

RADIO AGE

The Magazine of the Hour

MAY
1924

Outdoor Radio Number

How to make portable receivers for motorists and campers.

How to build small, compact sets for the traveling man.

Complete, illustrated article on an ideal vacation outfit.

Radio Age Data Sheets.

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May, 1922

—How to make a simple Crystal Set for \$6.

October, 1922

—How to make a Tube Unit for \$23 to \$37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

September, 1923

—Simple Radio Frequency Receiver.

December, 1923

—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924

—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was announced from stations WJAZ, WOC and WOAW.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924

—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors.
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924

—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

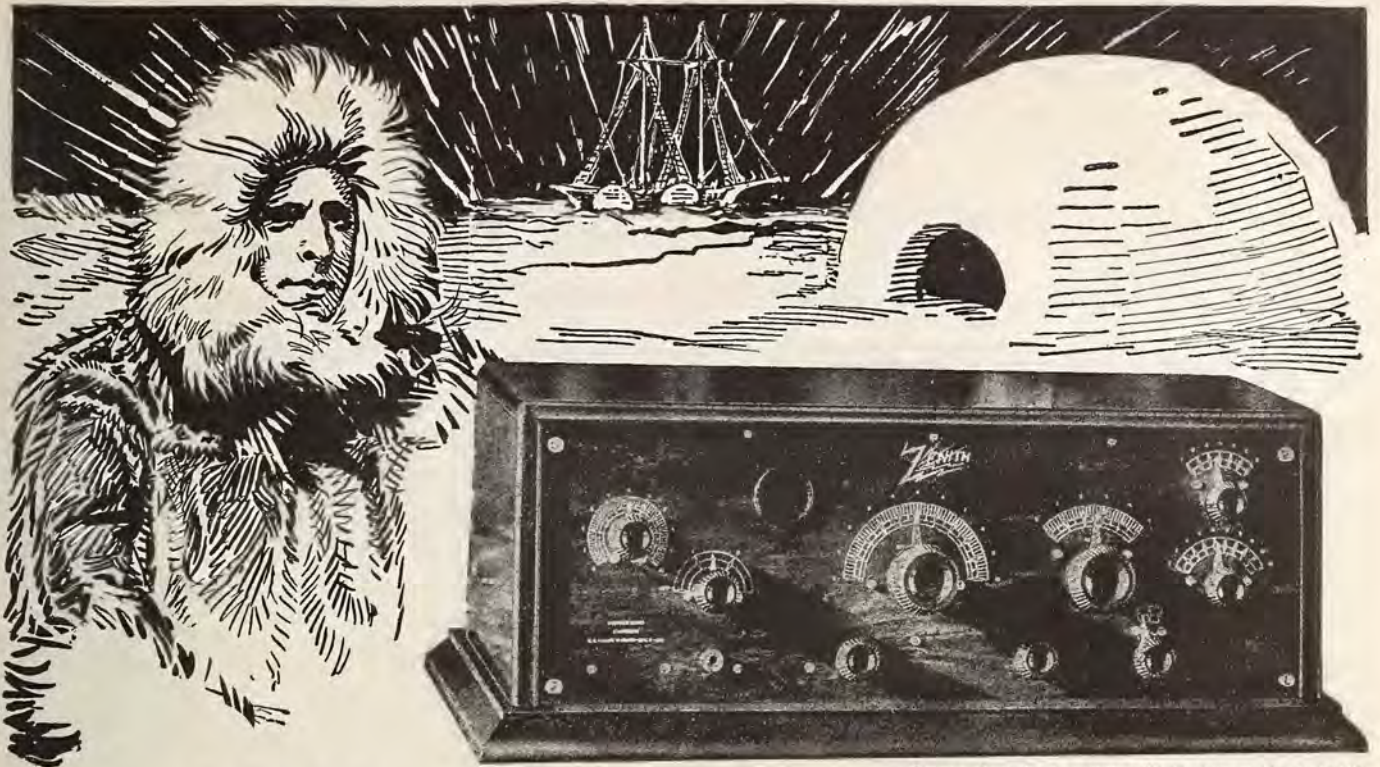
April, 1924

—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hook-ups.
—Radio Frequency Amplification.
—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

RADIO AGE, Inc.

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—"MacMillan"

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—(signed) H. Charles Collier.

The sets used by Captain MacMillan and Mr. Collier are earlier models—since improved by the addition of a *third stage of audio frequency*. These new models, described at the right, represent an achievement in radio construction not duplicated in any other set on the market. A demonstration will convince you.

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RADIO AGE

The Magazine of the Hour

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Volume 3

MAY, 1924

Number 5

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A Chat With the Editor

THIS May issue of RADIO AGE marks the beginning of the magazine's third year. Our first number was published in May, 1922. The thing of which we are most proud in connection with that first issue is the fact that it was a tangible evidence of our faith that radio would grow to immense importance. We believed the public would support a radio periodical which gave accurate, clear instructions on how to build receiving sets and how to operate them.

Now that we have achieved a circulation that has attracted attention of publishers, advertising men, manufacturers and news dealers the country over, we are just as confidently going forward with the purpose of doubling the present figures within the fiscal year. At the rate of increase in the last four months this will not be a difficult or a surprising accomplishment.

This magazine has only one office rule: "Put sufficient value in the book to make radio readers want it, and need it, and when they buy it they will become friends." We recently sent out large numbers of announcements to readers that their subscription terms had expired. In response we got the renewals of a great many subscriptions, together with the assurance from old readers that they would not care to miss a single number.

We have been helped on many occasions by suggestions from readers as to how to improve RADIO AGE. We have accepted the criticisms, whether favorable or adverse, as sure proof of interest in the magazine, and we have tried to adjust the material produced for our pages to the wishes of the readers. It is probable the readers are to be congratulated on the progress of RADIO AGE rather than its editor and publishers. We said the same thing a year ago, and we venture to say you will find the same sentiment in this column in our issue of May, 1925.

Frederick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



Get ready now for summer radio

YOUR radio batteries have served you well and faithfully over the long winter months. Now a great radio summer is at hand. To enjoy summer radio at its best, equip your receiver with the best batteries you can get. Put in new Eveready Radio "B" Batteries and see what wonderful, long-lived service they will give.

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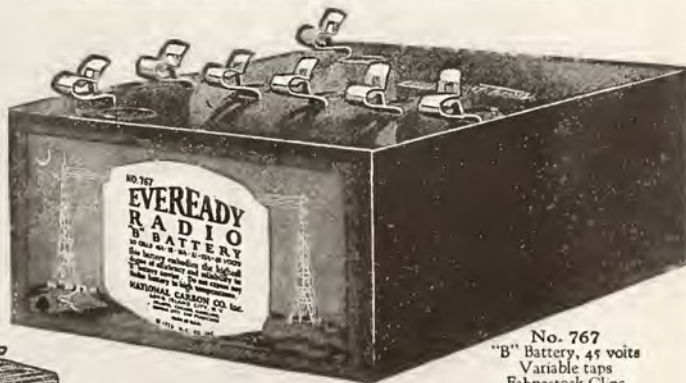
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RADIO AND THE OPEN ROAD

This is to be a radio summer in more ways than one. The picture above shows how two motor-tourists have made a receiver an important part of their roadside camp. Portable sets are easily made or purchased.

RADIO AGE

The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication
Devoted to Practical
Radio

Frederick A. Smith
Editor

The Construction of a Simple Portable Set

By FRANK D. PEARNE

TO THE real live wire radio fan, the value of a good, convenient portable set taken along on the summer vacation is well understood, but there are some who think it might be interesting, but it means an added load of baggage and much fussing around to get it installed in the camp or wherever he may decide to locate. This latter type of fellow doesn't know what he is missing, and as to the extra load he would have to carry he need have no fear, because a perfectly good portable set can be made in such a way that it is hardly any larger than a good sized camera and does not make a bulky package.

It is not necessary to carry any aerial material, or wires of any kind; just the smallest kind of a suitcase about 11 inches square carries the whole thing; and when it is placed in operation all one has to do is to open the case, plug in the phones and listen. Place the phones on the head and carry the case in the hand on a hiking trip, in the boat while fishing, or any other place and the entertainment is always there.

The greatest trouble seems to be in making the other fellow understand how little trouble it is to have the convenience of a radio set with him all the time, and that this is the time when the radio set is appreciated for the reason that he has plenty of time on his hands and can while away much of it lying under a tree and keeping in touch with the outside world, just as well as if he were back in the city. However, once he tries it out, he will never go to the country again without his little companion. The writer must confess that he, too, had this idea of a portable set being a lot of trouble, until one day when Mr. J. V. Steinborn walked into the electrical department of the Lane Technical High School and placed a small sized suitcase on the table, opened it up and plugged in the phones. Three different stations happened to be broadcasting at this time, and any one of the three could be brought in very nicely and the others excluded. Upstairs and down, through halls lined with steel girders, this set was carried and the music and market reports came in anywhere it might be placed, demonstrating that here was an ideal arrangement for the traveler

The circuit, which is a modification of the super-regenerative circuit, has all the peculiarities of the original, with perhaps the exception of the difficulty in tuning which is the most simple part of the set described.

Constructing the Loop

The receiver is operated by a loop aerial, which is entirely within the case, and this is the first part to be constructed. It consists of a flat box-like frame, constructed of four pieces of pine,

silk insulated wire are wound, each turn being separated from the next by a distance of $\frac{1}{8}$ of an inch. The ends of the loop so formed are brought to the inside of the frame by drilling two small holes through one of the flat sides of it, these holes being located near the place where the two adjustable spider web coils are mounted. All of the apparatus shown in the schematic photograph of the outfit is placed inside of this frame.

Next cut out a bakelite panel, which is to be placed over one end of the frame. It should be a little more than 11 inches square, as it should extend just far enough over the edges of the frame to come even with the outside of the winding all around. Now another frame is made to fit over the outside of the loop winding. This may also be made of pine $\frac{1}{2}$ inch thick and 6 inches wide. The length of the four pieces will have to be just right to make a nice snug fit around the panel, and because it is 1 inch wider than the inside frame, it will extend 1 inch over the panel when the other edges are equal. A flat piece of wood, approximately 12 inches square, is placed over the back of the two frames, to form the back of the case. This should also be $\frac{1}{2}$ of an inch thick and should be just large enough to fit even with the outside of the outside frame all around. It is fastened in place with small brass screws, so that it may be removed during the construction of the set. The general construction of these two frames is plainly shown in Figure 4.



FOR TRAVELS

Figure 1. Compact, portable set described by Mr. Pearne in the accompanying article. Miss Lenore Hill carrying the vacation outfit.

each 11 inches long, 5 inches wide and $\frac{3}{8}$ of an inch thick. This frame should be fastened together by setting in dowel pins and glue. No iron nails or tacks should be used. If one does not care to fasten it together this way he may use flat-headed, brass screws, making sure that the heads of the screws are drawn in below the surface of the wood, so that there will be no chance of the wire coming in contact with them. Around the outside of this frame, 20 turns of No. 24 single

The Spider Web Coils

Two spider web coils are necessary. From a piece of $\frac{1}{16}$ -inch sheet fiber, cut out two discs $3\frac{1}{2}$ inches in diameter. Draw a circle 1 inch in diameter in the center of each and cut 17 slots $\frac{1}{16}$ of an inch wide from the outside edge to the edge of the circle, spacing them evenly, by first dividing the outside edge into 17 parts. The first coil is wound in one slot and out the next, until 10 turns have been wound. The other disc is wound with 50 turns, with taps taken off at turns 10, 25, 32, 44, and 50. This is the stationary coil, and the ends of the taps, as well as the final end of the winding, are connected to the switch contacts. The 10 turn coil is wound with No. 28 single silk-covered

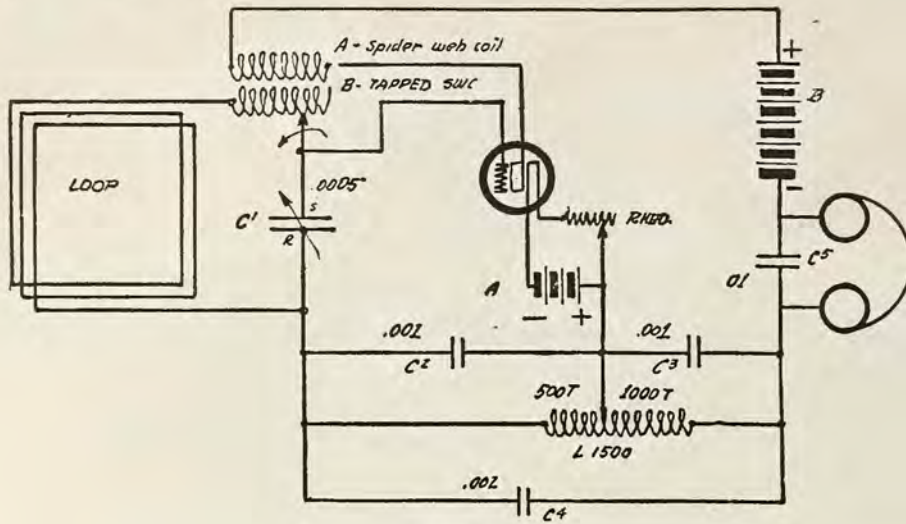


FIGURE 5

The wiring diagram shown above gives the connections for the receiver described by Mr. Pearne in the accompanying article. The set is a very efficient and compact receiver for use by people who travel during the vacation season.

wire and the 50-turn coil is wound with No. 24 single silk-covered wire. The coil containing the taps is mounted stationary in the position shown in the photograph, Figure 3, and the 10-turn coil is mounted on a flexible spring mounting, in such a way that the spring serves to keep it close to the other coil. It is so arranged that a threaded brass bar, which is supplied with a knob, extends through the panel, and as it is moved in and out by turning the screw the small coil will change its position and relative inductive value, with respect to the 50-turn coil.

The movable coil is shown in Figure 3. The 1,500-turn honeycomb coil shown in the cubbyhole below is tapped at a point 500 turns from the inside end, this tap being connected to the junction of the two .001 condensers and the positive terminal of the filament battery as shown in Figure 1. This coil should be mounted at least 5 or 6 inches away from the spider web coils, to prevent any energy being transferred between them. Varying the position of this tap on the honeycomb coil will make considerable difference in the reception, and while it is stated that the tap should be taken off at 500 turns from the inside, one should experiment and find just where it will give the best results. It will, however, be found somewhere near this point, and when once located, the connection is made permanent. The inside end of the honeycomb coil is connected to the variable grid condenser. The other side of this condenser is connected to the switch lever and to the grid binding post on the socket. It is a 23-plate variable condenser. It will be noted that the inside end of the honeycomb coil also connects to one end of the loop, to one of the .001 fixed condensers, and to one side of the .002 fixed condenser. The outside end of this coil is connected to the other side of the .002 fixed condenser, to one side of the .001 condenser, and to one side of the phones. The other side of the phones is connected to the negative side of the "B" battery, the positive side of which connects with the plate binding

post on the socket after passing through the 10-turn spider web coil "A".

The remaining loop aerial terminal is connected to the terminal of the spider web coil "B". The tube used in this set is a UV-199 and the filament current is supplied by a 3-cell flashlight battery. The rheostat should be of the high resistance type, not less than 25 ohms. Because of the low current consumption of the filament in this type of tube, this small battery will operate it continually for a great many hours. The plate battery consists of the smallest type of 22½-volt plate battery, and this, too, has a long life. The fixed condenser C5, which is connected across the phones, is not very critical, as its capacity may be anything between .005 and .01 M.F. In the set constructed by Mr. Steinborn he used a filament control jack, so that the rheostat may be set and left in one position. When the phone plug is removed the current is automatically cut off from the filament.

If, when the set is first connected up, it fails to give the expected results, re-



ARRANGEMENT OF PARTS

Figure 3. Inside of cabinet of portable receiver. This has been thrown together roughly to indicate compact arrangement. The batteries and aerial are self-contained in the small box. Compartment at the left shows how the head phones are stowed away when not in use.



FRONT OF CABINET

Figure 2. The portable receiver, with hinged doors opened to show panel arrangement.

verse the connections to one of the spider web coils, as this is the only chance one has of making a mistake. Solder all connecting wires and see that everything is well insulated, so that there will be no chance for short circuits. A slight whistle is usually present when the set is in operation. This is not pronounced enough to cause any interference, but is an indication that the set is working as it should. The position of the tap on the honeycomb coil will determine the strength of this whistle; it can be made to disappear entirely if the tap is correctly located. In the photograph of the front of the set it will be noticed that a series-parallel switch is shown. This should be eliminated, as it has been found to be of no service whatsoever, and consequently is not shown in the schematic drawing.

While the distance reception is not so marked with the built-in aerial, it will operate a WE10-D loud speaker on local stations. If a loop outside of the set is used it will pick up distant stations very nicely:

As to selectivity, the set was operated at the entrance to the Drake Hotel, Chicago, while their station was broadcasting, and this station was cut out and the other stations brought in without the least trouble. As shown in the photograph, the receiver was not mounted in a suitcase, but merely in a roughly constructed wooden case, as described, but it can just as well be placed in a suitcase if desired. Ample room for mounting all the parts will be found inside the frame.

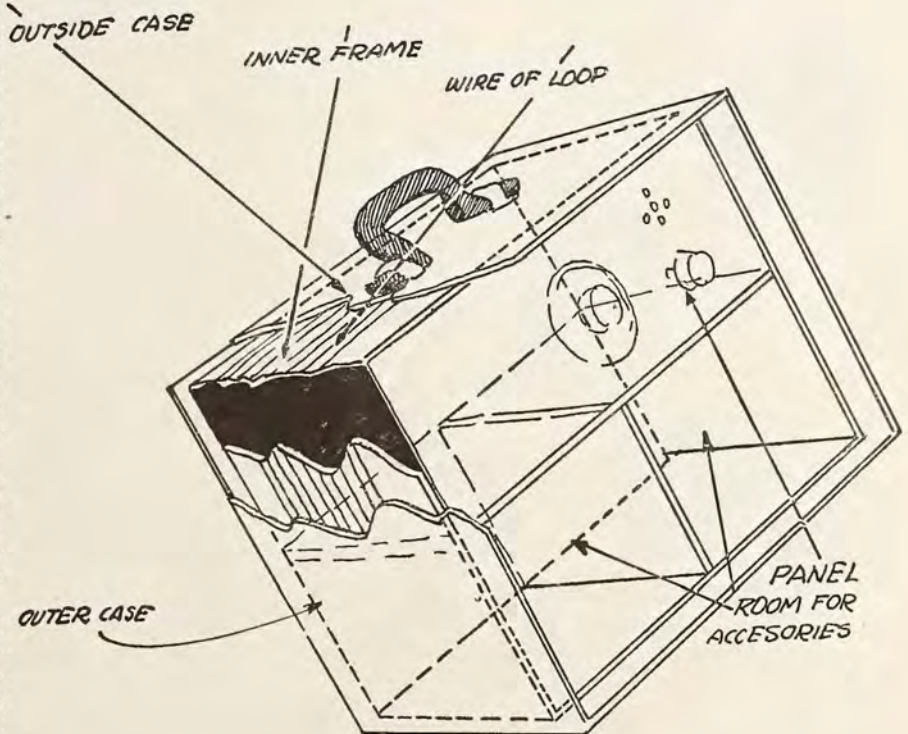


FIGURE 4

A small sketch showing how the various parts of the set are arranged into the cabinet. The loop is wound around the frame, which supports the entire receiver and batteries. This frame is in turn covered by another larger wooden box, which protects the entire set.



You may not believe it BUT—

Robert J. Casey The Vest Pocket Anthologist

And into the marts came one Diogenes with a flash lamp, bewailing with a loud outcry, that one Kunopos had sold to him a boot-leg C battery that had now died the death and that there was no honest man in all Athens, for that matter in the restaurants of the world, whither the men of Athens had betaken themselves. And he paused in his wailing, for two men awaiting the 5:15 to Thermopylae had begun to talk.

their head phones. There is no telling what is in the air——"

The sad voiced young scientist interrupted with no show of impatience.

"The apparatus was fairly simple" he said. "Professor Whatsisname of Newark used a tremendously high voltage to modulate the milk. But basically it was the same trick that is being turned every night in any broadcasting station. The theory of the thing was so sound that I couldn't help telling my friends about it. And there was Mike, you know Mike, who always had a sort of electrical impulse. Mike was convinced right away that this would be a great thing—no milkman, no deposit of 5 cents a bottle with the delicatessen; nothing but milk delivered on a piece of clean wire. He tried it and—well, there's no doubt its going to be a great thing for the cows and everybody."

"He actually worked it?"

"Well, yes and no. You see, he didn't have the high voltage so he thought to run the modulated milk from the filament of the tube to the plate by sending it through the storage battery first. He poured it in to a dry-charged battery and then dumped the electrolyte on top. He broadcast the milk all right, but the results were a bit local."

"But he received it on his set?" The inquirer had become excited.

"That's the peculiar part of it," said the sad faced young scientist. His set is a reflex and the milk got stirred up so going back and forth through the tubes that the loud speaker was full of creamery butter."

Diogenes, the philosopher, waited to hear no more. He threw away his flasher and horned in:

"Say, fellows," he said, "did I ever tell you how I tune out local stations and get Los Angeles on the loud speaker on one tube?"

They didn't listen. They had heard that one before.

IT WAS Ben Hecht, the talented radio engineer, who first undertook to broadcast the story of milk delivery via the ether. He did not make a point about the ether. He was willing to concede that it may have been delivered via the heavy-side layer. But as for the milk he had read in the Scientific Whoosit about a Newark genius who hoped to bring about a radio revolution in the milk business.

"All matter is made up of groups of electrical charges," he quoted from memory. "Positive whatchacallits and negative so-and-sos. These charges are held together by some sort of silly attraction, but they are in a state of constant motion. It doesn't seem to be much of a step to guess that everything in nature has its own vibratory frequency—its fundamental wave length, as it were. Nobody thinks it odd now that sound is split up into segments and transmitted through the air on an electric flash. Already the transmission of pictures—or light—by radio is common enough performance. Why, then, may we not split up other things into their positive whatchacallits and negative so-and-sos and transmit them over a magnetic wave to distant points.

"This man I was reading about has succeeded in broadcasting a quart of milk—"

"Yes," said the literary person who had not followed him. "And I daresay it was very disconcerting for folks in the neighborhood to get an earful of milk out of



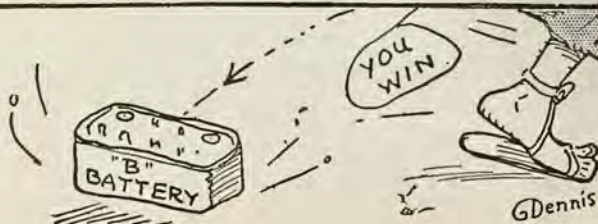
BROADCASTING STATION
C.O.W. CALLING M.O.O.



GIVE YOUR
ORDERS GENTS



POLLY PUT THE
LOUD SPEAKER
ON AND WE'LL
ALL HAVE BUTTER



G Dennis

An Ideal Radio Set for the Summer Camper

Can Also Be Adapted to an Automobile

J. A. CALLANAN

AWAY from the city, when camping in a lonely spot, a radio set affords a pleasurable pastime for the summer evenings. The camper has a decided advantage over the person in the city with its steel buildings, power lines, etc.

Even with an antenna of hasty erection, a ground of doubtful character and a set of mediocre sensitivity the distances received are practically always greater than when in the city. The set used may be equipped with an amplifier and a loud speaker to afford amusement to the entire camping party.

Antenna

The first step is to consider the antenna equipment. A small insulator to serve as a weight and one hundred to one hundred and twenty-five feet of single strand lamp cord is required. This equipment affords a wide variety of uses. The weighted end swung over a tree limb with the other end connected to the set makes a good antenna.

Of course, if no tree is convenient a telegraph or fence post serves, although not quite as effectively. Excellent reception is often obtained by merely winding the cord around the car as near the top as possible.

Ground

The ground equipment consists of a heavy metal rod, pointed at one end, about five feet in length and more lamp cord to serve as a lead with a clip to make

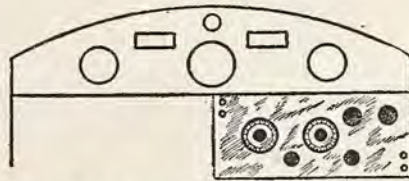
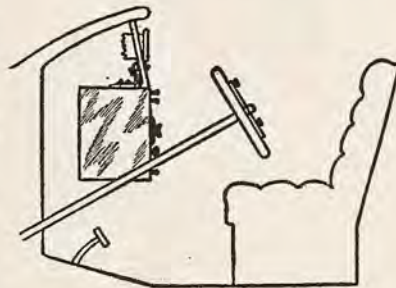


Figure 2. Sketches showing method of mounting receiver under the dash of automobile.

connection with rod as systematic as possible. Many make the mistake of soldering the wire to rod. This soon breaks off through rough usage and the camper finds himself in a poor position to re-solder connection. When camping near a stream the rod can be merely laid in a shallow part, saving the trouble of driving it into the ground.

The Set

Last year found campers using every

conceivable type of set and certainly having their troubles. This season we should be able to profit by those bitter experiences and use a set of simple, yet effective construction. After listening to experiences of last year, two circuits seem to stand out pre-eminently as reliable for camping use.

The De Forest ultra audion and Armstrong single circuit regenerative seem to have performed most consistently, the latter leading slightly because it is more easily adapted to almost any form of antenna. Each has only two tuning controls, is fairly selective and gives good volume.

We recommend the single circuit regenerative set as the most adaptable. The principal source of trouble in it seems to be that some couplers will not reach all wave lengths, unless used with a certain antenna. We suggest securing a ruggedly built coupler, with pig-tail connections on rotor, having between seventy-five and one hundred turns on primary and fifty or more on secondary (rotor). Only one set of switch points is necessary, so if the coupler has two sets of taps merely omit the fine ones.

The tuning condenser, a twenty-three plate vernier variable, should be able to withstand knocks and jars.

Another trouble which we recall is that the tubes were jolted so hard as to break their elements. This makes the new "gang" sockets with rubber suspensions especially desirable as they absorb sudden shocks, preventing damage to the tubes.

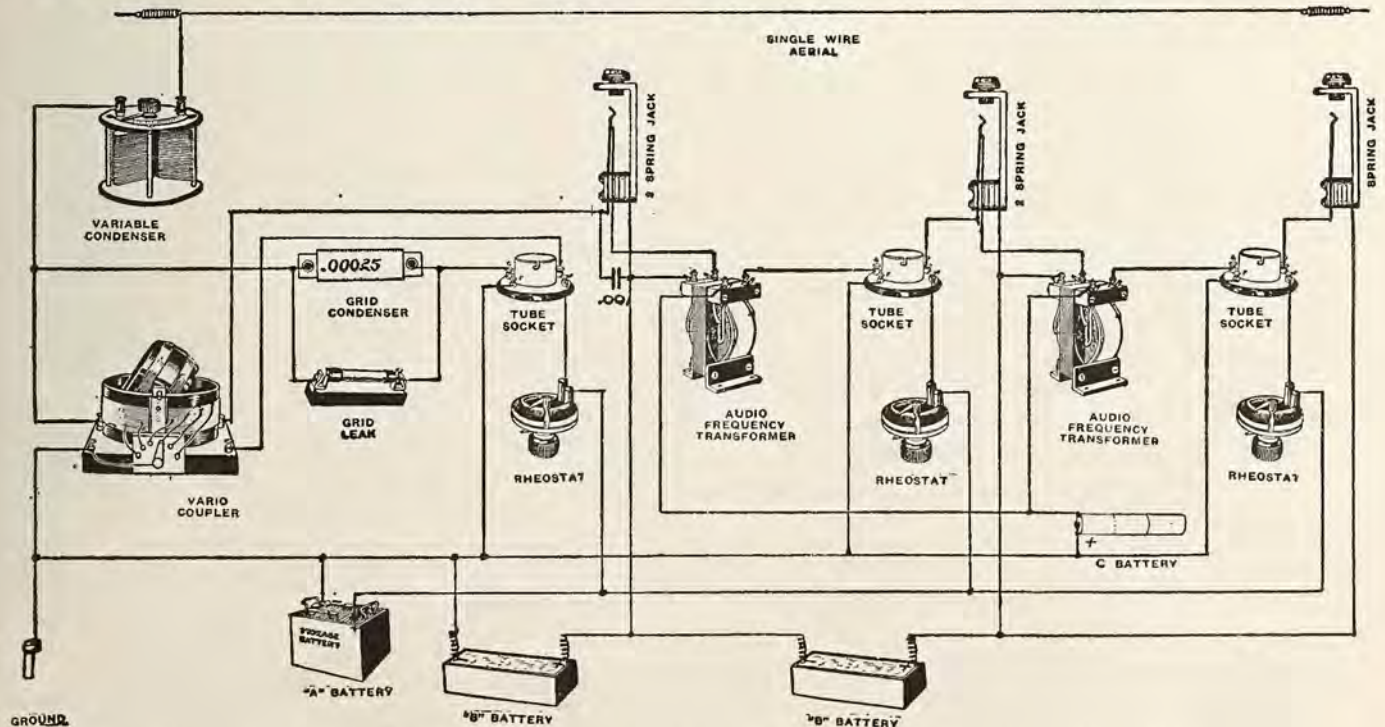


Figure 3. Schematic diagram of circuit used in the portable receiver for campers and motorists

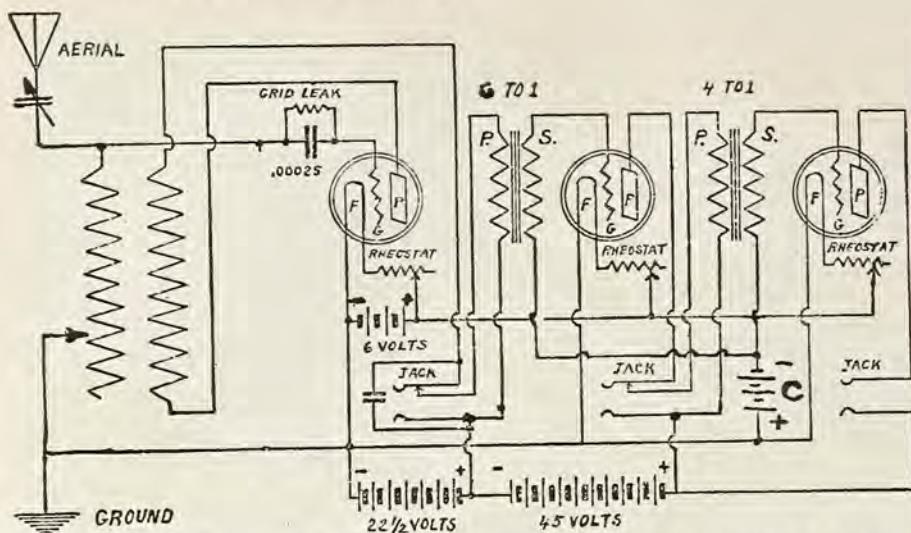


Figure 1. Picture diagram of apparatus for portable receiving set specially designed for campers and motorists.

Panel Layout

The panel layout is very simple as only two tuning controls (the coupler and variable condenser), the rheostats and one set of switch points are mounted on panel. A panel layout is omitted because the camper will no doubt desire to make it fit some part of his car or haversack. The old rule still holds "make leads of fairly heavy wire and run them as direct as possible." The picture diagram will be helpful in laying out circuit.

Installation In a Car

Figure 2 illustrates how the set can be mounted under the instrument or dash board. Two angle brackets will serve to secure set to the board. This method of mounting is generally the best, as it places the set in a convenient position for operation by either the driver or a passenger. It is also advantageous in that it is convenient to the storage battery, which can be used for filament current. On one car we noticed that the "A" battery leads were equipped with a plug which could be inserted in the dash board light socket. Another effective idea, where it is desired to use set both in and out of car, is to use UV199 tubes, tapping the storage battery at four volts for their supply when in car and using three dry cells when set is taken into a hotel, etc. These tubes will not give the volume of the UV201 A's, but for a really portable set seem more suitable. If desired, three stages of amplification can be used to awaken other campers in the vicinity.

Tuning

As there are only two tuning controls and the adjustment of rheostats is not critical, the set becomes quite simple to operate. Adding turns by means of taps and turning in the condenser plates increases the wave length, the opposite decreases it.

Tuning the rotor from a position at right angles to parallel with primary increases regeneration.

If the diagram is followed there will be no body capacity on the set. We would

be pleased to hear of your results upon your return from your summer vacation.

Radio Pays Farmer

Most radio fans find that their radio sets pay dividends in entertainment and instruction, but the farmer who tunes in WGY and other stations sending out produce market reports is in a preferred position. The farmer, on occasion, may turn radio market information into cash and make such information pay him dividends on his set. One such farmer is reported by F. R. Cozzens, of Roxbury, Ohio, in the Southern Ruralist, recently.

John Weldon, a farmer of my vicinity, recently got a tip from the air which yielded him \$19.60. The "tip" was an unexpected raise in the live stock market, coming at a time when Weldon was preparing to sell a shipment of hogs to a local buyer.

As a result, he got in touch with the city market and \$19.60 was his profit over the local buyer's quotations, after all shipping expenses were paid.

This was not a streak of luck, however, for Weldon gets such tips frequently, and they are a part of his plan for making his radio pay its way.

"When I installed my outfit in 1922, I determined to get something from the air besides music," Weldon told me, recently. "I could receive reports from two large city markets and a number of smaller ones, and to keep tab on these I bought a ledger.

"At the top of each blank page I wrote down the city where the market was located and names of the principal dealers therein, with their addresses. This book is kept on the table where the radio is located, and when I have something to market I get in touch with one of these cities and write down quotations as I receive them. Then I 'tune-in' for another city, and get their prices. Afterward, I go over these reports and compare them.

"It is a simple matter then to estimate distance, shipping cost and so forth, and from this I can select my market.

"Dealers in these cities are aware of

my method and I have made arrangements with them by letter to accommodate my shipments at any time. This not only applies to live stock, but to poultry, eggs and butter. The latter articles are shipped by parcel post the morning after the quotations are received.

"I have a wide range of markets to select from, where formerly I was compelled to depend upon a local buyer's quotations, or those in the newspaper, which were always two days late.

"And the radio offers another advantage: By getting weather reports and crop conditions from different parts of the country I can guess pretty accurately the trend of the market.

"From the news reports I learn beforehand about railroad strikes, freight tie-ups, grain pools, and many other conditions which are likely to affect the price of products grown upon my farm. I have a ledger filled with information of this sort, and it has become a habit with me to keep it open for new 'tips' whenever an evening's program is broadcast.

"It is not difficult to make a radio pay dividends when rightly handled, and scarcely a week passes without my outfit yielding me something of value."

Beacon to Guide Ferry Boats

The crossed coil radio beacon developed at the Bureau of Standards has been suggested as a means of guiding ferry boats across San Francisco Bay in foggy weather, and the bureau believes it will prove very useful for that purpose. This type of beacon marks out a line in the ether and a boat equipped with an ordinary receiving set can tell whether or not she is on that line, and to which side she is off.

The San Francisco ferry boats traverse a distance of three and a half miles and carry a very large proportion of the city's commuting population as well as all through passengers from the east and north. At times the fog is so thick that one end of the boat can scarcely be seen from the other, and strong tidal currents are encountered.

The crossed coil beacon consists of two coil antennas crossing each other at an angle of 135 degrees. A coil antenna gives its loudest signal in the plane of the coil and its weakest signal in a line perpendicular to that plane. On a line bisecting the 135 degree angle the signals from the two coils would be of equal intensity, while if the receiving set is moved to either side the signal from one coil becomes louder than the other. The coils are connected alternately to the sending set and one of the two signal letters is sent over each coil. The operation is automatic, the letters alternating rapidly.

The RADIO AGE data sheets printed on pages 37 and 39 should be carefully filed away as described in the preceding issue.

In a comparatively short time these sheets will represent a world of valuable information and reference.

Don't fail to save them.

For Traveling Men Only

By FELIX ANDERSON

THIS story is for traveling men only—if you're not a traveling man, don't dare to read another word further!

All right, Mr. Traveling Man, let's proceed.

This issue of RADIO AGE seems to be featuring portable receivers for motorists, campers, tourists and all other non-essential travelers—and it comes to the notice of the writer that probably the greatest travelers of the beaten paths, the nomadic salesmen, are being neglected.

The writer has had the opportunity to travel on various journeys, and can appreciate being stowed away in some town where a hotel, general store and post-office form the business district. Yea, verily, we all agree that the life of a traveling man, while it has its compensations, it has also its tribulations, and about the worst one the writer can think of is to get hung up in Snake Center or Banana Hills for a day or two until the only means of transit or escape finally decides to pay what seems to be a semi-annual visit. Usually these sentiments can be expressed in the following words, addressed to some fellow sufferer on the train:

"Wotta place; wotta place!"

Don't be alarmed and think that we've invented some new plan on how to round up your sales. What we've got is a plan that will make that time you spend waiting around a little town seem too short altogether. It even makes you want to sit up nights.

Consider the possibilities—now wait until we start over again.

A tip from us—take a radio set along with you! What could be more simple and enjoyable than to sit in some village hotel with a pair of phones clamped on your bean listening to a dandy review coming from a nice big theater in your favorite town VIA RADIO! Never thought it possible, did you? Neither did we until some one put us wise to the idea—FOR TRAVELING MEN ONLY!

We know only too well the arguments against the radio end of the thing—you don't want to drag a box about the size of a trunk around with you, and it's too much trouble to bother with if it's going to cost too much.

The Set

If you think you can convince yourself that it is worth while to carry a small box about the same size as your sample case (if not smaller), which will make those long, dreary, lonesome evenings seem about ten minutes, read on.

Materials Needed

First of all (if you're sold on the proposition), drop down to the handiest radio store and get the following apparatus:

- 1 variometer—split type.
- 1 23-plate variable condenser, with vernier.

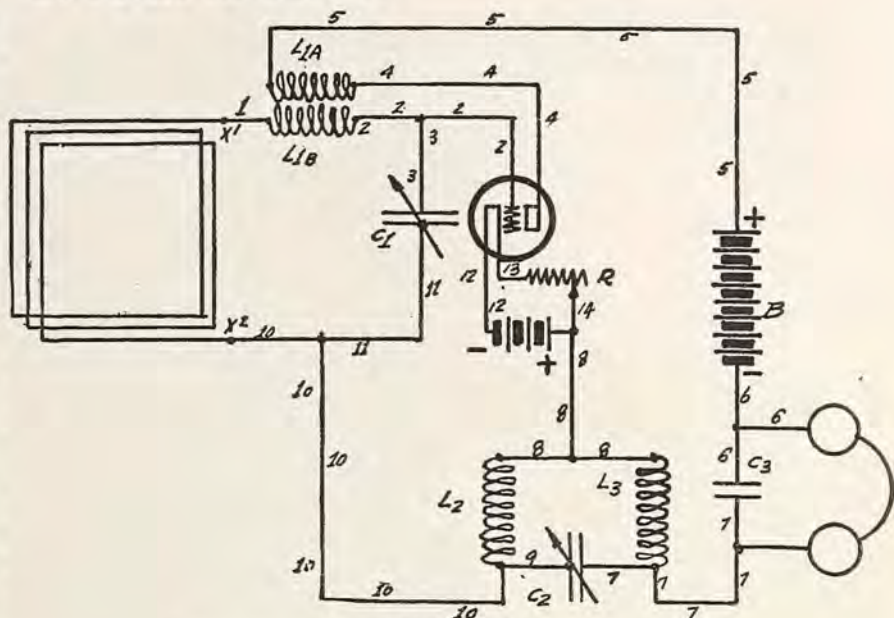


FIGURE 2
The wiring diagram of the Traveling Men's receiver.

- 1 43-plate variable condenser.
 - 1 tube socket.
 - 1 vernier rheostat.
 - 1 1250 turn honeycomb coil, unmounted.
 - 1 1500 turn honeycomb coil, unmounted.
 - 1 piece of tubing to mount coils.
 - 1 .002 fixed condenser.
 - 4 binding posts.
 - 20 feet copper bus bar connecting wire.
 - 1 lb. bell wire.
 - 1 cabinet.
 - 1 panel.
 - 1 pair phones.
 - 1 45 volt B battery (small size).
 - 1 UV199 tube.
 - 1 filament battery for UV199.
- Screws and other junk from the old hell box in the basement.

Construction

First of all, a slide should be arranged in the cabinet so as to allow you to raise the mounting board high enough to put the batteries under the apparatus. A glance at Figure 1 shows what we mean, the mounting board raised enough inside of the cabinet to allow room for the batteries.

Move the panel supporting bevels far enough back into the cabinet so that you can put a wooden, leather or canvas front on the receiver without touching the knobs; the panel of the set should be set back far enough into the cabinet to permit this. If you don't feel equal to the job, a cabinet maker will do it reasonably to your specifications.

Drill the panel and mount the assortment of apparatus you have collected in

the manner shown in the accompanying sketch. We won't give template instructions, due to the fact that you will probably buy apparatus which can be obtained in your locality, and the mounting arrangement will probably vary in accordance with your own individual taste. Outside of keeping the leads reasonably short, the layout shown does not necessarily have to be followed.

Wire the set according to the diagram shown in Figure 2, which has the wires numbered to correspond with the sketch wires for your convenience.

Now check over the whole business.

Operation

If possible, your initial test should be carried out near some broadcasting station.

Wind the pound of bell wire on the outside of a suitcase (should be empty if possible) and connect the terminals to X1 and X2. Now turn up the tube near maximum. Set C1 at 0 and turn the rotor on the variometer to an angle of about 60 degrees. With the phones on your head, set C2 all the way in. Cut C1 in slowly until in connection with the variometer the sound like escaping steam is heard loudest. Now vary C1 until a whistle is heard, and clear up the signal with C2 and the variometer. It is often necessary to give the filament rheostat a twist to accomplish clearest reception.

It will probably take a little patience to get this tuning procedure down pat (but salesmen and traveling men must have patience) and to get the maximum results.

(Continued on page 14)

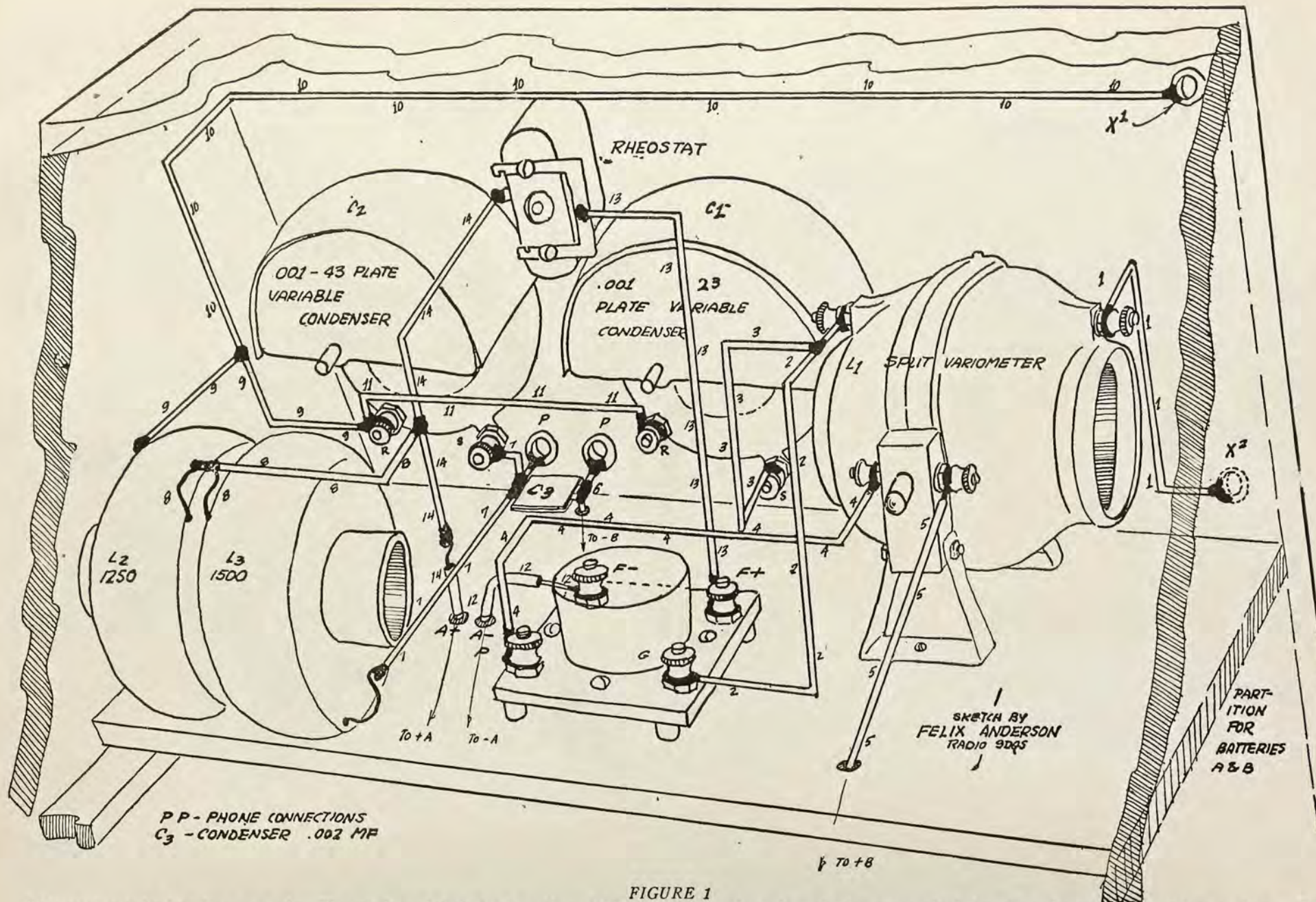


FIGURE 1

This receiver is for traveling men only. The set shown is built into a cabinet, holding the receiver, batteries and other accessories below the main part of the receiver as shown. The panel should be set back into the cabinet to allow the panel to be shielded by a leather or wooden front. The mounting board is arranged on two slides, to permit the batteries and phones to be placed below as shown. The numbered wires correspond to those shown in Figure 2.

Radio Panels

By JOHN B. RATHBUN

VERY few amateurs or even experienced radio set builders give the panel the attention that it deserves, and while it forms the backbone of the receiver yet the many important factors which enter into its selection and handling are generally neglected. Its very simplicity obscures its real importance to the proper working of the circuit, and as a result many troubles that are ordinarily charged up to the variable condensers, tubes and tuning inductances can be traced directly back to the panel due to leakage or static accumulations on its surface. The primary purpose of the panel is to provide a support of high insulating value for the apparatus mounted on its surface, hence it is evident that any defect in this insulation will immediately reduce the efficiency of the circuit or cause troublesome noises.

Radio frequency currents, however low their potential may be, are very leaky propositions and pass readily through materials that would ordinarily be high grade insulation against direct currents or low frequency commercial alternating currents. Pencil marks, surface dampness, dust, decomposed oil or even finger prints often serve as excellent conductors for radio frequency currents which may cause short circuits or grounds between adjacent metal current carrying parts. Organic matter or metallic dust imbedded within the body of the panel is also frequently the cause of short circuits, and the same applies to carbonized materials after being subjected to high temperatures.

Probably the most important panel materials are the commercial products listed under the "Phenol resin compounds" such as bakelite, Formica, condensite, and similar materials. Next comes hard rubber of which "Radion" is the most prominent example. All of these panel materials are dense materials which will not absorb moisture, and in addition having a considerable mechanical strength are easy to cut and drill. Glass and porcelain are excellent insulators but are impracticable for the radio amateur because of the difficulty met in drilling and cutting such hard and refractory solids. Unless thoroughly dried out in the oven and then impregnated with paraffine at high temperature, wood is out of the question for panels. It is hygroscopic, that is, absorbs moisture, and has a tendency toward warping that often results in trouble. Moisture is the enemy of insulation.

On the other hand, a panel may have too high an insulating value for the proper operation of the set. This may sound paradoxical, but it is true, nevertheless. If the surface insulation is exceedingly high, then static charges will be retained on its surfaces which are likely to make the set noisy or even cause reversed polarities on the tube grid bias. Modern tubes are very sensitive to the slightest electrical charges, and if small patches of static exist over the surface of the panel it is certain that they will have an appreciable effect



Photo by Pictorial Press

'OFT IN THE STILLY NIGHT'

An up-to-date night watchman in London, who has rigged up a portable wireless receiver and listens in while on duty

on the operation of the set. In cold weather, when there is little condensation on the surface, I have often found that rubbing the panel with a woolen cloth would set up static charges which caused a tremendous squealing and howling in the phones. There is no doubt but what noisy operation is often due to the retention of static charges on the surface of the panel.

To make a long matter short, I might say that the ideal panel should have sufficient insulation resistance to prevent the transfer of radio frequency currents across its surface, and yet at the same time should be of such nature that static charges are quickly dissipated. This does not mean that we must necessarily provide a leakage path for the grounding of the static charge. This can be eliminated by roughening the surface of the panel or "graining" it by means of fine sandpaper. The graining of the panel provides a multitude of fine sharp points which discharge the static into the atmosphere and hence without any effect on the insulation of the radio frequency currents. Body capacity shielding on the rear of the panel also rapidly disposes of the static if the shield is thoroughly grounded.

Graining is not only for the sake of appearance. It also has a material effect on the performance. For the best results,

the fine sandpaper should be rubbed back and forth in a direction parallel with the length of the panel while the panel is perfectly dry. After all the shine is removed, the panel can be dusted off and then mineral oil is rubbed in thoroughly to fill the depressions or scratches. Animal or vegetable oils should not be used for this purpose as they decompose rapidly and produce acidulous products which reduce the insulating value. Linseed oil should be particularly avoided, owing to the compounds which are formed by the oxidation of this oil.

With the possible exception of wood, the worst material for a panel is untreated vulcanized fiber. This material not only contains considerable moisture, but also frequently contains fine metal particles imbedded in the mass of the material which will absolutely short circuit radio frequency currents. As an experiment, the writer assembled an Ultra-audion set on a fiber panel using the same condensers, coils and tubes that had proved satisfactory on another set. After completion, the set was tuned in on a strong local station, but without results. Only the faintest indication of music could be heard where ordinarily the volume was nearly great enough to operate a loud speaker.

After trying in every way to tune in without success, the set was placed in a warm oven and was allowed to dry out for six hours. Without any further adjustment, the stations came in with their usual volume, thus proving that the trouble was entirely due to the moisture contained in the fiber panel. After allowing the Ultra to stand around the room for 24 hours, and subjected to the moisture of the air, it was again tuned in but with no better results than in the first experiment. During the 24 hours, the fiber had re-absorbed enough moisture to again completely short circuit the condenser! Drying the fiber and then coating it with shellac and varnish had no effect upon its tendency to absorb moisture. The moisture goes through a varnish coating like water through a sieve.

Layout and Drilling

In laying out the positions of the holes on a panel, it is best to make the layout on a piece of strong manila paper and to avoid marking on the panel itself. The paper template can then be attached to the panel and can be marked through by means of a center punch.

Very frequently trouble is caused by laying out the holes on the panel with a lead-pencil unless the pencil marks are removed after punching the centers. If allowed to remain on the panel, the pencil lines cause a multitude of conducting paths, just like so many grid leaks, and this, of course, results in short circuits and grounds. It is surprising how much current can be carried by a heavy pencil mark and how greatly this will affect the operation of the set. A thorough rubbing with a gasoline saturated rag is the only sure method of



Kadel & Herbert Foto

COMPACT PUSH-PULL

This photo shows the interior of a push-pull amplifier designed and built by Sidney Kasindorf, well known amateur of station 2-ATV. On extreme left is the first audio transformer and tube while on the extreme right is the pair of push-pull transformers mounted close together. The small flashlight batteries shown in the center are used as "C" batteries. Note how simple this layout is (lower photo). Upper photo shows Sidney Kasindorf and the panel arrangement of his push-pull amplifier. Note by the ruler that it is only ten inches long

taking off these marks, and this method can only be employed on the phenol type panels, as gasoline affects the finish of a hard rubber panel.

Deep scratches used for laying out the holes soon fill with dust and dirt and very frequently with fine metallic particles which are worn off from the rheostats or potentiometers. This, of course, results in leakage and grounds, and while not in evidence in the beginning, gradually decreases the signal strength and range. Your attention at this point is called to the great

quantity of metallic dust produced by the continual rubbing of the contact finger on the wire coils of the rheostats. It is often accountable for many cases of gradual declines in signal strength when accumulations form on the various insulations.

In all cases, no matter what the material may be, the panels must be drilled dry without the use of oil or water. If oil is used on the drill it dries out very slowly on the completed panel and has a strong attraction for dust. This dust in combination with the oil may be the cause of short

circuits when the holes are very close together and in any event does not add to the appearance of the job.

After drilling or cutting the panel should be freed from burrs and rough edges to insure that the screws and washers will seat properly when they are screwed up and so that they will not have a tendency toward causing loose connections. Certain insulating materials, particularly the phenol products, are very likely to split if the drill is fed too fast, and they will always flake off on the back of the panel or on the far side if the drill is not run fast enough or is "punched through" the work. A high drill speed and a comparatively low speed are necessary for these panels, and the drill should in all cases be applied to the front face rather than to the back, as the greatest chipping and burring takes place at the point where the drill finally breaks through.

Hard Rubber Panels

Hard rubber panels have many advantages and some disadvantages over the phenol compounds. They drill very easily with a hand drill and are not subject to breakage or burrs on the far face when the drill is fed rapidly. This makes the rubber panel very desirable for hand drilling. They have a high insulating value and are not hygroscopic in the slightest degree.

However, they are likely to "bloom" with age unless properly manufactured and this iridescent bluish glaze which forms on the surfaces of the rubber will in time greatly reduce the insulating value. With modern processes this is not so likely to occur as formerly, but a careful examination should be given to the rubber occasionally to see whether there is any evidence of the bloom. Another bad feature of the rubber panel lies in the fact that it is more easily affected by the heat of the soldering iron than the phenol panels, and that a very hot iron will cause the rubber to shrink around the soldered connection if the soldering iron has been held on this part for too long a time. It is always safest to go over the screws after soldering and tighten them up a second time to make up for the shrinkage.

Traveling Men's Receiver*(Continued from page 11)*

If you get a big room, take the wire and drape it around it from corner to corner and connect it to one of the aperiodic couplers as described in this issue. This will increase the range, but is not always successful when residing in a hotel that is 99 per cent steel. If this fails to get you a signal, connect the one end of the coupler to the bed spring, and the other to a water pipe, and try again. Usually this gets them. As a last resort, carry one of those light socket radio plugs with you (they're very compact), and if the place you're stopping at has electric light, try the lighting system in connection with the coupler just mentioned. We'll bet that you'll get signals then or never. Note: Wooden bed slats won't work

Aperiodic Antenna Coupling

By FELIX ANDERSON

THE term "aperiodic antenna coupling" may seem a bit technical to the average reader, and heretofore may have been classified as one of those mysterious radio terms which should only be used by engineers. Basically it is very simple. The underlying principle is the same as that of the ordinary variocoupler, inasmuch as the system takes advantage of the induction phenomena of transferring energy. It can be easily distinguished from ordinary coupling, due to the fact that there is usually present a connection from some part of the filament circuit to the coupling coil.

By using the term aperiodically coupled antenna, we mean that the aerial is not acting as a part of the tuned circuit of the set, but is merely doing the work of a collector of energy, and is transferring this collected energy to the remainder of the tuned circuit by the action of a coil. In using the system, one merely converts a conductively coupled receiver into a two-circuit or inductively coupled set.

Advantages

The advantage of a system of this kind are many. Primarily, it increases the selectivity of the receiver, a factor which should make it desirable from this standpoint alone. Further, it makes the receiver more stable, because the antenna does not affect the tuning circuit materially, and changes in the aerial system are not so easily transferred to the tuned circuit of the receiver.

The system, when used on sets of the regenerative type, which are prone to oscillate strongly, cuts down the nuisance of squeals inflicted upon neighbors, due to the fact that the low ratio of coupling between the tuning circuit and the antenna circuit is very low, and does not permit the transfer of any great amount of energy. The use of aperiodic coupling does not, however, stop the nuisance entirely; it merely lowers its intensity.

How Coupling Is Done

The installation of this type of tuning is very simple indeed. It merely consists of a coil of a small number of turns placed in inductive relation to the tuning system of the set, its terminals being connected to antenna, ground and filament circuit respectively. A little explanation in the way of reference to the accompanying sketches and diagrams will not be amiss. Referring to the isometric sketch, Figure 1, you will notice that familiar First Tube receiver, designed especially for beginners, and which was described in detail in the October, 1923, RADIO AGE. Originally, the antenna was connected directly to the terminal of the variometer that goes to the plate of the receiving tube.

This connection, while efficient, has the disadvantage of inserting a very high resistance into the tuned circuit—with disastrous affects upon the selectivity of the receiver. Any time you connect the

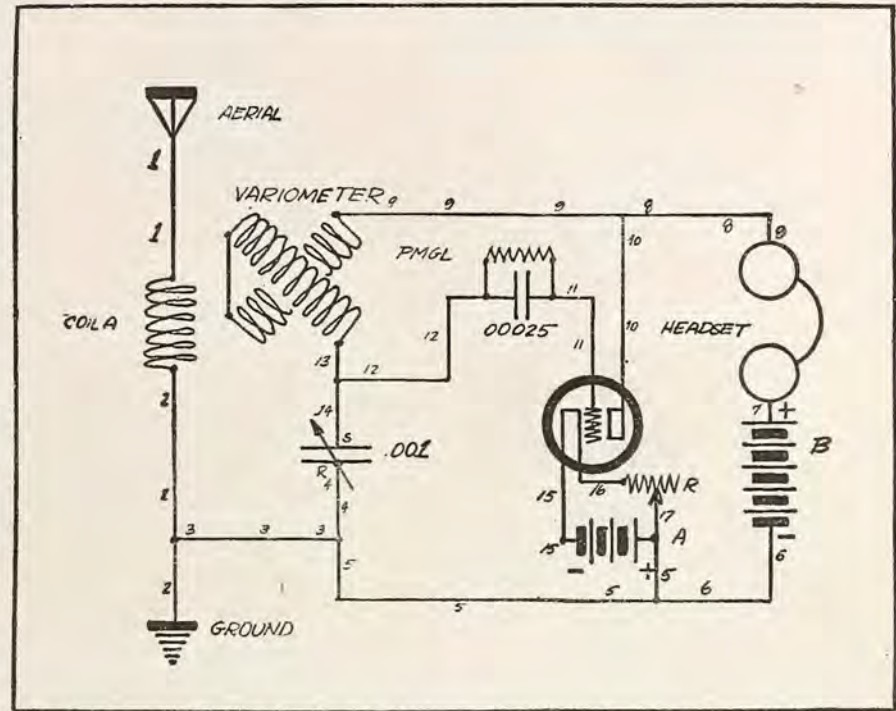


FIGURE 2

The wiring diagram of the First Tube Receiver, illustrated isometrically in Figure 1. The wires as numbered check up with the sketch wires as numbered to correspond.

antenna directly to the tuning circuit of the receiver, you will cause broadened reception, interference, and if the receiver is one of the regenerative type, will transmit energy causing interference. You will probably wonder how this can be avoided. If the connection is not placed there, the set will not work.

The addition of the coil shown wound on wooden pegs (reed can be used) directly on the side of the variometer solves this problem admirably. The signal current collected by the antenna, traveling through the coil sets up a field, which cuts through the windings of the variometer. When the variometer and circuit is tuned to resonance with this incoming signal, the interaction is greatest, and the greatest possible transfer of energy takes place, without having the disadvantage of broadening the tuning of the circuit by inserting the antenna system into the circuit. This action is also only noticed when the coupling coil of the antenna and the winding of the variometer run in the same direction.

Constructing the Set

The construction of the set itself is very simple, and the actual dimensions of the cabinet and panel are not important. However, a 7x12-inch cabinet allows ample room for all the parts, and makes a nice looking receiver. A bill of materials was published in the October, 1923, issue dealing with the construction of the receiver using conductive coupling,

and the only deviation from the original description lies in the variometer, which should be either of the wooden or molded type for the maximum results. If a wooden variometer is used, about 14 turns is made upon pegs, which should be glued into holes. If the antenna used is a short one, the number of turns can be increased to 20 with a slight loss in selectivity, but gain in volume. The winding should be in the same direction as that of the variometer stator, and if the 12-turn combination is used, should be placed as close to the wooden form as possible.

If a molded variometer is used, the arrangement shown in Figure 3 under 1 is effective, and can consist of a cardboard tubing dried and doped, and wound with the required number of turns. This tube should be slipped on, screwed or fastened with sealing wax to the molded form of the variometer as can be best accomplished with the design of the variometer used. It is often possible with certain types of variometers (basket-weave, molded type with smooth outside form and tube type) to wind the aperiodic coil directly over the variometer coils themselves. In this case the smallest number of turns should be used, due to the fact that with the smaller coupling distance between the coils, the smaller number of turns should be used.

The size of wire of the coupling coil is not important, but it is not advisable from an electrical standpoint to use wire

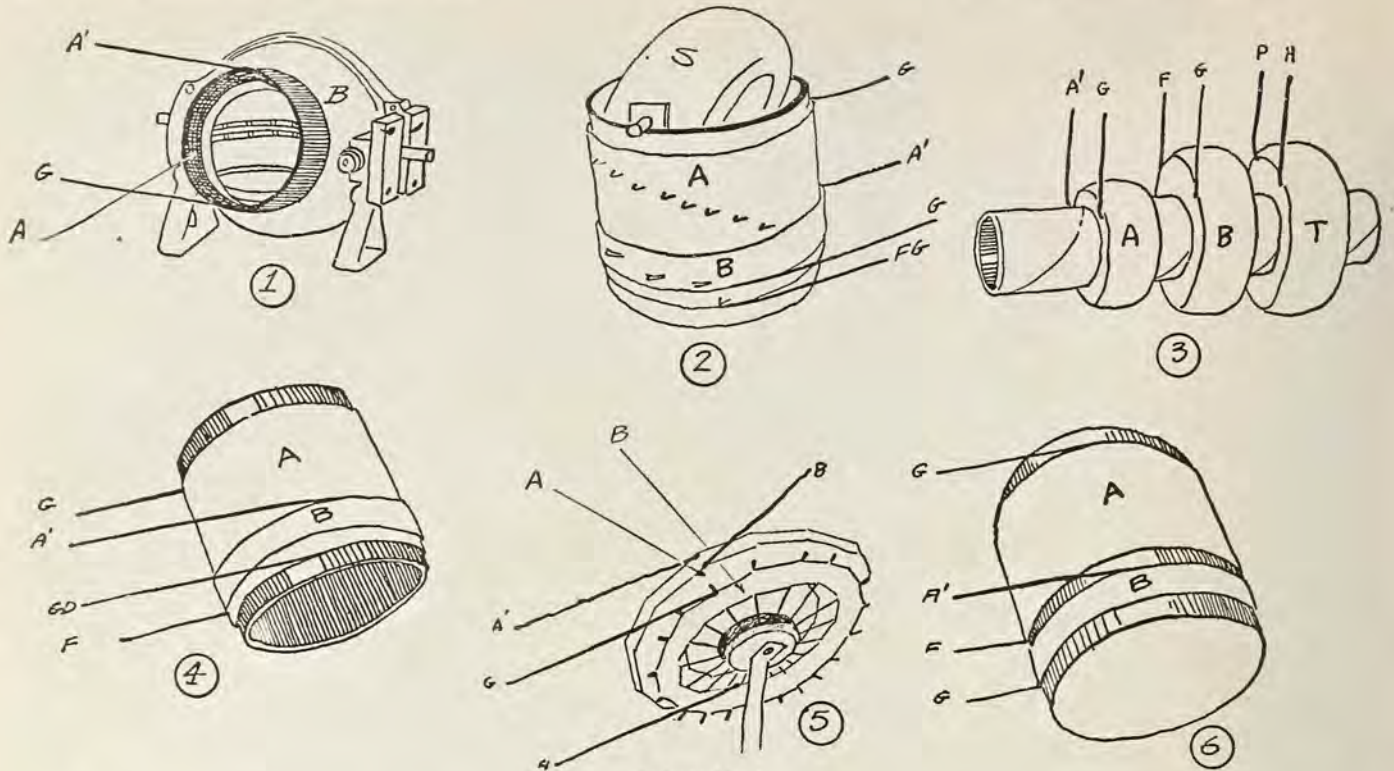


FIGURE 3

The above sketches show different possible permutations, which can be used to obtain aperiodic antenna coupling with simple receivers. (1) shows how to arrange the coil on a moulded variometer, (2) shows the method used on a variocoupler, (3) shows how honeycombs may be used to obtain loose coupling, (4) shows tight-aperiodic antenna coupling, (5) the method used with pancake coils, and (6) the method of looser coupling shown tightly coupled in 4.

not smaller than No. 24, and, personally, the writer prefers No. 18 or 20 double cotton or double silk covered for this purpose.

Single Circuit Receiver

Many users of single circuit regenerative receivers have been complaining of the lack of selectivity of their receivers,

and the addition of a coil of wire as shown in Figure 4 will materially increase the selectivity, reduce the nuisance of squeals and further increase the range due to sharper tuning. The coupling coil should be wound directly over the primary of the variocoupler as shown in Figure 3, illustration 2. It should consist of from 6 to 20 turns of No. 20 wire, double cotton insulated, the number of turns depending upon the size of the antenna as aforementioned. However, for all-around purposes, 15 turns will do nicely. The switch levers of the coupler connect to the grid and filament circuits of the set, and can be used to advantage to tune the circuit, and if difficulty is experienced in tuning the receiver, a 23 plate condenser should be shunted across the switches to help the tuning.

Ultra-Audion Receivers

The ultra-audion receiver, one of the broadest tuning sets now in existence, can be made highly selective by adding an aperiodically coupled antenna coil as illustrated in Figure 5 and Figure 3—sketch 5. The principle is the same as is used for the First Tube Circuit, but the arrangement will vary with the type of coil used. If a honeycomb is used as an inductance, the mounting may be carried out in the manner shown in Figure 3, illustration 3. In this case, there would be no tickler coil present, and only the antenna coil and aperiodic coil would be mounted on the mailing tube. The antenna coupling coil can have about 25 turns, and the space between the two should be varied until the best results are obtained. (Continued on page 18)

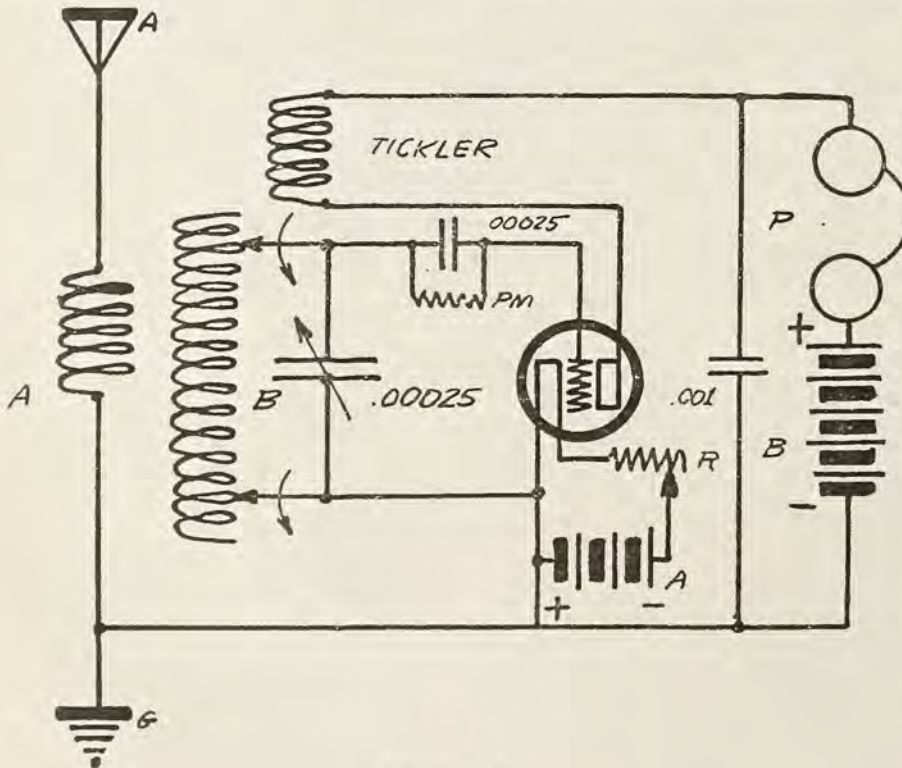


FIGURE 4

The aperiodically coupled single circuit receiver. A condenser of 11 or 23 plates should be connected across the two switch levers for the best possible results

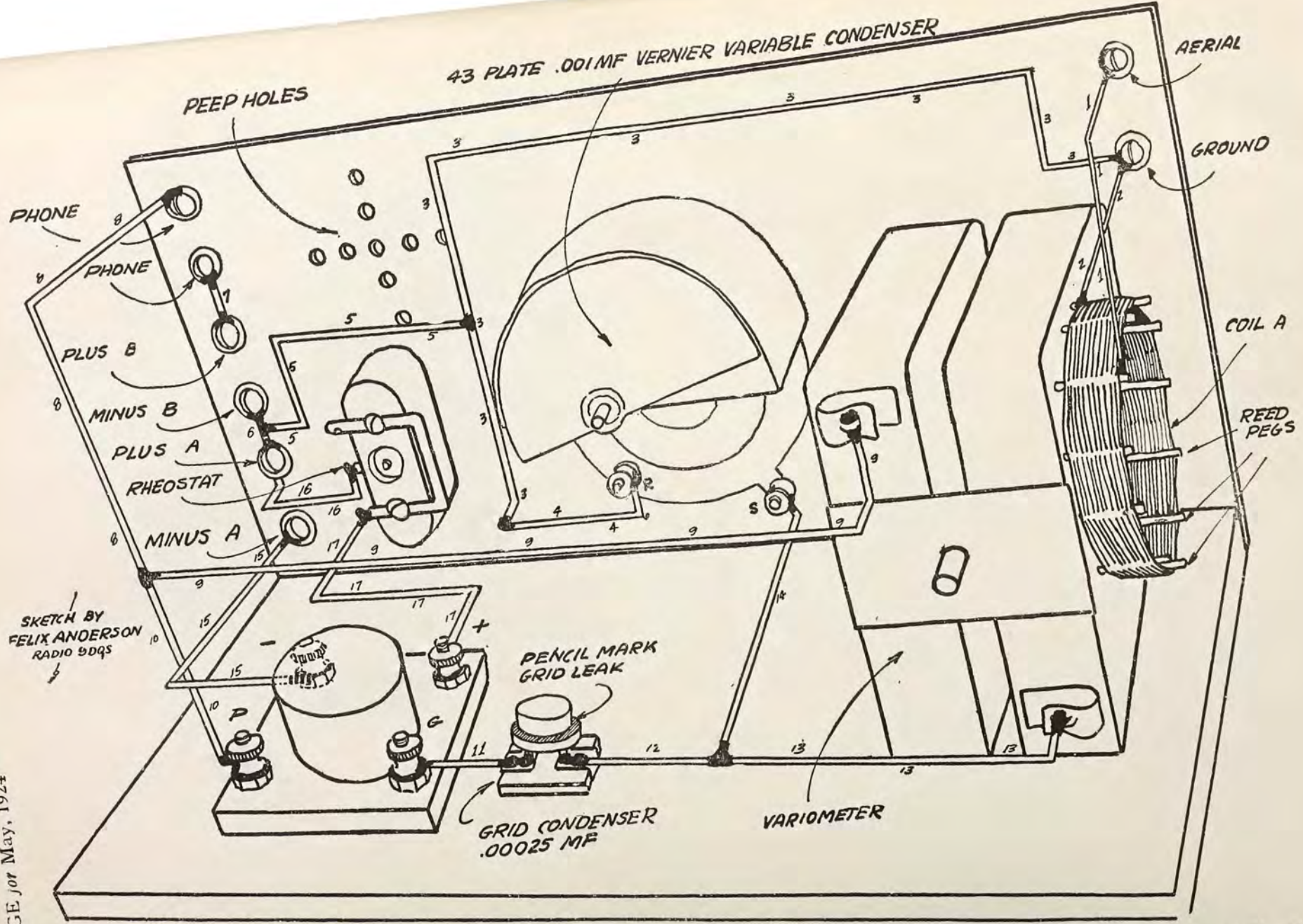


FIGURE 1
The method of loose coupling the First Tube Receiver, as described in the October, 1923, issue, to obtain the highest possible selectivity, the least possible radiation, and to correspond with the wiring diagram shown in Figure 2.

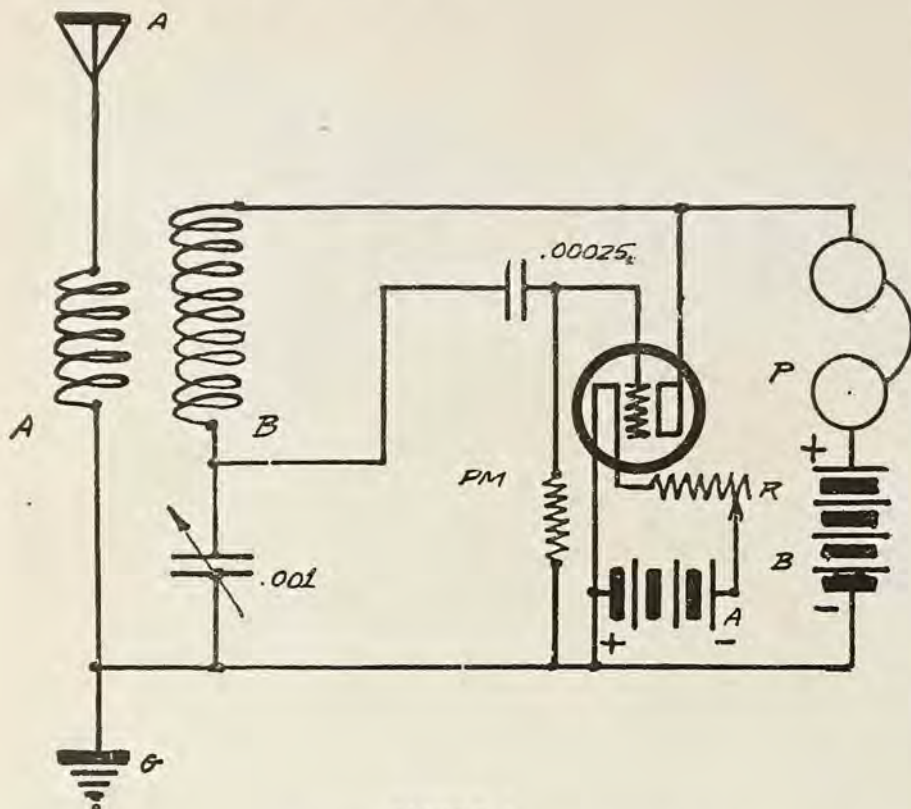


FIGURE 5

The diagram above shows the Ultra-audion receiver as it should be connected when loose antenna coupling is employed.

(Continued from page 16)

Honeycomb

The honeycomb coils are very good mediums for carrying out these ideas, and can be arranged in the manner shown in Figure 3, illustration 3. A circuit diagram for their connections is given under Figure 6. The receiver described in the March, 1924, issue (How to Make a Low Loss Tuner) is basically the same, the difference lying in the manner in which the coil is wound. At any rate, the honeycombs should have the following values: A, 20 turns; B, 50 turns, and T, 55 turns or less. The tickler of the receiver in the March issue (The Low Loss Tuner)

can, by the way, consist of as high as 35 turns, with a gain in efficiency.

Figure 3, illustration 4, shows what is meant by close coupling, and is used in neutrodyne, super-heterodyne and other circuits as a coupler. In this case, coil A should not have more than 8 turns for the greatest possible effectiveness. More turns will broaden the tuning and defeat the purpose of this type of coupler. If more turns are desired for the primary or A coil, the windings should be separated as shown under illustration 6, which provides a space of variable distance between A and coil B. The Wizard \$10 receiver uses this type of coupling. (The Wizard was described in the April, 1924, issue.)

This covers about all methods of coupling as far as sets go with the exception of Figure 3, illustration 5, which shows how the loose coupling idea may be carried out with flat coils. Two circular discs are cut out of bakelite or heavy cardboard or wood, and 15 toothpicks (the number of toothpicks is not important except from a mechanical standpoint) are clamped between these two discs, which are held together by a brass screw. The coupling coil is wound or rather woven on these toothpick supports, and is placed in inductive relation to the main coil of the set as shown. The connections should be made as shown in the circuit of Figure 5.

Just a hurried trial of one of these systems will probably greatly surprise the average reader as to their effectiveness. These suggestions are valuable in cases where a tuning system for a receiver is

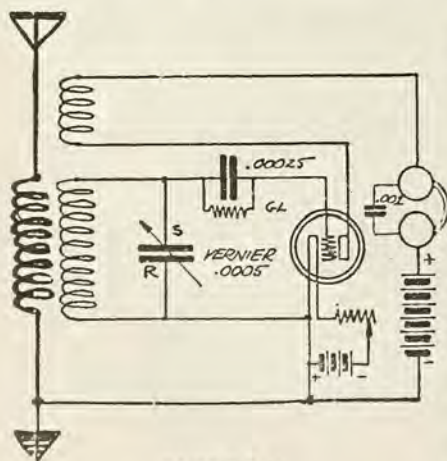


FIGURE 6

A wiring diagram for the honeycomb coils shown in Figure 3, Illustration 3.

necessary with but a few materials at hand. The unit shown under Figure 3, illustrations 4 and 6, are especially handy, as they can be used as wave traps couplers (fixed) and can be used on loop aerial receivers instead of the loop.

The writer will be glad to offer suggestions to interested readers.

Requiescat

THE following letter is sent to us from Mrs. Ada Richardson who says it came from "our boys in Indianapolis" and she wanted RADIO AGE readers to know about it:

Dear Home:

Thought I would write you and tell you about a very sad event which befell us yesterday. To wit:

A great calamity has fallen upon our home, our transformer mourns, and cannot be comforted.

It was only yesterday our tube smiled up to us with sweet and confident reassurance. But long before dawn it passed into that great beyond from which no tube ever returns. We shed a tear for our vanished playmate, and showered curses upon the terrible "B" battery, whose powerful current no self-respecting filament can long withstand.

A strange calm is visited upon our radio. The strains of beautiful music which once poured softly forth from its inmost recesses have died away completely. Even the variometer has become strangely grim and silent.

Our grief is more than we can endure; we are breaking under the strain.

It was vengeance, horrible vengeance, but the "B" battery has been paid in full. No longer can it hold a grudge against us for dropping it downstairs. We pray it shall have no mercy, and may it have to atone to the fullest extent for its destructible sin before it can find peace and everlasting happiness.

I thank you!

Well, it was tough luck and a tube only costs five dollars, so be careful! I have found out that "B" battery doesn't work worth a cent in the filament.

RALPH.



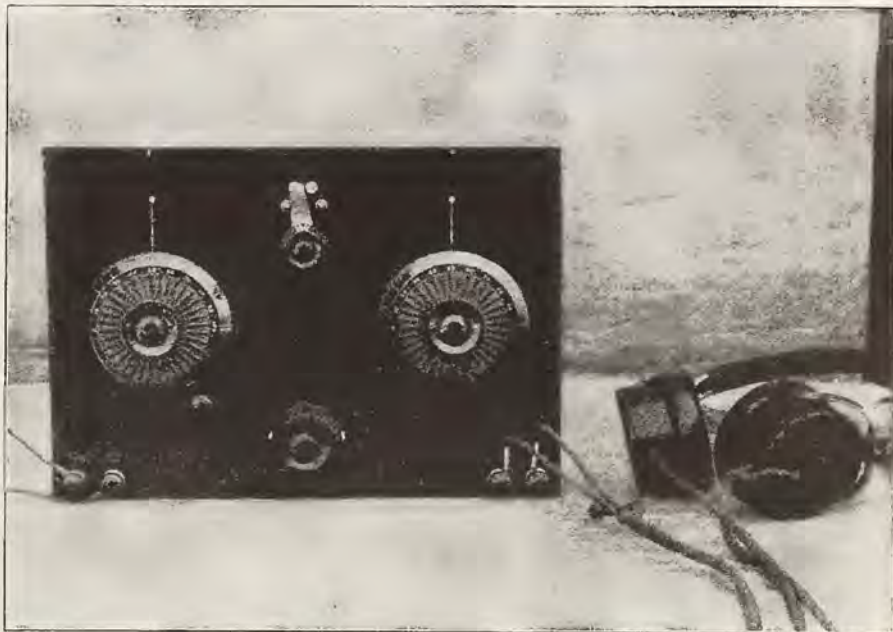
Doubling The Usefulness of Your Condenser

Converted Single Circuit Will Surprise You For Selectiveness and DX

By BRAINARD FOOTE

DESPITE the persistent outcropping of this or that "new circuit" the simplest one of all continues to hold its place as the most popular. This is the single circuit tuner and it is without question the equal of any other one-tube receiver when it comes to distance. Its chief failing is its serious interfering radiation and its annoying lack of selectiveness. Another drawback lies in the large variation of tickler coupling which is requisite on account of the varying absorption by the antenna with varying coupling between set and aerial as controlled by the series condenser.

With all of these objections, its sensitivity and its simple control have maintained it at the head of the list. Lately there have been several substitute tuners advocated in its place, all of them involving the addition of a simple and untuned antenna coupling coil and a modification of the tuning circuit consisting in shunting the variable condenser across the outer coil of the vario-coupler. This plan is highly desirable for several reasons. In the first place, and most important, it gains most remarkable sharpness of tuning without the slightest loss of volume. Next, the removal of the antenna from the tuned circuit removes the absorbing influence of the antenna on regeneration. With fixed coupling between aerial and set, the regeneration control is almost the same for all wave lengths. Then again, the fact that the antenna circuit is not tuned means that the radiation from the set while tuning is a great deal less than before—although still present in some degree, it is true.



PANEL VIEW

Figure 1. Neat design and selective sensitivity marks this coupled circuit tuner. The inductance coil is tapped and the tuning condenser has plenty of "room" between dial settings on low wave lengths.

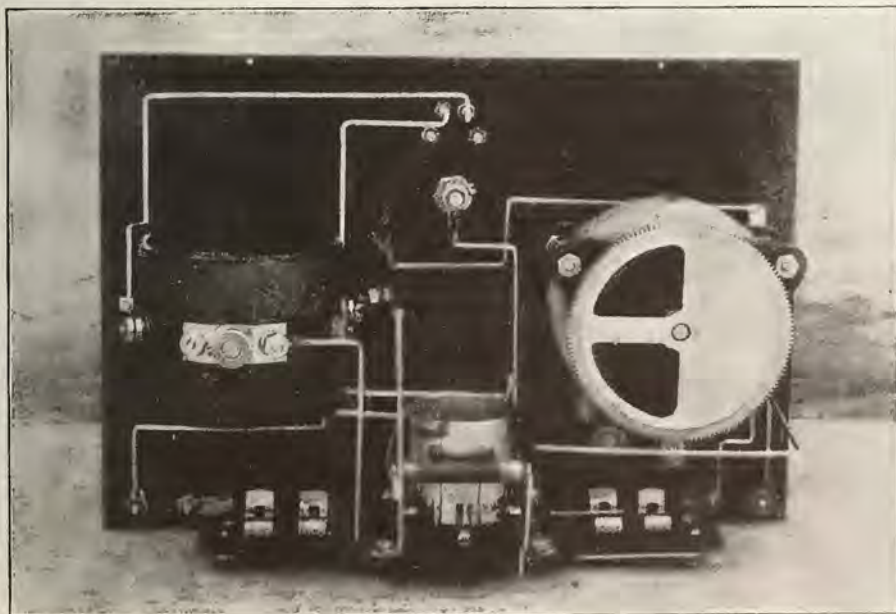
The Two-Range Feature

With all of this great gain, there is one objection which holds not only in the case of this converted coupled circuit receiver, but as a matter of fact in every case where the entire broadcast tuning range is covered by a fixed coil and a vari-

able condenser. While the tuning is easily done on waves about 400 meters, and the stations do not seem to be crowded together seriously, on the lower wave lengths the case is far different. Operators of the Neutrodyne and other tuned R. F. receivers will agree with me when I say that there is not enough latitude in the movement of the variable condenser for low waves. This is due to the fact that the value of inductance is too great for easy tuning on low wave lengths, and because of this that I am suggesting a slight alteration which I know will be of untold benefit to you in your short wave reception—say between 200 and 360 meters.

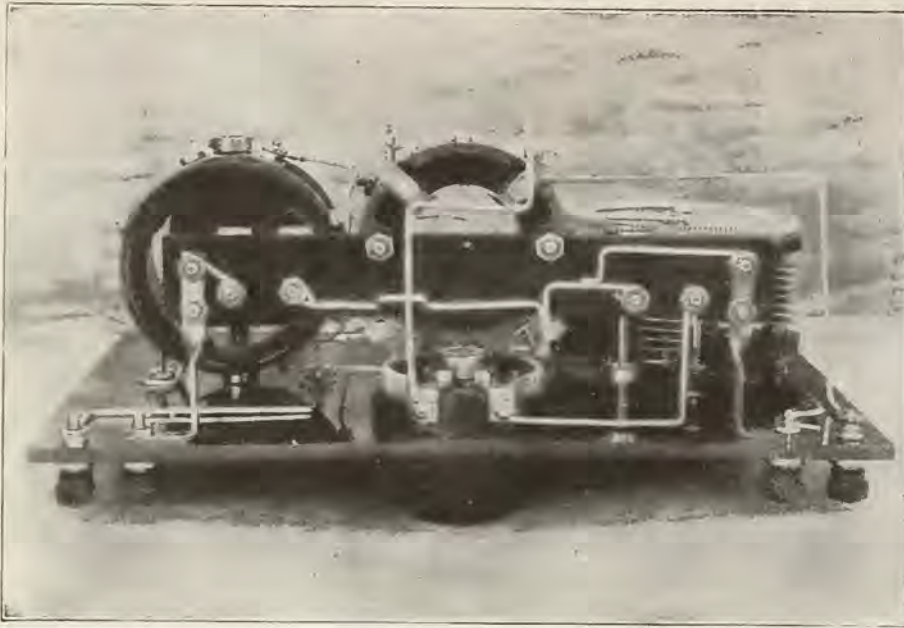
I am going to start off by telling you what can be done with a double range circuit and then to tell you later on how you can either build yourself such a set or modify your own single circuit receiver to give equally pleasing results. Figure 1 gives the panel view of the circuit in question—the three-circuit tuner entailing untuned antenna coupling coil, tuned secondary and tickler for regeneration.

Let us start off first by moving the switch lever to the right, where the entire secondary winding of 80 turns is in shunt to the condenser, the 600-meter commercial stations come in at 85 on the left hand dial. The highest broadcast wave length, 546 meters, is that of KSD, and is tuned in 66. Coming down, we find WWJ at 58, KYW at 62½, WCAP at 44, WJZ at 40, WMAQ at 38½, WOR



ASSEMBLED SET

Figure 2. And it works as well as it looks. You can remodel your old single circuit set in a few moments, or if you'll like to make a new one, here's a suggested arrangement



ANOTHER VIEW

Figure 3. Looking from beneath. See the coupling coil at the left, just inside the vario-coupler? The binding posts you see are as follows: Phones; "B" battery; "A" battery; ground and aerial.

at $27\frac{1}{2}$ and WDAP at 19. Still lower, KDKA comes in at 12. Now, you may say, doesn't that cover pretty well? Yes, you may tune lower than KDKA and hear several low wave stations. But the slightest touch of the vernier of the left hand dial will tune past a weak station so fast that you'll never notice the station at all

The Second Range

At this juncture, let's snap the switch

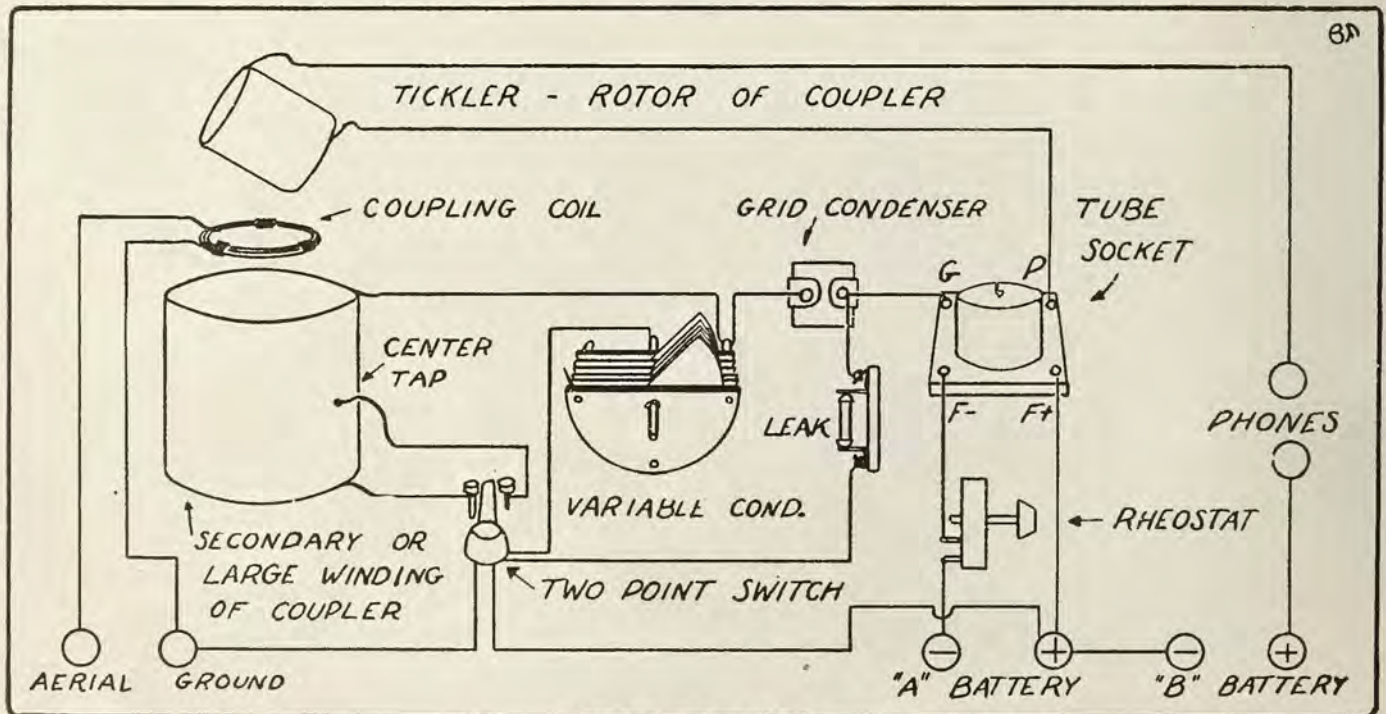
to the left, where only one-half of the vario-coupler winding is in shunt to the condenser. Now a surprise awaits you. On the upper range, WOR and WDAP, for instance, were only $8\frac{1}{2}$ dial degrees apart. How do you think you might easily tune in stations between those two—like WKAQ, WDAR, WGY and the like? But on scale No. 2 WOR comes in at $91\frac{1}{2}$ and WDAP at 68. There are $23\frac{1}{2}$ dial degrees between them now! Think what this means in ease of control!

Now you'll find no trouble in getting WHAS of Louisville, for WHAS comes in at $88\frac{1}{2}$ and WOR tunes in at $91\frac{1}{2}$. Likewise, there is plenty of "room" in between the other stations so that none of them seem to overlap. WTAM, WHAZ and other stations in that neighborhood come through with ease. I am not trying to claim, mind you, that tuning is sharper and that you get less interference on the lower range—but what I do mean is that the dial settings are so thoroughly spread out that you can set the dial at the exactly right position in a jiffy. The other range would do, perhaps, if you had a "vernier of verniers" to control it. But even then you couldn't tell just where the dial was set, because a change of a quarter of a degree would tune a certain station in and out again.

A case in point to illustrate what I mean by ease of control is that of WNAC and WEAN, the Shepard Stores of Boston and Providence, transmitting on wave lengths of 278 and 273 meters respectively. With the ordinary tuner, you'd most likely get both of them at once, or at least hear WNAC and tune right past WEAN without noticing that station at all. Of course, I am assuming that you do not live within local range of those stations and that these are both weak DX stations as far as you are concerned. With range No. 2 of the set illustrated you can tune in WNAC on $26\frac{1}{2}$ and WEAN on $23\frac{1}{2}$, giving three degrees of separation. And right between the two, on $25\frac{1}{2}$, comes WRW of Tarrytown.

A movement of a degree on the main dial is a "cinch" when you have a good vernier control, and there are those stations all within five meters and you can tune any one of them in and out with perfect ease. On the usual type of condenser

(Continued on page 56)



WIRING DIAGRAM

Figure 4. The hookup. The antenna coupling coil is being recognized as superior to either single circuits or double tuned circuits for coupling the antenna to the set. Note the tapped secondary—the "kink" which gives the condenser its double range.

How to Build a Basket Wound Variocoupler and Variometer

By W. E. KESSLER

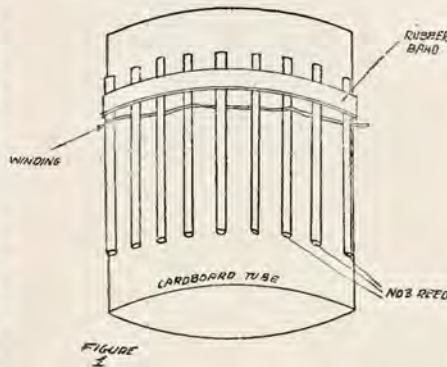
THESE instruments are practically of the self-supporting style, doing away with supporting frames and losses due to masses of dielectric and reducing distributed capacity by basket winding. They are very light and compact, being especially suitable for small portable sets.

Materials needed: About ten feet of No. 3 reed, such as is used for weaving baskets in schools. (If reed cannot be secured, common parlor matches will do for the variocoupler, but because of the necessary curving of the rotor of the variometer reed must be used for this rotor); a rubber band; about a foot of strip brass $\frac{5}{16}$ inches wide by about No. 14 B. & S. gauge; a $\frac{3}{16}$ inch piece of brass tube for a shaft; necessary No. 26 D. S. C. wire for variocoupler and No. 24 D. S. C. wire for variometer; cylinders to wind the coils on. For the coupler one cylinder of $2\frac{3}{4}$ inches in diameter and one of $3\frac{1}{2}$ inches in diameter will be needed. These can easily be made by cutting two discs from heavy cardboard or cigar box board and wrapping very heavy wrapping paper around these discs to make a cylinder.

Cut the reed in 2-inch lengths. For the rotor you will need 20, for the stator 23. Mark well these numbers or the winding will not come out right.

Snap a rubber hand around the larger of the cylinders, then insert one end of the reed under the rubber band, spacing the reeds evenly around the cylinder—see Figure 1. This will hold reeds in place around the cylinder until the winding starts. Now take your No. 26 wire and start winding. Raise the ends of two reeds slightly, slip the wire under these two, then turn the wire over one reed and then under two again. Continue this way until you get the number of turns desired—see Figure 1. I find that 90 turns on the primary and 54 on the secondary the best for a three-tuned circuit. For single circuits you will need fewer turns. When you have wound half the number of turns desired, skip a place $\frac{5}{16}$ inches wide so support for the shaft can be fastened on the reed.

When coil is wound slip off of cylinder and then by catching the windings between the first finger and the thumb (the finger, of course, being between two reeds), squeeze the wires tightly together and tie with a thread. Tie at four or five different places. Cut off all reeds excepting four close to the wire; these four are to hold the leads of the primary and secondary. Dip the coil in melted paraffin and it will become very rigid. Clamp the supports on the reed. The supports are flat strip brass $\frac{5}{16}$ inch wide, bent as illustrated and clamped on the reeds between the two halves of the winding. The shaft is fastened to the rotor by a drop of solder between the brass support



and the brass shaft. Note that because of the spacing of the reeds, the hole for the shaft may not come at a point half way between the ends of the brass strip used for supports—see Figures 2, 3, 4.

Repeat the above procedure, using the smaller cylinder, then insert the shaft, fasten rotor to shaft and the instrument is completed except for the pig tail wire which comes out through the hollow shaft. Two holes should be drilled through the shaft at each end just inside of the brass supports for the stator. Pins inserted in these holes after the instrument is assembled centers the rotor. By providing pins in the brass support for stator the pin in the shaft will engage the pin in support and so form a stop so rotor cannot be turned all the way around. If the shaft is made in two pieces, the ends fastened together inside the rotor by some insulating material, wood will do, all body capacity will be done away with.

By winding the coil without a space in the middle for supports and then placing supports at edge of coil, a 180-degree coupler can be made.

To build a variometer: Use No. 24 wire for this instrument. Make the stator the same as variocoupler, except that 80 turns are used in place of 90.

For the rotor: Wet the reed and wrap around a rod about 1 inch in diameter. Let reed dry on this rod. When taken

off it should spring out to a coil about 3 inches in diameter. If it does not, work it over a cylinder about $3\frac{1}{2}$ inches in diameter while dry. Let it remain there for a while and it should then be about the size desired. Cut this coil into 20 curved lengths 2 inches long. Be very careful and cut all the same length. Now cut a disc from a cigar box board $3\frac{1}{16}$ inches in diameter and cut a hole in the center $2\frac{3}{8}$ inches in diameter. Use some small brads and tack the 20 curved pieces of reed to the edge of this disc. See Figure 5. Do not hammer brads clear in up to the head, as they must be removed later. A $2\frac{3}{8}$ -inch cylinder should be placed through the hole in the disc. If it has been made right the ends of the reeds should just touch this cylinder.

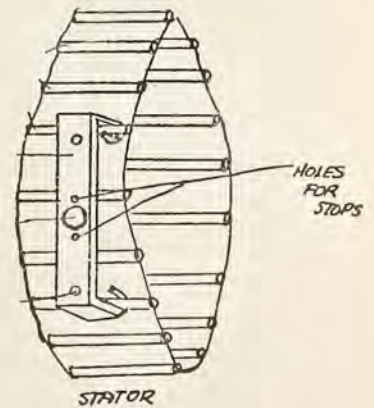
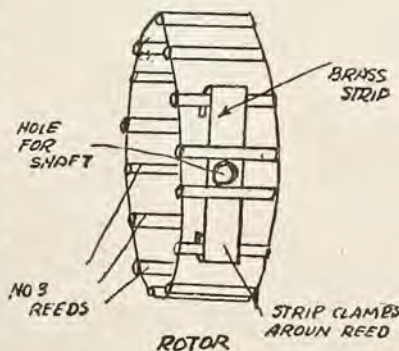
Start $\frac{5}{16}$ inches from the center and wind toward the ends of the reeds that touch the cylinder. Use same kind of winding as for the variocoupler; that is, two under and one over. When both sides have been wound with 40 turns each, 80 turns for the rotor, solder the ends together in the center, dip in hot paraffin, then remove from the cylinder. Pull out the brads and then break the disc so it can be removed.

Make the supports the same as for the variocoupler.

Jefferson Electric Co.

On the first of April, Mr. Paul Green, formerly Advertising Manager for the Cole Manufacturing Company took over the duties of Advertising Manager and Director of Sales Promotion for the Jefferson Electric Manufacturing Company, 426-430 South Green Street, Chicago, Illinois, manufacturers of transformers including a full line of radio transformers and ignition coils.

Mr. Green undertakes this work with a background of more than fifteen years of experience in advertising and merchandising, a very large part of which covered electrical and mechanical lines.



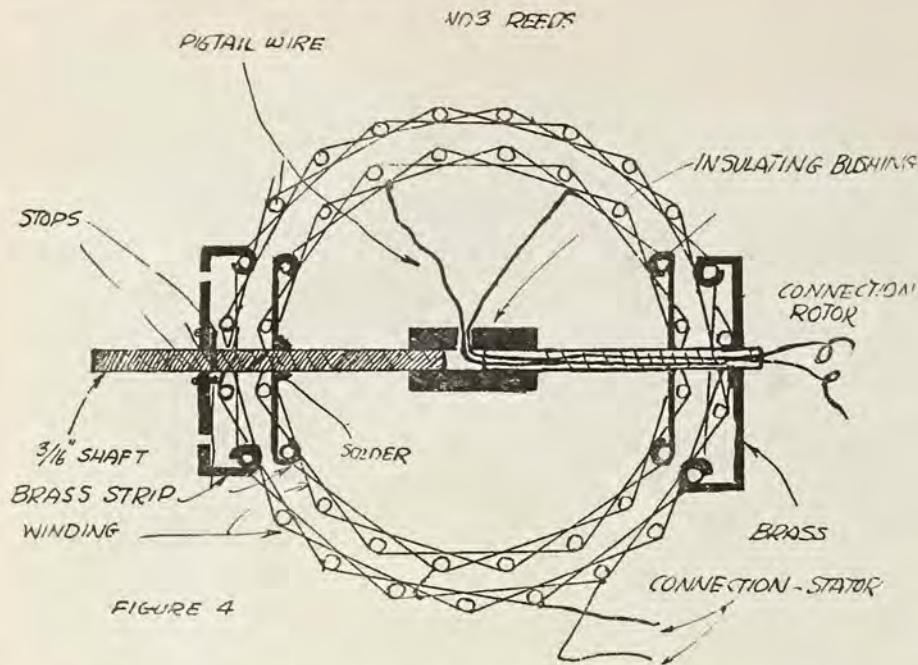


FIGURE 4

How the "SOS" Originated

The origin of the distress call of ships at sea, familiar to all operators and many fans, has caused considerable curiosity, and in order that a complete report could be made, the Bureau of Navigation of the Department of Commerce asked the International Bureau of The Telegraph Union at Berne for a resumé of the origin and history of "SOS."

According to advices just received from M. Etienne, director, the first suggestion of a distress call for ships was made by the Italian delegates to the preliminary conference on wireless telegraphy at Berlin in 1903. They urged the adoption of a universal signal, "SSSDDD," to be sent by ships in distress, explaining that all stations and ships should be obliged to receive the following messages, suspending their other communications and passing immediately to reception. The other delegates agreed to the need for such a signal, but left the final decision to a special conference.

Soon after this suggestion, the Marconi Company recognized the need for a distress call, and on February 1, 1904, the famous call "CQD" was instituted on all their ships by a general order. This signal was a combination of the general call "CQ" coupled with the letter "D," to signify distress. It was used only at the order of the captain of a ship in distress, or a station retransmitting the signal. All stations were to recognize the urgency of the call and make every effort to establish satisfactory communication without delay. The dismissal of operators was to follow the misuse of the call. Several countries, including the United States, adopted "CQD" and used it until the Berlin regulations were ratified.

At the Radio Telegraphic Conference in Berlin in 1906, the German Government

submitted the following suggestion relative to a standard distress call: "Ships in distress will make use of the following special danger signal: (SOS)."

Previously German ships desiring to communicate with all vessels in their proximity without knowing their names of calls would send an inquiry signal, "SOE." Germany planned to suggest this signal as the international signal, but

as the last letter, "E," represented by a single dot, was not believed sufficiently characteristic, being easily susceptible to loss, especially during atmospheric disturbances or in heavy traffic, or when carelessly transmitted, the delegates in 1906 suggested the final letter as "S," thereby having the honor to define what became the universal signal, ". " "SOS."

Interpretations such as "save our souls," "save our ships," given the call, the Berne Bureau points out, should be accepted with reserve. The Italian proverb: "If it is not true, it is well invented," they suggest is applicable to the literal translations offered. In a similar manner, Berne reports, the Marconi signal, "CQD," has been interpreted to mean "come quick danger."

The distress signal, "SOS," was adopted officially and put into effect by the International Radio Telegraphic Convention of Berlin in July, 1908. It was a matter of keen regret to the Marconi operators that their old signal, "CQD," was not adopted, and many continued to send "CQD" as well as "SOS" when accidents occurred. "CQD," however, was gradually forgotten. In 1912 the United States adopted "SOS" when the international agreement was accepted.

The signal today is "SOS" without spaces, the Berne Bureau explains, and should not be sent but

NO 3 REEDS

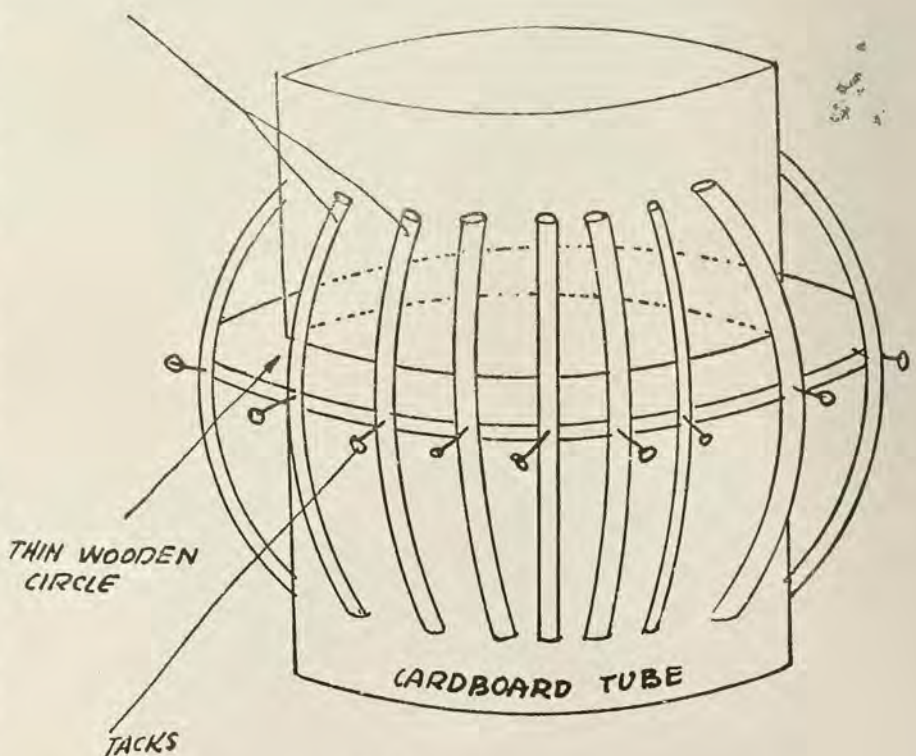


FIGURE 5.

What the Broadcasters are Doing



ON THE AIR—OFF THE STREETS

Boys of today are going to be the radio engineers and experts of the future. The Chicago Boys' Club knows that the little chaps have keen minds and is doing all it can to encourage them in the study of radio. Out of the Radio Department of the Chicago Boys' Club, at Club No. 2, 1725 Orchard St., there is a complete radio laboratory and workshop, where the little fellows are given an opportunity to build and test receiving sets and experiment with various parts. The boy in the picture is a typical Boys' Club enthusiast.

The Dill Bill

The National Association of Broadcasters made a vigorous canvass during April in favor of the bill fathered by Senator Dill in Washington which proposes amendment of the copyright act. The bill proposes that copyrighted music used by broadcasting stations shall be free from

tax by owners of the copyrights. It does not seek further to limit the privileges enjoyed by owners of copyrights under the existing law. In enlisting the aid of the public in pushing this bill along the National Association of Broadcasters sent out a broadside of letters to editors, accompanied by forms containing a protest

against taxation of music, which it requested should be distributed among radio readers with the suggestion that these forms be signed and sent to the senate committee which had the bill under consideration. Broadcast stations which are members of the association also went on the air with the request that telegrams,



HOW THEY MAKE IT REAL

In order to make radio plays more realistic and give the necessary atmosphere the above pictured bell board containing door, telephone, clock alarm and tap bells and also buzzer, all connected to batteries and operated by the pressure of buttons, are all used to produce sound atmosphere in radio drama. Photo shows Edward H. Smith, director of WGY radio station players with apparatus.

letters or post cards be forwarded to Washington in an effort to sway the senators against the taxation view. Almost countless thousands of messages went to Washington as a result. The Congress and the American public are fast awakening to the realization that radio wields a power in reaching the people that no other agency can approach.

Spanish Programs

Programs in Spanish to better entertain the thousands of Central and South Americans and the people of Mexico who nightly obtain their entertainment from KDKA, will be transmitted at intervals

from the world's pioneer station operated by the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa.

New Chicago Station

During the month just passed several new stations were opened. One of these was WES, operated in Chicago by the Sears-Roebuck Agricultural Foundation. The station operates on a wave-length of 345 meters. It is proposed to make the programs from this station of special interest to farmers and one of the first things decided upon in establishing the new center of entertainment and instruction was that all its program features were to be of

the highest class. Edgar L. Bill is director. The Chicago Herald and Examiner is cooperating with the Agricultural Foundation in the production of quality programs.

WJAZ, Chicago, changed its name to WGN and its wave length to 370. The Chicago Tribune made an arrangement with the Zenith-Edgewater Beach Hotel interests whereby it assumes control of programs. The Edgewater Beach Hotel station now has a wave length only ten points above that of WDAP, the Chicago Board of Trade Station. The result of this proximity has caused Chicago fans some grief and it is believed that WDAP's wave length will soon be changed.

Radio Helps Theater

It was announced by the Studebaker Theater, Chicago, on April 5th, that the broadcasting of the play "Abie's Irish Rose" had brought the sales of seats for that performance to such sudden activity that extra help had to be employed to handle the advance business. Many hundreds of men and women who had heard all or part of the farce over the radio and had heard the gales of laughter with which the play was greeted by the audience in the theater, went to the theater in person, telegraphed or wrote, demanding tickets. The management of the playhouse said the rush of business was something unprecedented and that it was due entirely to the broadcasting of the piece.

In view of the fact that there has been some dispute as to whether the broadcasting of opera, musical numbers and plays helps or hinders box office and counter sales, the incident is interesting.

French For Children

As part of the children's hour program beginning at 6:30 every Friday evening, WGY, the Schenectady, N. Y., broadcasting station is offering children's stories in French by Aime Le Blanc. Mr. Le Blanc is a direct descendant of Daniel Le Blanc, who settled in Acadia (Nova Scotia) in 1650 and whose family story is immortalized by Longfellow in the poem "Evangeline."

The introduction of Mr. Le Blanc on the children's program a few weeks ago brought congratulatory telegrams, telephone calls and a great many letters to WGY. Many of them were from French people and others from those who are studying French and who found the stories excellent instruction. French-Canadians were particularly enthusiastic with the new children's feature.

New Providence Station

George Spink, local playwright and theatrical producer, will be entertainment director of WKAP, new broadcasting station in Providence, R. I., which will be opened in the Narragansett boulevard home of Dutée Wilcox Flint. Concerts will be broadcast twice a week. Both classical and popular compositions will be played on Mr. Flint's \$2,200 pipe organ, which will be used not only for solo work but will also be made the basis of the orchestra music on Wednesday and Sunday nights.

RADIOTORIALS

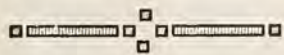
TWO years ago we printed the first issue of RADIO AGE. As an experiment we planned to run off a thousand magazines with which to test public interest in the then very youthful diversion. We asked newsdealers if they could use such a publication and their answer caused us to make that first issue ten thousand, instead of one thousand. Since then we have grown steadily until last month's total issue, if laid one magazine upon the other, would make a pile of paper approximately as high as the tip of the Woolworth Building tower.

With this number we celebrate our second anniversary. We have found radio fans to be pleasant company in these two busy years. They are an earnest, good-natured lot. They have determination and they are thorough. Many of our readers have mastered every circuit from the crystal set up to the multiple-tube receivers and the radio knowledge of the average fan as revealed by canny questions and criticisms is something to be marvelled at.

Only by sitting at the editorial desk and reading the vast volume of correspondence from all parts of the United States and Canada, not to mention the letters from places beyond seas, may one realize how firmly radio has taken hold of the world.

The editor's aerial, which once enjoyed a dignified solitude upon the editorial roof, now has so many companions that when we gaze upon the maze of wire we are reminded of certain places on the West front whence the Germans had withdrawn, leaving their entanglements behind them. In our first issue, May, 1922, we mentioned the fact that there were 600 radio fans in Cincinnati. It was intended as a statement which would prove the popularity of the art. At the present writing the Crosley Radio Corporation in Cincinnati is endeavoring to bring its production of only one of its various types of receivers to a total of 1,000 sets a day! Chicago had one broadcasting station and it now has eight. The boy who was rigging up a coil and a crystal is now building one of the super-sets and is not satisfied with anything less than coast to coast reception.

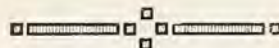
We took the liberty, a year ago, of making a prediction as to the future growth of radio. We were optimists then and so are we on this birthday anniversary. And so are about seven million operators of receiving sets in our forty-eight states. In short, RADIO AGE is glad it was born at about the time broadcasting was beginning. The progress of popularized radio is something worth while having been associated with



MORE and more is radio to lose its seasonal aspects and, like the automobile, it will be a year-round necessity. Early in the life of the industry it was taken for granted that the public would not carry receiving sets with them when they fared forth on summer travels. But the portable out-

fit has changed the situation. Nowadays a radio enthusiast may carry his or her receiver in a compact case and whether the journey is to be by automobile or boat it will be easy to take one's music and other entertainment and enjoy them in camp or at the summer resort hotel or cottage. In this number we offer a variety of suggestions for making and installing receivers particularly adaptable for the outing season. Manufacturers are preparing to supply the demand for compact portable outfits. We predict that the trade will be agreeably surprised at the way radio holds up from now until autumn.

This is to be radio's greatest year. Broadcasting will not be interrupted. On the contrary all stations will be on the alert for best means of responding to the national interest in the approaching election. Sports, as never before, will receive attention of the fans. Many a cigar store and corner pharmacy will have a receiver installed with which to get earliest intelligence as to whether the Red Sox scored on the White Sox. The ear phones and the loud speaker will supplant the newspaper scoreboard in many instances. Radio's lightning speed will not be overlooked when the public is interested, and it will become the universal servant of the great American curiosity.



RADIO has called out the landswehr. As in the war the younger recruits first answered the call to the colors, then those more mature, then the middle-aged and finally the elders. Grandfather is one of us. He has been through the various phases, including the buying of a crystal set for the grandson, the giving of a tube outfit to his daughter, and now he has his own distance-getter installed in the living room or the library and he rolls his own when it comes to tuning in.

He isn't going to miss any political speeches this summer—not if the tubes and batteries stand up! And if some of the baseball scores are announced when he is listening in he is not going to resent it. A few minutes of stock quotations or grain market figures will not annoy him. And, later on in the evening, if some studio songster sings "Silver Threads Among the Gold" or "When I Think of the Days That Are Gone, Maggie," well, the Old Boy is not going to miss his erstwhile game of cribbage or his editorial page very, very much.

Granddad probably will not devote so much time to winding coils and hooking up a circuit as some of the rest of us, but the radio set has taken its permanent place beside the big easy chair and Grandma is there near him. Mr. Announcer and Mr. Program Director will do well not to forget them. Bedtime stories and jazz music, if you will, but let us give them in full measure the best that youthful radio has for the old 'uns.

Measuring Time and Distance by Radio

SOME well informed radio engineers and many blasé radio fans were electrified and even astounded to observe the radio time and speed experiments of Captain R. H. Ranger of the Radio Corporation, conducted at the Cosmos Club in Washington before a section of the Association of Electrical Engineers. He not only transmitted a radio message 4,250 miles to Warsaw, Poland, and got a reply in approximately three minutes, but he measured the time required for a single radio impulse to make the round trip as .046 second. The latter experiment was to show that contrary to a popular conception, radio is not instantaneous.

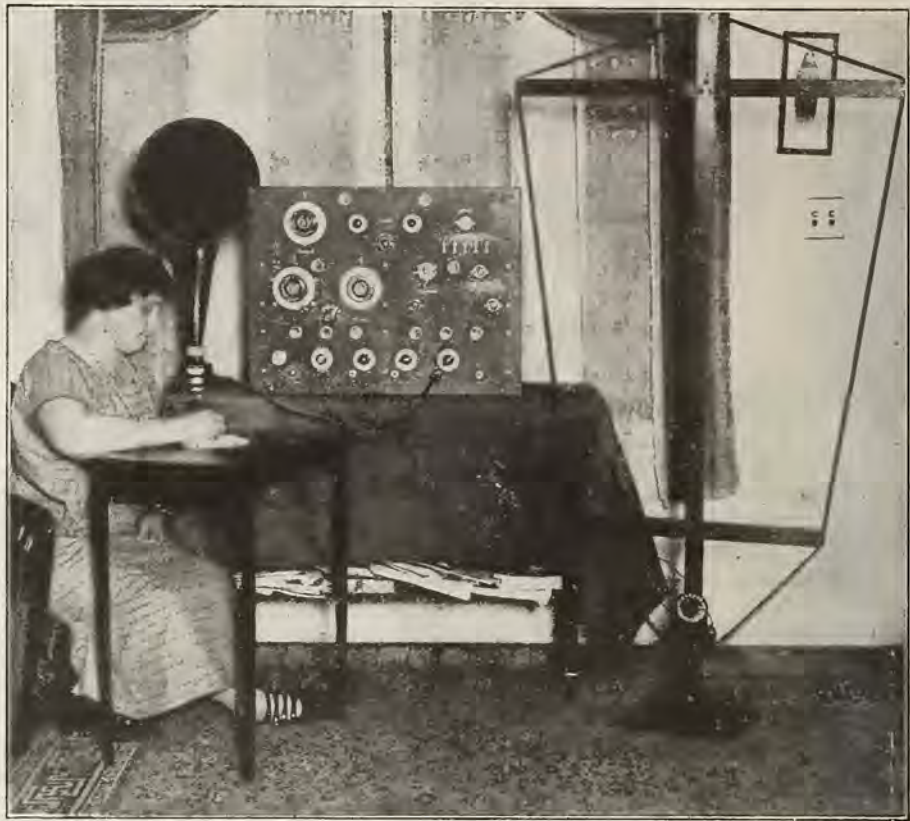
"The fact that a radio impulse traveling over a given distance negotiates this space in a definite and fixed time may set a new standard against which time and distance may be measured, giving a degree of accuracy and reliability surpassing even the accepted methods of astronomical observations," Captain Ranger declared.

"What does he mean?" some of the uninitiated immediately inquired. He meant that since it takes appreciable and measurable time for a radio signal, a dot in this instance, to travel a given distance, we have a new standard measuring instrument which will remain the same for centuries, and, with continued use, our ability to measure even small lapses of time will increase. Practical applications include aids to the mariner, until recently dependent upon dead reckoning when the sun was invisible and no radio beacons were available.

"Radio," Captain Ranger said, "will be the answer to civilization's demand for greater accuracy." Already this system makes it possible to check the accuracy of automatic relays and in the future we may expect more useful applications—for example, to check time differences between two distant points. With a globe-encircling chain of powerful stations, the world time could be carefully calibrated. The radio "dot" can eventually be made to act as a very accurate check on longitude determinations.

By way of exposition, Captain Ranger said: "Suppose clocks at Warsaw and New York are geared accurately to the sun's time at each locality. Then transmit Warsaw's sun time to New York. The difference in the two clocks, in New York, gives the portion of the day or revolution of the world between the two, which is the difference in the longitudes." With the present advances in radio, the least accurate part of such measurements comes in the solar observations, but in spite of this, he said, accuracies below fifteen feet in the 4,250 miles covered are in order. When the round-the-world radio "robin" has checked the speed of radio waves to the final degree, radio alone will give the actual distances between any two points, according to this engineer.

The actual experiments at the Cosmos Club were conducted by coupling the transmitting key in Washington to the



Kadel & Herbert Foto

THREE-STORY SUPER-HETERODYNE

Mrs. Henry Brinkman, Pelham, N. Y., tuning in with the receiver by Mr. Brinkman. Note the non-capacitance loop aerial which, by bunching wires, improves selectivity and eliminates capacity effect in tuning. Ten turns of wire, tapped at each turn, can be used collectively or separately.

Radio Corporation's New Brunswick transmission station by a land line, thence by radio to Warsaw, a distance of 4,250 miles. The return circuit was by land wire from the Polish receiving station thirty-five miles to the transmitter and back via radio to the River Head, L. I., receiving station; from there to Washington through the radio central by a land line. A 14-tube receiving set in the club was tuned in on the New Brunswick transmitter, but the signals picked up were shown visibly through the pulsations of a small electric light instead of on a sounder. By this means, code experts could read the transmissions emanating from New Brunswick as controlled by the sender's key in the club, and observe the messages sent Poland, en route as it were. Once the circuit was set up messages and replies were exchanged from Washington to Poland within three minutes, and later the single dot signals were calculated, with certain corrections, to have made a round trip of 8,500 miles in .046 of a second. This indicated the actual speed of radio as roughly 185,000 miles a second, due to some errors not possible to correct in the makeshift apparatus used.

Another experiment established the possibility of using a radio system to determine the location of ships at sea, serving

the purpose of a radio log. If a ship sails in a straight line between two ports, it will be possible and practical with proper recording apparatus to know just how far a ship had sailed in radio waves. With refinements, this would actually be a "radio speedometer," it was explained. We may come to speak of a ship traveling at "twelve wave lengths an hour" instead of twelve knots. A radio instrument in the pilot house will give the navigator his speed at a glance, as well as his distance from port.

Captain Ranger also covered the uses of radio in polar flights and in establishing the position of air and sea craft both aboard the vessels and at the land compass stations taking the observations, thus preventing any "faking" of positions in the future. Scientific expeditions, he said, could be furnished with accurate time, essential in navigation, by radio, or be actually guided by radio from base stations.

Concerning the possibility of communicating with Mars, the captain was skeptical, due to the fact that the earth's envelope acts as an impervious electric mirror and reflects radio waves to the earth. This "heavyside" layer, he explained, would also tend to deflect any signals emanating from Mars.



Pick-ups and Hook-ups by our Readers



Now here's a communication that is beautifully characteristic of the spirit which prevails among the transmitting amateurs and which is taking hold on the broadcast listeners with astonishing rapidity. It is this spirit which is the secret of the united efforts and success of the transmitting amateurs organization, the American Radio Relay League, who progress by unselfishly exchanging experiences

RADIO AGE,
Gentlemen:

Having been a reader of your magazine whenever we were able to obtain it from the news stands, we wish to say that we greatly appreciate the valuable articles it contains, and especially the feature of boosting the Reinartz circuits. Have been interested in the spiderweb coil circuits to a great extent myself, but since we have not the advantages of expert personal advice, etc., we have followed a great many of the suggestions in your magazine to advantage.

I am enclosing an article and diagram which might be, in our estimation, worthy of printing, and if you believe so, you are at liberty to print it.

Very truly yours,
H. HARDMAN,
Atty. at Law,
Lake Andes,
S. D.

Mr. Hardman's article follows:

My partner, Dr. C. L. Farrell, and I have been interested in the Reinartz spiderweb coil circuit and some of its modifications, and we believe that it is the most efficient, simplest controlled and cheapest set for the average fan to build.

Many fans give up in disgust after they have tried out some circuit or other and lose interest in it and take on something else, because they could not make it work out. Had they carefully checked up the circuit they would have found their greatest trouble due to the fact that had a change, which they did not consider vital, been made here and there in the circuit or instruments they were directed to follow and use their results

would have been different. It is most vital to the proper functioning of any circuit to follow strictly the instructions and circuit, otherwise the "blamed thing" will not always do what it is capable of doing.

Your attention is called to the circuit diagram accompanying this article (Figure 1). You will notice that it is not the regular Reinartz circuit, but if you fall down on the real circuit, try this one, and you will be greatly surprised at what the change of a couple of wires will do to make you have a real good set. We find it selective, very constant in its settings, and simple of control.

While the vernier condenser is not really necessary for fine tuning it is indispensable. Always get good sub-

is so simple when once learned, and by them it must be known, for what I have to say about the manner of controlling it is not new but what every electrical engineer must well know, but no doubt takes for granted that everyone else knows as well, and that it is not necessary to say anything about it.

We asked several reliable persons how to overcome this feature, however, and they each told us that the "spill-over" was a characteristic of that type of tube. However, we kept at our task of getting it under control, and after trying out fixed and variable condensers and grid leaks, choke coils, and various other resistances and leaks in every conceivable manner on the circuit with-

out avail, we happened to place a 400-ohm resistance potentiometer in the circuit as shown in the diagram, which very effectively solved our difficulty and stopped the spill-over of the tube, although I will add it must be used with discretion, and must not be overworked.

In every set we have tried a potentiometer on we have increased its volume, and we believe that it will increase the volume in set used with any of the tubes now in gen-

eral use, either the soft or the hard type. The purpose of the potentiometer is to add and subtract and therefore equalize the A and B battery currents, and the higher the resistance of the potentiometer the less the current consumption, and less drain on the batteries. We therefore placed an 1,850-ohm resistance type on our instrument, which would be such a small drain that it can be effectively used with an ordinary dry cell "A" battery.

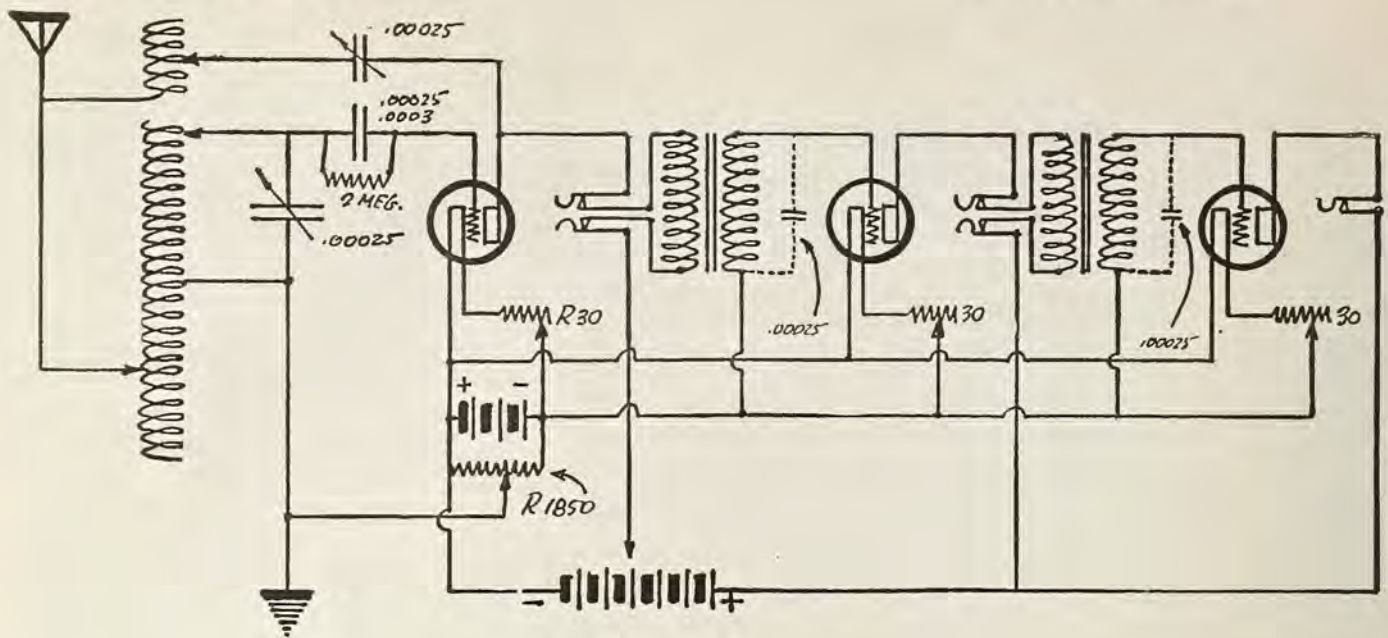
From our central location in the United States we have been able to hear broadcasting stations of the A and B class from nearly every state in the Union, and provinces in Canada. In a test we made with our set after installing the potentiometer we

DIAL TWISTERS

Name	Address	Circuit
R. Lewis Cohen	5603 Waterman Ave., St. Louis, Mo.	Single Circuit
Fred Becker	Newtonville, Mass.	Clapp-Eastham
O. Bell	73 Haring St., Bergenfield, N. J.	Not Stated
Miss L. L. Butz	Dwight, Ill.	Single Circuit
Richard Jones	300 N. Warner Ave., Bay City, Mich.	Single Circuit
Lawrence Berry	1406 Washington Ave., Alton, Ill.	Kennedy
Warren G. Henry	535 N. Leamington Ave., Chicago, Ill.	Reinartz
R. V. Hammer	216 N. Walnut St., Creston, Ia.	Three Circuit
Albert J. Sylk	4113 W. Cambridge St., Philadelphia, Pa.	Not Stated
Earl Fetty	Tekamah, Neb.	Ultra-Audion
Hudson Potter	1201 N. Main St., Rockford, Ill.	Crosley
Robert Hindman	172 E. N. Broadway, Columbus, O.	Not Stated
William F. Bird, Jr.	860 West Avenue, Buffalo, N. Y.	Single Circuit
Edward Brechel	3447 N. Seeley Ave., Chicago, Ill.	Cockaday
Verlin Shinn	1121 W. Sycamore St., Kokomo, Ind.	Not Stated
H. Winkle	835 Bordeaux St., Montreal, Que., Can.	Reinartz
J. Harrod Hill	East Falls Church, Va.	Neutrodyne
Lee Maxey, Jr.	4153 Drexel Blvd., Chicago, Ill.	Not Stated
H. A. Kunitz	417 Lexington Ave., New York City	Revised Grebe
Arthur Banke	Route 8, Lawrence, Kan.	Reflex
Russell Aikens	Grimsby, East Ontario, Can.	Single Circuit
Paul A. Dunn	512 River St., Elyria, Ohio	Short 54
Donald Buechner	322 Dwight St., Syracuse, N. Y.	Single Circuit
George F. Schaaf	707 Linden St., Lima, Ohio	Simplifon
Julian Franke	451 Dewald St., Fort Wayne, Ind.	Erla Triplex

stantial parts, not necessarily the highest priced. It is cheaper to buy than to make them, for the ready-made are always tested and you really know what you have.

The one thing that we had our greatest trouble with in these circuits hereinbefore mentioned was the use of the "A" tube. We desired to do away with the 200 type soft tube which was such a large consumer of our battery, and replace it with a tube which would give it longer life without recharging, and that was the "A" tube or D. V. 2 tube. We were unable to learn how to control the spill-over of these tubes from any literature sent out by the makers, and in this we believe that they have made a great mistake, when the suggestion



had excellent reception on an ordinary magnetic type of a loud speaker from the following stations, to-wit: WDAY, KDKA, WCAE, WOR, WOO, WTAM, PWX, WHAS, WDAP, KSD, WGY, WMC, WOC, WSB, WFAA, WBAP, KFI, KHJ, CFCN, WOAW, WLAG, KGW, KPO, WOS, WCAP, WHAA, as well as a number of other signals from other stations we did not try to bring in, especially those under 360 meters. Last winter we received the station from the agricultural school at Las Cruces, N. M., which, to us, was the best the set has done, inasmuch as they used only two 10-watt tubes in their transmitter, and this was accomplished on the detector alone.

We try to belong to that body of radio fans called the "help each other society," which has not yet been duly organized, but which seems to be in general use among the fraternity of bugs, and that is the object of this little article, so we pass it along to you for what it is worth, and hope it will be of some advantage to someone.

And now that Mr. Hardman has so kindly explained the use of this mysterious radio control, "the potentiometer," we trust that fans will profit by his experience, and govern their future receiver plans therefrom. We certainly are indebted to him for his generous and concise description of its use.

By the way—are there any experimenters who have had experience with the Super-Heterodyne receiver, and could give up fans some pointers on operation and construction? It certainly would be timely, and the boys would sure appreciate it. Information of this kind with reference to the Super-Heterodyne is very scarce, and the readers of this department would certainly profit by it. Come on you Super-Heterodyne addicts—kick in!

The Pickups Editor believes he has about the best records he has yet seen with regard to long distance reception with simple receivers. In this month's department we have receptions (which the contributors say are confirmed) records from foreign countries, excluding Canada.

That's what the Pickups Editor calls hot stuff. Do you know—it almost follows up the footsteps of the American Radio Relay League men, who are now transmitting and receiving on low waves, to France, Great Britain and Holland. They're ahead of us we'll admit—but we're right on their heels when it comes to receiving. And they claim the distinction of being the best radio men in the world. Now they've been in the game for ten years or more, and when a comparative infant in the radio game masters reception difficulties so well as to get trans-oceanic reception, we think it's mighty keen work. We'll be picking ohms off antennas if it isn't. Here's the first one:

RADIO AGE.

Gentlemen:

I read the pickups section of your magazine in every issue. I am fifteen, and have built my own set. A single circuit Regen with two steps of audio. I built it last September, but could not get her working till a few months ago. But when she started, you had to watch its smoke!

From November to March, I have received 237 stations. My best record is KDYX of Honolulu, Hawaii, from which I have a letter confirming reception!

On March 7, 1924, I pulled exactly forty-five stations out of the ether. Two local stations were broadcasting between 7 and 10 p. m., viz., KSD and WCK, two powerful stations. The stations heard were:

KYW, WGY, WOC, KDKA, WOC, KFKX, WDAP, KFKB, WCAE, WDAR, WTAY, WIAC, WFAF, WGR, KFGC, WFI, WBZ, WJAD, WOAI, WHAS, WWJ, WOR, WOAF, WOO, NAA, KFDY, WAAH, WRC, WOAW, WMC, WDAF,

WBAP, WFAA, WJAZ, CYB, CFAC, CKCK, WMAQ, KPO, WLAG, KHJ, WJZ and KGW.

I think this set is finer tuning than any other I know of.

Yours truly,

Ralph Lewis Cohen.

5603 Waterman Ave., St. Louis, Mo.

At one time, a Chicago newspaper was running a daily cartoon under the title of "Radio Ralph"! This must be the guy. Just think it over, from St. Louis, over the Rockies, deserts, and then over a vast expanse of water, his receiver reached out and wham!—in comes the soft twang of Honolulu music. That's radio. The Pickups Editor is putting your name on the list, of Dial Twisters, and wants to know when you are going to pick up Turkey. We'd like to be around when some of that harem dancing music comes through.

Mr. Fred Becker of Newtonville, Massachusetts, ranks about an even tie for the laurels this month with a list of stations, sixty-one in all, which he received on March 17. Those over a thousand miles distant are as follows: WHAS, KSD, WAAF, WSB, WTAY, WDAP, KYW, WJAM, WQAM, WLAG, WCBBD, WOS, WOAW, WMC, WBBF, KFKB, KFKX, KGW; making an aggregate mileage of over 41,000 miles, including the other forty-three stations which are under 1,000 miles.

This in itself is quite a feat—over sixty stations in one night. However, here is the meat of his letter. He writes:

"I have received the Pacific coast twelve times, KHJ six times, KPO twice, KFAR once, KLX once, KJS once and KGW once. I have also received British stations 2LO, 5WA and 6BM. If anybody can beat this record, let's see them."

The only thing that prevents us from giving Mr. Becker first place is that he does not say that his reception of the English stations is confirmed. In these

days we don't say that anything is impossible in radio.

Now, here's one that's just as good as Mr. Becker's list (those eastern bugs certainly make a fine showing), but has to take a lower rating because his list of stations for one night is smaller:

RADIO AGE,
Gentlemen:

Having read Mr. Boyenga's request for pickups of Reinartz owners, I am enclosing my record, which I think ought to get me in the society of Dial Twisters. My total amount of stations received on one tube in 125 stations, which includes 2LO of London, England. I have a confirmation of reception from that station. My record night with one tube was forty-four stations. Stations I have heard are:

WEAF, WJZ, WOR, WAAM, WBAN, WHN, WWJ, WBS, WRW, WDAF, WBZ, WOC, WSAF, WGY, WIP, KDKA, WLAG, WSB, WOS, KSD, WEI, WDAR, WPAL, WLW, WBT, WBAY, WLAW, KYW, WHAS, WHAZ, WCAE, WNAC, WJAZ, WLAQ, WGR, WCX, WDAJ, WMAK, WOO, WDT, WJAX, WRC, WBAK, WOAV, WCAP, WQAO, WMAQ, WMAF, WSAI, WJAR, WCBF, WGI, WCAU, WJY, WHAM, 6KW, WEAN, WTAS, PWX, WNAV, WSAD, WGAW, WQAN, WTAM, WRK, WJAS, WBAV, 9CE, WOI, WOAV, WFAF, WPAF, WMC, CKAC, WDAF, WSAY, WFAA, WHB, WOAI, KOP, WBAP, CFCN, WBBB, WPAB, WDBC, WMAF, WNAF, KFKX, WIAS, WAAW, WHK, KFKB, WEAM, WHAA, KFIX, WPAH, KOV, WAAF, WWAE, WIAD, WRM, WJAN, WCAL, WMAJ, WABT, CHYC, NAA, WCAD, WBAH, WEOA, KFKZ, WOO, WABL, CFCF, WSAJ, WCK, WQAO, WTAT, WTAY, WJAK, WTAB, WIAO, KHJ, KGO, WBL, WBBH, WABO, KFMZ, WBBF, WKAR, WSAR, WEAJ, WMAV, WCAS, WRAN, WBBG, WOAM, WBBR, WCAH, WGAL, CKCH, KFNF, KFLZ, WCBC, WQAE, KFMX, WJAM, WABM, WWAQ, WABI, WTAQ, WBBM, WMAH, WDAY, CJCM and KFL.

The above list comprises the total number of stations received on one and two tubes, totalling 156.

Yours very truly,
O. Bell.

73 Haring St., Bergenfield, N. J.

Now Mr. Bell is so enthusiastic about his Reinartz that he wants to organize a national body of Reinartz owners, which he says ought to be called the Reinartz Booster Club. If the gang is in any way inclined along those lines, Mr. Bell would appreciate hearing from them at the above address. He says he will send in the list of names he receives and suggests that we print them. (Which we will if the list does not get too big.) At any rate, the Pickups Editor wishes to thank Mr. Bell for his suggestion and hopes he will hear from him again

Boys, we have a YL (young lady) or DG (dear girl—that's what the transmitting amateurs call them)—in our midst. WHOEE! Just read over her letter. The only thing we hold as a drawback from giving this OW (old woman—another term used by transmitting amateurs for the female of the species)—the position of chief Dial Twister is that she didn't state whether her DX reception was verified or not. If we were she, we'd get it confirmed. Now for the letter:

RADIO AGE,
Gentlemen:

After having read your magazine for quite a time I have decided it is one of the foremost, if not the foremost, radio periodical published. I take pleasure in submitting to you a list of radio stations I have heard. My radio is a single circuit using a UV199 tube. Before this I used WD12's, but I had bad luck—burnt 'em out. The UV199 seems to do better than the WD12, judging from the results I get. My record consists of over seventy stations, but I shall set down here only those of distance:

WSY, WIK, WJY, WKY, WFAJ, WOR, WBZ, WEAF, WOAV, KPO, WHJ, WFI, KGO, KGW, KDZE, KFAF, CKCK, CHYC and PWX.

The four California stations I can get in any time they are operating, and all except KPO come in very plain.

The stations I think almost impossible to receive with a single circuit in the middle west are foreign ones, yet mine has done it. I have heard Melbourne, Australia, and London, England (2LO).

When I got Melbourne, I believed myself to be hearing something that was impossible, but my radio chart has Melbourne down for a station, and I know my ears didn't fail me. The signals were weak, but I got the name Australia announced three times, and Melbourne once. I tuned in London one cold, dark, but not cloudy night: fading was moderate, but I made sure before I logged them

Another time I heard the name Salt Lake City announced, but could not get the call letters, so did not log them. Before Christmas I got WKAH, West Palm Beach, Florida, but they seem to be off the list now.

As you say, everyone can try for the Dial Twisters. I hope that my list will stand a show, as I know all are given due consideration.

(Miss) Luez L. Butz.

Dwight, Ill.

The Pickups Editor does not happen to be married—but even at that he knows better than to argue with a YL. To be utterly frank, we wish Miss Butz would have confirmed her receptions before letting us hear from her—but as we said before, we take all letters at face value, and if the writer happens to be an Isaac Walton we don't assume any responsibility. The point is—confirm your extreme long distance receptions. We are glad to have the ladies visit our department (notice the OUR), and we would like to hear from more of them—it adds zest to the game to know that there are YL's interested.

Miss Butz has submitted a most unusual list, and we hope she will continue the good work. You gentlemen mechanics take a gallery seat; you've gotta' go some to beat that.

Back in the March issue one of our fellow DT's insisted that we correct his address, which was given as Milwaukee, Wisconsin, instead of Bay City, Mich. He also stated that he would like to see everybody in the country get as good results

STATIC PUNCTURING CONTEST

CAN old man static stop you or can you stop old man static? We offer the following prizes to DT's for the five best records submitted during the months of June, July and August. The contest is open to any reader of RADIO AGE, and any type of set. The Pickups Editor reserves the right to pick the winners.

We will be especially interested in lists submitted by persons making their receptions on portable receivers.

For each month, June, July and August, a different set of the same prizes are offered.

The baseball season is open—who will be the ones to sock old static for a home run? Wot sa, DT's?

PRIZES for June

A year's subscription to RADIO AGE for the second best list submitted showing receptions made during the month of June.

A year's subscription to RADIO AGE for the second best list submitted showing receptions made during the month of June.

For the third, fourth and fifth best lists, we will award a copy of the RADIO AGE ANNUAL to the contributor of the winning list.

If any transcontinental or transatlantic reception is accomplished, confirmation of such reception is necessary.

as he has and would answer all letters directed to him. We gave him fair warning that he would be avalanched with mail—and corrected his address. In the April issue we printed his hookup and the instructions he follows in operating the set, but—let him tell the story:

RADIO AGE,
Gentlemen:

Can't you sneak out the April issue a few days (or weeks) ahead of time? If you don't, I'll be in a padded cell trying to answer all the letters I'm getting from fans all over the country (He evidently hit the right medium when he sent his list and offer into RADIO AGE—Pickups Editor.) For heaven's sake—hurry! I have several letters that cannot be translated, these I have to pass up, hoping their writers will see the coming issue of RADIO AGE. Those who didn't send stamps, I cannot answer. It would cost me a fortune in stamps, and I don't know whether I'll be able to answer all of those who did send stamps.

Mr. Boyenga, in the March issue, said he was sure only a Reinartz would pick up twenty-five stations in two and one-half hours. Here you are, Mr. Boyenga—thirty-six (count 'em) in TWO hours:

KDKA, WGR, WLW, WKAJ, WTAS, WEAN, WIAD, WEAJ, WOC, WCK, WCAE, WCAP, KFI, CFCR, WOR, KHJ, WDAF, CFCA, WTAM, WOAN, WBAP, WHN, 8DAT, WDR, ISD, WNAQ, CFCB, JYW, WKAG, WHAZ, KPO, WDAJ, KELZ, WOS, KGO, KFKB

How's that for a single circuit bottle outfit? Can a Reinartz do this? If it can, then I'll go out for another and better record.

And that's that. You single circuit bugs—let's up and at 'em!

Very truly yours,

Richard Jones.

300 N Warner Ave., Bay City, Mich.

Mr. Jones got just what he asked for. Nearly everybody in the United States wrote him—at least from his letters he thinks so—but he should see the technical department of RADIO AGE. He'd think his mail was a mere handful compared to the Troubleshooters. Anyway, Dick, thanks for your letter and information. We hope to hear from you again.

Mr. Lawrence Berry, 1406 Washington Avenue, Alton, Ill., wants to be put on the DT list. He encloses a list of thirty-six stations heard in two hours—and Mr. Jones will have to share honors with him. At least, Mr. Jones, there is the consolation that it wasn't a Reinartz that accomplished Mr. Berry's work, as he uses a Kennedy receiver. Lawrence says that if we know of any hookup that will beat that—he'd like to have the circuit.

The following is a letter from a Dial Twister who has grown fond of his "little ole radio," as he terms it. You know, fellows, it actually gets that way—you learn to love it:

RADIO AGE,
Gentlemen:

I'm giving the "little ole radio" a party tonight—it's one year old. I thought I'd send in my year's labors to your interesting department.

I'm not at home to run the set every night, maybe four of the week; but I do get in on the air either early supper hour or early milkman hour and catch some odd ones now and then. I think this is a pretty good record for a Reinartz and next year I hope to pass it as we learn to know each other better every day, especially in respect to tuning.

I can tune as low as 187 meters and as high as 600 without loading coils. The low wave length range accounts for the number of "ham" phone transmitters I have heard.

As a rule silent night nets around ten to twenty-five stations on the average. Oh, if I only lived a few miles out of Chicago, with this set I don't know if this plasters the name

The RADIO AGE data sheets printed on pages 37 and 39 should be carefully filed away as described in the preceding issue.

In a comparatively short time these sheets will represent a world of valuable information and reference.

Don't fail to save them.

of Dial Twister on me or not—but here's hoping.

Respectfully,

Warren G. Henry

535 N. Lemington Ave., Chicago, Ill

March 12, 1924—"Little Old Radio's" first birthday. Reinartz detector and two-step audio, standard hookup, double inverted L aerial. WF phonograph attachment.

The result:

CFCN, KFI, KHJ, KFKB, KDPM, KDKA, KFKX, KSD, KFDD, WBAH, WBAP, WBAV, WBZ, WCAE, WCAL, WCAP, WCAS, WCAV, WCB, WCK, WCX, WDAF, WEAJ, WFB, WFAA, WGR, WGY, WHA, WHAA, WHAS, WHAZ, WHB, WIAO, WIAU, WIAD, WIAX, WIZ, WKY, WLAG, WLW, WMAK, WML, WQAV, WQAV, WQAV, WOC, WOI, WOO, WOR, WOS, WPAB, WPAH, WRC, WSAI, WSE, WSY, WTAM, WTAP, WTAS, WTAY, WVAE, WWI, WBBM, WSA, WCT, WAAP, WDAJ, WBU, WAAY, WPAD. (Chicago's) KYW, WMAQ, WSAH, WJAZ, WDAJ, WAAF, WTAY, Amateur voice mikes (I can't read code) 9AAD, 9AB, 9AIX, 9AOL, 9ASII, 9AVE, 9AX, 9BA, 9BCB, 9BEF, 9BFF, 9BNA, 9BOA, 9BRN, 9BYA, 9CAX, 9COW, 9CR, 9DMY, 9DNI, 9DOZ, 9DOS, 9EAS, 9ED, 9EY, 9EIX, 9HL, 9PO, 9US, 9YK, 9XN, 9XU, 9CVF, 9CVS, 9CW, 9CX, 9CYD.

Covering twenty states, District of Columbia and Canada.

We know how hard it is to log amateur voice "mikes." They growl and sputter and hum and fade—the voice sounds as though it were being run through a meat chopper. We appreciate Mr. Henry's list, and hope that when the "little ole radio" is two years old his list will have doubled itself. Come again, Mr. Henry.

Now here's a fellow who feels the same way toward his three circuit Regen—two variometers and a coupler—and who sends in a list of stations much similar to Mr. Henry's:

RADIO AGE,
Gentlemen:

I have been reading the records sent in by the various DT's and have come to the conclusion that I have one or two records that will place my name near the top of the list.

I use a home-made two-variometer 3-circuit regenerative set with one-stage amplification, although I have heard practically all the following on the detector only. It will be two years in August since I have had my set and to date I have logged 318 stations in 36 states, Canada, Cuba, Porto Rico and Mexico. In addition to the above I have heard 48 amateurs on phone, which I will not list.

Below I list just the stations of 800 miles and more from Creston:

CALL	LOCATION	DX MILES
WKAQ	San Juan, Porto Rico	2,400
6KW	Tuinucu, Cuba	1,600
6BY	Cienfuegos, Cuba	1,575
KPO	San Francisco, Calif.	1,575
CVB	Mexico City, Mexico	1,565
CYL	Mexico City, Mexico	1,565
PWX	Havana, Cuba	1,560
KLX	Oakland, Calif.	1,550
KGO	Oakland, Calif.	1,550
KGW	Portland, Oregon	1,535
KFI	Los Angeles, Calif.	1,450
KHJ	Los Angeles, Calif.	1,450
KFSJ	Los Angeles, Calif.	1,450
CJCA	Edmonton, Alta., Canada	1,290
WNAC	Boston, Mass.	1,250
WEAN	Providence, Rhode Island	1,235
WJAR	Providence, Rhode Island	1,235
CHOM	Calgary, Canada	1,220
CHBC	Calgary, Canada	1,220
CFAC	Calgary, Canada	1,220
CFCN	Calgary, Canada	1,220
WBZ	Springfield, Mass.	1,170
CKAC	Montreal, Que., Canada	1,125
CHYC	Montreal, Que., Canada	1,125
CFCF	Montreal, Que., Canada	1,125
WMAF	Dartmouth, Mass.	1,150
WHAZ	Troy, N. Y.	1,120
WBBR	Brooklyn, N. Y.	1,100
WEAF	New York City, N. Y.	1,100
WIZ	New York City, N. Y.	1,100
WDT	New York City, N. Y.	1,100
WJY	New York City, N. Y.	1,100
WHN	New York City, N. Y.	1,100
WGY	Schenectady, N. Y.	1,100
WOR	Newark, N. J.	1,090
WEAM	N. Plainfield, N. J.	1,050
WRAX	Gloucester City, N. J.	1,040
CKCH	Ottawa, Ont., Canada	1,030
WDAJ	Philadelphia, Pa.	1,000
WCAU	Philadelphia, Pa.	1,000
WIAD	Philadelphia, Pa.	1,000
WFI	Philadelphia, Pa.	1,000
WIP	Philadelphia, Pa.	1,000
WOO	Philadelphia, Pa.	1,000
CFCR	Kingston, Ont., Can.	970
WCAP	Washington, D. C.	960
WRC	Washington, D. C.	960
WHAM	Rochester, N. Y.	905
WCAD	Canton, N. Y.	900
WSAC	Clemson College, S. C.	900
WCAR	San Antonio, Texas	875
WOAI	San Antonio, Texas	875
WBT	Charlotte, N. C.	860
WHAB	Galveston, Texas	850
CKCK	Regina, Sask., Can.	850
WMAK	Lockport, N. Y.	845
WGR	Buffalo, N. Y.	835
WVAG	New Orleans, La.	830
WGV	New Orleans, La.	830
WTAF	New Orleans, La.	830
CKCE	Toronto, Ont., Can.	820
CFCA	Toronto, Ont., Can.	820
CFCR	Sudbury, Ont., Can.	800

NOVEL RADIO CALLS SUGGESTED

What would you say if you had to tune your ear musically before you could tune your set to a broadcasting station, and if all announcers sang their calls in musical notes?

As a substitute for the call letters of different broadcasting stations, which are sometimes confusing and unintelligible, the use of musical notes sung by the announcer has been suggested to Secretary of Commerce Hoover.

Dr. Charles M. Swingle of Cleveland, Ohio, who recommends this practice as an improved method of designating radio stations, says: "These notes should be sung by the broadcasters thus: 'do, me, sol, do, sol, me, do' might designate WJAX." The call of this station in announcements would then be: "WJAX, do, me, sol, do, sol, me, do," he explains, suggesting that later, only the notes be used.

More than one value would accrue by this method, he believes; more certainty of being understood, training of the broadcasters' voices, and encouragement of vocal music. "It is a psychological fact that one who hears only a few notes, is almost impelled by the musical instinct to sound them over, whereas this is not true of a complete song" he writes. This old instinct, according to Dr. Swingle, can be encouraged and again made to function for all.

In his reply to Dr. Swingle, the Commissioner of Navigation explained that the Government is forced to follow the rules of the International Bureau at Berne in assigning call letters to radio stations, and numerical designations for amateurs according to their districts. All of which makes the suggested change practically impossible.

WABT, Washington, Pa.....	800
WEAY, Houston, Texas.....	800
WEV, Houston, Texas.....	800

The above list of stations have all been heard since the first of the year. If the list is too long for publication cut it down to the 1,000 miles and up.

If this does not put my name in the list of Dial Twisters, how about the list for one day's work which you will find on a separate sheet?

If anyone doubts the veracity of the above, I have communications from nearly every one of the stations listed verifying the fact that I heard them on certain evenings.

Yours for D. T.
R. V. Hammer.

216 N. Walnut St., Creston, Ia.

The following stations were heard Monday, January 21, 1924. This list was published in the Des Moines *Sunday Register* January 27th. I heard one complete announcement and number from each station.

Heard During Daylight, up to 6:00 P. M.

	Miles
WMAJ, Kansas City.....	150
WAAV, Omaha.....	90
WOF, Ames, Iowa.....	90
WFAV, Lincoln, Neb.....	120
WBAH, Minneapolis.....	285
WIAK, Omaha.....	90
WHAS, Louisville.....	520
WOP, Philadelphia.....	1,000
WIZ, New York City.....	1,100
WMAO, Chicago.....	370
KFLZ, Atlantic, Ia.....	45
KYVW, Chicago.....	370
WHB, Kansas City.....	150
WOS, Jefferson City, Mo.....	225
WOC, Davenport.....	205
WDAF, Kansas City.....	150
WGY, Schenectady.....	1,100
WHK, Cleveland.....	680
WCX, Detroit.....	610
WTP, Philadelphia.....	1,000
WRC, Washington, D. C.....	960
WSB, Atlanta.....	770

Heard From 6:00 P. M. On.

WFI, Philadelphia.....	1,000
WOR, Newark.....	1,070
KDKA, Pittsburgh.....	790
WCAE, Pittsburgh.....	791
WLAG, Minneapolis.....	285

WGR, Buffalo.....	835
WIAO, Milwaukee.....	375
WDAP, Chicago.....	370
WTAQ, Osseo, Wis.....	350
WWJ, Detroit.....	610
WEAF, New York City.....	1,100
WCAP, Washington, D. C.....	960
WDAR, Philadelphia.....	1,000
WOAW, Omaha.....	90
CFCE, Montreal.....	1,125
WBZ, Springfield.....	1,170
KFKB, Milford, Kans.....	220
WPAB, State College, Pa.....	790
CFCA, Toronto.....	820
WOO, Kansas City.....	150
WCK, St. Louis.....	285
WHA, Madison, Wis.....	345
WBAP, Fort Worth.....	625
WMC, Memphis.....	490
WBAV, Columbus, Ohio.....	625
WHAZ, Troy.....	1,120
WCBZ, Zion, Ill.....	350
WLW, Cincinnati.....	560
KFJL, Ottumwa, Ia.....	140
KSD, St. Louis.....	285
WTAS, Elgin, Ill.....	350
KFIZ, Fond du Lac.....	385
WFAH, Port Arthur, Tex.....	795
KFKX, Hastings, Neb.....	200
KPO, San Francisco.....	1,570
CKCK, Regina, Sask.....	850
WOAI, San Antonio.....	875
WIAB, Rockford, Ill.....	295
KHI, Los Angeles.....	1,450
WBAK, Harrisburg, Pa.....	955
CFCN, Calgary, Alt.....	1,220
KFI, Los Angeles.....	1,450
WSAI, Grove City, Pa.....	810
KFMT, Minneapolis.....	285
XAJ, Dublin, Tex.....	600
WJAX, Cleveland.....	680
9MM, Converse, Ind.....	440
9BXZ, Des Moines.....	50
9HK, Clinton, Ia.....	210
9AAQ, Ackley, Ia.....	125
9AKE, Eagle Grove, Ia.....	150
9DA, Eagle Grove, Ia.....	150

74 stations and 42,720 miles.

The lists (either of them) would put Mr. Hammer's name on the prized DT list, because both of them are characteristic of a good operator. The point that tickles us is that Mr. Hammer uses a three-circuit regenerative receiver—the one our friends say is too hard to tune. Here's to Mr. Hammer and his far reaching receiver. Our hats are off to him—and may his signals never fade.

Albert J. Sylk of 4113 West Cambridge Street, Philadelphia, Pa., deserves the title of Dial Twister for his coast to coast reception in tuning in KFI of Los Angeles.

Mr. Sylk uses two WD11 tubes in a circuit which he does not name. He encloses a list of other stations heard on February 10th, together with KFI, making a total of 20 stations, the second best being KLZ at Denver. FB, ol' man.

Earle Fetty of Tekamah, Neb., writes a chummy little letter as follows:

RADIO AGE,
Gentlemen:

I am only a new subscriber to your wonderful magazine, but I have bought single copies before and I gathered from these that your policy was honesty. I am not casting aspersions by any means on Curtis Springer and Kenneth Fischer (more power to them), but who on earth ever heard of stations KFSB, WDI and KFSG? Most likely in their enthusiasm of getting a wonderful list of stations for one night, they misunderstood the announcer. But if they are good readers of this magazine they will turn to the up-to-date list of stations in the back of the book. Also I may be mistaken, but I believe that WOS, WCBZ and KSD are silent on Saturday nights. Notwithstanding all this, they still have a wonderful record that is hard to beat, but this is my list of stations heard on a single tube ultra-audio receiver, every station heard since January 15th.

KFLZ, WBAP, WCAH, WCAI, WHK, WIAK, WIAG, WOO, WOP, WPAH, WSB, WVI, KFLE, WBAH, WCAE, WGR, WHA, WHAA, WKY, WOI, WTAY, KFFO, WOAI, WCAP, WEAF, KFI, KYW, WIAZ, WDAF, WTAS, WMAQ, WCBZ, WOS, WOR, WDAR, WTAM, WLAG, KDKA, WGY, WOC, WOAW, WCK, WHAZ, WOR, WSAI, WHAS, WFAV, WEAU, WLW, WHB, WAAW, KSD, WCX, WCAJ, KFKB, KFKX, WNAC, WMAV, WDAR, KFNF, (this station just opened so it may not be found in the list) WRM, KEEQ, WBZ, KFFZ, KGO, CFAC and PWX.

Possibly not good enough for the DT list, but fair for one tube, don't you think? I marked the position of PWX on the dials and have gotten them two or three times since. I have not yet received my Reinartz book, but I suppose there is a great demand for them. When I get it I am going to build a two-stage amplifier, and then I'll hope to send in a list enough to choke a goat. Possibly a little suggestion from you will have these DT's check up their list by your lists and save time and slight embarrassment. Hoping to get your book soon, I am

Yours respectfully,
Earle Fetty.

Tekamah, Neb.

P. S.—I might add for the benefit of any prospective crystal set buyer out here that if some salesman says he'll guarantee to get KDKA, East Pittsburgh, he means KFKX, Hastings, Neb. Keep a wary eye open.

Brother Earle's letter contains some very good suggestions—fellows might be glad to know that we feel the same way about being careful about your DT lists. Casting no reflections on anyone or anybody, we wish to say that we always be

(Continued on page 41)

Radio and Talking Machines

MUSIC dealers and manufacturers of musical instruments sometimes express concern lest the vigorous but youthful radio giant trespass upon the elder industry. It is said that radio is cutting into the phonograph business. There is not much doubt that radio is distracting attention from phonographs but the radio receiver is here to stay and the music men would better absorb it than to try to battle with a fact.

Some phonograph makers have had the foresight to make their cabinets and tone arms in such a manner that they will allow for space for a radio receiver within the cabinet, and so that a special tone-arm may be easily connected to a device which will turn the sound chamber of the phonograph into an excellent loud speaker.

Several manufacturers already have demonstrated for RADIO AGE the merits of a special radio tone-arm for phonographs and it seems likely this is to become an important line.

The phonograph is always ready to play any desired selection at any time, while the radio is dependent upon the broadcasting stations. Then, too, if the battery happens to be run down, the phonograph will furnish entertainment until it is recharged.

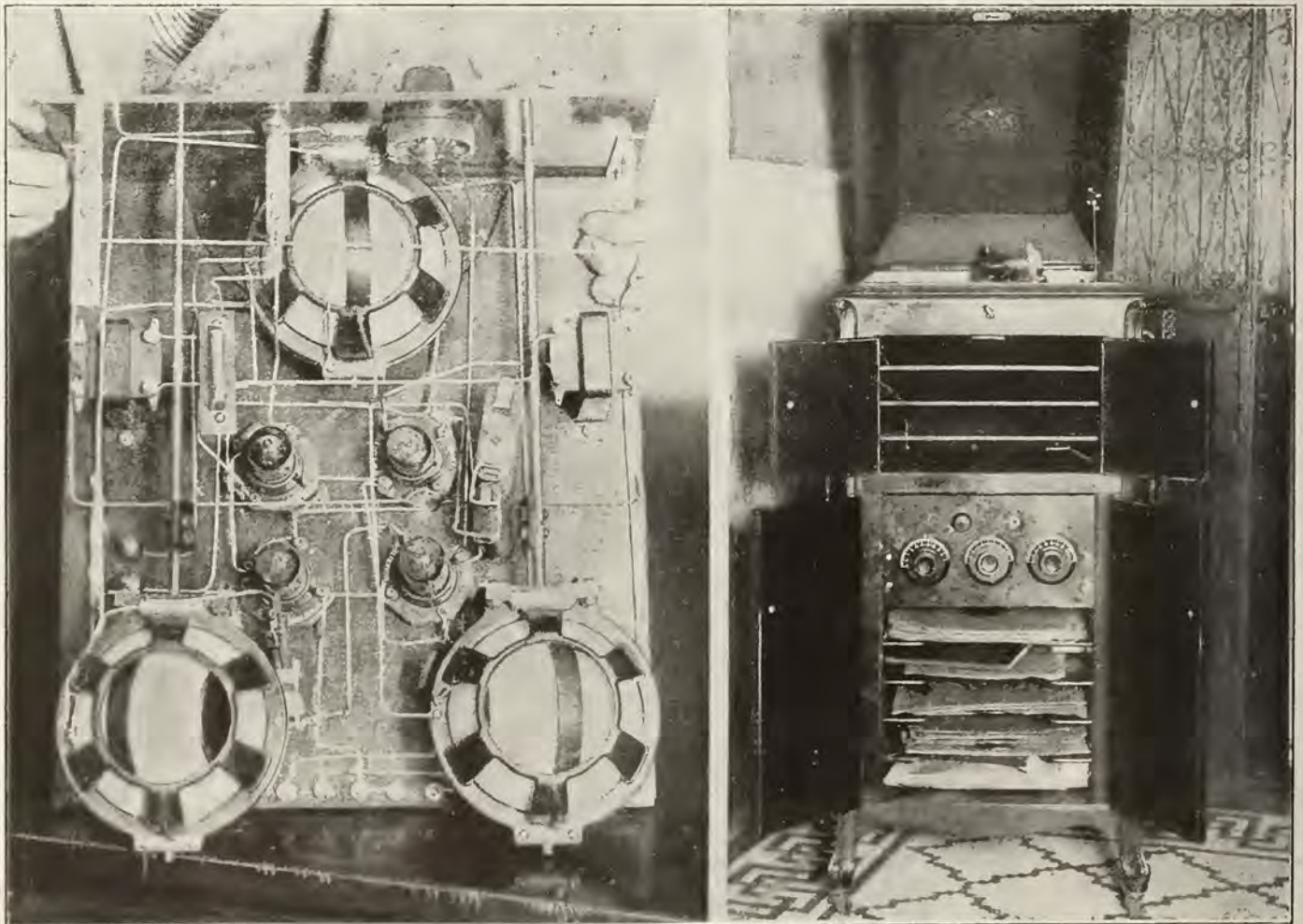
Combining both of these instruments in one cabinet would save considerable space in the small apartment which is one very important item. Some manufacturers are beginning to appreciate the demand for something of this kind, but the great difficulty seems to be that because there are so many different types of radio sets, and many fans like to build their own, that they hesitate in making a selection.

However, if the cabinets were made with the regulation phonograph equipment, and a blank panel mounted in a convenient place, they would find a ready sale for it. Such an arrangement would be a great help to both the radio and phonograph business.

"All-American" Moves

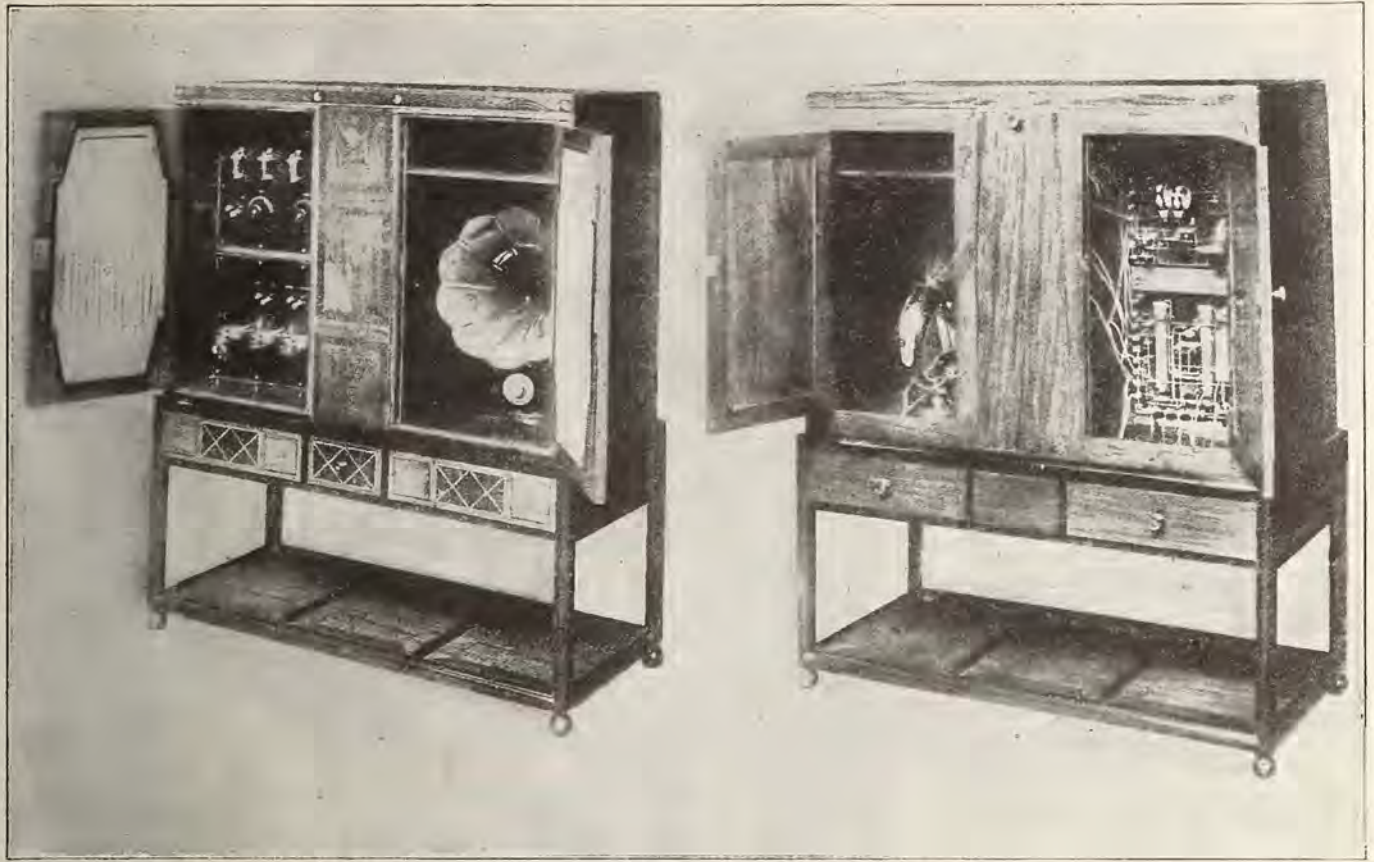
Increased business has compelled the Rauland Manufacturing Company to remove from its former quarters to a large new and modern steel and concrete building at 2650 Coyne Street, Chicago. The company reports that it is doing ten times as much business as it carried a year ago, although it had a good volume of business at that time. The company makes the "All-American" Transformer.

The new quarters not only provide much more manufacturing and office space, but the location is ideal for the laboratories, having been especially chosen with a view of avoiding electrical disturbances. Incidentally the laboratory is one of the most complete and up-to-date ones in the country. There will be available in the new factory every modern device for manufacturing precision radio and electrical apparatus



RADIO FOR THE PHONOGRAPH

An unusually effective and compact outfit, designed to fit a phonograph cabinet or small radio cabinet. Made by Richard Carlisle, president C. C. N. Y. Radio Club, it is a specially built four-tube Superdyne, using the upper variometer as a variocoupler, the rotor coil being split, half being used as feed-back. The wiring is unusually neat, and the set is a wonder for DX, when used on a small aerial or loop. At the right is a photograph of the set installed.



KING GEORGE'S OUTFIT

As they would say in England, it is a "seven valve" instrument. The description of the receiver, as written in London, asserts that it is "complete, with aerial and earth." The cabinet is inlaid with ivory and mother of pearl. The cabinet is made in three compartments, the left compartment containing the tubes, the center one the battery and the right, the loud speaker. Photo on left shows the front doors open and the other shows the back doors open. The set is capable of receiving signals from all parts of the world.

Radio Views on the White Bill

By CARL H. BUTMAN

(Copyright 1924)

WASHINGTON, D. C.—Congressman Wallace White's radio bill stood up well under fire of several objectors during a four-day hearing before the radio sub-committee of the House Merchant Marine and Fisheries Committee. It is the general impression that the sub-committee will now report favorably to the full committee and that early action in the House will follow. Secretary Hoover is sanguine as to the eventual passage of the needed legislation by the House, but no one dares prophesy on the attitude of the Senate, due to the multiplicity of investigation and urgent measures before that body. Following the conclusion of the hearings last week, Secretary Hoover said there seemed to be a general "unanimity of opinion" that the bill was a good one basically.

Appearing before the sub-committee at the opening of the session, Secretary Hoover read a report reviewing the radio situation and indicating the legislation needed by the Department if proper administration was to be continued. Chairman White of Maine, author of the bill,

presided at the hearings, assisted by Representatives Lehlbach, Free, Bacon, Davis, Bland and Larsen.

Pointing out the imperative need for legislation, although admitting that no law would be a "panacea," Secretary Hoover said in part:

"The tremendous development in electrical communications is to a large extent due to the fact that individual initiative has not only been unhampered by the Government but has been encouraged to the extent of the Government's ability and regulated so as to give the maximum service. The further legislation needed should in my view regulate only to the extent that is necessary in public interest for the development of the science itself; for the service of those who make use of it. It seems to me, therefore, that the fundamental thought of any radio legislation should be to retain possession of the ether in the public and to provide rules for orderly conduct of this great system of public communication by temporary permits to use the ether. It should be kept open to free and full individual develop-

ment, and we should assure that there can be no monopoly over the distribution of material.

Vital Public Interest

"Radio communication is not to be considered as merely a business carried on for private gain, for private advertisement or for entertainment of the curious. It is a public concern impressed with the public trust and to be considered primarily from the standpoint of public interest to the same extent and upon the basis of the same general principles as our other public utilities."

He also indicated the need for definite authority for the Secretary of Commerce to exercise "discretionary power" in accordance with the public interest in licensing stations, and not be forced to issue licenses to all applicants. While in sympathy with the provisions of the bill to prevent monopoly, Mr. Hoover said that in his opinion the determination of whether or not a concern was attempting monopoly illegally was not an administra-

tive one but a judicial one.

The Commerce head also referred to radio monopolies and told the committee that it was inconceivable that the American people would allow this new-born system of communication to fall exclusively into the hands of any individual, group or combination. In discussing the matter of payment for broadcasting, he said that he did not favor the placing of a license or tax on receiving sets.

Calling attention to the inadequacy of his facilities, he said that one of the great difficulties in the effective efforts of the Department has been the lack of funds, and that the attempt to police 20,000 stations with a total field force of 29 inspectors was obviously an absurdity.

Navy Voices Objections

Mr. Hoover was followed by Commander D. C. Bingham, of the Naval Communication Service, who said that the bill in general was satisfactory, but he voiced the same criticisms, opposing the licensing of any operators and the charging of fees for such licenses. He asked that station licenses be made for fifty years instead of ten, which appeared to be in opposition to the sentiment of the committee. He further explained that he was opposed to the advisory committee provided for in the White Bill.

In reply to the suggestion of the fifty-year license, Secretary Hoover said he was absolutely opposed to more than ten-year periods, as fifty-year terms would tend to create monopolies in the air.

Charles Caldwell, of New York City, who appeared on behalf of the Radio Broadcasters Society of America, was very emphatic in his reference to the American Telephone & Telegraph Company as the "radio monopoly." He said that in general his society favored the White Bill. Mr. Caldwell referred to the "big five," which he said included the American Telephone & Telegraph, The Radio Corporation of America, The General Electric, The Western Electric and the Westinghouse Electric companies. He took up the matter of patent rights which he said was a vital matter in the entire radio situation of today. He said that he favored the schedules of fees as provided for in the bill, but thought a fee of \$100.00 should be provided for entertainment stations. Mr. Caldwell believed that the decisions of the Secretary of Commerce, as provided for in the bill, should be reviewable by the Courts.

C. B. Cooper, representing the Radio Trade Association, endorsed what Mr. Caldwell said, saying that his association wants to support the bill with the changes suggested.

Railroads Interested

One of the interesting witnesses was A. R. Belmont, vice chairman of the Radio Committee of the American Railway Association, who suggested some radio possibilities for the railroads. He particularly desired the insertion of a clause which would allow the construction of radio equipment on "mobile railroad equipment."

Raymond Asserson, Broadcasting Supervisor of New York City testified on the efforts of the City of New York to purchase a radio broadcasting set from the American Telephone & Telegraph Com-



SMALL 8-TUBE SET

Kadel & Herbert Photo

Photo shows Chas. Murphy with the smallest 8-tube receiving set built by Leo Johnson of 2CTG, at Radio Show Hotel Pennsylvania, New York

pany. He said that the city of New York has wanted a sending station for the past three years but that it has been balked by the Telephone Company.

Joseph A. Devery, assistant corporation counsel of New York City, suggested that the authority to grant licenses, etc., should be lodged in some kind of a board or commission instead of with the Secretary of Commerce. At this point Representative Davis of the Committee said that a Communications Board might be organized for the regulation of radio, similar to the Interstate Commerce Commission for the railways, which would set rates and have other regulatory powers.

Another witness, Paul B. Klugh, executive chairman of the National Association of Broadcasters, told the committee that his organization represented 78 of the leading broadcasters of the country. This organization approves the bill "in spirit"

he said. He favored the appointment of the Advisory Committee as provided in the bill, but recommended the appointment of a board or commission, rather than leaving the whole affair in the hands of the Secretary of Commerce. The personnel of the Advisory Committee, he thought, should include amateurs, manufacturers and the broadcasters. Speaking of monopolies he referred to the American Society of Composers, Publishers and Authors as an "inquisitious monopoly."

E. S. Wilson, Vice-President of the American Telephone and Telegraph Company, appearing before the Committee at the second days' hearings, said that his company had "No intention or desire to monopolize the air," as had been charged. He said that in general his company was in favor of the White Bill, but made a few suggestions, indicating that an appeal should be allowed from the decision of the

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Two Stage Amplifier	Simple Radio Frequency
Junior Heterodyne	Ultra Audion
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Name.....

Address.....

City.....State.....



Kadel & Herbert Foto

UNIQUE SUPER-HETERODYNE

Henry Brinkman, Pelham, N. Y., has built his distance getter in three compartments. The top shelf has two stages of vario transformer tuned radio frequency. On second shelf is first detector, oscillator and three stages intermediate radio frequency. On third shelf is second detector and two stages amplification plus one stage of push-pull amplification. By cutting out top shelf with the two stages of vario transformer tuned radio frequency you then have a 10 tube super-heterodyne controlled by panel switches. Stations 2LO, London, and CWL, Mexico City, come in very clear when weather conditions permit.

(Continued from page 34)

Secretary of Commerce in the matter of granting licenses to broadcasting stations. In the event the Secretary of Commerce is about to revoke a license for any reason, he believes that the offender should be allowed to remedy any violation of the law before the license is revoked. No objection was made to the monopoly provisions provided in the bill. When Mr. Wilson's attention was called to these provisions, he stated that his company was thoroughly in sympathy with them. Answering questions of members of the Committee, Mr. Wilson stated that the Telephone Company had licenses for a number of stations for broadcasting, and that the Western Electric Company had sold 49 broadcasting stations equipment.

For Broadcast Advertising

William E. Harkness, who followed him on the stand, stating that he was Broadcasting Manager of the American Telephone and Telegraph Company, said that while no definite advertising policy has yet been adopted by the company, a rate is now being charged of \$100.00 for 10 minutes or \$400.00 per hour. In connection with the broadcasting of advertising, Mr.

Harkness explained that it had to meet with the approval of "listeners in." He said that the company was desirous of presenting both sides of a controversy during the same evening, if possible. The company does not favor any political party or any particular propaganda in its broadcasting, he declared, and made no effort to conceal advertising.

When Judge Davis, a member of the Committee, asked Mr. Harkness if he did not favor the appointment of a board or commission to have jurisdiction over radio communication rather than the Department of Commerce, he replied that he had no preference in the matter. Judge Davis, however, said that in his opinion the Government would have to do something of the kind. Broadcasting from WEAH Mr. Harkness advised cost approximately \$250,000 last year, while the company did not receive half that amount through advertising. He told the committee broadcasting stations were spending anywhere from \$10,000 to \$100,000 a year. The Telephone Company has no plans for charging for receiving amusement programs and does not contemplate such a step in the future, he added.

Amateurs Oppose Bill

K. B. Warner, Secretary of the American Radio Relay League, said that from the standpoint of his association the present law was satisfactory, and to that extent it is opposed to the new White Bill. He asked that a provision be inserted referring specifically to amateur radio operators, explaining that they would need protection for the future. The league is anxious to secure definite recognition for amateurs, he continued. Taking issue with Commander Bingham of the Navy, Mr. Warner said that he favored licenses for operators since they made for efficiency. He also favored fees for these licenses since this would allow more frequent inspection by the government and better enforcement of the law.

L. L. Lee, chief of the Radio Division of the Fleet Corporation, and John Nicholson of the Legislative Committee of the Shipping Board, appeared before the committee, opposing both the issuance of licenses to operators and the collection of fees for the same.

Mr. Lee told the committee that if the White bill is enacted into a law, it would

(Continued on page 38)

TROUBLE CHARTS (Q-20-21)

VACUUM TUBE TROUBLES

TUBES—Continued.

(5) **GRID LEAKS.** Most detector tubes are very sensitive to the value of the grid leaks, and for this reason a variable leak is to be preferred to a fixed leak. If the leak value is too high or too low, the signals will be weakened and the tube may become noisy and distort the signals. When the resistance of the leak is too low, then the signals are weakened. When the resistance is too high, or a defective leak is used, there will be much noise and distortion, and the tube will be very critical on the controls.

(6) **RHEOSTAT DEFECTS.** When the resistance of the filament control rheostat is too low, then we have all the effects of excessive filament voltage. The instant that the tube is lighted, you will hear a "click" and the signal will either be much distorted or else the tube will start howling. Use the rheostat specified in the tube direction sheet.

A rheostat having too high a resistance for the tube crowds all the control over to one end of the rheostat so that the adjustment is difficult. In such a case, the filament glows dimly on the first steps of the rheostat, and then suddenly brightens up after the rheostat has been moved more than half way over the scale.

In many circuits, a vernier rheostat is necessary for the control of the detector tube. A plain rheostat is not sufficiently accurate for this purpose. The carbon disc types are excellent for the control of detector tubes. Amplifier tubes are not as critical as detector tubes, hence a plain rheostat of the proper resistance can be used for the amplification stages.

(7) **BIASING.** For the best results a constant voltage should be maintained on the grid by means of a "C" battery placed in the grid line or by a potentiometer. In the case of detector tubes and radio frequency amplifier stages this should generally be a positive charge, while with tubes where audio frequency amplification is necessary, the grid should be given a negative charge. With circuits of the super-regenerative types where the detector tube also amplifies at audio frequency, a negative charge will be required on the detector.

Where radio frequency amplification is employed, and where trouble is had from free oscillations of the tubes, the application of a positive bias charge on the grid will generally stop the oscillations and produce maximum amplification in these stages. It is for this reason that a potentiometer is generally employed in the first radio stage, the potentiometer affording a simple means of controlling the bias on the first radio tube.

A small flashlight battery called a "C" battery is employed to hold a negative bias charge on the grids of audio amplifying tubes when the plate voltage much exceeds 45 volts. At 45 volts the biasing battery has not much effect, but at 90 volts it will be found that a "C" battery voltage of from 4.5 to 7 volts will give the maximum volume and freedom from distortion. The "C" battery biasing voltage increases in proportion to the plate voltage or "B" battery voltage.

INDUCTANCES (F-20-25)

HONEYCOMB OR DUOLATERAL COILS

GIBLIN-REMLER COILS. In the following table is given the electrical dimensions of the Giblin-Remler inductance coils. The wire in these coils is layer wound but to reduce the distributed capacity, threads are woven in zig-zag fashion back and forth through the turns so that adjacent turns are staggered. These air spaces between the turns reduce the distributed capacity to the lowest possible point, considerably below that of the conventional honeycomb coils with the diamond winding. The method also reduces the length of wire for a given number of effective turns, and hence also reduces the electrical resistance. It is said that tests reveal 200 per cent less distributed capacity with the Giblin-Remler coils than with honeycomb coils having an equal inductive value.

PROPERTIES OF GIBLIN-REMLER INDUCTANCE COILS

NO. OF TURNS (RATING)	INDUCTANCE NATURAL WAVE		DISTRIBUTED CAPACITY IN M. M. F.	WAVE LENGTH RANGE WITH CONDENSERS		R. F. OHMS AT 500 METERS
	(MILLIHENRYS) AT 1000 CYCLES	LENGTH (METERS) (COIL ALONE)		.00004	.001	
20	.030	39	14.3	63	334	1.1
25	.041	47	15.2	75	389	1.5
35	.083	87	25.4	128	550	3.5
50	.169	114	21.6	185	785	8.8
75	.377	163	19.8	266	1170	28.3
100	.666	217	19.9	358	1550	80.3
150	1.503	281	14.8	512	2320	
200	2.680	374	14.7	690	3110	
250	4.200	424	12.1	860	3880	
300	6.110	494	11.2	1030	4680	
400	11.040	618	9.7	1380	6300	
500	17.500	747	9.0	1730	7900	
600	29.200	1024	10.1	2260	10250	
750	39.000	1249	11.3	2660	11850	
1000	71.600	1620	10.3	3570	16000	
1250	108.000	1930	9.7	4380	19700	
1500	159.800	2300	9.3	5300	23800	

In the "wave length range" column above, a 0.001 variable condenser is assumed with a minimum initial capacity of 0.00004 microfarads. Since the latter capacity exists with the plates completely out of mesh, this minimum initial capacity of the condenser determines the lowest wave length which of course is greater than the natural wave length of the coil. The initial capacity of the condenser acts just like a fixed condenser of 0.00004 m. f. capacity connected constantly across the ends of the coil.

Comparison with the ordinary commercial honeycomb coils shown on sheet F-20-10 shows that the distributed capacity of the Giblin-Remler coils is very low, and as a result the natural wave lengths of the Giblin-Remler coils is also somewhat lower due to the lower distributed capacity. The distributed capacity of the coil acts just like a fixed condenser connected across the ends of the coil, and hence the wave length of the honeycombs is correspondingly higher for a given number of turns.

(Continued from page 36)

prevent the use of radio by Shipping Board vessels, except at an additional expense of about \$200,000 a year. He pointed out that radio is a very great help in the saving of life at sea and should be kept free from as much additional expense as possible. He thought that even freighters should be equipped with radio, but he objected if the Government proceeded to levy a tax on vessels properly equipped with radio in the interest of safety and in accordance with the law. He told the committee that as far as he had been able to learn, no foreign country charged fees for its vessel's radio equipment, adding that the fees provided for in the White Bill for vessels were most "unusual."

Major J. O. Mauborgne, of the Army Signal Corps, read a letter to the committee from the Secretary of War protesting against several features of the bill as being "prejudicial to the national defense of the country." He pointed out the need for leaving the regulation of wave lengths for the army in the hands of the Secretary of War instead of the Secretary of Commerce, and asked for special recognition of the Army in the bill.

During the course of his testimony, he said that the Department of Commerce stands on the policy that it represents the commercial radio interests of the country as against the interests of the government departments. With the exceptions noted in his testimony, Major Mauborgne said that the War Department is in sympathy with the White Bill.

Radio Corporation

The appearance of David Sarnoff, Vice-President of the Radio Corporation, was heralded with considerable interest. Advocating the need for legislation, Mr. Sarnoff pointed out that a "common sense compromise" between the benefits of private initiative and the evils of destructive competition must be found. He believes in the freedom of radio and the freedom of speech in broadcasting, he explained. It is his conviction that broadcasting can be made commercially practicable without collecting from the receiving end; its value lies in its universality and its ability to reach all, and he objects to selling it to a few, which he said would become "narrowcasting."

The R. C. A.'s ambition, he indicated, is to put radio within the reach of everybody, and the Corporation will support efforts of the Congress to enact legislation in the public interest and will not hamper further radio development.

Likening broadcasting to a bar at which causes may be pleaded before public opinion, he pointed out that if there had been broadcasting in 1858 there might have been no Civil War; the Lincoln-Douglas debates might have been broadcast to the whole nation, and Lincoln might have achieved his peaceful program.

Those appearing on the last day's hearings included: Judge S. B. Davis, Solicitor of the Department of Commerce; J. Harry Covington, representing the Tropical Radio Telegraph Company; and C. Francis Jenkins, inventor, of Washington, D. C.

Giving the Movies a Voice

DR LEE DE FOREST, famous scientist and inventor of the Audion, which makes radio broadcasting and receiving, long distance telephone and wireless possible, has at last succeeded in producing talking motion pictures, so uncannily realistic that a new art, differing as much from ordinary motion pictures as the latter does from the spoken drama—a combination of the two—has been created.

Dr. DeForest calls his latest invention the Phonofilm. By actually photographing sound waves on the same strip of motion picture film with the action, he is now able to produce absolutely perfect synchronization of sound and movement, the one thing that always proved the stumbling block in previous attempts to put the voice in movies.

Years ago Edison attempted to make talking motion pictures by combining the ordinary pictures and the phonograph. But he never succeeded in synchronizing them. Always the action was a jump ahead or a lap behind the sound, with consequent ludicrous results. Finally he gave up the effort. Then DeForest took up the problem and achieved success by combining the radio and the motion pictures. By a miracle, too, he has eliminated the metallic "ground" sounds so prevalent in the phonograph; so that the voice in the talking pictures is the same as a voice over the telephone.

In making a phonograph record, which was a component part of all previous talking pictures, the artist spoke or sang directly into a horn. By this process, the sound vibrates a diaphragm, which actuates a stylus, generally made of a sapphire. This sapphire cuts into a disc of soft wax a record of the sound waves. From this soft wax, a cast is made, and from this cast, the finished records are moulded in hard wax.

All of this process, as will be seen, is purely mechanical, from start to finish. In addition, the metallic effect is increased because of the artist, of necessity, speaking into the horn.

In making the Phonofilm, Dr. DeForest permits the artist the same latitude as to distance and action that he has on the stage. No recording horn is used. Concealed somewhere on the stage is a microphone, so delicately attuned that it picks up every sound, no matter how infinitesimal. If a telephone rings, it is recorded; or a knock on the door or the striking of a clock. The sound waves picked up by this microphone pass through a series of Audion amplifiers to a photoelectric cell located in a special attachment which can be placed on any motion picture camera. The lights from this gas-filled electric cell fluctuate in exact accordance with the volume of sound emanating from the actor's lips. This light then passes through a fine slit and makes delicate lines upon the photographic emulsion of the film, at the same time that the action is being photographed on the film.

From the negative thus made, a positive print is made in the usual manner. Dr. DeForest has invented a special attachment that fits into any projection machine. The usual arc light is used in projecting the picture. In the special attachment is a small incandescent lamp, which causes a pencil of light to penetrate the delicate lines which have been made by the sound waves, this pencil of light taking the place of the metallic needle used on the phonograph. The high lights and shadows fall upon another tube, known as a thalofide cell, which converts these photographic light waves back into sound waves. Then as the picture, on the same strip of film is projected on the screen, the sound is likewise projected. For this purpose a wire is run from the projection machine to a loud speaker behind the stage and the sound is thrown either on the screen or through its fine meshes. Thus it will be seen that no mechanics enter into the recording or reproducing of the sound waves, as both are accomplished by means of light.

The photographic reproduction of the sound waves occupies a space only three-thirty-seconds of an inch on the left hand side of the film, next to the sprocket holes, where it does not interfere with the pictures of the action. If the film should break, in the middle of a sentence, it is patched in the usual way. For the numbers of "frames" to a word are so many (just as they are in a scene) that two or three or even four may be eliminated without causing a noticeable break in the conversation.

One of the most remarkable talking pictures made by Dr. DeForest has just been completed of Chauncey M. Depew, venerable statesman, diplomat and after dinner speaker, 90 years old this month. Every word he utters, even an occasional cough, is faithfully recorded, in perfect synchronization with the movement of his lips and his gestures.

Fifty Million Audience

Radio broadcasting's greatest feat was performed the night of March 7 when stations located in San Francisco, Hastings, Neb., East Pittsburgh, Pa., Schenectady, N. Y., New York City and London, England, broadcasted simultaneously the Annual Alumni dinner given in New York City by the Massachusetts Institute of Technology. Engineers who had been working many months to perfect a radio relay or repeating system between San Francisco and London, a distance of more than 7,000 miles, had the satisfaction of knowing that their efforts had been rewarded by radio waves covering a million and a half square miles and that 50,000,000 people had been estimated as the number of available listeners.

Microphones placed in the main ball room of the Waldorf-Astoria Hotel in New York were the starting point in the radio repeating and broadcasting system. It was here that the speakers addressed directly their audience.

VACUUM TUBES (JJ-5-20) VACUUM TUBE CONSTRUCTION

FILAMENTS. When heated to a state of incandescence by the low voltage "A" battery, the filament of the tube gives off the electrons which act as the carrier stream for the plate current. This filament is generally of the "balr-pin" type often seen in the low voltage battery lamps, but in most cases is made of a different material than that used for the lamps in order to obtain the maximum electron emission per watt of battery current. The current consumption of a tube is of the greatest importance and every effort is made to cut this down to a minimum so that dry cells can be used with satisfactory results in place of the more expensive and troublesome storage batteries.

Among the more common filament materials are pure tungsten wire, pure platinum wire, thoriated tungsten (XL Filament) and the oxide coated wire. The last two are the most generally used at the present time because of the greater electron emission efficiency and their lower operating temperatures. The pure metal filaments ordinarily operate at a very high temperature, generally a brilliant white state, while the treated filaments glow with a deep red color, sometimes almost invisible except in the dark.

PURE TUNGSTEN FILAMENTS. The pure tungsten filament is the same as that used in the ordinary incandescent lamp, and operates at a very high temperature with a comparatively low electron emission. Owing to the comparatively low cost and the simplicity in exhausting the tubes, this filament is the one frequently found in the cheap bootleg tubes. The older tubes were of this type also, but within the last year the legitimate makers have practically discarded the pure metal filament for the more efficient treated types.

PURE PLATINUM. Pure platinum is used under the same circumstances as the pure tungsten, and has the same general operating characteristics. Like the pure tungsten filament, the filament operates at a very high temperature, has a comparatively low electron emission, and is only used in the pure state in the cheaper tubes. Like the tungsten, it is a good manufacturing proposition and can be made very uniform in regard to voltage and current consumption with little expense.

(XL) THORIATED TUNGSTEN FILAMENT. This differs from the pure tungsten filament in having a small percentage of a thorium compound mixed in with the tungsten to form an alloy before the wire is drawn. During the course of operation, the thorium gradually evaporates until at the end of the useful life of the filament, only the tungsten remains. Thorium gives off electrons at a very much lower temperature than pure tungsten or platinum, hence the electron emission per watt is very much higher than with a higher temperature. Furthermore, the filament has a longer life. The emission remains fairly constant until the thorium disappears, whereupon the tube assumes the characteristics of a pure tungsten filament requiring a higher operating temperature.

The electrons are emitted from the outer layer of thorium or "skin" which is only one molecule deep. As this skin evaporates under normal conditions it is continually replaced by the thorium in the interior which gradually soaks through and merges with the outside layer. Should the temperature of the filament be raised to the point where the evaporation is greater than the rate of supply, then the emission will soon fall off or the tube will cease to function altogether until the temperature and evaporation are reduced to where the supply of thorium from the interior equals the rate lost by evaporation from the surface.

VACUUM TUBES (JJ-5-21) VACUUM TUBE CONSTRUCTION

THORIATED TUNGSTEN—Continued.

If the excess temperature and filament voltage are not applied for such a long period that all of the thorium is exhausted, then the filament can be restored by heating the filament at the normal temperature for from 15 to 20 minutes with the plate current off (without "B" battery). This allows the thorium in the interior to soak through to the outside to form another emitting film. This treatment is effective providing that all of the thorium has not been exhausted by prolonged overheating.

The UV-201A and the C-301A are examples of tubes having thoriated tungsten filaments. This accounts for the small current consumption of these tubes and their high efficiency in terms of emissivity. The old UV-201 and the C-301 having pure tungsten filaments are much less efficient than the later type. The emissivity of the UV-201 or C-301 is approximately 1.6 milliamperes (plate current) per watt of filament current. The emissivity of the UV-201A and C-301A is approximately 36 milliamperes per watt of filament current or over twenty times that of the old tubes with the pure tungsten filaments. This means that the newer tubes do not exhaust the "A" battery so rapidly, or what is the same thing, more tubes can be used with the same rate of battery discharge.

In comparison with other filaments, the thoriated or XL filament is best adapted for low current tubes as it can be made in smaller sizes than the coated filaments, and again it is capable of withstanding high voltages which makes it well fitted for use in power tubes. A special method of exhaustion is used with the thoriated filament tubes if necessary, in order to maintain a high degree of vacuum throughout the life of the tube. This method of removing gases from the interior of such tubes leaves a deposit on the glass which causes the discoloration or silvery coating seen on the bulbs of the UV-201A, C-301A, UV-199 and C-299 tubes. This method causes the vacuum to improve during the life of the tube and thus reduces one cause of rapid decline toward the end of the useful life experienced in straight exhaustion. The pressure inside of a completed XL tube is less than one-half millionth of the atmospheric pressure.

COATED FILAMENTS. A coated filament is used where a very low voltage "A" current is desired as with the WD-11 and WD-12 tubes where a single dry cell of 1.5 volts is employed. In a few cases, notably with the Western Electric tubes, a coated filament is also used for power tubes, but this is the exception rather than the rule.

A coated filament, as the name suggests, is a built up structure. It consists of a metallic platinum wire on which a coating of highly emissive oxides is applied. Such tubes operate at a very low temperature, even lower than that of the thoriated or XL filaments, and should be kept at a very dull red that usually can only be well seen in the dark. As with the XL filament tubes, a "clean up" chemical agent is also employed in creating and maintaining a high vacuum, but this agent does not cause discoloration of the bulb as with the thoriated tubes, although a small deposit may be seen occasionally on the interior glass stem support.

The coated filaments give a very high emissivity at the beginning, and the initial efficiency is often greater than that of the XL type, but this falls off gradually as the coating evaporates. There is not the same uniformity among tubes of the same make and type with coated filaments as with XL filaments, and hence there is much variation in the results obtained with the individual tubes. It seems difficult to produce a uniform coating.

The Loop Antenna

By R. H. LANGLEY,
Radio Engineer, General Electric Co.

THE loop antenna is a very interesting device. It is unique different in its method of operation from the outdoor antenna. The outdoor antenna is in effect nothing more nor less than a condenser. It is a very large condenser to be sure so far as its physical dimensions are concerned, but electrically it is a relatively small condenser. The loop on the other hand is an inductance. This fundamental difference between the two is the reason why it is necessary to use different methods of tuning in the two cases.

Let us examine this special form of inductance, which we call a loop and see why it serves as a pickup device for radio signals and how it should be made to be effective.

There is a very close parallel between the ordinary direct current generator or dynamo and the loop antenna exposed to passing radio wave. In the dynamo a number of coils corresponding to the loop antenna are rotated in a powerful magnetic field. The purpose of rotating them is in order that they may move with respect to the field and thus have a voltage generated in them. The amount of this voltage depends, of course, upon the strength of the field and the speed at

which the wires are swept through it.

In the radio case, the coil stands still, but the field moves swiftly past the coil, thus accomplishing the same result. The speed at which the field moves cannot, of course, be varied and is always the speed of light, that is 186,000 miles per second.

Let us see now what form of loop would have the greatest voltage generated in it by a passing radio wave. Let us think of this radio wave as very much like great smooth waves on the ocean, which, of course, also move forward with a very definite velocity. The turns of wire on our loop antenna are necessarily in series with each other, that is to say, they form a continuous winding. If the maximum voltage is to be generated in any one turn of the loop, then the voltage generated in the two sides of this turn should be in opposite direction so that they may add and not oppose each other. If the voltage generated in both sides of the loop were in the upward direction at any one instance, then these two voltages would cancel each other, but if the voltage on one side of the turn was up and on the other side of turn, it was down, then they would add and if the loop were connected to a receiver, a current would flow

around the turns of the loop. This is, of course, exactly what we wish to have happen.

Now in order to have the voltage generated on one side of the loop in the opposite direction to that generated on the other side of the loop, the loop would have to be one-half a wave length long, that is to say it would have to be long enough in the horizontal direction so that one side was in the crest of the wave when the other side was in the trough of the wave. Since the distance between the crest of the wave is the wave length itself, then the distance from the crest to the trough is one-half the wave length.

The higher the sides of the loop are, that is, the longer the vertical wires are, the greater will be the voltage generated, and of course the voltage generated in each turn is added to the voltage generated in all the other turns.

But a loop one-half a wave length long is quite out of the question. It would be as long as a steamship and almost as difficult to handle. The loops which we are using every day are of quite reasonable dimensions. They are only a few thousandths of a wave length long. How do they function? In order to answer this

(Continued on page 43)

The DeLuxe NEUTRODYNE BUILD THIS FAMOUS 5 TUBE KIT

Complete Assembly Outfit of Receiving Set to Reach From Coast to Coast.

WRITTEN Money-Back Guarantee. This is the amazing set selling by thousands all over America. No radio knowledge needed, no skill with tools, no experience. Every one instantly understands our extra complete instructions and simple, clear blueprint diagram. Just 2 or 3 hours fascinating fun builds your set. You can't go wrong. You get the big broadcasting stations. Extraordinary long distance from Coast to Coast is easy. Only the best in this set—ALL genuine STANDARD NEUTRODYNE parts LICENSED under the original HAZELTINE patents and guaranteed to give perfect results and satisfaction. Also all parts are MATCHED for beautiful appearance. The front is the handsomest ever made, reproducing fine mahogany, with every marking engraved in GOLD. A magnificent ornament. A perfect, highest grade, efficient, powerful instrument that you cannot duplicate for THREE TIMES THE PRICE.

WHAT THIS GENUINE STANDARD SET CONSISTS OF—
1 Drilled Radion Mahogany Panel, like mahogany, engraved in gold; 3 4-inch Radion Mahogany Dials, gold engraved; 2 gold-plated Jacks; 3 genuine Hazeltine Neutrodyne transformers mounted on the famous Comaco Bakelite End Condensers (positively the only Neutrodyne Kit including these famous Comaco Condensers); 2 Hazeltine Neutrodyne; 5 Bakelite Sockets; 1 6-ohm Rheostat, and 1 20-ohm Rheostat with gold-plated knobs to match panel; 2 genuine Killark completely shielded Audio Transformers; 1 Baseboard; 20 feet Tinned Bus-Bar; 1 .0025 Freshman Grid Condenser; 1 Tubular Glass Grid Leak; 1 Set Engraved Binding Posts; 1 .002 Micon Condenser; 1 .006 Micon Condenser; Exact Size Special Panel; Instructions and Blue Print; all packed in large handsome partitioned box, \$34.49 complete.

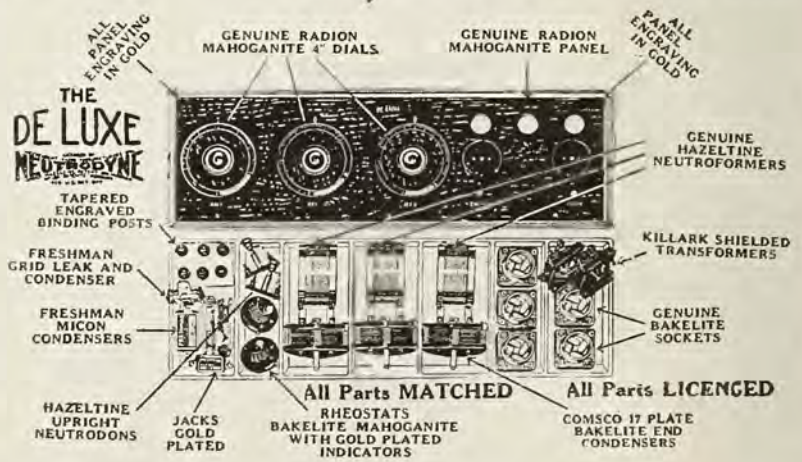
ACCESSORIES TO PUT SET IN OPERATION. Everything needed to operate set after building—5 Tested Tubes (Type 201A), \$19.50; 2 45-volt extra large Variable "B" Batteries for Neutrodyne, \$6.50; 1 60-ampere Hour Storage Battery (guaranteed 2 years), \$11.25; 1 pair 3,000-ohm Head Phones and Cord, \$3.75; 1 Antenna Equipment, \$1.50; COMPLETE OUTFIT, \$35.40. (Accessories also sold separately.) If you order Building Outfit and Operating Outfit both together we will include fine Mahogany Finish **CABINET FREE.**

SEND NO MONEY. We ship C. O. D. Pay your postman. Then build and enjoy your set under our WRITTEN Money-Back Guarantee sent with equipment. We acknowledge all orders by return mail. Ship same or following day. We answer every letter we get on same day. The Radio Shack are the largest Radio Dealers in America. No inferior goods. Only the best and most reliable. You buy in safety. Send your C. O. D. order today. This present low price cannot continue. **Act NOW.**

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GENUINE STANDARD HAZELTINE NEUTRODYNE
WRITTEN MONEY-BACK GUARANTEE

SEND NO MONEY
\$34⁴⁹
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Send Coupon

If I have marked a cross (x) in UPPER square at left ship me the De Luxe Neutrodyne, \$34.49, C. O. D. If I have marked a cross (x) in LOWER square at left ship me Complete Outfit of Operating Accessories, \$43.40, C. O. D. Send CABINET FREE if I have ordered both together. Everything ordered is subject to your WRITTEN Money-Back Guarantee.

Mark X here only if you want radio set.

Mark X here only if you want operating outfit.

Name (Print Plain).....

Address.....

FREE BARGAIN LIST Mark X

Pickups & Hookups

(Continued from page 31)

lieve our contributors to the very word—if they take advantage of our faith in them—and the other fellows kick enough we will have to require confirmations from very distant station. We don't want the Pickups fans and DTs to be dubbed a bunch of "radio liars," so let's be a little careful about putting the name and call of a station down before we are quite sure.

I am sure that his warning against dishonest salesmen will be appreciated.

The Pickups Editor can remember way back when he used to jump with glee and joy when a code signal first came in through his "radio receiver," consisting of an 80-foot antenna, one pair of phones (they looked more like Indian clubs), a mineral detector and a phone condenser—what a contrast the following presents:

RADIO AGE,

Gentlemen:

I am submitting the list of stations received from March 1st to March 9th on my Crosley set:

WCAL, WOAW, WOS, WHAS, KOB, WMC, WOR, WHAA, WHB, WDAR, WBZ, WCAE, KFKB, WCX, WCBD, WGY, CKCK, WJAZ, KFI, WCAP, WSB, WBAP, WFAA, KYW, WMAQ, WAAF, WOC, WMAJ, KFKX, WOR, KDKA, WIP, WWJ, WTAS, WEA, CFCH, WLW, WSAI, KOP, WJAX, WTAY, WOAG, WLAG.

I am 11 years old.

Very truly yours,

Hudson Potter.

1201 N. Main St., Rockford, Ill.

Beginners in the game refuse to get a thrill out of listening unless they hear at least a dozen outside stations the first time they operate. Nowadays an eleven-year-old boy gets 19 stations in nine days. Wot r we cuming to?

William F. Bird, Jr., of 860 West Avenue, Buffalo, N. Y., wants to be put on the DT list. He got 34 stations in one night on a single circuit, and says, "It's everything it's cracked up to be." He has picked up 92 stations, including PWX, 6KW and WKAQ. Tts FB, OM.

Edward Brechel of 3447 North Seeley Avenue, Chicago, Ill., wants to help the Cockaday title along. He says:

"I built the Cockaday according to the diagram in the RADIO AGE last August. It was my first attempt at radio. Talk about sharp tuning—it's like taking candy from a baby."

To substantiate his claim, he encloses a list of 83 stations heard over a period of seven weeks.

Verlin Shinn of 1121 West Sycamore Street, Kokomo, Ind., has a list of stations, 30 in all, including KHJ, 3 Canadians, and others which puts him on the DT list.

RADIO AGE,

Gentlemen:

I have been a reader of your magazine for some time now and it certainly is the "goods." The Pickups

Department is a very good idea and that is the first thing I look at when I get RADIO AGE, but I have never seen any pickup records from Montreal under this heading. Wake up, Montreal fans, show our friends in the United States that you, too, can get distance and pile up stations. Here is one who wants to see what you are doing. Come on, now, send them in.

The following is a list which almost everyone who owns a one-valve set in Montreal should be able to duplicate and perhaps better. This list was received in four days, averaging two hours per night, on a Reinartz one-tube receiver, using the famous Northern Electric No. 215A peanut tube; using a Freshman "Antenella" in the lamp socket and a bedspring for the ground. I received excellent results with this arrangement, music and speech coming in very clearly. The stations marked with a star (*) are received whenever they are broadcasting.

Station	Location
*CKAC	Montreal, Que.
*CFCE	Montreal, Que.
*CHYC	Montreal, Que.
WHAZ	Troy, N. Y.
*WTAM	Cleveland, Ohio
WOR	Newark, N. J.
*WEAF	New York, N. Y.
WJZ	New York, N. Y.
*WJAX	Cleveland, Ohio
WFI	Philadelphia, Pa.
WCAE	Pittsburgh, Pa.
*WRC	Washington, D. C.
*WCAP	Washington, D. C.
*KYW	Chicago, Ill.
*WDAP	Chicago, Ill.
*WJAZ	Chicago, Ill.
WDAR	Philadelphia, Pa.
*KDKA	Pittsburgh, Pa.
*WGY	Schenectady, N. Y.
*WBZ	Springfield, Mass.

Now for a correction in the March number of RADIO AGE. Under the Pickups Department, H. S. Frederickson, 406 Howard Street, Charles City, Ia., lists "35, Station CKAC, Calgary, Canada." This is an error, as station CKAC is the Lapresse Publishing Company's station, Montreal, Que., Can.

Here is a suggestion. Being troubled by interference from a local station and not being able to tune him out, I connected an old crystal receiver to the valve set, and it acted as an excellent wave trap, enabling me to tune out the interfering station completely and tune in KYW and WJAZ, Chicago, Ill., in less than ten minutes. This was the first time that I tuned in the two above mentioned

stations, but have tuned them in often since. Not a bad idea, I think.

Will you kindly publish this letter in your Pickups Department, if it will not take up too much space, and then get ready for a shoal of letters from Montreal, with distance records.

Very truly yours,

H. Winkle.

835 Bordeaux Street, Montreal, Que., Can.

All right, Mr. Winkle—we'll brace ourselves for the mail. We'd like to hear more from our Canadian friends.

Before signing off, we want to call your attention to our little summer vacation portable receiver contest—let's see who can get the biggest pickup record on a portable receiver.

BREMER - TULLY

\$500 Nameless Circuit

B T 3 Circuit R. F. Transformers and the \$500 Nameless Circuit have solved the problem of Radio Frequency Amplification—Nothing to equal it for strength of signals. Orders are far in excess of production. Place your order with your dealer at once for future delivery. Illustrated folder of Diagrams, etc., on request.

BREMER - TULLY

Manufacturing Company

532 S. Canal St. Chicago Ill.

378 DX STATIONS

DX Fans. If you have not logged 300 stations in past six months you need a Kennedy Three Circuit Tuner. The Kennedy Tuner logged 378 stations from September 15th to March 15th, including 2LO, London; 5WA, Cardiff, Wales; CFCN, Calgary, Alberta, Canada; KGW, Portland, Oregon; KFI and KHJ, Los Angeles, California; KPO, San Francisco, California; KGO and KLLX, Oakland, California.

Kennedy Tuner Takes the Place of

3 Honeycomb Coils at \$1.40.....\$ 4.20
1 Honeycomb Coil Mounting..... 5.00
1 23-Plate Vernier Condenser..... 5.00

INCLUDING GLOBE \$5.00 \$14.20
TROTTER DIAGRAM

T. J. KENNEDY

Radio Globe Trotter

470 W. 159th Street, New York, N. Y.
GUARANTEE: If not satisfied after 30 days will cheerfully return your money.

LATEST HOOK-UPS

Blue Prints Show You How To Build Your Own 17"x27" blue print gives complete instructions, pictures, hook-up, wiring diagram. Shows full size templates for drilling panels. Your choice of these hook-ups:

Reinartz Tuner.	5 tube Nontrodine.	50c
One Tube Reflex.	4 tube Superdyne.	
Radio & Audio Free Amp	4 tube Reflex.	
Honeycomb Rec.	3 tube Cockaday.	
Ultra Audio Rec.	2 tube Amp.	

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Soldering Made Easier

No soldering outfit is complete without a good brush for applying the soldering acid. Every radio dealer should carry these in stock. Put up, 1 gross to the package. Send for prices and samples.

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11400 Madison Ave.,
Cleveland, Ohio

Always Mention RADIO AGE When Writing to Advertisers

Trouble The Shooter



A. E. H., Chicago, Ill.

Question: I made one of your Low Loss Tuners as described in the March, 1924, issue of RADIO AGE, and I find it highly selective, just as you say it would be. I do not, however, get the long-distance stations I am seeking, and would like to have you suggest what my trouble might be. I use a 125-foot antenna, single wire, about 40 feet off the ground. Wound the coils as specified, putting 22 turns on the tickler. Fixed grid leak 2 megohms with UV199 tube. I am using an 11 plate condenser across the secondary.

Answer: Would like to suggest that you rewind the tickler with a smaller wire about No. 24, and make it have 25, 28 or even 35 turns. The tickler in connection with the grid leak (which I think has too low a value) should be adjusted so as to effect a delicate control of the regeneration. Would advise the use of a pencil mark grid leak, which can be easily adjusted to maximum effectiveness after a little experimenting. You might try varying the B battery voltage, but I am sure that this is not necessary if the set is adjusted with respect to the tickler and grid leak, which are very important units of any set.

J. J. B., Toronto, Ont., Canada.

Question: I constructed one of your Baby Heterodyne receivers and have been getting very good results with it, hearing many long-distance stations. I desire to add two stages of amplification, and would like to know if you think that it will operate a loud speaker. I am getting signals with good volume on the detector unit now as it is. Please let me have a diagram.

Answer: I am printing a diagram of the Baby Heterodyne as described in the

February issue in Figure 1. The connections shown require a separate B battery. The set should operate a loud speaker on stations of about 500 miles using average power.

M. R. C., Los Angeles, Cal.

Question: I have constructed one of the Baby Heterodyne receivers as specified in the February, 1924, issue of RADIO AGE, and do not seem to be getting the results I should. I followed the specifications as closely as possible,

of all, make sure that all your coils are wound in the same direction. If they are bucking each other, the set will not work. Try reversing one of the terminals of the M and N coils. Do not reverse both coils or you will still have the same trouble. Mr. Rathbun failed to state in his article that coils M and N should be bank wound, which gives rise to the many questions as to how these coils should be wound into the small space shown in the isometric sketch. Further, I would suggest that you substitute a set of honeycomb coils of the

proper number of turns for coils M and N, as later experiments with the set prove that they are just as effective as hand-wound coils. These honeycomb coils should be mounted on a piece of mailing tube, and the coupling between them should be varied until the greatest effective position is found. Start with about $\frac{3}{4}$ -inch coupling, and vary until you find it operates easiest and with the greatest clearness. WD11 or WD12 tubes do not give the best results due to their respective construction of grid and plate, which makes them a poor tube at audio frequencies in this circuit. The dry cell tube of the UV199 or UV201A type is much to be preferred. The characteristics of the WD tubes also give rise

IMPORTANT NOTICE Regarding Technical Information Service

AFTER May 1st, 1924, the Technical Office of RADIO AGE will operate under the following rules:

- (1) Before writing, search your files of RADIO AGE, and you will without question find answers to your inquiries there.
- (2) Do not ask us to compare advertised products. Information of this nature should be obtained from the manufacturers and not RADIO AGE.
- (3) Don't expect the Technical Office to devote its entire efforts to your questions by asking a great number of them—stick to the subject you are puzzled about, and don't put down everything you can think of. Also do not request information that would require a large amount of work; give the other fellow a chance.
- (4) Put questions in the following form:

A—A standard business size (not freak party invitation or correspondence) stamped, self addressed envelope must be enclosed. A stamp alone will not get you an answer.

B—Write with typewriter or ink, and on one side of the paper only. Pencil letters will not be considered. Most all radio men write a terrible "paw," so if possible use a typewriter.

C—Make diagrams and questions on separate sheets, and fasten all correspondence together. Label your diagrams carefully. Failure to fasten your correspondence usually results in losing some part of your letter when the mail

is sorted. Put your name and address on each sheet.

D—Write orders for back numbers, subscriptions and the ANNUAL on separate sheets. You'll get an answer sooner if you take the time to write your questions on separate sheets, as above specified.

E—Keep a copy of your letter and diagrams so that we can refer you to them.

F—Address all requests for information to RADIO AGE, Inc., Technical Office, 500 North Dearborn Street, Chicago, Ill.

but still find that it does not work. The set is not selective, only gets local stations without much volume, and has much body capacity. It is often afflicted with a high pitched squeal, which cannot be varied by turning the condensers, and no amount of tuning will remove it.

Answer: I have referred the matter of troubles with the Baby Heterodyne personally to Mr. Rathbun, the designer of the set, who suggests the following cures for troubles with the receiver: First

to the presence of body capacity in the circuit. One way of remedying this defect is to reverse the connections of the secondary condenser. The rotary plates should be connected to the filament, and the stationary plates should go to the grid circuit. The high pitched squeal is no doubt caused by the grid leak not being properly adjusted. Use a pencil mark type grid leak and adjust it until the highest efficiency is obtained. Instructions on the

(Continued on page 44)

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Loop Antenna

(Continued from page 40)

question let us ask ourselves how we would build a coil of wire in order that absolutely no voltage should be generated in it by the passing wave. The only way in which this could be accomplished would be to so build the coil that the same voltage would be generated in both sides of it and that the voltages generated in the two sides would be opposed to each other.

This would give a complete cancellation and no voltage at all at the terminals of the loop or coil. It is obvious that the only way in which this could be done would be by so arranging the loop that it had no length at all. That is to say, arranging it so that the two sides were exactly in the same position in space. This would mean that the horizontal wires across the top and bottom of the loop would cease to exist and the loop would become nothing but a wire laced up and down between pegs on the plain surface of a board.

If there is any distance at all between the two sides of the loop, then there will be some difference not in the amount of voltage generated in the two sides, but in the time at which this voltage is generated and there will consequently be some voltage at the terminals of the loop since complete cancellation of voltages cannot occur.

If the loop is rotated so that its horizontal wires are at right angles to the direction in which the signal is coming, then the loop has no length so far as those signals are concerned. The passing wave strikes both sides of each turn in the loop at exactly the same instance and the voltages generated are therefore equal and opposed and there is no terminal voltage. This is, of course, the fact which gives the loop antenna its very useful directional property. It is to be noted, however, that if the loop is turned ever so slightly from this zero position then the voltages no longer cancel and there is a voltage at the terminal. This means that the zero position of the loop is very sharp, but the maximum position is very broad.

In applying the loop antenna to an actual radio receiver, it is necessary that provision be made to tune it to resonance with the desired signal. This is accomplished by means of a variable air condenser and since this condenser has a very definite maximum capacity, the amount of inductance which the loop can have is also limited. This maximum inductance with the maximum capacity of the variable condenser must give resonance to the longest wave to be received. The specification for the best loop antenna, therefore, is that it shall have just as many turns as possible, each turn being just as long as possible and just as high as possible and still have no more than the required maximum inductance. The higher the loop is, the greater will be the voltage generated in each side of each turn and the longer it is, the greater will be the difference in time at which these voltages are generated in the two sides of the loop and consequently the greater will be the voltage at the terminals, but it must not have an inductance value greater than that required for tuning

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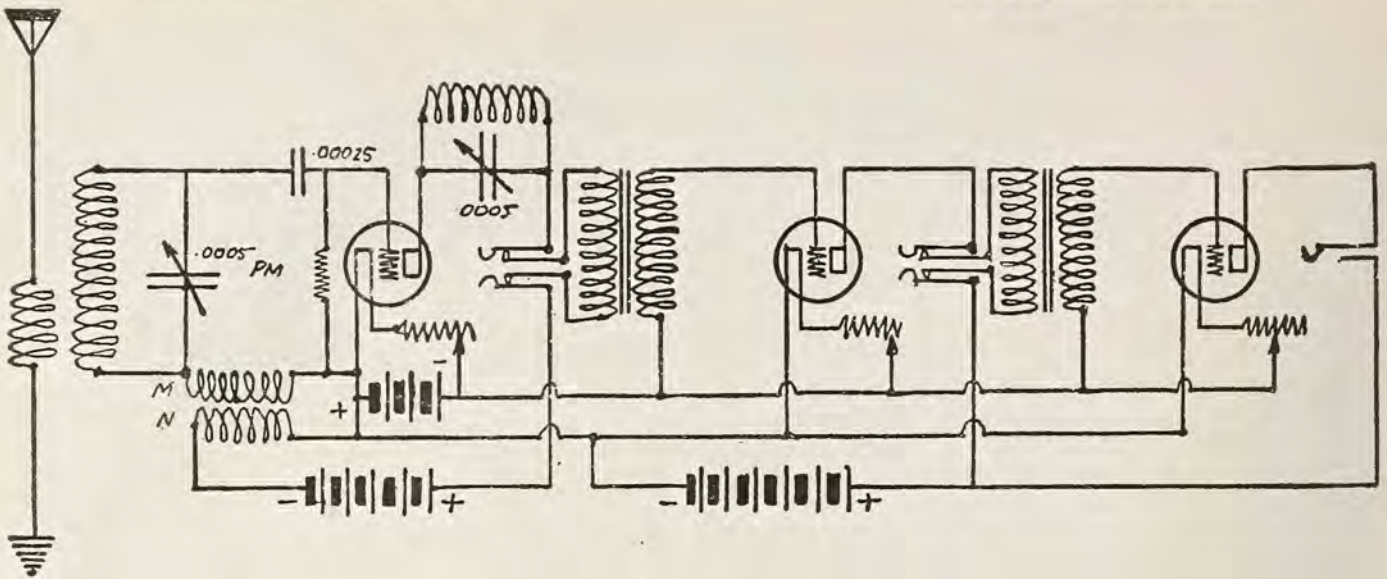


FIGURE 1

A wiring diagram of the Baby Heterodyne, as described in the February, 1924, issue, in connection with a two-stage amplifier. This set requires the use of a separate set of B batteries.

(Continued from page 42)
 construction of a pencil mark grid leak appeared in the July, 1923, RADIO AGE, and can be found in the RADIO AGE ANNUAL. The use of WD 11 or 12 tubes in the circuit is also another cause of broadened tuning, and I would suggest that you refrain from using them. Selectivity and long antennas do not go together, and if your antenna is a long one, cut it down. Experiments show that good work has been done with antenna of not over fifty feet in length. I am sure that if you carry out these changes you will find that the set will do everything that is claimed for it.

K. N., Portland, Ore.

Question: I made one of the super-

heterodyne receivers described in the March, 1924, issue, but I am not getting results. The signals from local stations come in with good volume, but the turning of the oscillator condenser seems to have no effect at all upon the signal. Is this right? I can turn the dial all the way around without the slightest change in signal strength or pitch. I have checked over the set again and again, and find that the connections are all made as specified. Used good parts, and I know that my tubes are not defective, having tested them out in other sets. What would you suggest?

Answer: The trouble lies in the fact that the wiring diagram of the oscillator is not correct, having no filament return connection. If the remainder of your

set has been properly connected, and if you will connect the oscillator as the accompanying diagram (Figure 2) shows, you will have no trouble in getting the proper results. The oscillator dial should be very sharp in its tuning, the signal coming in only on two points on the dial. These points are sometimes so sharp, covering probably only a fraction of a degree, that care must be taken not to pass over them. The tuning on the secondary condenser may seem a little broad on local stations, but the oscillator is always very sharp. If you will make this correction, the set will function properly without questions.

R. P., New York City, N. Y.

Question: In the November, 1923,

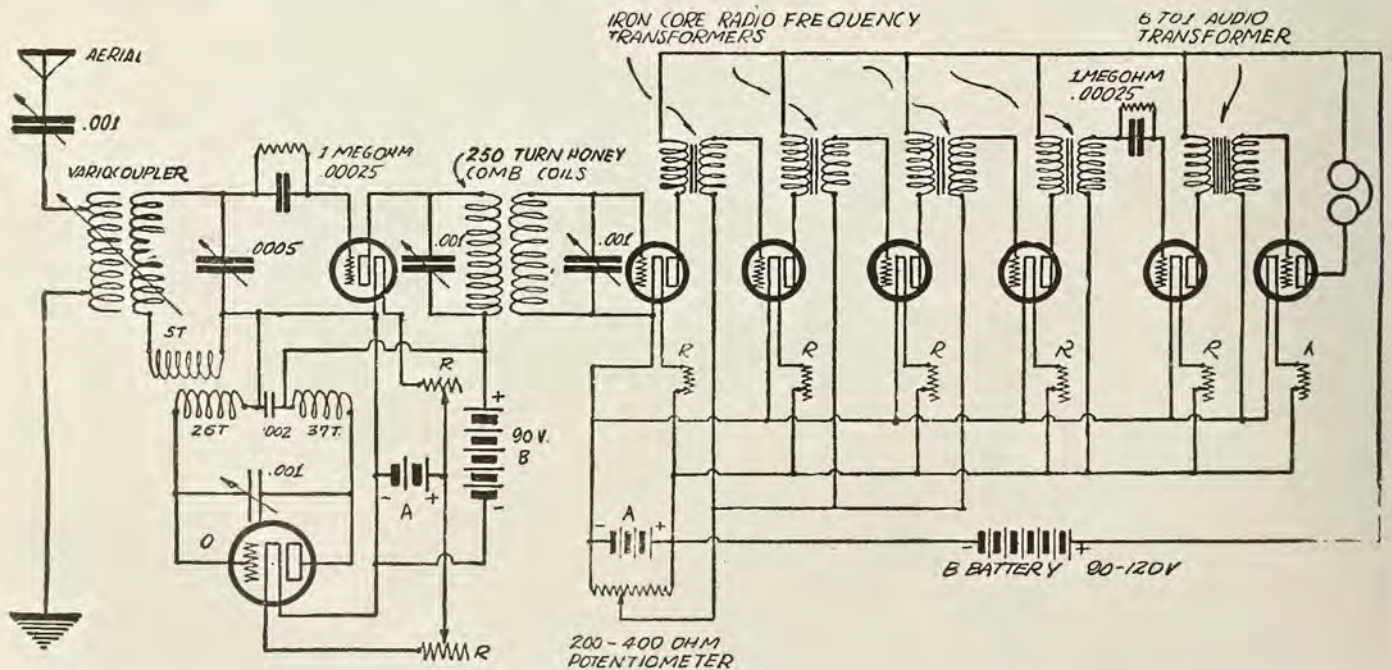


FIGURE 3

A wiring diagram of the super-heterodyne receiver, given in the November, 1923, RADIO AGE, with changes in the oscillator and modulator circuits, which have been found more efficient.

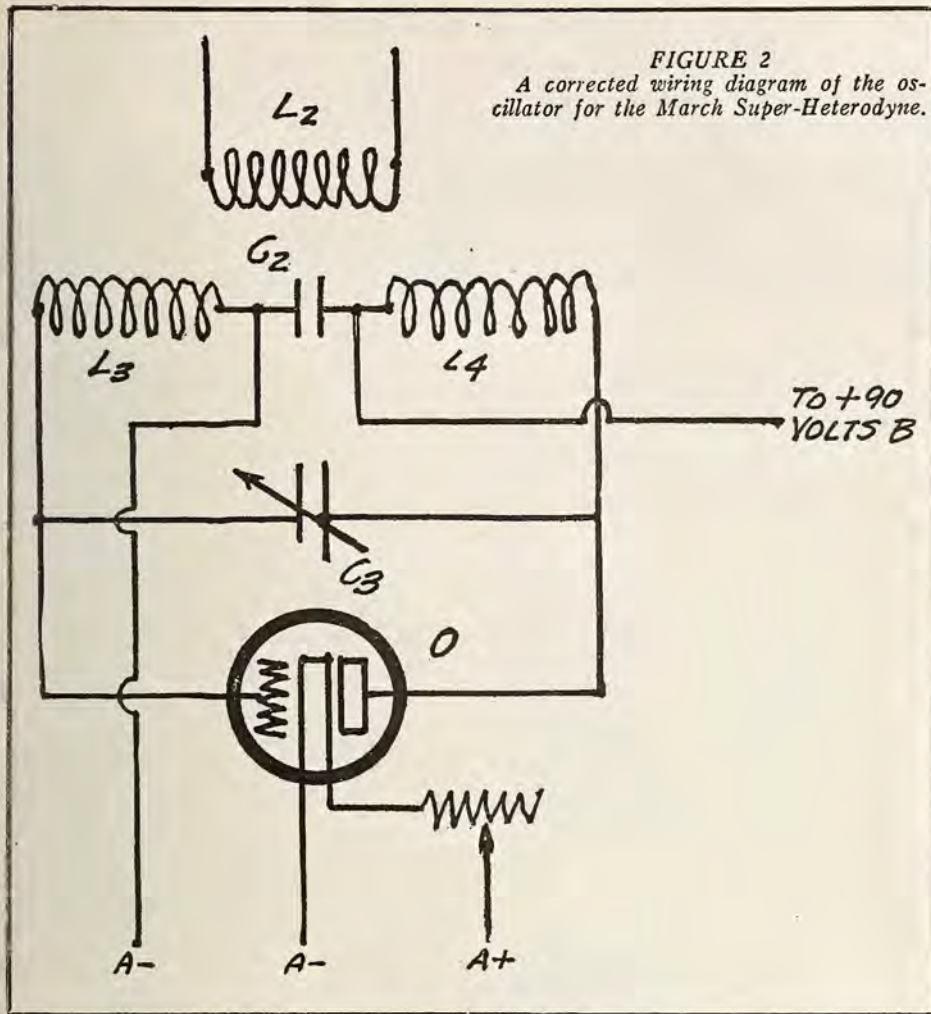
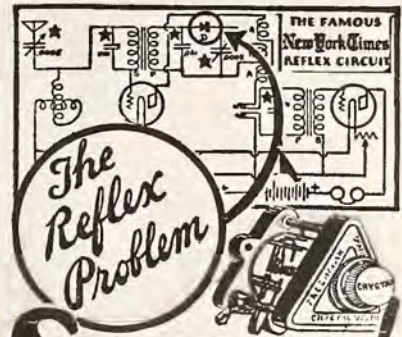


FIGURE 2
A corrected wiring diagram of the oscillator for the March Super-Heterodyne.

issue of RADIO AGE you publish a diagram of the super-heterodyne receiver, I notice that all other tubes but the oscillator and first detector have filament rheostats, and I wonder if this is correct. I have constructed the set, but find that it lacks with respect to control, and I wonder if this is not the defect. Please print a diagram showing how the rheostats should be connected.

Answer: The reason no rheostats were shown is due to the fact that Mr. Pearne suggests the use of WE tubes, which are rated at 6 volts 1.5 ampere, which would not require a rheostat in either case. However, if other tubes are used as oscillator and modulator, the rheostats should be used and the connections should be made as shown in Figure 3. I am also suggesting a few changes in the oscillator which have been found of improvement through further experiments. These changes take place in the number of turns on the oscillator coils. Some kind of hard tube should be used for oscillator in the set, preferably a UV201 (old type), WE or VT1, UV201A or, better still, a UV202 transmitting tube. With these changes, you should be able to get much better results than with the old circuit. I might also say that the primary of the long-wave coils may be tuned with a .0005 MF fixed condenser of the mica type, taking the place of the .001 MF condenser now shown. The secondary should

be tuned with the variable condenser, in the following manner: A buzzer and battery of extremely low power should be connected across the terminals of the first condenser (primary long-wave condenser). The secondary should be shunted by a crystal detector and a set of headphones. Setting the buzzer into operation, the secondary condenser is turned until the signal is heard at maximum, indicating that the two coils are in resonance. The long-wave coils are then tuned, and the set is ready for use, after the buzzer and head set, together with the battery and crystal, are removed.



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"For efficient reception with loop aerials, a correct relationship must exist between the length of wire in the coil, the number of turns and the total of the areas enclosed by the several turns. In the Betts-Bonner loop a unique arrangement of wire gives a total enclosed area over 50 per cent greater than that enclosed by the ordinary type of loop of corresponding dimensions and wound with the conventional flat or pancake coil with 1/4-inch spacing.

"The two binding posts make it possible to use one of two different numbers of effective turns—giving a wide range of wave lengths and more efficiently adapting itself to the varying antenna requirements of different sets and 'hook-ups'.

"The range of wave lengths, in connection with a receiving set of average efficiency and tuned by a variable condenser of .005 capacity, is from 100 to 610 meters. Higher wave lengths are reached if the tuning condenser has a greater capacity, or if a fixed condenser is added across the loop terminals."

Willard Booklet

"Better Results from Radio" is the title of a booklet issued by the Willard Storage Battery Co., Cleveland, O. The publication is illustrated and takes up various phases of battery care and operation in a way that offers valuable assistance to the radio fan. The booklet describes also the Willard Colloid Rectifier, which keeps "B" storage batteries fully charged. The book is sent free to those writing for it.

Republic Transformer

The Hansen Co., 1772 Wilson ave., Chicago, manufacturers of the Republic Audio Frequency Transformer, gives the following information regarding their product:

"The coils are wound by an entirely automatic process on automatic coil winding machines designed and built by our engineers, using No. 40 magnet wire with the very best insulation, and of exactly the correct number of turns. The metal case is enameled with nickel plated trimmings. The laminated cores of silicon steel are correctly proportioned and shaped for the most effective Electrical field. The primary and secondary posts are clearly marked so that there need be no error in connection."

The list price is \$2.50.



R. C. A.'s Publication

The Radio Corporation of America has a very pleasant way of greeting its customers and friends. Twice every month it sends out a little publication called The Town Crier. According to the editors, Pierre Boucheron, advertising manager of the R. C. A., and Charles T. Wandres of the Advertising Department, The Town Crier is not primarily a sales promotion paper or a serial catalog. It is intended merely to say hello and to



Pierre Boucheron



Charles T. Wandres

be a friendly little chat such as would take place should one of the executives of the corporation stop in at a dealer's shop. A page of editorials, cartoons and the like is followed by a page of descriptions of successful selling methods used by dealers and distributors throughout the country in selling Radiolas and Radiotrons. Photographs are shown wherever possible, giving first hand information on window displays, booths, advertising literature and advertisements that have produced sales. All articles of a similar nature are grouped together under a suitable column head, such as "Window Displays," "Sales Gleams," "Advertising Tie-up," "Behind the Counter," etc.

Page three usually contains a number of articles of general radio interest by leaders in the industry. Some recent articles have been "Paying for Broadcasting," by David Sarnoff; "Radio and the Farmer," by Owen D. Young; "In the Radiola Factory," by H. T. Melhuish, and many more. The fourth and last page contains the technical departments, which give complete descriptions of new items in the R. C. A. line, new developments and circuit improvements for existing models, explanation of operation for sets, Radiotron characteristics and performance, and R. C. A. service notes.

The Town Crier circulates twice a month among the entire list of R. C. A. radio dealers and distributors and their salesmen, and about 2,200 phonograph dealers all over the country. During the first six months of its existence, just completed, The Town Crier has made many friends in the trade who report that they enjoy the periodical and its friendly helpfulness and they always manage to find time to read it.

Three Big Shows

Final arrangements have just been made for the world's first Annual International Radio Show which is to open at Madison Square Garden, New York, on Monday, September 22nd and continue until Sunday night September 28th.

The coming exposition, the largest and most complete show of its kind ever staged anywhere, will be held under the auspices of the newly organized Radio Manufacturers' Show Association, composed of sixty of the most prominent American radio manufacturers. U. J. Herrmann and James F. Kerr, the well-known theatrical managers who have made such a gigantic success of the annual Chicago Radio Show, will be Managing Director and General Manager respectively. There will also be an Advisory Board made up of E. B. Malloy, Chairman of the Radio Division of the Associated Manufacturers of Electrical Supplies, Paul B. Klugh, Executive Secretary of the National Association of Broadcasters and Calvin Harris, the pioneer radio publicity expert.

The Radio Manufacturers' Show Association will hold three great expositions next season which will probably revolutionize the shown end of the business. The first will be in New York, at Madison Square Garden, September 22nd to 28th, the second will be held in Chicago, at the Coliseum November 18th to 23rd and the third will take place on the Pacific Coast early in 1925. The name of the latter city and exact dates will be made known soon.

The Board of Directors of the R. M. S. A., has taken an exclusive ten year lease on Madison Square Garden for its Annual and International Radio Show which will be held there every Fall until 1934. The Association has also taken over the Chicago Coliseum for a like period and another ten year lease is being negotiated on a Western exposition building. The new organization, which is heavily financed, is indeed a permanent institution which promises to be of great benefit to radio in general.

Managers Herrmann and Kerr have incorporated many of their own original ideas into next season's plans which are expected to make the show itself an unusually attractive spectacle and also eliminate nearly all of the unpleasant features of past radio exhibitions, for both exhibitors and patrons.

An outstanding feature next season will be the introduction of foreign exhibits. Several of the leading European manufacturers have applied to Manager Kerr for space and he is now trying to rearrange his plans so as to enable them to have a section of their own.

Manager Kerr has opened headquarters at the Prince George Hotel, 14 East 28th Street, where he will remain with his personal staff until September 15th.

Over seventy per cent of the available space has already been taken and important applications are coming in by every mail. All indications point to a complete sell out of exhibiting space within two or three weeks, in spite of the fact that the opening date is six months off.

New Crystal Detector



The new Freshman double-adjustable crystal detector has several distinctive features. It has a knob which can be brought through to the panel and when turned varies the crystal contact with the loop-whisker, thus permitting the operator to find sensitive spots without disturbing the tension on the whisker spring. It has an insulated housing for the crystal, so that no matter how the crystal is turned there can be no possible short-circuiting with consequent loud scratches and clicks in the head phones.

The lever at the base unit adjusts the contact tension, the whisker being the exclusive Freshman loop design which operates in concentric evolutions about the face of the crystal, thus covering every point on the crystal, as it is adjusted by a little knob on the panel. A special crystal was selected of pure natural ore of a special type which will withstand voltages as high as 130 without burning out. This is highly important in reflex work.

The crystal is glass-enclosed and is supported by insulated ends, giving ample strength and mechanical protection to the unit, at the same time permitting base

mounting instead of panel mounting when designed. The panel knob is engraved "Crystal," giving a neat attractive appearance to the panel and requiring little space.

The crystals themselves are replaceable by fresh units which are sold mounted in the non-metallic housing

Amperite

Amperite, the "self-adjusting" rheostat, is always connected in series with the "A" battery and the vacuum tube filament. It is manufactured by the Radiall Co., 320 West Forty-second street, New York, who write us that it is now being used as standard equipment by more than 50 manufacturers of receiving sets and that among other laboratories which have stamped it with their approval are the Westinghouse, Wireless Specialty and Chicago Radio Laboratory.

Balloon Race Progress to Be Reported by Radio. Amateurs Will Follow All Movements

Eight free balloons, which will take off from Kelly field in this city, April 23, for the National Balloon elimination race, will be followed closely by radio amateurs and the movements reported by radio to the "Balloon Race Executive." Through the co-operation of amateur radio operator spectators, who witness the start of the race, will be able to keep tabs on the progress of contestants and valuable information on air currents may be obtained.

The request for radio assistance was made by Colonel Culver, signal officer of the eighth corps area, and Captain T. E. Boudinot, signal officer at Kelly field. The local arrangements were made through L. D. Wall, district superintendent of the American Radio Relay League. This will be the first time that a great national race of the kind will have been followed by private radio men.

The information desired is:
Location in which the balloon is sighted.
Date and time.
Position, high or low.
Direction it is traveling.

All messages by radio men or other observers should be addressed to "Balloon Race Executive," San Antonio, Texas.

Arrangements are being made by Mr. Wall to have three or four local amateurs keep a twenty-four watch during the race. These will handle incoming messages and promptly transmit them to officials in charge of the race.

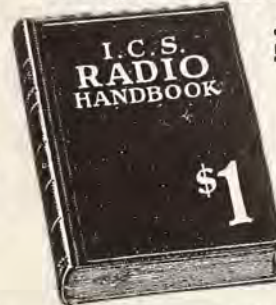
Inflating of the balloons will start about 8 A. M. on the 23rd and it is expected they will take off about 5 P. M. It is doubtful if anything will be heard from them before the 24th, as they will not carry any lights and will not be visible at night. With favorable winds some of the balloons are expected to travel as far as Canada and they may be in the air as long as three days.

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How to Use Various Vacuum Tubes

TO MEET the needs of our readers as evidenced in the many questions about tubes, their adaptation and requirements, this data and the accompanying table is presented. To preserve and file this valuable information for ready reference will greatly lessen the need of covering the points involved in personal inquiries and it will prove a very present help in time of doubt.

A vacuum tube is very similar to an ordinary electric light bulb in the particular that it is a glass bulb from which the air is evacuated. A point of difference is that it contains elements in addition to the filament. These elements are known as the grid and plate, the grid consisting of tiny wires in mesh or lattice work and the plate in a strip of metal, in some cases corrugated.

Why Is Tube Evacuated?

The chief reason for evacuating an audion (vacuum) tube is that the filament can remain heated. If it were rendered incandescent in the open air it would soon oxidize and burn away. This is prevented by keeping it in a vacuum.

When metal is heated it gives off what are known as electrons (negative electricity). When these fly through an evacuated space they create a conductive path for electricity. This path has a very high resistance. We heat the filament of the tube by means of a battery known as the "A" supply. The positive side of a high voltage battery known as the "B" supply, is connected to the plate and phones.

Like electricity repels, unlike electricity attracts. Therefore, when an incoming signal charges the grid of the tube positively a strong flow of electrons (negative) from the filament to the plate takes place, with a corresponding flow of electricity from the plate to the filament and back to the "B" battery through the phones. When the grid becomes negatively charged it deflects the electrons from the plate and a much weaker current flows. The incoming waves charge the grid positively and negatively alternately so that signals are made audible in the phones according to the fluctuations of the current. Thus, the action of an audion tube is analogous to a valve, with the grid as a stopcock.

Kinds of Audion Tubes

We have what are designated as hard and soft tubes. A soft tube is one in which there is not a high degree of vacuum. This type is adapted to function as a detector only. A hard tube is one which has a high degree of vacuum. This type is adapted to function either as detector or amplifier.

Advantages, Limitations

Any $\frac{1}{4}$ ampere tube can be operated on dry cell batteries, as they are feasible for use in providing current of $\frac{1}{4}$ ampere or less on any voltage.

This type of tube is convenient for portable sets. They are fair detectors, in consideration of their current consumption, but for audio frequency amplifiers will not

afford volume comparable with that realized in employment of a six-volt tube.

They do away with storage battery and charger and bring the first cost of a complete outfit within the reach of every purse.

Now, then, while the "peanut" tube uses less current than a storage battery tube, its amplification constant is much less. Given the identical transformer, it will require three audio frequency stages with these tubes to equal two stages with the six-volt tubes. To this limitation add the distortion resulting from an overloaded third tube and we have food for thought.

These "peanut" tubes can be used in any standard circuit without necessitating any change other than that relating to filament potential ("A" battery). Results will be fair in consideration of the above stated facts.

Dry cell tubes are not to be considered seriously for realization of maximum efficiency in REFLEX CIRCUITS.

How to Make Selection

NOTE.—The filament voltage is less than that of the rated battery voltage. This is explained in that the voltage drop through the resistance offered in wiring and rheostat reduces the potential impressed upon filament at the time it reaches it to meet its rated potential.

Dry Cell Tube Requirements

UV199—C299.

Filament voltage, 3 volts; battery, 4.5 volts; rheostat, 30 ohms; plate voltage as detector, 20 to 35 volts; plate voltage as amplifier, 40 to 80 volts; "C" battery, 1 to 4.5 volts; grid leak, 2 megohms; grid condenser, .00025 mfd; filament current consumption, 0.06 amperes; plate current, $\frac{1}{4}$ to 4 milliamperes; amplification constant, 6.25.

A fair detector, fair audio frequency amplifier lacking in volume. A good radio frequency amplifier.

UV201A—C301A.

Filament voltage, 5 volts; battery, 6 volts; rheostat, 16 to 30 ohms; plate voltage as detector, 18 to 45 volts; plate voltage as amplifier, 40 to 120 volts; "C" battery, $4\frac{1}{2}$ volts; filament current consumption, $\frac{1}{4}$ ampere; plate current, 1 to 7.5 milliamperes; amplification constant, 8; grid leak, 2 megohms; grid condenser, .00025 mfd.

Can be operated on dry cells economically if not used more than an hour or two a day. Storage battery preferred. A fair detector, but not sensitive—some think it good. Undoubtedly a good audio frequency amplifier, perhaps the best of the ordinary priced tubes. Very economical. From all standpoints the best audio frequency amplifier, in consideration of first cost, upkeep and effectiveness.

A Two-Element Tube for Dry Cell Operation

The Diode.

It is a small reproduction of the old Fleming valve. It is somewhat better than a crystal detector in range and volume,

but does not afford as clear reception. It does not require a "B" battery. Will not amplify. Cannot be used in regenerative circuits.

WD 11-12—

Note—The only difference in these tubes is in their bases. The WD11 has a prong base, while a WD12 has a standard base.

Filament voltage, 1.1 volts; battery, 1.5 volts; rheostat, 6 ohms; plate voltage as detector, 20 to 45 volts; plate voltage as amplifier, 40 to 90 volts; "C" battery, 1.5 to 3 volts; filament current consumption, $\frac{1}{4}$ ampere; plate current consumption, $\frac{1}{4}$ to 4 milliamperes; amplification constant, 6.5; grid leak, 2 megohms; grid condenser, .00025 mfd.

It is a good detector and fair audio frequency amplifier. A hard tube.

Table for Storage Battery Tube Requirements

VT1—J tube—

Filament voltage, 2-5 volts; battery, 4 to 6 volts; rheostat (vernier), 6 to 15 ohms; plate voltage as detector, 12 to $22\frac{1}{2}$ volts; plate voltage as amplifier, $22\frac{1}{2}$ to 45 volts; "C" battery, about 4.5 volts; filament current consumption, 1.1 amperes; plate current, .5 to 2 milliamperes; grid leak, 2 megohms; grid condenser, .00025 mfd.

UV200—C300—

Filament voltage, 5 volts; battery, 6 volts; rheostat (vernier), 6 ohms; plate voltage (detector only), 15 to 24 volts; filament current consumption, 1 ampere; plate current, $\frac{1}{4}$ to 1 milliamperes; grid leak, $\frac{1}{2}$ to 2.5 megohms; grid condenser, .00025 mfd.

UV201—C301 — Filament voltage, 5 volts; battery, 6 volts; rheostat, 6 ohms.

Plate voltage—As detector, not critical, as amplifier, 45 to 100 volts. "C" battery, 1.5 to 4.5 volts.

Filament current consumption, 1 ampere; grid condenser, .00025 mfd; grid leak, 2 megohms; plate current, 1 to 5 milliamperes; amplification constant, 6.5.

Not a desirable detector usually, but satisfactory where a hard tube is required. Good radio frequency amplifier. Good audio frequency amplifier, but not as economical as the UV201A in current consumption.

VT2E—Filament voltage, 7 volts (will work on 6-volt battery for A F amplification in receiver).

Rheostat, 6 ohms; plate voltage, up to 350 volts; "C" battery, 8 to 20 volts.

Filament current consumption, 1.35 amperes; plate current, 40 milliamperes; amplification constant, 7.

Designed as a 5-watt transmitter, but is one of the best audio frequency amplifiers.

216A—Filament voltage, 6 volts; battery, 6 volts; rheostat, 6 ohms.

Plate voltage, 120 volts; "C" battery, about 9 volts.

Filament current consumption, 1 ampere; plate current, 8 milliamperes; amplification constant, 6.

Designed particularly for audio frequency amplifier.

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Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326	KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341	
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270	KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234	
KDPT	Southern Electrical Co.	San Diego, Calif.	244	KFLA	Abner R. Willson	Butte, Mont.	283	
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360	KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248	
KDYM	Savoy Theatre	San Diego, Calif.	244	KFLD	Paul E. Greenlaw	Franklinton, La.	234	
KDYO	Oregon Institute of Technology	Portland, Oreg.	360	KFLG	National Educational Service	Denver, Colo.	268	
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360	KFLH	Erickson Radio Co.	Salt Lake City, Utah	261	
KDYZ	Star Bulletin	Honolulu, Hawaii	360	KFLP	Eyvette M. Foster	Cedar Rapids, Iowa	240	
KDZB	Frank E. Siefert	Bakersfield, Calif.	240	KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261	
KDZE	Rhodes Department Store	Scottie, Wash.	270	KFLR	University of New Mexico	Albuquerque, N. Mex.	254	
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278	KFLU	Rio Grande Radio Supply House	San Benito, Texas	236	
KDZJ	Electric Supply Co.	Wenatchee, Wash.	360	KFLV	Rev. A. T. Frykman	Rockford, Ill.	240	
KDZO	Nichols Academy of Dancing	Bozeman, Mont.	360	KFLW	Johnston Electric Supply Co.	Duluth, Minn.	275	
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261	KFLX	George Roy Cloughy	Galveston, Tex.	234	
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360	KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231	
KFAE	State College of Washington	Pullman, Wash.	330	KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273	
KFAF	Western Radio Corp.	Denver, Colo.	360	KFMO	University of Arkansas	Fayetteville, Ark.	263	
KFAJ	University of Colorado	Boulder, Colo.	360	KFMR	Morningside College	Sioux City, Iowa	261	
KFAN	The Electric Shop	Moscow, Idaho	360	KFMS	Freimuth Dept. Store	Minneapolis, Minn.	231	
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280	KFMT	Dr. George W. Young	Minneapolis, Minn.	231	
KFAU	Independent School Dist. of Boise City, Boise High School	Boise, Idaho	270	KFNU	Stevens Bros.	San Marco, Tex.	240	
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280	KFNV	M. G. Sateren	Houghton, Mich.	266	
KFAY	W. J. Virgin	Medford, Oreg.	283	KFMX	Carleton College	Northfield, Minn.	283	
KFB	F. A. Buttrey & Co.	Havre, Mont.	360	KFMY	Roy Scouts of America	Long Beach, Calif.	229	
KFBC	W. K. Schuber	San Diego, Calif.	360	KFNB	Roswell Broadcasting Club	Roswell, N. M.	234	
KFBE	Reuben H. Harbo	San Luis Obispo, Calif.	360	KFNC	Henry Field Seed Co.	Shenandoah, Iowa	266	
KFBG	First Presbyterian Church	Tacoma, Wash.	360	KFNG	Wooten's Radio Shop	Coldwater, Miss.	254	
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283	KFNH	State Teachers College	Springfield, Mo.	236	
KFBL	Leese Bros.	Everett, Wash.	224	KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234	
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360	KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240	
KFBV	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283	KFNM	L. A. Drake Battery and Radio Supply Shop	Peabody, Kansas	240	
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238	KFNN	Peabody Radio Service	Peabody, Kansas	240	
KFCF	Frank A. Moore	Walla Walla, Wash.	360	KFNY	Montana Phonograph Co.	Helena, Montana	261	
KFCJ	Electric Service Station (Inc.)	Billings, Mont.	360	KFNZ	Royal Radio Company	Burlingame, Calif.	231	
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360	KFOB	Glenwood Technical Association	Minneapolis, Minn.	224	
KFCP	Ralph W. Flygare	Ogden, Utah	360	KFOC	First Christian Church	Whittier, Calif.	236	
KFCV	F. J. Matney, Jr.	Houston, Texas	252	KFOE	Vern Teers	San Francisco, Calif.	240	
KFCY	Western Union College	Le Mars, Iowa	258	KFOF	Rohrer Electric Co.	Marshfield, Oregon	240	
KFCZ	Omaha Central High School	Omaha, Nebr.	258	KFOH	The Radio Bungalow	Portland, Oregon	283	
KFDA	Adler's Music Store	Baker, Oreg.	360	KFOJ	Moberly High School Radio Club	Moberly, Missouri	246	
KFDD	St. Michaels Cathedral	Boise, Idaho	252	KFOL	Leslie M. Schaffbush	Marengo, Iowa	234	
KFDH	University of Arizona	Tucson, Ariz.	360	KFON	Echophone Radio Shop	Long Beach, Calif.	234	
KFDI	Oregon Agricultural College	Corvallis, Oreg.	360	KFOO	Latter Day Saints University	Salt Lake City, Utah	268	
KFDJ	H. Everett Cutting	Bozeman, Mont.	248	KFOP	Wilson Construction Co.	Dallas, Texas	261	
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	Fork, Neb.	360	KFOQ	Ora William Chancellor	Galveston, Texas	240	
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360	KFOR	David City Tire & Electric Co.	David City, Nebraska	226	
KFDX	First Baptist Church	Shreveport, La.	360	KFOT	College Hill Radio Club	Wichita, Kansas	231	
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360	KFOU	Hommel Mill Co.	Richmond, Calif.	254	
KFDE	Harry O. Iverson	Brookings, S. Dak.	360	KFOV	Davis Electrical Corporation	Sioux City, Iowa	234	
KFEC	Meier & Frank Co.	Minneapolis, Minn.	360	KFOX	Board of Education, Technical High School	Omaha, Nebraska	240	
KFEJ	Guy Greason	Portland, Oreg.	360	KFOY	General Electric Service Co.	St. Paul, Minn.	226	
KFEL	Winner Radio Corp.	Tacoma, Wash.	360	KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233	
KFEO	J. L. Scroggin	Denver, Colo.	360	KFPB	Edwin J. Brown	Seattle, Wash.	224	
KFER	Auto Electric Service Co.	Oak, Nebr.	360	KFPD	Garretson and Dennis	Los Angeles, Calif.	238	
KFEV	Radio Electric Shop	Fort Dodge, Iowa	231	KFPE	Harold Chas. Mailander	Salt Lake City, Utah	242	
KFEY	First Presbyterian Church	Douglas, Wyo.	263	KFPF	C. C. Baxter	Dublin, Texas	242	
KFEZ	Bunker Hill & Sullivan Mining and Concentrating Co.	Keellog, Idaho	360	KFPN	The New Furniture Co.	San Antonio, Texas	242	
KFFA	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248	KFPQ	Missouri National Guard	Jefferson City, Mo.	242	
KFFB	Jenkins Furniture Co.	Boise, Idaho	240	KFPR	G. & G. Radio & Electric Shop	Olympia, Washington	236	
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360	KFPP	Tacoma Daily Ledger	Tacoma, Wash.	252	
KFFG	Dr. E. H. Smith	Hillsboro, Oreg.	229	KGGB	Hallock & Watson Radio Service	Portland, Oreg.	360	
KFFH	First Presbyterian Church	Hillsboro, Oreg.	263	KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360	
KFFI	Marksheffel Motor Co.	Colorado Springs, Colo.	360	KGO	General Electric Co.	Portland, Oreg.	312	
KFFJ	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226	KGU	Marion A. Mulrony	Honolulu, Hawaii	Waikiki Beach	360
KFFV	Graceland College	Lamoni, Iowa	360	KGW	Portland Morning Oregonian	Portland, Oreg.	492	
KFFX	McGraw Co.	Omaha, Nebr.	278	KGY	St. Martins College (Rev. Sebastian Ruth)	Lacy, Wash.	258	
KFFY	Pincus & Murphy	Alexandria, La.	275	KHJ	Times-Mirror Co.	Los Angeles, Calif.	395	
KFGZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226	KHJ	Louis Wasmer	Seattle, Wash.	380	
KFGC	East Kentucky University	London, Ky.	248	KJ	C. O. Gould	Seattle, Wash.	380	
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248	KJR	Northwestern Radio Co.	Seattle, Wash.	270	
KFGF	Leland Stanford University	Stanford University, Calif.	360	KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360	
KFGH	Arlington Garage	Arlington, Oreg.	234	KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360	
KFGI	Grady Hardware Co.	Boone, Iowa	226	KLX	Tribune Publishing Co.	Oakland, Calif.	509	
KFGJ	Heidreder Radio Supply Co.	Utica, Nebr.	224	KLZ	Reynolds Radio Co.	Denver, Colo.	509	
KFGK	First Presbyterian Church	Lawrence, Tex.	266	KM	San Joaquin Light & Power Corp.	Tacoma, Wash.	360	
KFGL	Emmanuel Missionary College	Berrien Springs, Mich.	268	KMB	Portland Wireless Telephone Co.	Stockton, Calif.	360	
KFGM	Western State College of Colorado	Gunnison, Colo.	252	KMC	Los Angeles Examiner	Los Angeles, Calif.	360	
KFGN	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280	KND	Electric Lighting Supply Co.	Los Angeles, Calif.	360	
KFGO	Utah Electric Shop Co.	St. Joseph, Mo.	226	KNX	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360	
KFGP	Central Christian Church	Shreveport, La.	266	KOB	Detroit Police Department	Detroit, Mich.	286	
KFGQ	Ambrose A. McCue	Nash Bay, Wash.	283	KOP	Hale Bros.	San Francisco, Calif.	423	
KFGR	Fallon & Co.	Santa Barbara, Calif.	360	KPO	Apple City Radio Club	Hood River, Oreg.	360	
KFGS	Star Electric & Radio Co.	Seattle, Wash.	270	KOV	Doubladay-Hill Electric Co.	Pittsburgh, Pa.	270	
KFGT	Clifford J. Dow	Lihue, Hawaii	275	KOW	Charles D. Herrold	San Jose, Calif.	360	
KFGU	Robert W. Nelson	Hutchinson, Kan.	229	KRF	V. C. Battery & Electric Co.	Berkeley, Calif.	278	
KFGV	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469	KSD	Post Dispatch (Hites) Pub. Co.	Stockton, Calif.	546	
KFGW	Ross Arbuckle's Garage	Iola, Kans.	246	KSS	Presbyterian Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif.	360	
KFGX	Benson Polytechnic Institute	Bozeman, Mont.	360	KTW	First Presbyterian Church	Seattle, Wash.	360	
KFGY	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234	KUO	Examiner Printing Co.	San Francisco, Calif.	360	
KFH	North Central High School	Spokane, Wash.	252	KUS	City Dye Works and Laundry Co.	Los Angeles, Calif.	360	
KFII	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224	KUY	Const Radio Co.	El Monte, Calif.	360	
KFIJ	Alaska Electric Light & Power Co.	Juneau, Alaska	226	KV	Portland Wireless Telephone Co.	Stockton, Calif.	360	
KFIK	V. H. Broyles	Pittsburg, Kans.	240	KWH	Los Angeles Examiner	Los Angeles, Calif.	360	
KFJ	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240	KYO	Electric Shop	Honolulu, Hawaii	270	
KFJ	Daily Commonwealth and Oscar A. Huelsmau	Fon Du Lac, Wis.	273	KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536	
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248	KZM	Preston D. Allen	Oakland, Calif.	360	
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233	KZN	Cope and Johnson Co.	Salt Lake City, Utah	360	
KFJD	National Radio Manufacturing Co.	Oklahoma City, Okla.	252	KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360	
KFJE	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252	WAAB	Wabash University	New Orleans, La.	268	
KFJF	Delano Radio and Electric Co.	Bristow, Okla.	233	WAAC	Tulane University	New Orleans, La.	360	
KFJG	Hardsac Manufacturing Co.	Ottumwa, Iowa	242	WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360	
KFJM	University of North Dakota	Grand Forks, N. Dak.	229	WAAF	Chicago Daily Drivers Journal	Chicago, Ill.	286	
KFJO	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. Dak.	280	WAAG	Gimbel Brothers	Milwaukee, Wis.	280	
KFJP	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258	WAAM	I. R. Nelson Co.	Freeman, Neb.	263	
KFJQ	Thomas H. Warren	Dexter, Iowa	224	WAAN	Arnold, Edwards, & Plante, Co.	Washington, D. C.	283	
KFJR	Le Grand Electric Co.	Le Grand, Kans.	226	WAAP	Omaha Grain Exchange	Omaha, Nebr.	360	
KFJS	Iowa State Teachers' College	Cedar Falls, Iowa	229	WABA	Lake Forest College	Lake Forest, Ill.	266	
KFJT	Tunwall Radio Co.	Fort Dodge, Iowa	248	WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266	
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254	WABD	Parker High School	Dayton, Ohio	283	
KFKA	Colorado State Teachers College	Greeley, Colo.	248	WABE	Young Men's Christian Association	Dayton, Ohio	283	
KFKB	Conkley-Nees Hospital Association	Millford, Kans.	286	WABC	Lake Shore Tire Co.	Jacksonville, Fla.	248	
KFKC	Conroy Radio Laboratories (Ben H. Woodruff)	Denway, Ariz.	224	WABH	Young Men's Christian Association	San Luis, Ohio	240	
KFKD	F. F. Gray	Butte, Mont.	283	WABI	Bangor Railway & Electric Co.	Bangor, Me.	240	

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You will find it a valuable addition. It is designed and manufactured complete by us, after years of careful experimenting. It is not to be confused with imitations hastily assembled from ordinary parts. The price is \$8.50. Shipment is made parcel post C. O. D. plus a few cents postage. If you prefer, you can send cash in full with order and we will ship postage pre-paid. Send us your order today.

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receiver tips.....\$2.00

Patd. Aug. 28, 1923



HOWARD RADIO COMPANY, Inc.

4248 North Western Avenue, Dept. A

CHICAGO, ILL.

Always Mention RADIO AGE When Writing to Advertisers

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Table listing broadcasting stations with columns for call letters, station name, address, and phone number. Includes stations like WABL Connecticut Agricultural College, WABN F. E. Doherty Automotive and Radio Equipment Co., and WPAL Superior Radio & Telephone Equipment Co.

Radio Threatens American Band Concert

Now that half a million people can listen to the programs broadcast from a single station, what will happen to the village bands? Of what use are the uniformed and spangled players that decorate the small town band-stands when the townspeople can just as well sit at home with the phones clamped on their ears? Will the trend be to keep the family at home instead of on the country green or city park?

No longer do we see the old German bands that traveled from place to place and enlivened the atmosphere with their cheerful "toots." The old time fiddlers have vanished into the past and the wailing of their instruments is recalled only in the memory of our grandfathers. Are the deep throated, drumming park bands headed in the same way? Can it be that the trombone and the cornet will no more inspire listless citizens to drop comic sheets and orange peels on the green?

What a relief such a change would be to the townspeople of Parkville, Ohio, who for years have undergone the mental suffering of being compelled to listen Friday nights while Tom Green's band got in a couple of hours practice in the vacant room over the local hardware store. Yet again what a tragedy to drift aimlessly about the empty streets on a Saturday night without the familiar martial strain of music.

Surely someone will be quick to declare that something vital and human has gone out of life if radio undertakes to encroach

Note the Vernier Gearing

Pfanstiehl

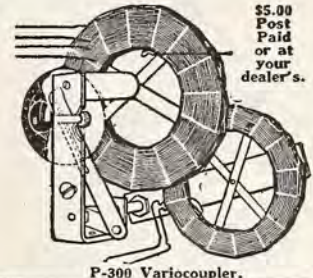
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P-300 Variocoupler.
Using this Unit in our Efficiency hoop-up (furnished with Unit) a Wisconsin fan picked up Hawaii.

PFANSTIEHL RADIO SERVICE CO.
Highland Park, Ill. Telephone Highland Park 154 Chicago Tel. Haymarket 8010

upon the famous institution known as the American band. What excuse, if any, will the farmer have for taking his family to town if he cannot sit back comfortably in his automobile, and when the band has finished playing, reach out and toot his horn for dear life.

The opportunity to meet his neighbors and shake their hand on the strength of a band concert will have been gone and heaven knows a loud speaker is no excuse to break a bottle of lemonade. The disappearance of the band will be a disappointment to the youngsters.

ERLA BLUE PRINTS

Erla Receivers out-distance other sets with an almost unbelievable volume and a naturalness that cannot be distinguished from the source of reception.

This is the famous Erla Reflex Hook-up. Less than one year old—but has taken the entire nation by storm. Every listener-in raves about it and wants a set of his own immediately. So easy to construct that anyone who can handle a screw driver can build the set complete in a surprisingly short time—about 1½ hours. Everything is so simple and easy.

NO SOLDERING WHATEVER—ONLY A SCREW DRIVER NEEDED

The results from the Erla 3 tube is naturalness itself and cannot be improved upon. Actual size working diagrams make everything simple and easy. Every piece of apparatus and every wire is pictured in its exact place—every article needed is listed on the diagrams.

Diagrams sent same day your order is received. Send P. O. or Express Money Order or Bank draft or Bank Cashier's check. Do not send stamps or personal checks.

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3 sheets for making 1 tube set 25c
3 sheets for making 2 tube set 35c
3 sheets for making 3 tube set 50c

Frank D. Pearne

Sole Distributor of Erla Diagrams for U. S. and Canada

829 Waveland Avenue, Chicago, Ill.

Dealers, Write for Quantity Prices

Always Mention RADIO AGE When Writing to Advertisers

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WPAM	Auerbach & Guettel	Topeka, Kans.	360	WSAN	Allentown Radio Club	Allentown, Pa.	228
WPAP	Theodore D. Phillips	Winchester, Ky.	360	WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360	WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WPAR	Ward Battery and Radio Co.	Beloit, Kans.	236	WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WPAT	St. Patricks Cathedral	El Paso, Texas	360	WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WPAU	Concordia College	Moorhead, Minn.	360	WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273	WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360	WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WQAC	E. B. Gish	Amarillo, Texas	234	WSB	Atlanta Journal	Atlanta, Ga.	429
WQAD	Whitall Electric Co.	Waterbury, Conn.	242	WSL	J. & M. Electric Co.	Utica, N. Y.	273
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275	WSM	Alabama Power Co.	Birmingham, Ala.	360
WQAF	Sandusky Register	Sandusky, Ohio	240	WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258	WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WQAN	Scranton Times	Scranton, Pa.	280	WTAF	Louis J. Gallo	New Orleans, La.	242
WQAO	Calvary Baptist Church	New York, N. Y.	360	WTAG	Kern Music Co.	Providence, R. I.	258
WQAP	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360	WTAH	Carmen Ferro	Belvedere, Ill.	236
WQAS	Prince-Walte Co.	Lowell, Mass.	266	WTAJ	The Radio Shop	Portland, Me.	230
WQAX	Radio Equipment Co.	Peoria, Ill.	360	WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WRAA	Rice Institute	Houston, Texas	369	WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224	WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WRAH	Stanley N. Read	Providence, R. I.	231	WTAO	S. H. Van Gordon & Son	Osseo, Wis.	220
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248	WTAR	Reliance Electric Co.	Norfolk, Va.	280
WRAM	Lombard College	Galesburg, Ill.	244	WTAS	Charles E. Erbstein	Elgin, Ill.	275
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236	WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WRAO	Radio Service Co.	St. Louis, Mo.	360	WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WRAW	Antioch College	Yellow Springs, Ohio	242	WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WRAW	Vuecno Radio Shop (Horace D. Good)	Reading, Pa.	238	WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WRAX	Flaxon's Garage	Gloucester City, N. J.	268	WTAX	Williams Hardware Co.	Streator, Ill.	231
WRAY	Radio Sales Corp.	Scranton, Pa.	280	WTAY	Iodan-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WRBZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233	WTBZ	Thomas J. McGuire	Lambertville, N. J.	283
WRK	Radio Corporation of America	Washington, D. C.	469	WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360	WWAB	Hoinig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WRL	Union College	Schenectady, N. Y.	360	WWAC	Sanger Bros.	Waco, Texas	360
WRM	University of Illinois	Urbana, Ill.	360	WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360	WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273	WWAF	Galvas Radio Supply Co.	Camden, N. J.	230
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360	WWAG	Michigan College of Mines	Houghton, Mich.	420
WSAC	Clemson Agricultural College	Clemson College, S. C.	360	WWJ	Ford Motor Co.	Dearborn, Mich.	273
WSAD	J. A. Foster Co.	Providence, R. I.	261	WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244	WWL	Loyola University	New Orleans, La.	280
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309	WYAM	Electrical Equipment Co.	Miami, Fla.	263
WSAJ	Grove City College	Grove City, Pa.	360	WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430	CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400	CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440	CHYC	Northern Electric Co.	Montreal, Quebec	410
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400	CJCA	Edmonton Journal	Edmonton, Alberta	450
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410	CJCG	London Free Press Prtg. Co.	London, Ont.	430
CFCK	Radio Supply Co.	Edmonton, Alberta	410	CJCD	F. Eaton Co.	Toronto, Ont.	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400	WAAF	Sprot-Shaw Radio Co.	Vancouver, B. C.	420
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440	CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CFCO	Semmenhaack-Dickson (Ltd.)	Bellevue, Quebec	450	CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450	CJCX	Percival Wesley Shackleton	Olds, Alberta	400
CFCR	Laurentide Air Service	Sudbury, Ont.	410	CJCS	Evening Telegram	Toronto, Ont.	430
CFCW	The Radio Shop	London, Ont.	420	CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CFDC	Sparks Co.	Nanaimo, B. C.	430	CKCD	Vancouver Daily Province	Vancouver, B. C.	430
CFDE	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400	CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CFFC	Queens University	Kingston, Ontario	450	CKCH	Canadian National Railways	Ottawa	435
CFUC	University of Montreal	Montreal, Quebec	400	CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CHAC	Radio Engineers	Halifax, Nova Scotia	400	CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CHBC	Albertan Publishing Co.	Calgary, Alberta	410	CKY	Manitoba Telephone System	Winnipeg, Manitoba	450
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410				

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400	2HS	Julio Power	Habana	180
2DW	Pedro Zayas	Habana	300	2OL	Oscar Collado	Habana	290
2AB	Alberto S. de Bustamante	Habana	240	2WW	Amadeo Saenz	Habana	210
20K	Mario Garcia Velez	Habana	360	5EV	Leopoldo V. Figueroa	Colon	360
2BY	Frederick W. Borton	Habana	260	6KW	Frank H. Jones	Tuinucu	340
2CX	Frederick W. Borton	Habana	320	6KJ	Frank H. Jones	Tuinucu	275
2EV	Westinghouse Elec. Co.	Habana	220	6CX	Antonio Figueroa	Cienfuegos	170
2TW	Roberto E. Ramires	Habana	230	6DW	Eduardo Terry	Cienfuegos	225
2HC	Heraldo de Cuba	Habana	275	6BY	Jose Ganduxa	Cienfuegos	300
2LC	Luis Casas	Habana	250	6AZ	Valentin Ullivarri	Cienfuegos	200
2KD	E. Sanchez de Fuentes	Habana	350	6EV	Josefa Alverax	Caibarien	225
2MN	Fausto Simon	Habana	270	8AZ	Alfreda Brocks	Stgo. de Cuba	240
2MG	Manning G. St. John	Habana	280	8BY	Alberto Ravelo	Stgo. de Cuba	250
2JD	Raul Perez Falcon	Habana	150	8FU	Andres Vinnet	Stgo. de Cuba	225
2KP	Alvira Daza	Habana	200	8DW	Pedro C. Anduz	Stgo. de Cuba	275
				8EV	Eduardo Mateos	Stgo. de Cuba	180

SOS Signals

Few radio listeners know that behind the scenes in the broadcasting station there is stationed a licensed code operator whose only duty during the period the station is on the air is to listen in for distress signals. While music and addresses are going out from an adjoining room he sits at a receiving set that is tuned to 600 meters, the wave length of ship and coast stations. At the first signal of distress he notifies the engineer in charge and the broadcasting stops at once, the air is left free for the unobstructed transmission of SOS signals.

On Saturday evening, March 22, shortly after 11 o'clock, while WGY, the Schenectady, N. Y., station was in the midst of a dance program from Albany, an SOS was picked up from a ship at sea. Instantly WGY left the "air" and remained out until permission was received to resume. This is the first time, during two years of operation, that WGY has been interrupted by distress signals.

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State _____

If book alone is desired, mark cross here and enclose \$1.00. If subscription only, mark cross here and enclose \$2.50.

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Order by mail if your dealer cannot supply you and we will ship immediately. Written 5-day money back Guarantee with each set.

Our next year's production schedule of two million phones UNDOUBTEDLY places us as the

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1. One of the finest phones on the market regardless of price.
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4. Made of standard double pole construction (no single pole nonsense to save expense.)
5. Made of the best materials money can buy. Powerful magnets, genuine tinsel cords, aluminum cases.
6. Manufactured under ideal working conditions.

"GOOD SOLDERING MEANS GOOD RECEPTION"



Patent Applied For

The "Jiffy" Torch and Soldering Outfit

The JIFFY self-blowing gasoline torch and soldering outfit is the only complete set on the market which will withstand continued and hard usage over a long period of years. The torch cannot explode, and develops an extreme heat of 2,300 degrees F. under prio-electric test. Simply touch a match to the burner and the torch operates. There are no needle valves or adjustments to get out of order, and no pump.

Jiffy Torch and Soldering Outfit, consisting of Torch, Copper Soldering Iron, Metal Stand, bottle of non-corrosive flux and solder.

Price, \$2.50 Postpaid

Jiffy Torch only, without Soldering Outfit

Price, \$1.25 Postpaid

If your dealer can't supply you, send stamps, cash, money order, or sent C.O.D.

Handycap Manufacturing Corp.

DEPT. A RIVERDALE, ILL.

Dealers' Inquiries Solicited

Doubling Condenser's Usefulness

(Continued from page 20)

and coil control, whatever be its construction, those stations might all come within the boundaries of the same dial degree and it would be no child's play to set that tuning dial to the exact wave of any one of them.

The Construction

Owners of single circuit receivers who would like to try this arrangement may do so with scarcely any expense and very little trouble. A glance through the following constructional data will tell them what changes must be made in their already built receivers. Fig. 2 gives a view from the rear, and the parts employed in the set illustrated are as follows:

- Panel, 7x10 inches.
- Variocoupler.
- Vernier condenser (.00025).
- .00025 grid condenser.
- 2 megohm grid leak.
- Tube socket.
- 4 Fahnestock clips.
- 2 three-inch dials.
- Switch lever, 2 switch points, 2 stop points.
- 4 binding posts.
- 4 lengths bus bar for connections.
- 1 rheostat, 16 ohms.

Most any vario-coupler may be employed by connecting one tap at the 40th turn and the other at the 80th, but the type shown was chosen because it is already provided with two binding posts for connection to the middle and end of the outer winding. The variable condenser chosen should have between 11 and 15 plates, and the type illustrated has 14 and a .00025 mfd. capacity. Note the style of vernier in use. Some form of vernier MUST be employed, as it would be physically impossible to set the dial at the exact proper point by use of the large knob alone. The vernier MUST NOT be of the extra plate variety, however, as this makes impossible the accurate notation of dial settings for stations received. A dial setting of the large dial would only hold true provided the vernier plate were at exactly the same position every time. Hence the vernier should, by a gear, a friction contact on the shaft, or friction on the dial, move the entire set of movable plates and not move an extra plate or small extra condenser.

In Fig. 2 the rear of the set is exhibited. Note the neatness and simplicity of its assembly. The socket is fastened to a long strip of hard rubber which is in turn supported by two brass brackets cut from a piece of brass strip. The brackets are attached to two of the binding posts, and are used as connecting members, too. The four clips on the mounting strip are for connection to the "A" and "B" batteries and their rear placing permits these batteries to be put inside the cabinet if you like. The set might then be self-contained.

Points of Assembly

The grid leak is fastened between two "loops" of bus bar, soldered directly to the winding. If you prefer to use a regular mounting, this should be added to the list of parts. Fig. 3, the bottom view, shows the position of the coupling coil, just inside the grid end of the coupler. This is made by winding 15 turns of double covered wire about No. 22 in size on a cylinder slightly less than the diameter of the inside of the coupler tubing. The coil is then slipped off the cylinder and the wires bunched together. They are then slipped inside the coupler and allowed to spring apart until the coil fits the tubing snugly. Remove it then and wrap several strips of bicycle tape around to keep the wires together and replace it inside. Be sure to get the coil at the grid end, for it is that half of the coupler winding which is in circuit regardless of how the switch may be thrown.

Fig. 4 is the circuit diagram and it requires no further explanation. The circuit delivers a good deal of volume from local stations and if you are within 15 miles of some of them you can operate your speaker after a fashion even though you use a dry cell tube. A power tube or 201-A quite satisfactorily works the speaker on your loudest local station. As far as distance is concerned, results are as good with dry cell tubes as with storage battery tubes, and the selection of your "A" battery will have to be made accordingly. Except with a soft tube like the 200, the "B" battery should be a 45-volt unit.

Your aerial, for such a circuit, ought not to have too high a capacity and a single strand of wire 80 to 100 feet long is satisfactory. (I mean one wire, not necessarily single stranded wire, as several strands make for strength and lasting qualities.) Its capacity may be kept low by elevating the wire ten or twelve feet above the roof and keeping the lead-in wire four or five feet out from the building wall on the way down. This is done so that the "natural period" of the aerial system, which includes the coupling coil, may be lower than 200 meters. Otherwise its absorbing effect at its fundamental might interfere with regeneration on that wave length. As it is, the regeneration control, the tickler, is not varied more than five degrees for securing regeneration over the entire wave length scale. This means great ease in securing regeneration and limits the active control to only one—the tuning condenser.

I could, of course, continue describing the tuning possibilities of this slight alteration of the old faithful and reliable single circuit tuner, and I could ask how many of you can tune out WSAI or WLW on 309 meters and hear KGO of Oakland, California, on 312 meters? No, the single circuit won't do that—but I have succeeded in hearing KGO without a peep from WLW several times in New York City with the coupled circuit tuner.

So, if you'd like to pep up your single circuit set and tune out some of the louder stations to hear that far-off broadcaster whose announcements are now killed by

blasts of local jazz selections, or if you're thinking about building a simple and effective receiver, try the coupled tuner, for you can't go wrong.

New Aerial Idea

Hartford, Conn.—An Italian radio experimenter, Adriano Ducati, has communicated very successfully with amateurs in this country with a novel antenna arrangement, the use of which is new to radio men in the United States, according to a communication that has just been received by the American Radio Relay League. Mr. Ducati increases the capacity between his antenna and counterpoise with an extra counterpoise erected above the regular antenna system.

He is easily the foremost amateur in Italy inasmuch as he was the first to establish two-way connection with this country. Being unfamiliar with all of the methods employed by American radio men, he did not place any special stress on his novel aerial. The technical department of the A. R. R. L., however, is interested in the use of an additional counterpoise over the antenna and experiments will be made shortly to determine its special advantages.

Hearings on Radio Monopoly

Within about ten days, the Federal Trade Commission will issue a call for hearings on the alleged radio monopoly, and summon witnesses to testify in connection with the answers filed recently.

The answers deny the charges of the commission, claiming that their agreements were not set forth fairly in the complaint.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio Age, published monthly at Chicago, Illinois, for April 1, 1924.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Frederick Smith, who, having been duly sworn according to law, deposes and says that he is the Editor of Radio Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., Chicago, Ill.; Editor, Frederick Smith, Chicago, Ill.; Managing Editor, Frederick Smith, Chicago, Ill.; Business Manager, M. B. Smith, Chicago, Ill.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) Radio Age, Inc., Chicago, Ill.; Frederick Smith, Chicago, Ill.; M. B. Smith, Chicago, Ill.; John H. Lohbeck, St. Louis, Mo.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

FREDERICK SMITH,

Editor.

Sworn to and subscribed before me this 5th day of May, 1924.

VIRGINIA VAN COURT

(My commission expires Sept. 27, 1927.)



Approved By Over 200 Experts New Crosley Engineering Achievement

A three tube set with five tube efficiency—the greatest selectivity with the minimum effort—positive calibration to any wave length between 200 and 600 meters. These are only a few of the many advantages offered in the remarkable new Crosley Trirdyn Radio Receiver.

It was only after a year of constant experimenting that our engineering department perfected this exceptional receiver. Thorough tests proved to us that it would out-perform any receiver ever before produced. But we were not satisfied with our own opinion. So we shipped out 200 of these sets to experts in every part of the United States. Their criticisms are one and the same—"tried out your new Trirdyn Receiver Saturday night and logged 13 stations, among them Cuba, New York and Omaha, between 9 and 10 o'clock. The set was very selective. During the time this test was on, local station KSD was operating and we went through them without any difficulty or interference whatever. The range of the local station was not more than three points variation in the dial setting."

"Tried one of these sets out and obtained wonderful results. Were able to log all stations which we heard very successfully. This set should go over big." "The set has wonderful volume and is selective," etc.

This new Crosley triumph is called the Trirdyn because of its original combination of the three "R's"—Radio frequency amplification, Regeneration and Reflex. The first tube incorporates non-oscillating, non-radiating tuned radio frequency amplification; the second tube, a regenerative detector reflexed back on the first tube for one stage of audio frequency amplification. Then it has a third tube which acts as a straight audio frequency amplifier. It uses the ultra selective, a periodic antenna circuit and external selector coil, which adds to its wonderful selectivity.

The Crosley Trirdyn in range, volume and selectivity is the equal of any five tube receiver on the market. Greater volume will, of course, be obtained through the use of storage battery tubes, but it will function well in any type and can be used with either indoor or outdoor antenna.

The opinions of many experts have convinced us that the Trirdyn is the best receiver ever offered the public regardless of price.

Practically every radio dealer can furnish you Crosley Radio Sets, including not only the Trirdyn, but the Model 51, a two tube set for only \$18.50; the Model V, a single tube receiver at \$16.00; the Model VI at \$24.00; the Super VI at \$29.00; the Model X-J at \$55.00, and the Super X-J at \$65.00.

*All Crosley Regenerative Sets Are
Licensed Under Armstrong U. S.
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You can! Hundreds of ambitious men are already earning thousands of dollars in this wonderful new industry—many working only in their spare time. Mail coupon below for Free Book which describes fully the amazing money making opportunities in Radio and tells how YOU can earn from \$500 to over \$10,000 a year!

THE astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio—and thousands of young men are needed right now to meet the ever increasing demand of work. Never before has there existed so many and such remarkable opportunities for making money in this wonderful new field.

Men are needed to build, sell and install radio sets—to design, test, repair as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities.

Easy to Learn Radio at Home in Spare Time

No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

Scores of young men who have taken our course are already earning from \$75 to over \$200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% even while taking our course! Emmett Welch, right after finishing his training started earning \$300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns \$250 a month. Still another graduate, only 16 years old, is averaging \$70 a week in a radio store.



Send for FREE BOOK

Learn more about this tremendous new field and its remarkable opportunities. Learn how you can quickly become a radio expert and make big money in Radio. Find out what remarkable successes our graduates have had—even a few weeks after their training finished.

We have just prepared a new 32 page booklet which gives a thorough outline of the field of Radio—and describes our amazing practical training in detail. This Free Book, "Rich Rewards in Radio" will be sent to you without the slightest obligation. Mail coupon for it *now!*

1000 Mile Radio Set



FREE

In order to complete your practical instruction at home, learning by actual experience, this splendid regenerative receiving set is now included without the slightest additional cost.

Wonderful Opportunities

Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer"—"We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible — fascinating easy work—a chance to travel and see the world if you care to or to take any one of the many radio positions all around you at home. And Radio offers you a glorious future!

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