between the pieces of the core, but will come up squarely against the core iron. Put another piece of Figure 1 on the other side in the same way, and follow this with another long one on the other side in the same way, and follow this with another long one on the other side, which will go between the next two pieces of the core. Continue in this way until the entire outside shell is completed. It will be necessary to fill out the side irons with extra pieces of Figure 1,

(Continued on page 30.)

Send in Calls Heard

NOW that cooler weather is luring the radio fans back to their receiving outfits the old rivalry as to who hears signals from the most distant transmitting stations has flamed up again. We have some letters telling of some remarkably long distance signals received.

Why not find out what your neighbor is doing in the way of long distance receiving?

Beginning with the next issue RADIO AGE will publish a department called "Pick-Up Records". Under that title we will publish each month the lists of calls heard by readers. This is not only a valuable feature for radio fans on the receiving end but it tells transmitters how successfully they have been operating.

Send in your lists, giving call numbers of stations heard and location and distance.

Biggest Radio Store Has Its Own School

(Continued from page 10.)

miles of underground cable, with the heaviest network, of course, in the "Loop" district. Using the same set, speech was transmitted through the heaviest part of the net work, reception (of the voice) being accomplished with only a detector tube connected with a lamp socket, no amplification being used.

Of course this method is still in an experimental stage, and there are many engineering problems still to be solved, but the tests indicate that the underground cables of the Edison company and other central station companies can, perhaps, some day be utilized in broadcasting news and musical programs.

General George O. Squier, Chief Signal Officer of the United States Army, was quoted recently, in commenting on the Chicago tests, as stating that the public has become accustomed to look to the electric socket for every domestic convenience and may some day come to look there for news and entertainment as well.

At present, reception of space broadcasting—by radiophone—has the objection that antennae in some form is required, engineers say. Difficulties in erecting aerials have already been experienced in some localities and they may be expected to be increased as radio receiving sets are installed promiscuously. With carrier-current broadcasting through the lamp socket, the need for the aerial is eliminated, as only a small condenser properly inserted between the socket and an ordinary receiving set is effective.

The radio section of the Edison electric shops was among the first established, by a central station company, in this part of the country. Although a success financially, it is interesting to recall that this department was launched primarily as a means of stimulating interest and aiding in the development of radio. This department handles every imaginable radio device and like others in the Electric Shop contains a stock that is as complete as any to be found in the country.

Collectively and individually many of the department heads and employes of the Edison company have gone in for the serious study of radio. The Central Station Institute of the company, as early as last December opened a 20-lesson course for the radio enthusiasts in the company's ranks.

This course includes elementary electricity, with special attention to alternating currents; theory of radio, covering oscillating currents, transmitters, receivers, antennae and vacuum tubes practice of radio, covering construction and operation of apparatus used. Lectures were given by the company's engineers and radio experts, several of whom were formerly radio instructors in the United States Army.

The Edison Symphony Orchestra, of which Morgan L. Eastman, is conductor, has been a frequent feature of the KYW musical program. Mr. Eastman, also acts as musical director of the Westinghouse Radiophone station.

Radio Airmen

Illinois now has two training schools for aircraft radiomen, one at the Chanute aviation field at Rantoul and the other at the Great Lakes Training Station. The U. S. naval bureau of aeronautics maintains a flying school and airdome at Pensacola, Florida, and Great Lakes students go there to complete their course. Sixty men were graduated to the new rating during last year at Pensacola. The Rantoul school was moved there from Post Field, Fort Sill, Oklahoma, where the largest observors' and radiomen's school was being maintained in conjunction with airplane and balloon pilots' schools. The course for radiomen aviators covers a period of six months.

Biggest Radio Vacuum Tube in the World and How It Was Made

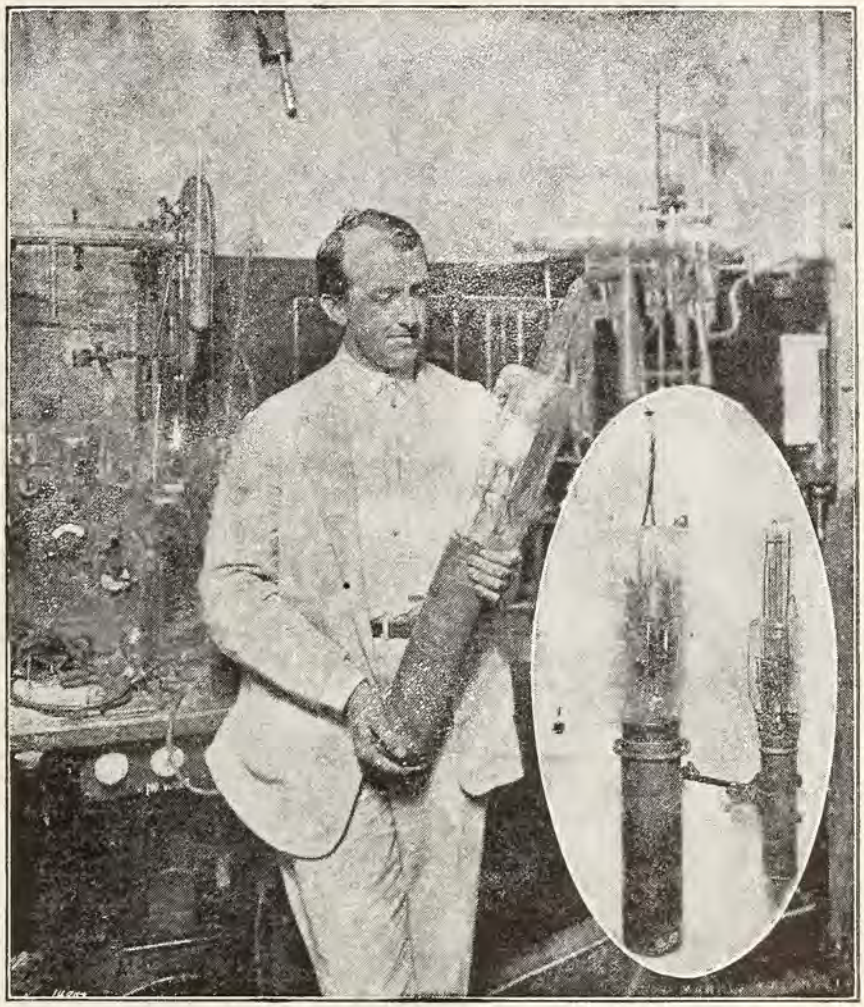
Western Electric Engineers Develop Tube to Handle 100,000 Watts of High Frequency Power.

WHEN engineers of the Bell Telephone System accomplished the first transmissions of speech across the Atlantic in 1915, they used 300 vacuum tubes, not much larger than the ones in your radio set, to generate the necessary high frequency power. Since that time developments have gone on in the Bell System Laboratories of the Western Electric Company in New York, resulting in the manufacture of tubes of the same general type which will supply 250 watts and more. Two of these 250-watt tubes generate the power for the larger broadcasting stations, such as WBAY, WEAF and others. Now the telephone laboratories have developed a tube capable of supplying 100,000 watts, or 200 times the power required for the usual broadcasting station of 100-mile range.

The essential feature of the new tube is that the "plate" is a copper cylinder forming the outer wall of the tube. In the customary tubes used in radio sets, the "plate" is an actual plate or small cylinder of thin metal enclosed in a glass tube. If even a small fraction of an ampere is passed through the plate circuit of one of the small tubes, the plate will become very hot. In the larger "power" tubes this heat becomes so great that some means other than radiation must be provided to carry it off, or the tube will collapse. This is easily done when the plate is the outer wall of the tube, for it can be put into a tank of water which circulates through a radiator. The tube is then water-cooled just like and automobile engine.

This sounds easy enough. The real difficulty was to make the whole tube air-tight and to get the wires for the filament and grid into the tube while keeping them insulated against about 20,000 volts. After much study, the problem was narrowed down to finding a way to make an air-tight joint between the heavy copper tube which forms the "plate" and the glass of the upper part of the tube, and to bring the heavy wires through this glass. Credit for the answer is to due to W. G. Housekeeper, a Western electric engineer, who discovered a way to seal copper to glass which would make an air-tight joint that would not crack at any ordinary working temperature.

One of these big tubes stands three feet high and is 3 1-2 inches in diameter at the bottom. To heat the filament for which in radio receiving tubes a single dry-cell or a small storage battery is enough, this tube used 6,000 watts. For the plate circuit, instead of the familiar "B" battery, a high voltage direct-current generator is used, or an alternating current rectifier.



W. G. Houskeeper, the Western Electric engineer whose epoch making invention led to the production of the world's largest vacuum tube, and the tube itself. Insert shows in graphic fashion just how the new monster tube compares with the little "peanut" tube used in the average radio receiving set and the 10,000 watt tube which only recently was considered the last step in this department of science.

The significance of these big tubes is that only a very few would be necessary to operate even the largest radio stations now in service. The combination of vacuum tube and its current supply, it is expected, will be less costly, more rugged and more easily adapted to various wavelengths than any other source of radio power now in use.

Coats Wins Fame

Paul B. Coats, the Chicago novice who made an efficient super-regenerative receiving set of the Armstrong pattern and installed the remarkably successful unit in his touring car, has won considerable fame from the account of his achievement published in the September issue of Radio Age. The Radio Club of Illinois held its first meeting of the season the other day and Mr. Coats gave a demonstration of the circuit.

Wisconsin U Resumes

The University of Wisconsin station, W H A, at Madison resumed operations on October 2, after six weeks of silence. Improvements have been made in the plant. The regular noonday broadcasts are resumed. They comprise weather forecasts and educational lectures. Educational and musical programs will be broadcast on Tuesday and Friday evenings.

Minneapolis in Line

The city of Minneapolis is to have a high-powered radio telephone transmitting station capable of reaching into the farthest stretches of the Northwest. The cost of this station for the first year will be borne by business men of Minneapolis who feel that in the new science of radio telephony they have a weapon, which, if properly used, can be a powerful influence for Minneapolis' welfare.

P. J. Carr Campaigns by Radio

First in Chicago to use the Radio broadcaster as a means of reaching the people is P. J. Carr, Treasurer of Cook County, who is a candidate on the democratic ticket to succeed himself.
The other evening Mr. Carr spoke through the instrument at station W D A P in the Drake Hotel.
This is what he said:

STATION W D A P—P. J. CARR, TREASURER OF COOK COUNTY, ILLINOIS, SPEAKING:

Folks, perhaps you would like to hear a word or two about the organization which collects Cook County's taxes.

The County Treasurer has nothing at all to do with establishing the amount of taxes nor has he anything to do with spending them. His task merely is to collect the money and later to apportion it to the organizations entitled to it. However, between the time he makes collections and the time he makes disbursements he has large sums in his custody. It is the County Treasurer's business so to administer these funds that the people shall derive the greatest possible benefit and I am glad to say that from April, 1921, when I was appointed County Treasurer, until the present I have obtained from these funds an interest total of $654,419.90 or $100,000 more than that produced by anyone of my predecessors in the history of Cook County.

In this way, during an era of unparalleled public extravagance, I have tried to lighten the tax payer's heavy burden.

Tax paying is not the most agreeable job in the world but I am endeavoring to make it easier for the citizens of Cook County. I have established 100 substations throughout the county and I now contemplate a system by which every tax payer may pay his taxes at a convenient sub-station, located in banks, drug stores and other suitable places, so that he may have the same facilities that are now accorded those who pay gas and electric light bills. However, for this service there will be no extra charge of any kind. This system, which I believe is feasible, will do away with every possible inconvenience occasioned by present methods.

There are a number of other things we are trying to do for the public. We have a corps of experts who, without any charge whatsoever give advice to those in trouble with tax sharks. There is a foreign language bureau where tax payers who have difficulty with American speech may transact their business in the mother tongue.

I have also caused to be established a department in charge of a competent real estate expert where all requests for tax bills may be presented and receive immediate attention.

This department has earned the approval of thousands of taxpayers and has been commended especially by all real estate agents, bankers and brokers as they are assured of receiving their tax bills in ample time to avoid penalties.

To better the efficiency of my office, I have devoted my time and energy to its duties and I have demanded from all of my employes that business-like, efficient and decorous treatment be accorded to everyone who has occasion to come in contact with us. From the many commendations, both verbal and by letter, which I have received, I believe that I have been fairly successful.

In conclusion, I take advantage of this opportunity to invite you who are residents of Cook County to send to my office any suggestions in reference to the tax matters which I have tried to discuss in this limited time. Indeed I shall be glad to have any of you call upon me to discuss these tax problems so important to all the tax payers of Cook County.

I thank you.

WDAP Becomes a Station De Luxe

By EDWARD L. TAYLOR

RADIO broadcasting has taken a great step forward in Chicago through the establishment of the super-station located in the Drake Hotel. Fans everywhere will be interested in the Midwest Radio Central, for its equipment is powerful enough to keep it in communication with both the Pacific and the Atlantic coasts. Its call number will be WDAP, which was the number assigned to the station when it was in the Wrigley Building tower. However, it is a far more powerful plant than when it was perched above the Chicago River at Michigan boulevard.

Radio fans everywhere will be interested doubly in the prospective opening of this great station when they learn that one of the prime features of the service to be rendered from WDAP will be the excellence of its programs. The owners announce that they will transmit vocal and instrumental gems sung or played into the microphones by the highest class artists available in the country.

Those who have listened to WDAP for the last few months have been impressed with the quality of the entertainment provided. Many of them know that the two men back of the interesting service rendered from the Wrigley tower and now the promoters of the de luxe station on the Drake roof, are Thorne Donnelley and J. Elliott Jenkins, Chicago pioneers in radio.

The studio of Midwest Radio Central is located on the eleventh floor of the Drake. Two features distinguish this studio: Its luxurious appointments and its elaborate arrangement for improvement of its acoustics. Heavy wall drapes and rich carpets deaden all sounds originating there and one's voice sounds small and thin as compared with its carrying power outside the chamber. There is also a total absence of echoes.

Something like this will take place when the station is in operation: The studio director gives a brief talk before each concert in which he will stress two points; all talking must cease during the singing, speaking or playing of each number and each number *must* be rendered distinctly. Next the director steps over to the telephone and tells the station operator to start the transmitter. When he receives word that the station has signed on, he signals the artist or artists to start the first number and they group themselves about the microphone.

The director tests the modulation and the audio frequency by listening in on a headset which is connected in series with the line and is therefore able to correct errors in transmission conditions from the start.

In order to make the feeble microphone currents from the studio capable of moulding or modulating the tremendous radio frequency currents radiated from the great

The June number of Radio Age carried an illustrated article on how a photograph was sent by radio from Rome, Italy, to Bar Harbor, Maine, in forty minutes. Transmitting photographs by radio code has since engaged the interest of thousands. Here is Miss Nellie D. Stevens decoding a "radio-photo" of Miss Virginia Valli, Universal Film Star, which was sent from London to New York by wireless. On the artist's drawing board are two portraits of Miss Virginia Valli. The picture on the left of the board is a copy of the portrait transmitted through the air. On the right is the result of Miss Stevens' decoding. She is now engaged in perfecting a method of transmitting finger-prints by radio in the United States. To the left is facsimile of coded portrait as received by Carl Laemmle, President of the Universal Film Manufacturing Company.

aerial, devices known as line amplyfiers are used.

Although the distance between the studio and the station is only a few yards special care must be taken to guard against line losses. For this reason the wires are encased in conduits, which, in turn, is grounded, rendering it incapable of affecting the delicate frequency currents which traverse its core.

From the plate glass panel on the transmitter to the beautiful, draped studio, the Drake Radiophone station is symbolical of the latest developments in the science of radio broadcasting. The very latest is the equipment incorporated in this mammoth transmitter which will hurl the voice and music far out over the land and sea, thousands of miles in every direction. A brief description of the set is all that space permits.

The input to the transmitter is approximately one kilowatt, which will afford ample power to charge the antenna at the tremendous frequency at which the radio waves are propagated. Inasmuch as over ninety per cent of this energy is modulated it can be readily seen that the efficiency of the set is very high. Modulation is accomplished through the use of the huge pliotron tubes which impress the modulated energy upon the grid of the oscillators in such a way that the efficiency is very high. The oscillators in turn charge the aerial with the radio frequency currents which travel through the air to the antenna of the amateur's receiving set.

The aerial at the Drake is of the common "T" type in which the waves are undirectional. The feature of the antenna is the fact that the lead-in is also part of the antenna. This is done by making the lead-in of a small cage type aerial in which the internal resistance is reduced to a minimum. Another feature of the aerial is that of the insulators which are made of heavy plate glass of over an inch in thickness and approximately two feet in length thus insuring against losses and leakages in the antenna system.

Running down the side of the building in the shape of a huge fan we find the counterpoise. This counterpoise is spread out directly beneath the aerial so that the radiation is greatly increased. The added factor of the ability of this counterpoise to keep the grids of the tubes from being drained is another feature worth mentioning. Coupled with a good ground connection a better antenna and ground system could not be desired. But we must turn our attention to the device which supplies the station with the high voltage power necessary to operate the tube set.

Above the main operating room the powerful motor generators are installed. These are of the ball bearing type in which friction is reduced to a minimum. As Mr. Sughart, the chief operator, laughingly put it, they would have to be shut off half an hour before the station was ready to sign off in order to come to a stop when the program was finished. Of course the generators are operated by remote control from the room below as is every other phase in the operation of this station. The voltage from the plate generator, the one which handles the plate current to the tubes, is controlled by field rheostats while the control of the filament generator, the one which furnishes the filament current, is handled automatically by the generator itself.

A big feature of the Drake radiophone station is the fact that microphone lines are to be run to all parts of the hotel to pick up music and conventions held in the hotel. These will be relayed to the station where they will be broadcast. Thus the station can at any time call upon any number of novelties to assist it in the furtherance of the programs.

WDAP is owned and operated by Mr. Thorne Donnelley and Mr. J. Elliott Jenkins of Chicago. These two men have done much to aid the progress of radio in Chicago, and it was due to efforts on their part that Chicago was served with a program on Sunday evenings, the time when a radio concert is most enjoyed. This service will be continued every Sunday and will also be gradually extended until it embraces every night in the week. The station is in charge of Mr. Sughart, whose efforts to serve the public as the public wishes to be served have met with such a great success. So as Mr. Sughart says, "Station WDAP signing off for the evening. Good night."

Syndicated Music

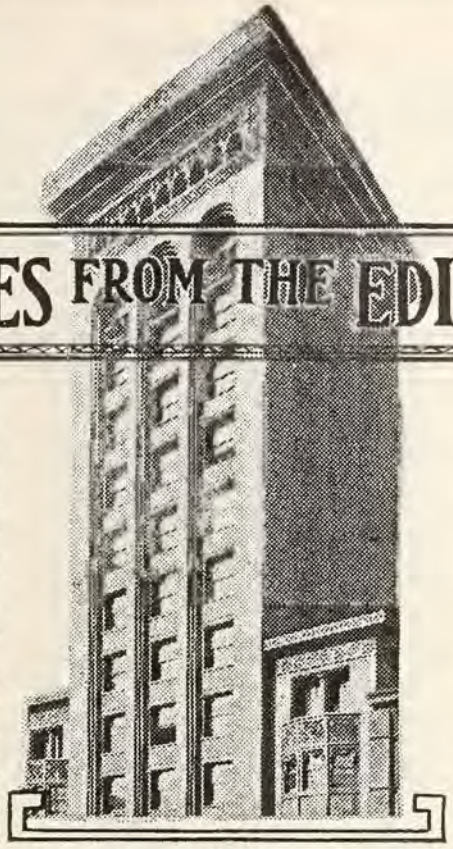
The day may yet come when the whole country will be able to sway to the music of a single orchestra. The Hotel Commodore in New York City has just completed the installation of a radio receiving set and a loud speaking telephone outfit that is attracting considerable attention, particularly among the dancing masters of the East and others who see in it the possibilities of buying their music from one central source just as they obtain their light and heat and power.

The amplifying and loud-speaking apparatus, which has been installed by the Western Electric Company as part of the permanent equipment of the hotel, is similar on a smaller scale to that used at Madison Square Garden on Armistice Day, when 38,000 people in and about the building were able to take part in the service. Projectors have been placed at various points in the ball room and connected through vacuum-tube amplifiers to the radio set. The antenna on the roof of the hotel picks up music sent out by the broadcasting stations and passes the waves through an ordinary type of receiving set in which they are amplified. The power amplifiers then increase the strength of these signals.

"I have been much interested in this demonstration of dance music by radio." says Joseph O'Brien, President of the Dancing Masters Association, in discussing the Commodore equipment. "First class music for dancing is essential if we are to please our patrons and this kind of music costs us real money. It is an obvious waste for a hundred academies to employ a hundred orchestras if they can connect by radio with a central station which transmits dance music. If such a station were established, it could readily afford the best orchestra in the world—one made up entirely of top-notchers. Yet the cost to each subscribing academy would be less than its present payroll. Of course, this would not eliminate local musicians because there always will be need for them to furnish music for instruction and special dancing."

1,000 Radio Patents

More than 1,000 patents have already been issued by the United States patent office covering new designs on materials connected with radio. Between 2,000 and 3,000 patents are pending. With this work ahead of the officials for investigation and approval the patent office is one of the busiest places in Washington.



THOUGHT WAVES FROM THE EDITORIAL TOWER

FIGURES supplied by the Radio Chamber of Commerce estimate that the present number of 1,500,000 receiving sets now in use will be increased to 5,000,000 in the next few years. It is likely that a great percentage of this increase will be derived from the farmer. And that opens an interesting line of discussion.

It cannot be denied that there are hundreds of thousands of farmers who are not yet "sold" on radio. They have heard about it from newspapers, magazines and from visitors from the cities where radio has long been a business convenience and a social diversion. There are several reasons why the farmer, for whom radio one day will open avenues of interest hitherto undreamed of, has not "put in his set."

One reason is that distributors have been so busily engaged in looking after the demand for apparatus in the more densely populated districts that they have not organized the drive on the rural communities. It is sure to come. Another reason is that the crystal set is not effective in getting signals for more than 15 to 25 miles and hosts of farmers live further than that from the nearest broadcasting station.

This raises the problem of the storage battery which is an essential of the set which will give the farmer an adequate radius. Farmers whose houses are not wired for electric lighting are put to some difficulty to recharge their batteries. If their homes were wired they could use easily the standard home-charging device for the purpose. But the farmer who must carry his heavy battery to town to get it charged may ofttimes be most eager to listen in just at the time when his battery is in the doldrums.

We learn of one farmer who used the battery from his automobile for radio at night and for motor purposes during the day. Anybody who has tried to extract one of those heavy batteries from the almost inaccessible spot in which motor manufacturers are fond of bolting them into the car structure will appreciate that this farmer must needs be a super-fan to go to this trouble. He ran the engine of the car for four hours a week during the snow-bound season thus charging his battery for another seven days of markets, music and news by wireless.

Those knights of the open road who have gone hither and thither among the farmers selling them cheap crystal sets on the misrepresentation that the outfits will receive messages from impossible distances are about through with their confidence games. The farmer is getting radio wise in his day and generation and from now on he will have to be shown.

The way to produce the sales of that other 3,500,000 receiving sets is to offer the farmer sets that will perform with a minimum of trouble and expense. Manufacturers who deliver such outfits will find the farmer a willing, yes, almost a profligate spender.

It is a matter of pride with Radio Age that many of our subscribers are of the R. F. D. sort. We should like to hear from farmers and manufacturers, both, as to ways and means of making radio most easily accessible to the rural citizen. He is possibly not the backbone of the radio future but he at least is the ribs of it. Incidentally farmers should be especially interested in the special government article published in this number, explaining how to construct a tube set for $23.

DON'T bomb the broadcaster! He is not only doing the best he can but he is doing very well. Also, in a majority of instances, he is doing his best without cost to the receiver.

Broadcasting stations have made mistakes but they are improving their service as experience teaches better methods. The broadcasting station usually is operated by a business organization that is engaged in manufacturing and selling radio equipment. Broadcasting is a direct and most important meth- of of interesting the millions in radio, because it offers them news and entertainment, not to mention a service which has become indispensable to business. Therefore, it need not be feared that the proprietors of broadcasting stations will carelessly permit their product to decline in merit. They want to improve it.

But broadcasters need help. They need intelligent criticism from operators of receiving sets. They need protection from foolish radio dealers, who turn on their loud speakers to the limit and do their best to convince the public that the studio in the broadcasting station is a cage of roaring, yelping, yipping lions.

"Well, if that's radio, I don't want any of it in my house."

You have heard men and women make that emphatic announcement at radio shows and in radio shops. That exclamation means radio business deferred, if not definitely lost. It is business that might have been saved had the operators of the receiving station toned down their instruments so that human speech, and sweet music would come forth, instead of shrieks of a lost soul.

Broadcasting stations should organize. They should exchange information and ideas as to the best and most popular programs to give the radio millions. They should

combine to oppose the attempted extortions that continually are being practiced. They should know what their rights are in relation to broadcasting copyrighted music. They should stand together to demand that every advantage of the law be taken in putting out of business the ill-mannered fan who breaks up the best of broadcasting programs by sending outside his legal wave-length.

The day of broadcasting talking machine records is past. The public has had just enough of the excellent entertainment by high class artists to be satisfied with nothing less. Such entertainment is available in every big community.

The public wants a mixture of superior music and jazz stuff. It wants a little bit of heavy discussion of civic or social conditions, and a great deal of humor that IS humor. It wants a song from the operatic star, but it also wants the old-time ballad, or the modern song hit.

Many broadcasting stations know the foregoing assertions are true and might be excused, if they called such comments trite. But many others have seemingly failed to get the conviction that broadcasting is the lifeblood of radio. Radio isn't going to gain any new friends through broadcasting of views by an eminent citizen on the moral responsibility of the protoplasm to the scientific aspects of unadulterated blah.

Ben Franklin said, in the perilous revolutionary days: "We must all hang together, or we shall hang separately."

Sad News for the Crooks

(Continued from page 9.)

sioner Enright and M. R. Brennan, superintendent of the police telegraph division, to send on a 400 meter wave length. Later, if the Department of Commerce has to allow a wider scope to present users of the 360 meter wave, the New York police will be permitted to widen their range to 500 meters.

"We have already made arrangements," Mr. Brennan said yesterday, "to equip our police boats and inspection district offices with radio telephonic receiving sets. As we progress with the idea, receiving stations will be installed in all precinct headquarters and special operators will be detailed to attend them twenty-four hours a day. When the other larger cities take to radio telephony for administrative purposes, we expect to be able to establish a network of broadcasting and receiving stations that will make it possible to give a national alarm almost instantaneously."

How to Kill Radio

BROADCASTING is the heart of the radio game, public, private commercial, educational.

If transmission is poor radio listeners are going to be discouraged.

If programmes are inferior and poorly balanced casual dabblers in radio are not going to be influenced thereby to buy apparatus and get into the game in earnest.

Broadcasting of grand opera in Chicago last year started a demand for receiving sets that amounted to a "craze."

Broadcasting has made the radio business and broadcasting can kill it.

How [to] Construct a Tube Set

[(Continued from page 8.)]

tube to be much more positive in adjustments than the crystal detector.

Notes on Soldering

It has been stated above that certain connections were soldered. In fact, one could well advise that all connections about a radio circuit be soldered, but soldered correctly. There are some general hints that may be given but judgment and experience are essential. (1) The soldering copper must be clean and the tip well coated with solder. If the tip of the soldering copper is not bright, it should be filed clean. It is then heated, care being taken that the tip is not directly in the flame. After the copper is hot —not red hot—it is dipped in the soldering flux or paste and the copper tip coated with solder. (2) The wires are cleaned where the soldering is to be done, using fine sandpaper, then a small amount of soldering flux or paste is applied at the joint, and the wires to be soldered are tinned or coated with solder before the wires are joined. After the wires are tinned they are soldered together, using just enough solder to make the joint solid. The joint should not be jarred while the solder is still soft; to do so weakens the joint and gives the solder a dull appearance. A good soldered joint will be smooth and bright. (3) All excess soldering flux or paste should be cleaned off. Gasolene or alcohol will assist in cleaning off the paste. This last point is sometimes overlooked and the excess of flux often causes the copper wires to corrode.

Cost of Parts

The following list includes the cost of parts of the electron tube detector unit and the "A" and "B" batteries. It does not include the cost of the telephone receivers or of any of the other equipment used to make up the complete receiving outfit given in the previous description of the simple crystal receiving set.

Electron Tube Detector Unit.

Electron tube	$5.00 to $6.50
Electron tube socket	0.75 to 2.00
Filament rheostat	1.00 to 2.50
Grid leak and grid condenser	0.50 to 1.50
By-pass condenser about	0.35
Ten (10) feed No. 14 bare tinned copper wire about	0.10
Miscellaneous binding posts and screws, about	0.75
Batteries:	
"A" storage battery, 6-volt, 60 amper-hour capacity	$15.00 to $20.00
"B" battery, 22 1/2 to 45 volts	1.00 to 3.00
Total	$23.25 to $36.70

Signal Electric Co. Expands

The Signal Electric Manufacturing Company of Menominee, Michigan, has acquired the Hulbert patents and taken over the assets and liabilities of the Hulbert Electric Manufacturing Company, of Chicago, Illinois.

Under this arrangement production of the Hulbert Battery charger will be increased and others of the Hulbert patents will be developed and put into production.

Mr. C. H. Hulbert will hereafter be identified with The Signal Electric Manufacturing Company, in the capacity of research and development engineer.

400 Meters for KYW

Chicago's KYW, the Westinghouse broadcasting station on the roof of the Commonwealth Edison building, has been raised to the B class and its wave length has been made 400 meters, instead of 360 as formerly. The change was made with the authority of the government radio inspector because of the increased importance of the station following its erection of new aerial towers and other additions and improvements. The new wave length was used for the first time on Sunday, September 17.

Expert Explains Radio Frequency Amplification

Interesting Facts About Phenomenon of Wireless Telephony

By CHARLES KILGOUR

Radio Engineer for Crosley Manufacturing Co.

In an Interview

ALTHOUGH radio frequency amplification is no mystery to the average wireless telephony amateur, there are many, especially those who have but recently become radio fans, who will be interested in a brief explanation of this phenomenon. Mr. Charles Kilgour, radio engineer, who is in charge of the corps of engineers employed by the Crosley Manufacturing Company, operators of the radio station WLW, in Cincinnati, Ohio, has made a close study of radio frequency amplification, and, in a discussion of it, said:

"Everyone knows the purpose of the ordinary two stage amplifier is to make louder the sound as originally received through the detector tube or crystal. This amplifier makes any audible signal louder; therefore, it is called an audio frequency amplifier.

"The extremely weak electrical alternating currents induced in the antenna circuit of the receiving set have a frequency far too high to produce an audible effect on the head phones. Broadcasting stations usually use the 360 meter wave length, which means that the current picked up has a frequency of more than 800,000 cycles per second. The lowest note of the piano or organ has about 16 beats, or cycles, per second, while the highest beats approximately 8,000 times per second.

"The high frequency current picked up from the broadcasting station is called a radio frequency current, because it is at this high frequency that the message is radiated through space. Combined with the radio frequency pulsation there is a low frequency variation which is the part we wish to hear. The detector so alters the current that the high frequency part has no effect on the head phones while the low frequency part acts upon them, causing them to give out an audible note. This is called rectification.

"Understanding this, it is apparent the name indicates that a radio frequency amplifier does its work before the detector has acted. It is inserted in the set between the tuner and detector. As in the case of the audio frequency amplifier, a vacuum tube with its proper circuits is used to strengthen the electrical current. In this case, however, this is accomplished before the current has been rectified by the detector. One stage of radio frequency amplification will not have as great an effect on the output as a single stage audio frequency amplifier of proper design, but it has several advantages.

"If a great volume of output is desired, why do we not use more stages of audio frequency amplification? We cannot ordinarily use four or six stages because audion amplification becomes very noisy when cascaded in this manner and sounds generated in the tubes themselves have a tendency to drown out the signal. On the other hand, a radio frequency amplifier does not have this bad quality in anything like the same degree.

"There is another important advantage derived from the use of the radio amplifier. Detector tubes fail to rectify very weak signals so there is nothing for the audio frequency amplifiers to work with, no matter how efficient they may be. A properly designed radio frequency amplifier, however, will strengthen these weak signals to such an extent that the detector will do its work properly and the audio frequency amplifier will make the sounds boom out in the head phones or loud speaker. Properly designed radio frequency amplifiers are very successful and open a new field of enjoyment for those who 'listen in.' "

That Reinartz Article

The illustrated article on the Reinartz unit, how to make it and what it will do, and why, seems to have aroused interest from Boston to San Francisco. If you missed the September number you may obtain one by sending twenty-five cents in stamps to Radio Age, 64 West Randolph Street, Chicago. Better write today. Supply is limited.

Charles E. Kilgour, writer of the article on this page in which radio and audio frequency is explained, is the man who supervised construction of the Crossley Manufacturing Company's new broadcasting plant at Cincinnati, Ohio. Mr. Kilgour is a radio engineer and a good one. Also, as will be observed by those who read his interview, he knows how to tell what he knows.

Radio Combine in England?

English officials are at logger-heads over a proposal of Postmaster General Kellaway to grant the exclusive right of broadcasting and the monopoly of the sale of receiving instruments. This plan contemplates barring American and other foreign-made radio equipment from the English market and would place the sale of equipment in the hands of a combine of instrument makers.

Opposing this proposal Capt. Wedgewood Benn, member of parliament, argued that radio is supplementary to the daily press. He denied the right to limit its transmitting facilities to a combine. He said radio was the most important social development since the discovery of printing.

It is predicted that $30,000,000 will be spent in England in two years by this combine in buying receiving apparatus and building broadcasting stations and that 80 per cent of this sum would be paid to labor. Mr. Kellaway said there would be no monopoly and then went on to explain that all of the English manufacturers could become members of the company. He said the English should "keep this new form of communication in the hands of our own people."

Localizers for Airmen

A device to use electro-magnetic waves in assisting an aviator in determining when he is above a landing field has been produced by the United States air mail service after experiments covering three years. The apparatus is called a "localizer." Briefly, it transmits radio signals in practically a perpendicular direction and these, penetrating fog or clouds, reach the aviator and inform him of his location. The device will greatly assist aviators in night flying, it is anticipated.

Chicago's International Radio Show

Exhibits by Manufacturers Will Predominate and There Will be Abundance of Features for Crowds

Arrangements are complete for the Chicago radio show which will be open to the public on October 14 to October 21 at the Coliseum. The exposition promises to be one of the most important trade displays ever assembled in the country. Directors of the show announce that practically every large manufacturer of radio apparatus in the country will be represented. The presence of manufacturers in large number will make the show distinctive in that it will not be a bazaar, but an exposition of the progress radio science has made.

It is announced that this is the first radio show to receive indorsement by the National Radio Chamber of Commerce and by the Radio Division of the national electrical manufacturers. The preponderance of manufacturing exhibits is expected to bring large numbers of jobbers and dealers to Chicago for the purpose of getting a line on the latest improved radio merchandise.

It will be the first time that the manufacturer has taken the opportunity to meet the jobber, dealer and the public all at the same time. Aside from the show it will be a sort of a great get-together convention for all those interested in radio. Meetings of some of the most important committees of the National Radio Chamber of Commerce will be held at the same time.

An elaborate entertainment program is rapidly being arranged. Ed Wynn, the famous comedian, and his company will put on their show the opening night of the exposition and it will be broadcast. There will be a society night, a radio ball, a children's afternoon and other features during the week. While the entire Coliseum will be given over to the exhibits, the Coliseum Annex will be given over to meetings, entertainment, the radio ball and other features.

The remainder of the exhibition space is being rapidly sold, the amount already taken insuring the success of the exposition from the standpoint of both the exhibitor and the spectator. There will be plenty of room for the crowds, as sixty per cent of the entire floor of the Coliseum will be used for aisles, preventing overcrowding and giving the exhibitor a chance to talk to his prospective customers.

The public will be well entertained. The exhibits will include the latest radio apparatus, many exhibits being of improvements made during the summer and shown for the first time. There will be novelty exhibits and a score of aerials on the roof of the Coliseum will catch and disseminate all that is being sent out from the broadcasting stations all over the country.

In the large space in the center of the building will be a display of radio controlled automobiles, torpedoes, a pump that pours out real water and other mechanical devices operated from a small sending station.

U. J. Herrman, managing director of the Chicago Radio Show, and Manager James F. Kerr visited more than a dozen radio shows in different parts of the United States before making their final plans for Chicago's show and thus have been able to avoid the mistakes made by the other shows. The Chicago Radio Show will be an annual affair and holds an exclusive lease on the Coliseum for this kind of a show and for a long term of years.

Two Cincinnati Shows

CINCINNATI claims to be the greatest radio center in the United States, in proportion to its population. It cannot be denied that the Ohio city had taken hold of the wireless game with an enthusiasm to be marvelled at. Any visitor to Cincinnati will be struck by the number of radio aerials he sees strung up on the roofs of buildings, especially in the business districts. One of the reasons for this abundance of aerials is that the Crosley Manufacturing Company, operators of station WLW is almost continuously "on the air" with interesting news, entertainment and market features.

Cincinnati is to have two radio shows this month, the first of which will be known as the Radio and Electrical Exposition, while the second will be conducted by the Tri-State Tobacco Growers' Association. The Radio and Electrical Exposition will be conducted in Music Hall, October 2-7, while the Tri-State Tobacco Growers will conduct their exposition in Covington, just across the Ohio River from Cincinnati, October 21-28. The latter exposition will be one of the largest of its kind ever conducted in the Middle West, President Harding and the Governors of Ohio, Kentucky and Indiana having promised to be present.

Porcelain Sockets

Many radio manufacturers and thousands of amateur operators have adopted the Crosley Vacuum Tube Socket because of its many advantages over more complicated and less efficient ones. This socket is made of one piece of porcelain, the same material that is used in the base of a vacuum tube to insulate the four prongs. The contacts are of special, strong phosphor bronze, nickel plated, which eliminates to a great degree corrosion at the contacts. The nuts and screws are brass, nickel plated.

As the socket is made of porcelain, wires can be soldered to the contact posts without fear of melting the material of which the socket is made, and it will be found that it will not be affected by overheating of the tubes. The bayonet slot, imbedded in the wall of porcelain, is completely backed up and reinforced to prevent the possibility of breakage, and as the barrel that surrounds the tube is made of porcelain, there is no possibility of ground hum, so often noticed in sockets having a metal wall.

This socket was designed to prevent short circuiting of high voltage "B" battery current across the filament contacts, thus eliminating the danger of burning out the filament through careless insertion of the tube. This feature appeals especially to the dealers who are called upon to replace tubes that have been burned out as a result of use in ordinary sockets.

The Crosley Sockets have another unique feature in that they can be mounted either on a base or panel.

Injunction Granted

An important step in clearing up the somewhat tangled situation regarding radio patents was taken by Justice O'Malley of the Supreme Court in granting the injunction asked by the Freed Eisemann Radio Corporation of New York against the Wireless Specialty Apparatus Company.

It is stated that the Wireless Specialty Apparatus Company recently published a series of statements which indicated that crystal radio receiving sets are controlled by patents owned by them.

The contention of the Freed Eisemann Radio Corporation, now sustained in the courts, was that these statements constituted unfair business competition and an injunction was granted restraining the Wireless Specialty Apparatus Company. The injunction was part of the suit. The balance, in which $150,000 damages was asked is still pending.

The outcome of the suit, it is said, will have an important bearing upon the entire crystal radio patent situation.

Questions and Answers

This is the "trouble department" of Radio Age. No trouble to us, but representing difficulties of our readers. Many letters are received asking what charge is made for answering questions as to hook-ups, etc. This is a free service department and all questions will be answered without charge, either in the magazine or, if self-addressed and stamped envelope is sent, we will send the answer promptly by mail. This department is conducted by Frank D. Pearne, Technical Editor of RADIO AGE.

F. L. G. Chicago, Ill.

Question: Will you kindly inform me if good results can be obtained by using honey-comb coils as loading inductances? If this can be done, will you please mark the enclosed diagram, showing where they should be inserted, so that condensers will be in shunt around them. If there is any charge for this service, I will gladly remit upon being notified of the amount of same.

Answer: Yes they will work very well, but in this particular case you must have a coil consisting of 70 turns, tapped at a point 20 turns from one end as shown in the diagram returned by mail. This can be done very well by winding 70 turns of No. 26 wire on a plain tube 2 3-4 inches in diameter and tapping at the twentieth turn. This will bring your set up to something more than 600 meters. If you want a greater wave length use more turns and tap of the intermediate contact in the same proportion. Thanks for your offer to pay the charges, but this service is already paid for when you buy the magazine. It is furnished free to the readers of Radio Age.

T. J. S., Boston, Mass.

Question: In your September number of Radio Age I saw your Reinartz tuner. I have started to make same and would like to make one step of amplification to start with. Can you send me any more information as to the construction of same? I have the enclosed list of apparatus, so I have a good start. I started to make a radio receiving set with two steps of amplification described in another magazine and got as far as the first stage of amplification and it did not sound good. As I have made three sets of the crystal type and had good luck, I want to hear from you before going ahead.

Answer: I do not know of anything which I might add to the instructions given in the September number. All I can say is, go ahead and if you find anything which you do not understand, just write to me and I will be very glad to help you. I think that after you get started you will find the set quite easy to construct.

B. L. H., Danville, Ill.

Question: I am starting to set up a transmitting station and come to you for some information. Do I have to pass an examination before I can do this and if so who will give it to me, and where? Can you tell me anything about what this examination would be? That is, do I have to be able to send at any certain speed and what is the nature of the questions that will be asked? Do you recommend any special type of antenna for a transmitting station? If so, will you please send me a description of it, as I want my station to be a good one.

Answer: Yes; you will have to pass an examination before you will be allowed to send messages. You can find out all about this by writing to the United States Radio Inspector, 9th District, Federal Building, Chicago, Ill. The ability to send is not so important as how much you can receive. For an amateur license you will be required to receive 10 words per minute and you will have to be able to tell the function of all parts of your set and answer the other questions asked by the inspector. Use a "T" aerial for sending. The following diagram will show you how to construct it.

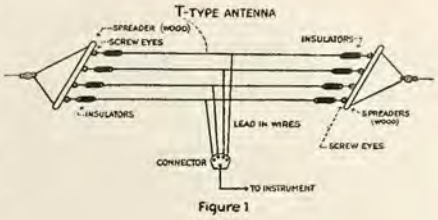
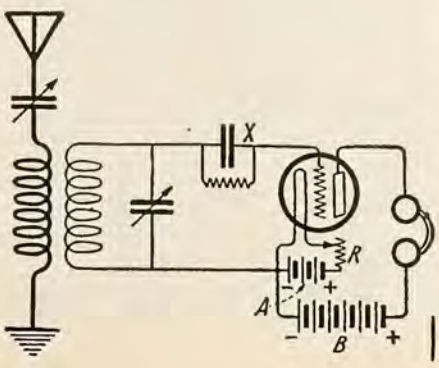


Figure 1

B. B., Levering, Mich.

Question: I have been very much interested in the questions and answers in your magazine and want to ask several questions myself. I am within a few miles of the Straits of Mackinaw, and want to be able to hear as far as Atlanta. With ready made parts, I have hooked up a receiver as shown in the enclosed diagram. With this set I have heard Pittsburgh, Louisville, Davenport and faintly from Atlanta. Is there any suggestion you could make to improve it? Do you think a variable condenser in the aerial would improve it? Will you please send me a hook-up for one stage of radio and two of audio frequency to go with this set?

Answer: If you get these results, don't change your set. Variable condenser in your aerial circuit will help, providing your aerial is not too small. I am mailing you the desired circuit.



C. C. T., Garner, Iowa.

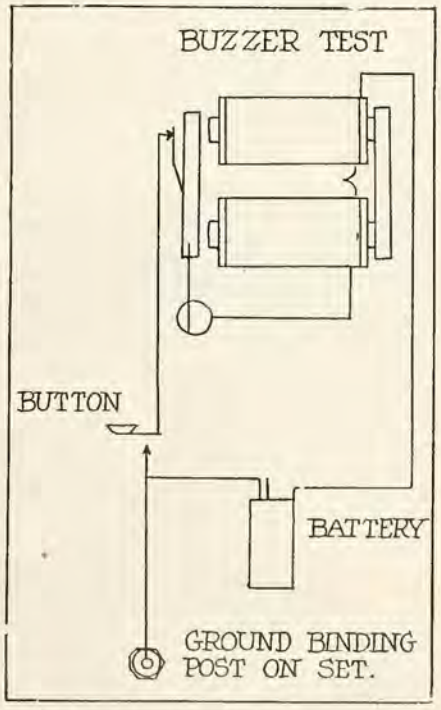
I noticed the "super" hook-up in the Radio Age this month and am wondering if it is strong enough to use a loud speaker in place of the phones for stations 500 or 750 miles distant? Will it be advantageous for me to use an aerial instead of a loop?

Answer: Yes, a loud speaker can be used with this circuit. Do not try to use an aerial on this set, but stick close to the directions. The values and constants have been carefully figured out and any change may upset the entire plan. I have experimented personally and found the loop gives better results.

W. Y., Jr., Muskegon, Mich.

Will you kindly send me a pamphlet or details of how to make a vario-coupler? Also please send me a wiring diagram to use a vario-coupler with an audion detector and one variable condenser. Give all the details possible in the construction of the vario-coupler.

The description of the vario-coupler will require too much space to print here, so I am sending it by mail. Connect it to the circuit as shown on this page.



E. B. F., Lansing, Mich.

I have a crystal set which I made myself. When I can find the adjustment on the crystal I get very good results, but this does not happen very often. As you can see I have a buzzer test hook-up connected to the set but cannot hear the buzzer in the phones, so it doesn't do any good. Is it connected right? I have tried it several different ways and can hear it outside of the set, but it won't come through the phones. If you can show me how to connect it to my aerial I will appreciate it very much.

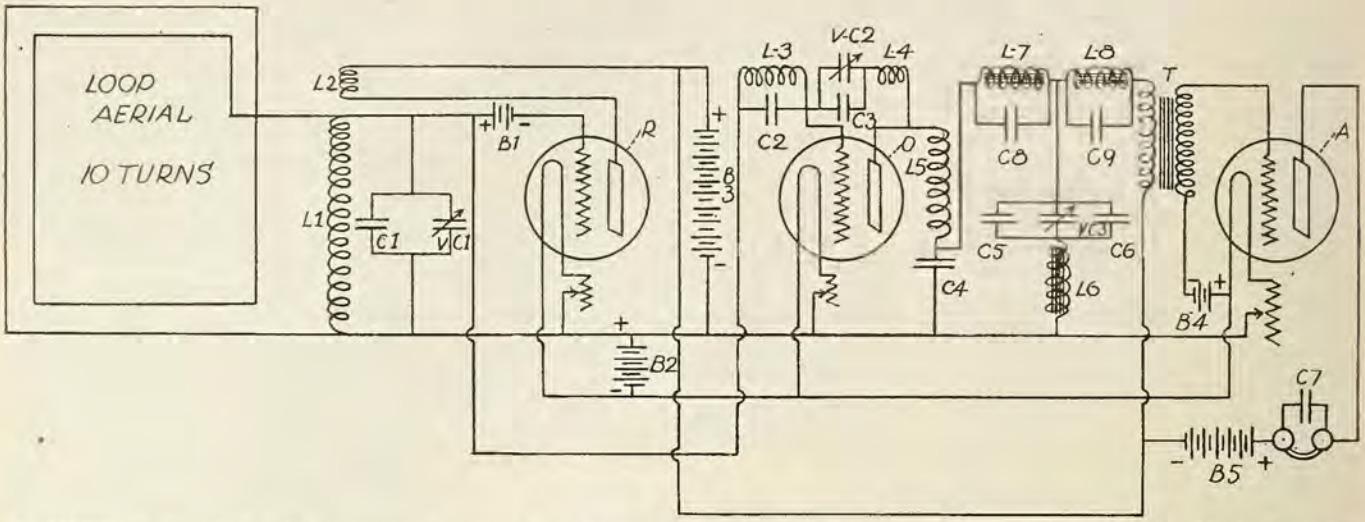
Answer: The hook-up which you

(Continued on page 22.)

Armstrong Super-Regenerative Circuit

3-Tube Arrangement

ARMSTRONG SUPER-REGENERATIVE CIRCUIT.



QUITE a number of Armstrong super-regenerative circuits have been published in the different papers and magazines, some of which, when tested out, will give results and some will not. This makes the question of amateur construction rather vague and uncertain and many who want to construct a set of this kind have decided to wait and let the other fellow work them out and find the best circuit, before spending any time and money on it. The circuit here shown has been used with some success by amateurs and seems to work better than any of the others.

At times very good results have been obtained and frequently the results are not so good, which seems to show that the circuit is all right, but that the trouble must be in the proper adjustment of the many controls. This being the fact then, it would seem that the whole matter resolves itself into the question of the user becoming well enough acquainted with the set to know just what is the cause of this variation in efficiency. For the benefit of those who wish to construct this circuit, the following list of apparatus used and their values are given.

M-1- Fixed condenser .0005 M. F.
M-2- Fixed condenser .0025 M. F.
M-3- Fixed condenser .0005 M. F.
M-4- Fixed condenser .005 M. F.
M-5- Fixed condenser .002 M. F.
M-6- Fixed condenser .002 M. F.
M-7- Fixed condenser .0005 M. F.
M-8- Fixed condenser .002 M. F.
M-9- Fixed condenser .002 M. F.
L-1- is the stator of an ordinary vario-coupler. L-2- Vario-coupler rotor. L-3- is a 1250 turn honey-comb coil. L-4- 5 Milhenries inductance coil. L-5- is a 1500 turn honey-comb coil. L-6- .1 Henry inductance coil. L-7- .1 Henry inductance coil. L-8- .1 Henry inductance coil. T- Audio frequency transformer. V.C.-1- .0005 Variable condenser. V.C.-2- .0005 Variable condenser. V.C.-3- .001 Variable condenser. B-1- 2- to 6-volt dry battery. B-2- 6-volt storage battery. B-3- 90-volt battery. B-4- 22½-volt battery. B-5- 200-volt battery. The loop aerial should consist of a few turns of No. 18 wire wound on a 4-foot frame. The exact number of turns for any particular set will have to be found by experiment. It usually requires from 6 to 12 turns.

Questions and Answers—Continued

show is wrong, but I don't see how you can help hearing it in the set. The accompanying arrangement will give you a buzz in the phones if you will connect it as shown.

N. E. L., Sault Ste. Marie, Ont., Canada.

I have read your article on the Reinartz tuner in the September issue of the Radio Age with a great deal of interest and intend to construct a set just as soon as I can gather together the necessary material. If not inconveniencing you too much I should certainly appreciate it if you give me some information as to how to tune it. If you have any other information you can give me along these lines, it will be most gratefully received.

Answer: I am glad to know that you intend to build this set, as I have had nothing but good reports from the many fans who are using them. I have not heard of one failure. The adjustment for tuning is quite simple. There are three switches and two or three condensers (according to which one you decide to construct). The switches should be set in one position and the dials on the condensers moved back and forth. If no sound is heard, move the switches to different positions and try again with the condensers. Continue in this way until a station is heard and then change the adjustments until the signals come in clear and plain. The filaments of the tubes should be turned up until they burn brightly, but not bright enough to destroy them. You will soon learn just where to set all the controls to get the best results, as it is only a matter of practice.

J. H. C., Chicago, Ill.

I like your questions and answers very much and read them all with great interest. I want to ask you one question which is not clear in my mind. Why is it that on most all radio frequency circuits they always say to use a loop antenna? Can I use my outside aerial which is 90 feet long with two wires and about 35 feet high, instead of the loop? If not, will you please tell me why?

Answer: The reason you are advised to use a loop aerial is because radio frequency, while it will bring in the distant stations very well, will also greatly magnify static and interference. The loop aerial is particularly adapted for this work because it eliminates much of this trouble, which will bother you considerably if you use the outside aerial. Stick to the loop for good, clear music.

Radio Guides Ships

A loop aerial receives loudest signals only when its edge is pointed in the exact direction from which the signals are being sent. In this way, it is possible to tell the exact point of the compass from which a station is operating.

The United States government has developed this radio compass principle into a complete chain of stations for the purpose of giving the captain of a ship his exact position whenever he asks for it.

This chain is made up of a series of units, each comprising a central station and two compass stations.

Let us suppose that the ship's call letters are WIY and that the call letters of the control station are NUT.

The ship desiring to learn her position calls NUT and, when NUT answers, makes the signal "QTE?" which means "What is my position?"

The station NUT then instructs the ship's operator. to make the letter V repeatedly for one minute, interpersing the letters with its call letters and, at the same time, NUT sends instructions over the private land wires to the two compass stations to listen for these V's and take their bearings.

It is a matter of only a few seconds for the compass stations to do this. We will assume that the compass station to the East finds that WIY's signals are coming from 240 degrees and the station to the West finds that they are coming from 130 degrees. The compass stations immediately telegraph over the land wires these two bearings, the officer in charge of NUT "projects" the two bearings on the large chart on his table and the point where they cross is inevitably the position of the ship.

Almost before the minute is up this officer has figured the ship's exact latitude and longitude and, as soon as WIY has finished his V's, NUT sends him by radio his exact position.

These radio compasses have been developed to such an extent that they are accurate within one degree and this is sufficient for any ship to steer a true course down the coast.

This means that the navigator of today on the coasts of the United States is independent of fogs or darkness or any of the elements which so frequently combine to force a skipper to resort to the uncertain methods of "dead reckoning" for days at a time.

Present Stock O. K.

E. E. Bucher, general manager of the Radio Corporation of America, says no discoveries have been made recently that revolutionize present radio equipment. He made the assertion in an address to the convention of electrical jobbers recently held in Chicago. Many jobbers had expressed a fear that their stocks might be rendered obsolete on account of progress in efficient equipment. Mr. Bucher told them that electrical experts were working ceaselessly on new developments but that none thus far need lead dealers to junk their stock or give it away at a low figure.

Did *You* Ever Hear of Lightning Striking Radio Antennae?

IT is generally agreed that telephone wires, electric service wires and metal bathtubs constitute a greater menace from lightning than do outside radio receiving aerials. It is best, however, for the radio operator to follow the advice of the insurance underwriters and install a lightning arrester in his lead-in.

Elimination of the outside aerial will do away with the possibility of danger from lightning. The rules laid down by the national board of fire underwriters concedes this, as they do not regard a receiving set with an indoor antenna as a hazard. Tentative rules of the board are as follows:

Rule 86—National Electric Code —Radio Equipment.

(For receiving stations only.)

Antenna—(a) Antennae outside of buildings shall not cross over or under electric light or power wires of any circuit of more than six hundred (600) volts or railway, trolley or feeder wires; nor shall it be so located that a failure of either antenna or the above-mentioned electric light or power wires can result in a contact between the antenna and such electric light or power wires.

Antennae shall be constructed and installed in a strong and durable manner and shall be so located as to prevent accidental contact with light and power wires by sagging or swinging.

Splices and joints in the antenna span, unless made with approved clamps or splicing devices, shall be soldered.

Antennae installed inside of buildings are not covered by the above specifications.

Lead - In Wires — (b) Lead-in wires shall be of copper, approved copper-clad steel or other approved metal which will not corrode excessively and in no case shall they be smaller than No. 14 B. & S. gauge, except that approved copper-clad steel not less than No. 17 B. & S. gauge may be used.

Lead-in wires on the outside of buildings shall not come nearer than four (4) inches to electric light and power wires unless separated therefrom by a continuous and firmly fixed nonconductor that will maintain permanent separation. The nonconductor shall be in addition to any insulation on the wire.

Lead-in wires shall enter building through a noncombustible, nonabsorptive, insulating bushing.

Protective Device—(c) Each lead-in wire shall be provided with an approved protective device properly connected and located (inside or outside the building) as near as practicable to the point where the wire enters the building. The protector shall not be placed in the immediate vicinity of easily ignitable stuff, or where exposed to inflammable gases or dust or flyings of combustible materials.

The protective device shall be an approved lightning arrester which will operate at a potential of five hundred (500) volts or less.

Protective Ground Wire—(d) The ground wire may be bare or insulated and shall be of copper or approved copper-clad steel. If of copper the ground wire shall be not smaller than No. 14 B. & S. gauge, and if of approved copper clad steel shall be not smaller than No. 17 B. & S. gauge. The ground wire shall be run in as straight a line as possible to a good, permanent ground. Preference shall be given to water piping. Gas piping shall not be used for grounding protective devices. Other permissible grounds are grounded steel frames of buildings or other grounded metallic work in the building and artificial grounds such as driven pipes, plates, cones, etc.

The ground wire shall be protected against mechanical injury.

Wires Inside Buildings—(e) Wires inside buildings shall be securely fastened in a workmanlike manner and shall not come nearer than two (2) inches to any electric light or power wire unless separated therefrom by some continuous and firmly fixed nonconductor, making a permanent separation. This nonconductor shall be in addition to any regular insulation on the wire.

Receiving Equipment Ground Wire—(f) The ground conductor may be bare or insulated and shall be of copper, approved copper-clad steel or other approved metal which shall not corrode excessively under existing conditions, and in no case shall the ground wire be less than No. 14 B. & S. gauge, except that approved copper-clad steel not less than No. 17 B. & S. gauge may be used.

The ground wire may be run inside or outside of building. When receiving equipment ground wire is run in full compliance with rules for protective ground wire in section (d), it may be used as the ground conductor for the protective device.

What Steinmetz Says About Radio and Lightning:

DR. STEINMETZ, who is an authority on high power electrical phenomena, was asked the following question during his visit to the Radio Congress:

Question: Dr. Steinmetz, many of us have amateur radio receiving sets in our homes. We have heard rumors that the Underwriters consider that there is a fire hazard because of the antenna and the ground connections and that certain restrictions may be placed on amateur installations.

Answer: There is no hazard in the amateur radio receiving station. It involves no fire risk nor risk to life. It is merely a harmless toy, but is a great deal more than a toy. It is one of the most valuable developments of the last years, by its instructive and educational value and the recreation and pleasure which it supplies. It would, therefore, be very regrettable if by a misguided public opinion obstructions were placed in the way of the fullest and freest developments of the amateur radio station. With regard to the possible lightning risk from the grounded antenna, first—the lightning risk in a city is very remote in any case and, second—the grounded antenna rather acts like a lightning rod and exercises a protective action against lightning. Any danger from the radio power received by the amateur station obviously is ridiculous when considering that the energy of a single pound of coal would be more than enough to operate the radio receiving station continuously for over a thousand years.

From a Statement Issued by

THE RADIO CORPORATION OF AMERICA

Radio Transmits Power

DISCUSSION by Charles P. Steinmetz of radio power transmission, as published in the September number of Radio Age has acquired new interest because of recent experiments on the Pacific Coast in which power was transmitted over a distance of eight miles. It was the contention of Dr. Steinmetz that the probability of power transmission by directed radio was very small, except in special cases where the distances were moderate and the efficiency of transmission of secondary importance.

Wallace E. Vail, President of the United States Radio Corporation, announces in San Francisco that engineers in the service of that company have demonstrated the feasibility of power transmission and that they are now devoting their energy toward perfecting the apparatus so that results can be obtained at great distances.

Mr. Vail is quoted as saying that it was demonstrated that power could be directed over electromagnetic waves sufficiently strong to be of use for industrial purposes and that the experiments proved that directed radio could be made of tremendous importance in warfare.

A large ship's bell placed nearly a quarter of a mile from the sending apparatus was rung at will during the demonstration. Engineers were unanimous in declaring that a powerful weapon will be available for the United States government when the machine is perfected.

Capable of passing through metal and concrete, the power waves could be used to explode the ammunition magazines of the largest battleships, far beyond gunshot of the American coast, Mr. Vail declared.

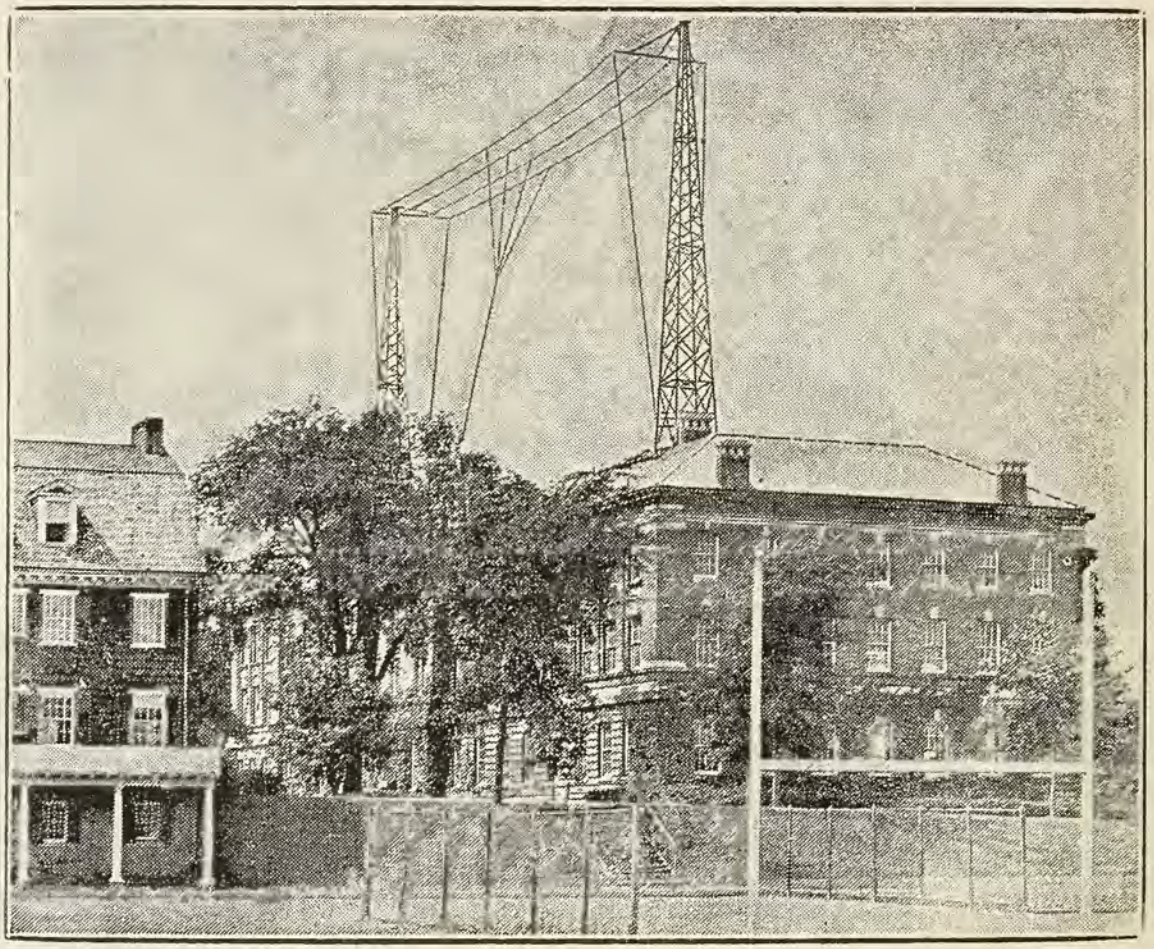
Today, in its imperfect state, the contrivance has lighted an electric light from a distance of eight miles, has rung a bell over the same distance, and this in spite of the fact that no effort has been made to focus the radio energy as the inventor Marconi has recently done.

Engineers declared that if the invention of Marconi could be incorporated in that of the radio concern, possibly unheard of results might be accomplished.

Mr. Vail today declared that applications have been made to

(Continued on next page.)

Biggest College Broadcasting Station



Coincident with the opening of the college year, a new and unique radio broadcasting station, officially listed in the Government call-book as W H A Z, was opened under the direction of the Electrical Engineering Department of the Rensselaer Polytechnic Institute at Troy, New York, and radio receivers from coast to coast may listen-in during the coming season on interesting and entertaining programs of a different sort, while the youthful researcher in the field of scientific development, especially along the lines of his favorite hobby, may gather much valuable information. This new broadcasting station is the most powerful in an educational institution in this country and has a range as great as any continental equipment so far established. In fact, there are only about half a dozen stations of such size and power in operation.

The Troy Polytechnic broadcasting station was made possible through a large gift from Washington A. Roebling, the late Charles G. Roebling and John A. Roebling of the John A. Roebling Sons' Company, of Trenton, N. J., all graduates of the Institute who are famous as the builders of the Brooklyn Bridge.

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the patent office at Washington to protect the transmitter.

Dr. Steinmetz said last month: "Theoretically, this is an interesting speculation, but whether it could ever become a possibility would depend on the question, whether a radio wave of such length could be found as to make the losses of power by absorption, etc., economically permissible, and whether stations for such wave length and power would be economically feasible. Furthermore, it would have to be an international development. Therefore, even if such radio transmission by a stationary electromagnetic wave sheet were possible, its realization at best is rather distant, so that the present outlook for radio power transmission is very remote."

Further details of the San Francisco experiments will be published in the November number of Radio Age.

Entertainment for Campers

Motorboating has always been popular at camps along water fronts, but this year the summer colony at Oakmont, Pa., where all Pittsburghers find relief from the hot offices and streets, had an added feature—radio. Here the Allegheny River affords an opportunity for this rare treat. KDKA, at the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., less than ten miles away, furnishes the entertainment.

One camp, fortunate enough to possess a motor boat, has it equipped with a loop antenna, and almost any time during the afternoon and evening baseball scores, latest news, market reports, and good music is heard while motoring up and down the river.

Another antenna is erected at the camp so that the Aeriola, Sr., is sometimes taken down to the beach, where, during the lazy afternoons and evenings, the girls listen in on the Fashion Talks and other features of particular interest to them.

Wires Join Wireless

Announcement has been made by Edward J. Nally, President of the Radio Corporation of America, that an agreement had been signed between his company and the Postal Telegraph-Cable Company whereby every office of the Postal Company in the United States becomes an agency of the Radio Corporation for the acceptance of radiograms for transmission across the Atlantic Ocean and for the delivery of radiograms received from overseas for points in the United States.

This important linking up of radio and wire line services reflects the rapid growth of the Radio Corporation's overseas telegraph traffic since the return of its high power stations by the Government after the close of the World War.

These stations transmit and receive radiograms directly to and from England, France, Norway and Germany, and through connecting stations abroad, to and from all countries in Europe, Asia and Africa.

The Radio Corporation now maintains the only direct line of telegraph communication with Germany and Scandinavia; and additional direct service is planned for the near future with Belgium, Holland, Italy, Poland and Sweden, giving to those peoples the opportunity to communicate directly with their scattered brethren and nationals in all sections of the country.

Prior to the arrangement made by the Radio Corporation of America whereby it is enabled to use the extensive land line service of the Postal Telegraph Company, practically all of the radiograms transmitted to transatlantic countries originated in New York City and Washington, D. C. The contract just signed gives to the inland commercial centers and the thousands of small points reached by the postal system equal facilities with those now enjoyed by the eastern cities mentioned, the Postal Telegraph Company performing the same service for radiograms of the Radio Corporation of America as it does for cablegrams to be transmitted by submarine cable.

Mr. Nally pointed out that although heretofore radiograms received from Europe, destined to points inland in the United States, had been forwarded over telegraph land lines, the complimentary service established by the agreement with the Postal Company insures prompt organized collection as well as distribution of radiograms at all points in the United States and gives to every section of the country the benefits of the phenomenal advances made in recent years in the radio art.

With the coming development of high speed wireless telegraphy the new arrangement will permit the Radio Corporation of America to carry out its plans for the inauguration of a low rate plain language radio letter service to and from all points in the United States and Europe, thus contributing largely to the establishment of closer and more friendly relations between the peoples of both lands.

The Radio Corporation's present offices in New York, Washington and San Francisco for the reception and delivery of radiograms will be continued, and its plans for the opening of additional offices of its own in the more important centers from time to time will go forward as the growth of business warrants.

It will be remembered that the Radio Corporation of America is the outgrowth of the Marconi Wireless Telegraph Company of America, and was formed after the close of the war in response to the appeal of Government representatives and to the national desire for an American owned, controlled and operated radio Communication company on a scale equal to the task of developing the new art and making it of the greatest possible service to the American people and the American government.

Radiograms coming over the land wires of the Postal Telegraph system from all sections of the country will be received at the Central Radio office at 64 Broad Street, where all the Eastern radio stations of the corporation are controlled. So far has automatism been carried in this new art that a bit of perforated paper tape in Broad Street sends a message to Europe without the aid of human hands, and, at the other end, another bit of tape likewise without prompting by human operators takes the message out of the air and visualizes it for the operator with a wavering line of blue ink.

Radio as a Profession

Much has been read and written in regard to the question: What does Radio offer as profession to the ambitious young man of today?

Although this is a relatively broad subject, still the question can be answered in a few words. The only factors that limit the heights to which a man can climb in Radio, are his pep or enthusiasm, and his knowledge of the subject.

If we recall the early days of the telephone and automobile industries, we will remember that similar questions were asked at that time. But is there any more need now of asking what opportunities these industries offer? Large and small fortunes have been reaped by the men who had the foresight to get started early and grow up as the industries developed.

Radio, however, is moving faster and outstripping them all. It is difficult to predict exactly what the future of Radio will be, but that we can prepare ourselves for some remarkable achievements is the warning given by the large number of enthusiasts who are now busily engaged in furthering its progress.

It was said that knowledge of the subject is one of the two prerequisites a man must have in order to attain big success in Radio. But where is the man to obtain this valuable knowledge? It is true that Radio is now being taught in many of the schools of the country; but these schools are generally located in the larger cities, and hence are accessible to only a very small percentage of the large number of men and boys who are

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anxious to learn more about this most fascinating subject. How, then, can this larger number be served?

Here is where the Radio correspondence school plays its role. With the correspondence school the mailman brings the school to the home instead of the man having to go to the school. Having his lessons with him all of the time, the ambitious learner can devote all spare moments of the day toward acquiring the desired knowledge. With the improved methods of instruction, the modern correspondence school is now considered as efficient as the resident school.

As an effective correspondence school in modern and commercial Radio, we can cite the American Electrical Association, located at 4513 Ravenswood Ave., Chicago, Illinois. Mr. Arthur G. Mohaupt, who is director of the school, is a college trained engineer with a broad experience in the engineering and teaching professions. He gives all his students his personal attention, and in this way succeeds in making the home instruction practically as effective as actual class room instruction. Mr. Mohaupt will gladly answer any questions that our readers may have in regard to the course or his methods.

Die Cast Wood Horn

(From the American Art Mache Company.)

Our Madera Horn is manufactured by breaking down selected wood to its original fibre, then compressed with 12 tons of pressure and 800 degrees of heat which produces a wood that is much more compact than the original state in which it grows.

Our horns and cabinets have been tested by the engineers of all of the leading radio concerns in the U. S. Through these tests we have gained positive conclusions that the principle of our horn is correct and that horns made of metal are not logical for clear tones. They come fitted with attachments for half head sets or single receivers. We can furnish the horns without base fitted with attachment for any loud speaker if you will give us the name; cabinet cannot be used for this purpose.

We have spent considerable time and money to perfect this item and judging by the replies received from users, dealers, jobbers and manufacturers, we know that our effort has met with success

Club Notes

On Thursday, September 21, the the Radio Club of Illinois entertained the radio fans of Chicago. Many enthusiastic amateurs took advantage of the invitation extended by the Secretary, John P. Tansey, and from noon until midnight, the crowds kept coming. They were entertained by talks given by Opie Read, the well-known journalist and lecturer; Alderman Anton J. Cermak, Chairman of the Committee on Compensation; Alderman George Maypole; Lucius J. L. Malmin, United States Judge of the Virgin Isles; U. J. Herrmann; and A. H. Kopprasch.

Paul B. Coats gave a demonstration of the Armstrong super-regenerative receiving set. The Radio Club of Illinois is located at 16 East Ontario Street, where many entertainments of this kind take place and where visitors are welcome.

Lane Radio Club

The first meeting of the Lane Radio Club was held on Monday, September 11, at which new officers were elected for the coming year, and future plans discussed. The membership is comprised of students and instructors in Lane Technical High School.

NEW BROADCASTING STATIONS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this Bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name = Name of station.
Loc. = Geographical location: O = west longitude, N = north latitude, S = south latitude.

(Continued on next page.)

ANNOUNCEMENT

Subscribers to THE NATIONAL RADIO MAGAZINE are notified that with this issue RADIO AGE discontinues distribution to such subscribers. Although under no obligation to do so, having no connection whatever with THE NATIONAL RADIO MAGAZINE, we volunteered to send our magazine to National subscribers up to and including October.

If you like RADIO AGE you will want to continue receiving it. We make you this *special offer*. Sign and return the blank below and receive RADIO AGE for six months for only $1 or send $1.50 and receive this leading mid-west radio periodical for TWELVE MONTHS. Cut out the coupon and send TODAY.

This Coupon and $1

Cut this out and send to Radio Age, 64 West Randolph Street, Chicago, Ill., and receive this magazine for six months. The regular subscription price is $2.50 per year.

RADIO AGE,

64 West Randolph Street, Chicago.

Enclosed find $1 for which please send me Radio Age for six months.

Name .....

Street No. .....

City .....

State .....

With Pleasure

We are glad to publish the following letter and would like to hear from any others who have something to say about their radio activities:

To The Editor:

In your September issue of Radio Age we noticed a list of companies featuring free radio concerts at their place of business. It is our desire to inform you and the public that we also offer that service at our store at 6845 Stony Island Avenue. Accommodations have been provided so that people interested in radio may be comfortably seated at any time of day to listen to, inspect or inquire about radio.

MIDLAND RADIO CO., Chicago,

(R. O. Ogden.)

(Continued from page 28.)

Call = Call letters assigned.
System = Radio system used and sparks per second.
Range = Normal range in nautical miles.
W. l. = Wave lengths assigned: Normal wave lengths in italics.
Service = Nature of service maintained:
PG = General public.
PR = Limited public.
RC = Radio compass station.
P = Private.
O = Government business exclusively.
Hours = Hours of operation.
N = Continuous service.
X = No regular hours.
m = a. m. (12m = midday).
s = p. m. (12s = midnight).
Rates = Ship or coast charges in cents: c = cents. (The rates in the international list are given in francs and centimes.)
I. W. T. Co. = Independent Wireless Telegraph Co.
R. C. A. = Radio Corporation of America.
S. O. R. S. = Ship Owners' Radio Service.
C. w. = Continuous wave.
I. c. w. = Interrupted continuous wave.
V. t. = Vacuum tube.
FX. = Fixed station.

Alphabetically by names of cities.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

City.	Call signal.	City.	Call signal.
Allentown, Pa.	WIAN	Neenah, Wis.	WIAJ
Atlantic City, N. J.	WHAR	Norfolk, Nebr.	WJAG
Binghamton, N. Y.	WIAV	New Orleans, La.	WIAF
Birmingham, Ala.	WIAG	Newton, Iowa	WIAH
Bluefield, W. Va.	WHAJ	Norwood, Ohio	WIAL
Boise, Idaho	KFAU	Ocean City, N. J.	WIAD
Burlington, Iowa	WIAS	Omaha, Nebr.	WIAK
Butte, Mont.	KFAP	Paducah, Ky.	WIAR
Butte, Mont.	KFBF	Portland, Me.	WJAL
Cedar Rapids, Iowa	WJAM	Reno, Nev.	KFAS
Cedar Rapids, Iowa	WKAA	Rockford, Ill.	WIAB
Cincinnati, Ohio	WHAG	Rockford, Ill.	WJAH
Clarksburg, W. Va.	WHAK	Rochester, N. Y.	WHAM
Cleveland, Ohio	KDPM	Saginaw, Mich.	WIAW
Corinth, Miss.	WHAU	San Antonio, Tex.	WJAE
Davenport, Iowa	WHAI	San Diego, Calif.	KFBC
Dayton, Ohio	WJAJ	San Jose, Calif.	KFAQ
Decatur, Ill.	WHAP	San Luis Obispo, Calif.	KFBE
Eugene, Oreg.	KFAT	Santa Ana, Calif.	KFAW
Galveston, Tex.	WIAC	Savannah, Ga.	WHAO
Hanford, Calif.	KFBD	Seattle, Wash.	KDZT
Havre, Mont.	KFBB	Springfield, Mass.	WIAP
Hollywood, Calif.	KFAR	Springfield, Mo.	WIAI
Holyoke, Mass.	WHAX	Stockdale, Ohio	WJAK
Huntington, Ind.	WHAY	Tacoma, Wash.	KFBG
Joplin, Mo.	WHAH	Tampa, Fla.	WHAW
Joplin, Mo.	WJAC	Tarkio, Mo.	WIAT
Lansing, Mich.	WHAL	Troy, N. Y.	WHAZ
Le Mars, Iowa	WIAU	Venice, Calif.	KFAV
Lewiston, Idaho	KFBA	Vinton, Iowa	WIAE
Lincoln, Nebr.	WIAX	Waco, Tex.	WJAD
Lincoln, Nebr.	WJAB	Washington, D. C.	WHAQ
Lincoln, Nebr.	WKAC	Washington, D. C.	WIAY
Louisville, Ky.	WHAS	Waupaca, Wis.	WIAA
Marion, Ind.	WIAQ	Wichita, Kans.	WHAN
Milwaukee, Wis.	WIAO	Wichita Falls, Tex.	WKAF
Moscow, Idaho	KFAN	Wilmington, Del.	WHAV
Muncie, Ind.	WJAF	Yale, Okla.	WHAT

List of stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 meters), alphabetically by call letters.

[Additions to the List of Radio Stations of the United States, Radio Service Bulletin, edition June 30, 1922.]

Call signal.	Station operated and controlled by—	Location of station.	Wave lengths.
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	360
KDZT	Seattle Radio Association	Seattle, Wash.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAP	Standard Publishing Co.	Butte, Mont.	360
KFAQ	City of San Jose	San Jose, Calif.	360
KFAR	Studio Lighting Service Co. (O. K. Olesen)	Hollywood, Calif., 1645 Hudson Avenue	360
KFAS	Reno Motor Supply Co.	Reno, Nev.	360
KFAT	S. T. Donohue	Eugene, Ore., 681 Willamette Street	360
KFAU	Boise High School, independent school district of Boise City.	Boise, Idaho	360, 485
KFAV	Cooke & Chapman	Venice, Calif.	360
KFAW	The Radio Den	Santa Ana, Calif.	360
KFBA	Ramey & Bryant Radio Co.	Lewiston, Idaho	360
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif., 5038 Cliff Place	360
KFBD	Clarence V. Welch	Hanford, Calif., 315 North Douty Street	360
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBF	Butte School of Telegraph (F. H. Smith)	Butte, Mont.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
WHAG	University of Cincinnati	Cincinnati, Ohio	360

How to Make an Audio Frequency Amplifying Transformer

(Continued from page 12.)

so that the brass clamps which are to hold the core together will come up flush. If this has been correctly finished, it will look like the drawing, Figure 9.

Care should be taken, when the core iron is being placed inside the tube, to see that the wires of the coil come out on the proper sides. The two wires of the inside coil should come out on one side (the flat side) of the core, and the ends of the other coil should come out on the other side as shown in Figure 14. Next make the brass clamps, which hold the transformer together. To do this, cut out two pieces of brass one-sixteenth of an inch thick, in the shape and size shown in Figure 10. These are to be placed on each side of the finished core, to hold it together. Cut out the large square hole in the center by drilling holes close together around the edge and then cutting the whole piece out with a cold-chisel, and finally dressing it to size with a file. The holes, through which the screws are to be placed, are drilled with a Number 18 drill. The flanges should be turned over at the bottom to make the feet on which the transformer is to stand. As these flanges are to serve as a mounting on a panel or base, they should also be drilled to allow screws to pass through and fasten them down.

Two pieces of hard rubber, or fiber, one-eighth inches thick, are next to be cut out as shown in Figure 11. These are used for the purpose of mounting the binding posts, to which the terminals of the coil are connected, when the transformer is completed. The location and size of these holes are plainly shown in the drawing. Next, four brass bushings of the size shown in Figure 12 are made. This can be done by cutting off four pieces of brass tubing one-fourth of an inch in length, and having a hole through the center, large enough to accommodate the 8-32 screws which are to be used for holding the transformer together.

These brass bushings are placed under the hard rubber strips to set them out one-fourth of an inch, to prevent the screws of the binding posts coming in contact with the metal parts of the transformer. Now, from a piece of thin brass, cut out four small connectors as shown in Figure 13. These need not be more than one-thirty-second of an inch thick, and are to be placed under the screws of the binding posts to allow for soldering the terminals of the coil as shown in Figure 14.

(Continued on page 31.)

WHAH	John T. Griffin	Joplin, Mo., 112 West Sixth Street	360
WHAI	Radio Equipment & Mfg. Co.	Davenport, Iowa	360
WHAJ	Bluefield Daily Telegraph and E. K. Kitts	Bluefield, W. Va.	360
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	360
WHAL	Phillips Jeffery & Derby	Lansing, Mich.	360
WHAM	University of Rochester	Rochester, N. Y.	360
WHAN	Southwestern Radio Co.	Wichita, Kans.	360
WHAO	Frederic A. Hill	Savannah, Ga.	360
WHAP	Dewey L. Otta	Decatur, Ill., 659 West Eldorado Street	360
WHAQ	Semmes Motor Co.	Washington, D. C.	360
WHAR	Paramount Radio & Electric Co.	Atlantic City, N. J.	360
WHAS	Courier-Journal and Louisville Times	Louisville, Ky.	360, 485
WHAT	Yale Democrat-Yale Telephone Co.	Yale, Okla.	360
WHAU	Corinth Radio Supply Co.	Corinth, Miss.	360
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAW	Pierce Electrical Co.	Tampa, Fla.	360
WHAX	Holyoke Street Ry. Co.	Holyoke, Mass.	360
WHAY	Huntington Press	Huntington, Ind.	360, 485
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	360
WIAA	Waupaca Civic and Commerce Association	Waupaca, Wis.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	360
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Ocean City Yacht Club	Ocean City, N. J.	360
WIAE	Mrs. Robert E. Zimmerman	Vinton, Iowa	360
WIAF	Gustav A. De Cortin	New Orleans, La., 139 North Alexander Street.	360
WIAG	Matthews Electrical Supply Co.	Birmingham, Ala.	360
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	360
WIAI	Heer Stores Co.	Springfield, Mo.	360
WIAJ	Fox River Valley Radio Supply Co.	Neenah, Wis.	360
WIAK	Journal-Stockman Co.	Omaha, Nebr.	360, 485
WIAL	Standard Service Co.	Norwood, Ohio	360
WIAN	Chronicle & News Publishing Co.	Allentown, Pa.	360
WIAO	School of Engineering of Milwaukee and Wisconsin News.	Milwaukee, Wis.	360
WIAP	Radio Development Corp.	Springfield, Mass.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	360
WIAR	J. A. Rudy & Sons	Paducah, Ky.	360
WIAS	Burlington Hawkeye & Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust and Savings Bank	Le Mars, Iowa	360
WIAV	New York Radio Laboratories	Binghamton, N. Y.	360
WIAW	Saginaw Radio & Electric Co.	Saginaw, Mich.	360
WIAX	Capitol Radio Co. (Paul C. Rohwer)	Lincoln, Nebr.	360
WIAY	Woodward & Lothrop	Washington, D. C.	360
WJAB	American Radio Co.	Lincoln, Nebr.	360
WJAC	Redell Co.	Joplin, Mo.	360
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAE	Texas Radio Syndicate	San Antonio, Texas	360
WJAF	Munsey Press	Munsey, Ind.	360
WJAG	Norfolk Daily News (Huse Publishing Co.)	Norfolk, Nebr.	360
WJAH	Central Park Amusement Co.	Rockford, Ill.	360
WJAJ	Y. M. C. A.	Dayton, Ohio	360
WJAK	White Radio Laboratory	Stockdale, Ohio	360
WJAL	Victor Radio Corp.	Portland, Me.	360
WJAM	D. M. Perham	Cedar Rapids, Iowa	360
WKAA	Republican Times and H. F. Paar	Cedar Rapids, Iowa	360
WKAC	Star Publishing Co.	Lincoln, Nebr.	360
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360

Commercial land stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours.	Station controlled by—
Chicago, Ill.[1]	WQX	140	PR(FX)	X	Walter A. Kuehl.
Kanatak, Alaska[2]	KGC	300, 525, *600*, 1625	PR(FX)	X	Associated Oil Co.
Pittsburgh, Pa.[3]	KQV	*200*, 425	PR(FX)	X	Doubleday-Hill Electric Co.
Port Townsend, Wash.[4]	KRP	300, *600*	PG		Port Townsend Radio Co.

[1] Loc. (approximately) 0.87° 37′ 00″, N. 41° 53′ 00″; range, 50; rates, none.
[2] Loc. (approximately) 0.157° 39′ 30″, N. 57 42′ 00″; range, 300; system, Kilbourne & Clark, 1000; rates, none.
[3] Loc. (approximately) 0.80° 20′ 00″, N. 40° 20′ 00″; range, 200; system, composite, v. t., telephone, and telegraph; rates, none.
[4] Loc. 0.122° 46′ 02″, N. 48° 07′ 01″; range, 300; system, composite, 250; hours, 12 noon to 11 p. m.; rates, ship service, 6 c. per word.

Alphabetically by call signals.

[b = ship station; c = land station.]

Call signal.	Name.	Call signal.	Name.
KGC	Kanatak, Alaska....c	KRP	Port Townsend, Wash....c
KQV	Pittsburgh, Pa....c	WQX	Chicago, Ill....c

Government land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922, and to the International List of Radiotelegraph Stations published by the Berne bureau.]

Station.	Call signal.	Wave lengths.	Service.	Hours	Station controlled by—
Bethel, Alaska	WVI				U. S. Army.
Jupiter, Fla. (RC)[1]	NAQ	800	RC	X	U. S. Navy.
Selfridge Field, Mich. (Mount Clemens).	WVAO				U. S. Army.

[1] Loc. 0.80° 04′ 57″, N. 26° 56′ 59″; range, 150; system, U. S. Navy.

(Continued on page 32.)

Radio Corporation Election

Edward J. Nally, president of the Radio Corporation of America, announces that at a meeting of the Board of Directors of the Radio Corporation of America, held September 8, Mr. Sarnoff was elected Vice President and General Manager of this corporation.

Mr. Sarnoff is probably one of America's youngest executives, being only thirty-two years old. He has been associated with radio for more than sixteen years, and with the Radio Corporation of America since its organization. An early exponent of the modern radio broadcasting idea, Mr. Sarnoff is today considered one of the foremost workers of the radio industry. His activities have been marked by ever increasing achievements as an executive of unusual ability.

At this same meeting, Mr. William Brown was elected to the office of Vice President and General Attorney. Mr. Brown has been connected with the Radio Corporation of America for a number of years, during which time he has handled many of the important legal matters that have been incidental to rapid growth of this organization.

Mr. Nally, who sailed for Europe on September 9, on the Homeric, while abroad will visit England, France, Germany, Holland, Norway, Poland and Sweden.

Mr. Nally states that his company recently concluded contracts with the governments of Poland and Sweden for the building of high-power radio stations to be used for direct duplex radio telegraph service between these countries and the United States, thus adding two additional radio circuits to the five already in successful operation between the United States and foreign countries.

The transocean telegraph traffic of the Radio Corporation, Mr. Nally states, is growing at a very gratifying rate. The world-wide recognition being accorded noteworthy scientific and commercial radio developments in the United States is giving to America a larger sphere in the affairs of international communication.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months.

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Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 19th of month for succeeding month's issue.

HELP WANTED.

HUNDREDS U. S. GOVERNMENT POSITIONS continually open to men—women over 17. $92-$190 month. Quick, steady raise. Paid vacation. No strikes. Steady work. Short hours. Common education sufficient. "Pull" unnecessary. Write immediately for list positions. Franklin Institute, Dept. J 117, Rochester, N. Y.

PUBLICATIONS.

RADIO MANUAL, everything the beginner should know. How to build and operate an inexpensive receiving set. Sixty-four pages, thirty illustrations. Twenty cents. Postpaid. Raydio Publishing Company, Caxton Building, Cleveland, Ohio.

How to Make an Audio Frequency Amplifying Transformer

(Continued from page 30.)

These binding posts may consist of plain brass machine screws and a nut. The connectors are mounted on the hard rubber pieces before the transformer is assembled.

To assemble the transformer, the top screws are first put through the holes in the hard rubber piece on one side, then a bushing placed on each of the screws, then the screws are put through the holes in the frame on one side and then through the frame on the other side. The other two bushings are next slipped over the screws and the other hard rubber terminal strip is placed in position and the whole is fastened together. The screws should not be drawn up too tight, as this might bend the frame out of shape, but it should be held together fairly tight. The finished transformer is shown in Figure 14.

Send $1.00 to Radio Age, 64 Randolph Street, Chicago, and receive this middle-west radio periodical for six months. Regular subscription price is $2.50 a year. Thus you will be getting two months free.

(Continued from page 30.)

Special land stations, alphabetically by names of stations.

[Additions to the List of Radio Stations of the United States, edition of June 30, 1922.]

Station.	Call signal.	Wave lengths.	Station controlled by—
Birmingham, Ala.	5XAG	*200*, 375	Matthews Electrical Supply Co.
Butte, Mont.	7YP	*200*, 375	Butte College of Telegraphy (F. H. Smith).
Corvallis, Oreg.	7YJ	*200*, 375	Oregon Agricultural College, department of physics.
Fort Worth, Texas	5ZAH	*200*, 375	Fort Worth Record.
Do	5ZV	*200*, 375	Fort Worth Star Telegram.
Galesburg, Ill.	9XW	*200*, 250, 375	Lombard College.
Pittsburgh, Pa.	8XY	Variable	West Penn Power Co.
Portland, Oreg.	7XL	250-1650	Northwestern Electric Co.
Raleigh, N. C.	4YC	*200*, 375	North Carolina State College (electrical engineering department).
Reading, Pa.	3XAH	*200*	Donald B. Heilman, 54 South Sixth Street.
Tacoma, Wash.	7YO	*200*, 375	Tacoma City College.
Troy, N. Y.	2XAP	Variable	Rensselaer Polytechnic Institute.

Special land stations, grouped by districts.

Call signal.	District and station.	Call signal.	District and station.
2XAP	Second district Troy, N. Y.		Seventh district:
3XAH	Third district: Reading, Pa.	7XL	Portland, Oreg.
4YC	Fourth district: Raleigh, N. C.	7YJ	Corvallis, Oreg.
	Fifth district:	7YO	Tacoma, Wash.
5XAG	Birmingham, Ala.	7YP	Butte, Mont.
5ZAH	Fort Worth, Tex.	8XY	Eighth district: Pittsburgh, Pa.
5ZV	Do	9XW	Ninth district: Galesburg, Ill.

Alterations and Corrections

Broadcasting stations, by call signals.

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1922.]

KDN (San Francisco, Calif.).—Address Fairmont Hotel.
KQP (Hood River, Oreg.).—W. l., 360 only.
WAAW (Omaha, Nebr.).—W. l., 360, 485.
WBAJ (Toledo, Ohio).—W. l., 360, 485.
WBAV (Columbus, Ohio).—W. l., 360, 485.
WCAD (Canton, N. Y.).—Erroneously given in June Bulletin as Canton, Ohio.
WGV (New Orleans, La.).—W. l., 360, 485.
WSY (Birmingham, Ala.).—Hours, 2:30 p. m. except Sunday and 8 p. m. every day.

Special land stations, by names of stations.

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1922.]

ASHLAND, OHIO (8ZN).—Address 208 Claremont Avenue.
BOULDER, COLO. (9XAQ).—Station operated and controlled by University of Colorado (department of electrical engineering).
CAMBRIDGE, MASS. (1XO).—Address 11 Windsor Street.
CHICAGO, ILL. (9XG).—W. l., *200*, 375; address, 4601 North Central Park Avenue.
DENVER, COLO. (9ZAG).—Address 1124 South University Street.
HAMILTON, OHIO (8XAG).—W. l., *200*, 275, 375; address 325 North B Street.
KANSAS CITY, MO. (9XAB).—W. l., *200*, 500; station operated and controlled by Western Radio Co., 6 West Fourteenth Street.
KANSAS CITY, MO. (9XK).—Address 3525 Walnut Street.
LA CROSSE, WIS. (9ZY).—Address 241 South Seventeenth Street.
LANSING, MICH. (8XM).—Call signal erroneously given as 8ZF in June Bulletin.
LITTLE ROCK, ARK. (5ZL).—Address 1301 Welch Street.
LOS ANGELES, CALIF. (6XAQ).—Address 140 South Oxford Street.
MADISON, WIS. (9XM).—W. l., 375, variable; station operated and controlled by University of Wisconsin (department of physics).
MINNEAPOLIS, MINN. (9XI).—W. l., *200*, 375, 1100, 2000.
NAPA, CALIF. (6ZAD).—*Read* Sunnyvale, Calif., P. O. Box 391.
NEW ORLEANS, LA. (5XH).—Address of owner 131 State Street, Boston, Mass.
OAKLAND, CALIF. (6XAJ).—Address Hotel Oakland.
PARKESBURG, PA. (3XW).—W. l., 375, 2500, variable.
PHILADELPHIA, PA. (3XC).—W. l., 400, 425; address, 2046 Arch Street.
PHILADELPHIA, PA. (3XV).—W. l., *200*, 250, variable; address, 5847 Ellsworth Street.
PORT ARTHUR, TEX. (5XV).—W. l., *200*, 225, 250, variable; station operated and controlled by Louis W. Hatry, 2048 Fifth Street.
PORTLAND, OREG. (7ZB).—Address 555 East Forty-fourth Street North.
PORTLAND, OREG. (7ZT).—Address 967 Vernon Avenue.
SAN FRANCISCO, CALIF. (6XX).—Address 433 California Street.
SOUTH PASADENA, CALIF. (6XAS).—W. l., *200*, 260, variable.
URBANA, ILL. (9XJ).—W. l., 375, variable.
WASHINGTON, D. C. (3XZ).—W. l., 175, *200*, 260, 330; address, 542 Irving Street.

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Compact, High-Class Receiving Set

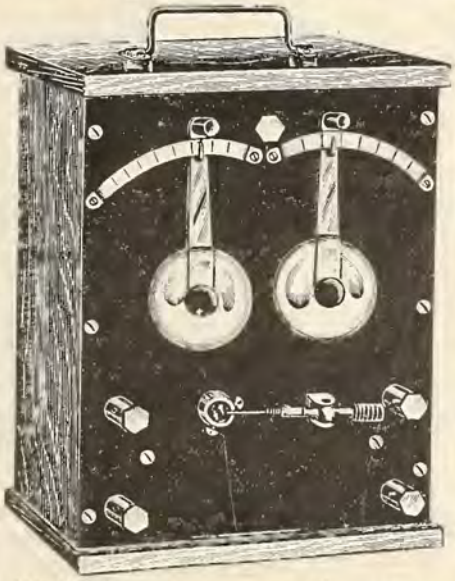
Looks Well and Performs Well

THIS instrument is assembled in a walnut cabinet with a highly polished Bakelite front, all metal parts highly nickeled.

The Crystal Detector is of the very latest pattern, with ball and socket arrangement, so same can be moved up and down, sidewise and forward and back so that the most sensitive point on the Galena can be located.

The Galena retainer is of standard size so that all mounted Galenas will fit it.

The size of the set is as follows: Height, 10 inches; width, 8 inches; depth, 6½ inches.



There are two tuning levers on the front. After locating the most sensitive point of the Galena the two levers are moved back and forth until the best result is obtained.

This receiving set WILL NOT receive messages from great distances but it works perfectly under favorable conditions from 15 to 25 miles away from the broadcasting station.

Each receiving set is guaranteed to be in perfect condition, being thoroughly tested before accepted from the factory.

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