November 15, 1924
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RADIO PROGRESS

"Always Abreast of the Times"

In This Issue:

WATCH FOR HOOK-UP NUMBER

YOU WILL UNDERSTAND THIS MAGAZINE---AND WILL LIKE IT

PUBLISHED TWICE A MONTH

RADIO PROGRESS

SPECIAL HOOK-UP NUMBER

TO BE ISSUED SOON

15 Worthwhile Hook-ups

Undoubtedly you have tried following various wiring diagrams and found that they were not what they pretended to be. This will be a carefully selected list of sets which do work. They include the best hook-ups of crystal sets, single tubes, regenerative and non-regenerative, two and three tube radios, reflexes and also the more ambitious styles, like neutrodyne and superheterodyne.

Among them you will find several, anyway, which you will wish to try out.

Watch For This Issue

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 1 Number 17

Contents for

NOVEMBER 15, 1924

RADIO PROGRESS is issued on the 1st and 15th of each month by the Oxford Press at 8 Temple Street, Providence, Rhode Island. John F. O'Hara, Publisher. Yearly subscription in U. S. A., $3.00. Outside U. S. A., $3.50. Single copies, 15 cents. Entered as second-class matter, April 4, 1924, at the Post Office at Providence, R. I., under the Act of March 3, 1879. Address all communications to RADIO PROGRESS, 8 Temple Street (P. O. Box 728), Providence, R. I. Title registered at United States Patent Office.

Good Things Coming!

Low loss condensers—that is what you hear now on every hand. Perhaps you don't know why a condenser needs particularly low losses and granted that it does, how can the losses be reduced to make them low? If you don't know, read, **"Killing Losses in Condensers,"** by Harris, in our next issue.

Resistance is a fine thing—sometimes it is a fine thing to avoid. On the other hand, oftentimes it is really necessary for best operation of the set. Where to use it and where to omit it is described in a good article, **"Do We Want Resistance or Not?"** in the December 1 issue.

Does your set use an outside aerial or a loop? Sometimes it is an advantage to be able to change from one to the other. How to do this and why is covered in **"Using Loop or Outside Aerial,"** by Taylor.

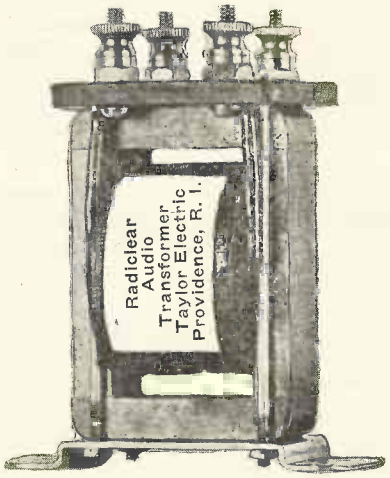
No doubt you have been enjoying the series of articles by Dr. Goldsmith. In the next issue is an unusually good one which explains how to get quality as well as a lot of noise in radio. See **"Putting Quality Into Waves."**

One of the popular sets on the market is the Regenoflex. The music going through such a set does not follow a straight line, but takes a rather devious path. If you want to keep up to date in the way of circuits you will be interested in **"Tracing Signals Through Regenoflex,"** by Arnold.

You Can Understand the Words

Single tube sets are not much troubled with distortion. When the phones are plugged in you can understand the words of the lecture.

But when the same set is used to work a loud speaker the words are mushy. It sounds as if the announcer had flannel in his mouth. This is often due to trouble caused by the audio transformers, which connect one tube to another.



There are a great many transformers on the market which are very good. We have not found any of all we have tested that are as good as the

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It has these advantages:

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3. The large number of turns makes the music loud.
4. The air gap in the iron prevents distortion.
5. The ratio is adjusted so that the unit will not howl.
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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 1, No. 17 NOVEMBER 15, 1924 15c PER COPY, $3 PER YEAR

Variometer or Variocoupler—Which?

Although They Look Alike They Act Quite Differently

By HORACE V. S. TAYLOR

PERHAPS you know two brothers, John and James Smith. They look much alike and behave alike too, but when you are doing business it is necessary to know whether it is John or James you are talking to. It is the same with the variometer and variocoupler. They belong to the same family, and in many respects are very much alike. But

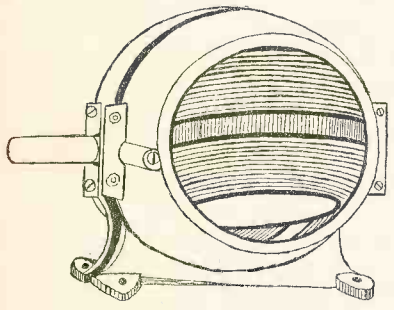

Fig. 1. A Good Variometer

when you hook them up into a radio set it is well to know which is which, and why.

They both consist of two coils of wire, one on a larger spool or tube than the other. The inside one in each case can be turned so that it has a different relation to the outside. So far they are exactly alike. When we come to the connections, however, we find that they are no longer similar. Remember there are two separate windings. In the variocoupler the two are always separated into two distinct circuits, but in the variometer they are in series.

Good Team Work Here

Let us start with the variometer. As we have said the two windings are connected in series. The inside one, which turns or rotates, is called the rotor, and the outside one, which is stationary, the stator. The rotor and stator each have two leads from the beginning and end of each winding, and one of the rotor leads is connected to one of the stator. This leaves one rotor and one stator connection free and these two form the two terminals of the unit.

When the two coils are turned so that the axis of one lies along the axis of the other, that is, when they are both exactly in line, then the two coils naturally affect each other. If the winding is in the same direction when looked at from the top so that the current turns around and round the tube in a single direction in both rotor and stator, then the magnetic effects add and the team work between the two halves is good.

If now the rotor is turned upside down, then the current will spin around to the right in one coil, and to the left in the other when viewed from the top. With this position of the rotor, the two coils no longer have team work, but they get in each others way—that is that they subtract one from the other. The result is that the effect of the variocoupler is quite small in this position.

Close Fit Required

By looking at Fig. 1 it will be seen that the rotor turns inside the stator with a fairly tight fit. This is necessary for the following reasons: When the two coils are turned to aid each other so that they both have the same direction of winding, then the exact fit of one within the other does not make so much difference, but when they are turned so that the two halves buck, and one substracts from the other, then the closer they are alike the lower will be the answer. The effect of the coil is called the inductance, or electrical weight. It is measured in millihenries. As an illustration of how the two work,

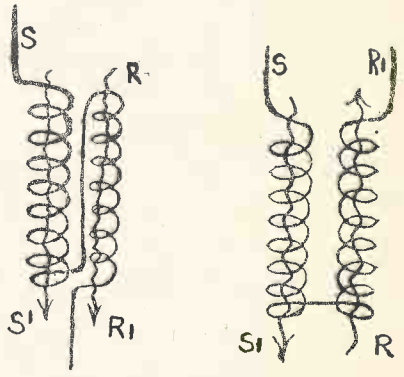

Fig. 2. Turning Rotor of Variometer

suppose the outer coil has a value of eight. If the inner coil is only a moderate fit, it will be six, and 8—6=2, which will be value in the "off" position.

Suppose now we make the rotor a better fit inside the stator so that it is more nearly the same size. In such a case it will increase from six to seven. Now in the bucking position we have 8—7=1. Here the zero position has an effective weight of only half what it did before. In other words, the range of the instrument is much greater than in the previous case. Of course, this is an advantage. It would be desirable if

possible to drop the inductance in the "off" position way down to zero. Unfortunately, this cannot be done, because the two coils must not be exactly the same size, or the inner coil would interfere with the outer one, and so could not be turned on its shaft. However, the closer the fit is made, the more nearly zero may be approached in the "off" position.

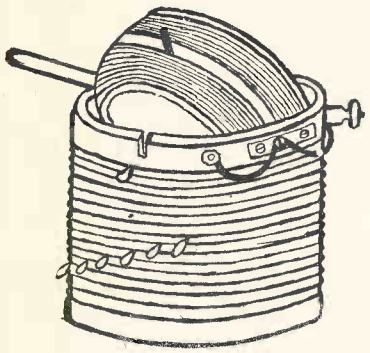

Fig. 3. A 90 Degree Variocoupler

Magnetism by Wavy Lines

Refer to Fig. 2 to make clearer the action of these instruments. The magnetism is shown by a wavy line. The reason for making it wavy is not because the line of force run that way, but merely to make the arrows stand out more. At the left is shown the two coils connected in series. S and S' are the two terminals of the stator, and R and R' the rotor. Notice that S' is connected to R. This connection is made permanently once and for all in the bearings of the instrument. When R is turned so that the coils have the same polarity as in S, the two fluxes or bunches of magnetic lines flow in the same direction (down) and so reinforce each other. At the right hand side the rotor has been turned 180 degrees, and so the two fluxes are opposing each other, one up and one down. The result would be zero if they were just alike, but as has been explained, they never are the same, and so the answer is not quite zero.

Loose Fit on Variocoupler

When we look at the variocoupler as shown in Fig. 3, we notice that there is no attempt made to have the outside and inside coils fit close together as in the variometer. If they did fit tightly it would be no disadvantage at all from the electrical point of view, but the instrument would cost considerable more to build. Since there would be no advantage at all, and the cost would be higher, such a design is never used. There is no electrical advantage, as just mentioned, in having the inductance of the two coils alike. Since the variocoupler always has two circuits, which are always connected in different parts of the set, there is never any chance of one subtracting from the other.

Furthermore, the two circuits in general are not designed to affect each other more than a certain amount. When the two coils are turned at right angles, there is no effect, one upon the other, but when they are in line the influence on one or the other is greatest. You will find as a rule that the dial setting on this unit is seldom up to 100, showing that the coupling between the two (which is a measure of the influence of one on the other) is too large when set to the maximum value. Since this coupling has to be reduced anyway by turning the dial, there is evidently no advantage in making the two coils have nearly the same value and so increasing this coupling. In such a case the net result would be that the dial would have to be turned farther away from the full on position.

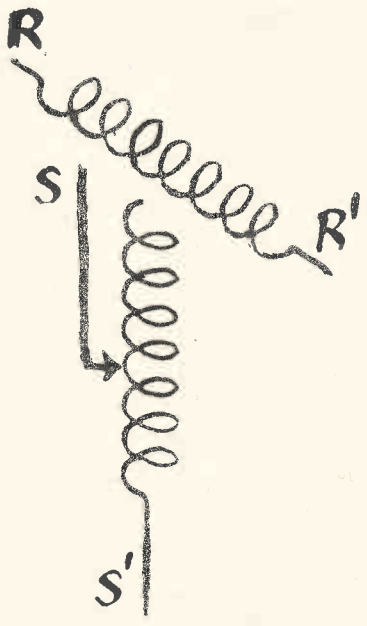

Fig. 4. Circuit of Variocoupler

Looping the Stator

A number of loops can be seen on the stator of the coupler (Fig. 3). These are used by connecting each tap to a switch point. The switch arm sliding over these points can pick out any one of the taps at will. By varying the position of this switch the effective number of turns in the stator is varied. The loops are made in winding the coil by leaving about one-quarter inch slack in the wire, and twisting this amount around until it is tight. After the insulation has been scraped off the loop, the lead to the switch point is soldered on, as just explained. The average coupler will have about 50 or 60 turns on the stator. It is customary to bring out a tap about every 6 to 10 turns. The exact figures do not make much difference. Of course the smaller the number of turns, the more taps will be needed. In most radio sets it is unnecessary to use more than ten taps in all.

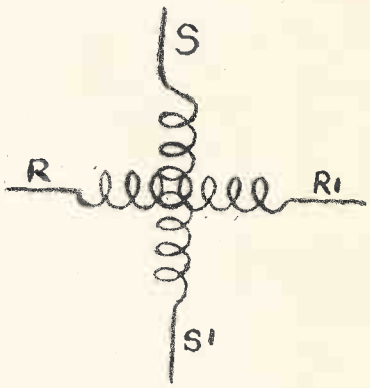

Fig. 5. Diagram of Split-Variometer

Many people notice that variocouplers usually have taps and variometers omit them, and think that it is the taps which determine whether the unit is a variocoupler or variometer. In this they are mistaken. As has been noted, the essential difference between the two is whether there is one circuit (two terminals) or two (four terminals). It is true that most couplers do have a number of taps, but the instrument is still a coupler, even if these are omitted. The circuit diagram of the unit itself is shown in Fig. 4. Here the stator has an arrow running to the side, which indicates that the terminal is adjustable to one of several taps. The rotor is shown at an angle with its two terminals brought out separately. The fact that there are four terminals in all shows that it is a coupler we are illustrating.

The Split Variometer

In some articles, especially those of some time back, you see a reference to the so-called "split variometer." By this unit is meant a variocoupler with tight fitting coils which has had the internal connection broken, and two ends brought

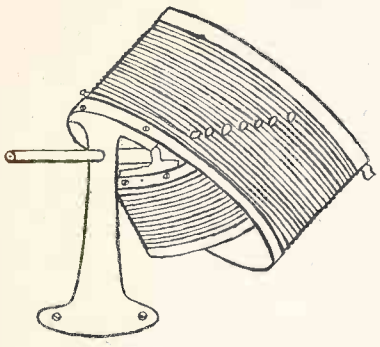

Fig. 6. A 180 Degree Variocoupler

out as extra terminals. By splitting the variometer, in this way it is really converted into a variocoupler. The chief reasons for using a split variometer instead of the variocoupler is so that the man who writes about it can sell his particular kind of instrument. We have never seen a circuit calling for a split variometer, where an ordinary variocoupler would not do the work just as well. If such a unit were substituted, and it was found that with the dial turned on full, the coupling was not great enough to get the result wanted, then it would be necessary to change to a variocoupler made by splitting a tight fitting variometer as described. However, we have never seen a case where it was necessary.

The wiring of a "split variometer" is shown in Fig. 5. By comparing with Fig. 4, you will see that electrically they are just alike. The arrow is omitted, showing no taps are used with this hook-up. If a line is run joining R' and S, then the conventional symbol for the variometer will be obtained.

Ninety Degree Coupler

In Fig. 6 we have a "90-degree coupler." Comparing this with Fig. 3, we observe that both have a stator coil, which is tapped, and both have a rotor, which turns aside the stator. The difference is that the axis of the one is parallel to the turns on the stator, while in the other (Fig. 6) the shaft which rotates the inside coil is put through the stator at an angle of 45 degrees. Electrically the two forms of unit work just alike. When the two coils are in line the coupling is a maximum, and when they are at right angles, it drops to zero.

The difference in the two lies in the amount of rotation needed to change the coils from being in line to the position of right angles. In Fig. 3 it is quite obvious that a ninety degree turn of the shaft will rotate the inside coil from a position of being in line to that of being at right angles. Ninety degrees more will carry it around in line again. Such a unit has zero couplings in the center of the dial. If the dial which you use is graduated from zero to one hundred, as is customary, then zero couplings will occur at 50 on the dial. Full coupling is to be obtained at either zero or 100. Half coupling may be found at either 25 or 75. So each amount of coupling will have a pair of values spaced equally to

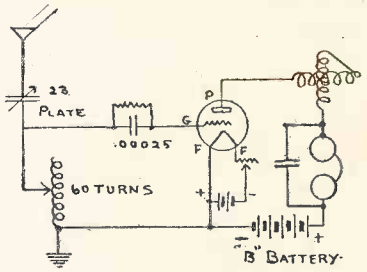

Fig. 8. Variometer for Regeneration

the right and to the left of 50 degrees. The only difference between the two values of each pair is that the polarity is reversed from one to the other. In some hook-ups this reversal of polarity makes no difference, while in others, particularly in regenerative sets, one side increases regeneration, and the other decreases it by the same amount.

Tipping the 180 Degree Coupler

On the other hand, this style of unit requires a half circle turn in order to change the coil from right angles to in line. The operation is rather hard to illustrate on paper, but if you have one of these units, or can look at one in a radio shop, you will see that with the dial set on zero the coils are at right angles. When the dial is turned 50 degrees, they are approaching being in line, but have not yet reached that position. But when the dial is turned to 100, then the two coils are just in line, and have the maximum coupling.

The variocoupler is probably the most popular type of unit for tuning a radio set. A popular hook-up is shown in Fig. 7. This has the merit of being very simple and easy to construct, but has the rather serious drawback that it is a bad squealer. If it is worked by a person who is not familiar with the best way of tuning, it is likely to cause considerable annoyance to the neighbors within a radius of several blocks.

The stator of the coupler is shown connected between the aerial condenser and ground. A variable tap switch, T, selects one of the proper taps to give a

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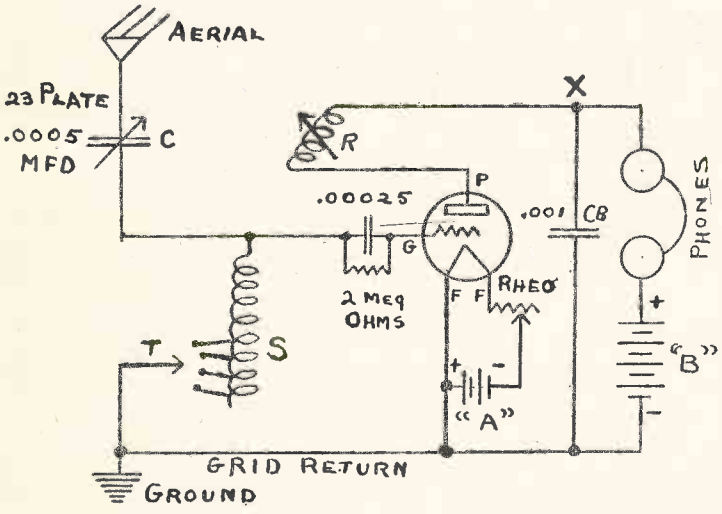

Fig. 7. Popular Variocoupler Hook-up

American Radio Relay League

SECRETARY WILBUR THANKS OPERATORS

The American Radio Relay League has received a copy of a message from Curtis D. Wilbur, secretary of the Navy, addressed to the radio telegraph amateurs of the United States, in which he expressed the Navy Department's appreciation of the assistance of amateurs in communicating with the Shenandoah.

The message is a duplicate of that which Secretary Wilbur asked to have broadcast in code from the Naval Research Laboratory station at Bellevue, D. C. The tribute to the amateurs follows:

"To Amateur Radio Operators of the United States:—

"The co-operation of the amateur radio operators with the Naval Research Laboratory has resulted in increasing the communication efficiency of our Navy. The new long distance communication records made by the Shenandoah are a direct result of your co-operation.

"Interest, such as you have shown in the Navy in time of peace, is the country's best guarantee of our Navy's readiness when called upon for our country's defense.

"It seems appropriate, therefore, that on Navy Day, which coincides with the completion of the wonderful transcontinental flight of the Shenandoah, I congratulate and thank you for your contributions toward a better and more efficient Navy.

"Curtis D. Wilbur."

Why They Deserved Thanks

The amateurs were useful particularly during the western half of the Shenandoah's trip, when both official messages and news dispatches were received from the ship and delivered. In fact, a great many amateur stations in this country gave valuable service in communicating with it during its cross country flight. A prominent one in the West, was that of the University of Arizona, 6YB, operated by Oliver Wright and six other student operators with the assistance of Professor Cloke, head of the Department of Electrical Engineering. Word was sent out from the American Radio Relay League that amateurs were needed to keep the big airship in contact with the ground, so preparations were made to have the university radio station in readiness for any emergency that might arise.

By the time that the dirigible was hovering in the vicinity of the Tucson mountains, 6YB had been twice rebuilt and the antenna system arranged for the reception of short waves. Wright had been in touch with NKF, the station of the Naval Radio Research Laboratory at Bellevue, D. C., and had picked up an official message which the navy department wished to have forwarded to the Shenandoah. The crew of the airship as it approached Tucson were uncertain as to their location, and were pleased when radio contact was made with the university station, and the desired information was received.

Picked Up 800 Words

The service given the Shenandoah by this group of students was typical of the spirit and enthusiasm in which amateurs in the South and West took advantage of opportunity offered to co-operate with the Navy Department by their radio contact with the airship. At Dayton, Ore., H. Louis, operator of amateur station 7EO, received 800 words of press from the ship which appeared in newspapers all over the country the following morning.

VARIOMETER OR VARIOCOUPLER?

Continued from Page 7

coarse adjustment on the wave length. The fine adjustment is made by turning condenser C.

The output from the tube runs from the plate P, through the rotor R, of the variocoupler to the point X, where the high frequency goes through the bypass condenser Cb, back to the filament. The low or audio frequency vibrations run through the phones and "B" battery to the filament. The amount of feedback or regeneration is controlled by the tickler, which is the rotor of the variocoupler.

Variometer for Feedback

One very popular use of the variometer is shown in Fig. 8. It is here employed to vary the amount of feedback or tickler action instead of using the rotor of the variocoupler. In this set the primary consists of 60 turns of wire, wound on a three-inch tube. This should be tapped every eight or ten turns. The stator of a variocoupler could be used very nicely for a position like this, but of course the rotor would be wasted. The primary tuning is affected by the 23-plate condenser in just the same manner as in Fig. 7. The circuit of primary and secondary is just like this latter hook-up.

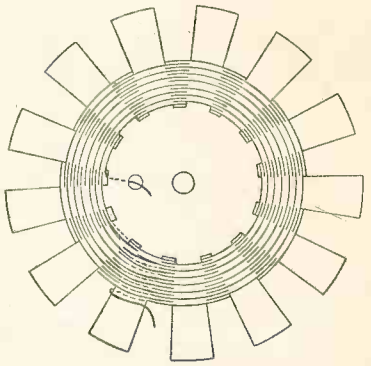

Fig. 9. Popular Spider Web Coil

When we come to the output we notice a change. Instead of running to the rotor of the coupler, the plate circuit is conducted through a variometer. This unit is used to tune the output circuit to the same wave length as the input. When this has happened, then we get regeneration or feedback through the capacity of the tube itself.

Use of the Spider Web Coil

Instead of a three-inch tube, the 60 turns mentioned in Fig. 8 may be wound on a spider web coil such as shown in Fig. 9. This is a very convenient way of winding a coil, and has the advantage that taps may be taken off at various places, just as desired. When completed it is just as efficient as the ordinary winding, and is somewhat better in that the distributed capacity is lower. This reduction in capacity gives a little bit sharper tuning for the completed set.

Pulling in the Waves

The Best Ways of "See-ing" the Ether Vibrations

By ALFRED N. GOLDSMITH, B. S., Ph. D., Fellow, I. R. E.,
Chief Broadcast Engineer, Radio Corporation of America

BEING blind is a terrible affliction. And yet all mankind is stone blind to a very real sort of light, namely the radio wave. Scientists and engineers have repeatedly proved beyond question that the electro-magnetic waves which carry broadcast communication are really identical, except in frequency (or wave length,) with the ordinary light which is so easily perceived by the human eye. But, although the radio waves are really light waves, the human eye does not respond to them at all. Otherwise men standing near a broadcast station would see a brilliant glow surrounding the aerial wires of the station and marking the transmission of the program from the station.

The frequency or speed of vibration of a light wave of the ordinary variety determines its colors. Thus, if the frequency is high, the light is called a "violet," and produces a definite sensation of "violetness." As the frequency becomes lower, the color of the light progressively changes through blue, green, yellow, orange and red. This color has the slowest vibration. When the frequency of the light waves becomes still lower, they become invisible to the human eye, and are called "infra-red." When frequencies of a million or so a second are reached, which is much faster than the oscillation speed of violet, the invisible light waves are known as radio waves, and are capable of carrying messages in the well-known fashion. So that we are quite justified in speaking of radio waves as "dark light" or "invisible light," from the physical standpoint.

An Electrical Eye

Since the eye cannot see these waves, it becomes necessary to find a substitute "electrical eye" which will enable them to produce effects which can be perceived by the human senses. The radio

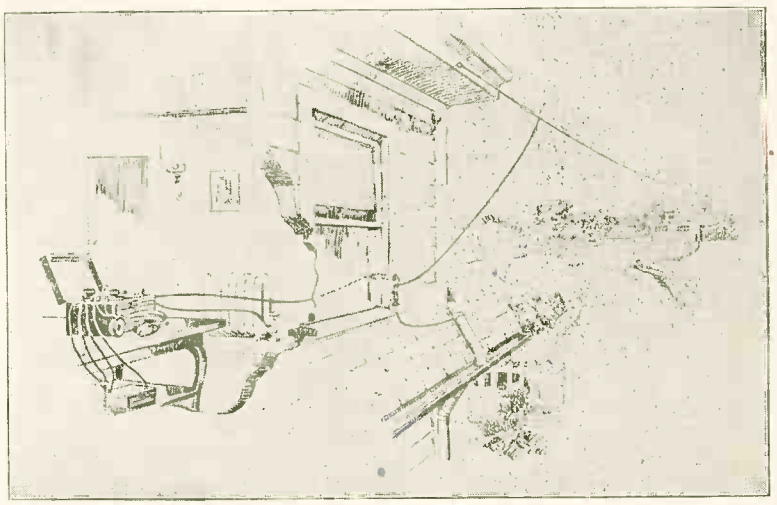

Fig. 1. An Outside Aerial for Open Spaces

waves sweep through most substances as though there were no obstacle there, so it is necessary to find some material which will trap these vibrations or make them deliver their energy to the receiving set. The wooden or concrete walls of a house, for instance, or the human body, do not stop radio waves to any extent. It is true that most houses are transparent to radio waves, which makes it possible in most cases to receive messages with apparatus which is entirely indoors. But metallic objects do absorb some of the energy of the waves, and it is for this reason that we use aerial wires in tapping the ether for radio messages.

The best sort of aerial is the highest and longest system which can be conveniently used, and which will not be too long to receive the desired frequencies or wave lengths. For the usual broadcasting waves and receiving sets, the aerial wires should not be more than about fifty feet high and one hundred and fifty feet long. It is difficult to use the ordinary radio set conveniently with much longer aerial wires. The freer and more open the antenna, as a general rule, the louder the signals when using a non-regenerative receiver (such as a crystal set or a single tube radio without any "feed back coupling"). The aerial wires for such sets should be kept away from buildings, metal lath in walls, telegraph, telephone, or power wires, water or drain pipes, gutters, metal roofs, or other metal objects.

Why Poor Aerial Works

If a regenerative receiver is used, it is not so important to take precautions to have an antenna which is away from other absorbing objects. The regenerative receiver is one which has a feed back or "tickler" control of intensity which, by proper handling, will make up to some extent for the defects of the aerial. A good ground connection direct to permanently moist soil is generally necessary for proper operation with

a non-regenerative receiver, but the goodness of the ground is not quite so important with the regenerative set. Sometimes, instead of an actual ground connection, a "Counterpoise" ground is used. This is merely a wire or two insulated from the ground and stretched under the antenna. It is connected to the ground binding post of the receiving set in place of the usual ground connection.

an antenna 50 or more feet long, may be made of number 28 or 30 (although a larger size, say number 16, is very popular) silk or cotton covered copper wire, held in place by small hooks or thumb tacks or other unobtrusive fasteners. Figure 2 shows a good layout. A lightning arrester is not required at all, nor an antenna switch. For five or ten-mile reception, this arrangement is very

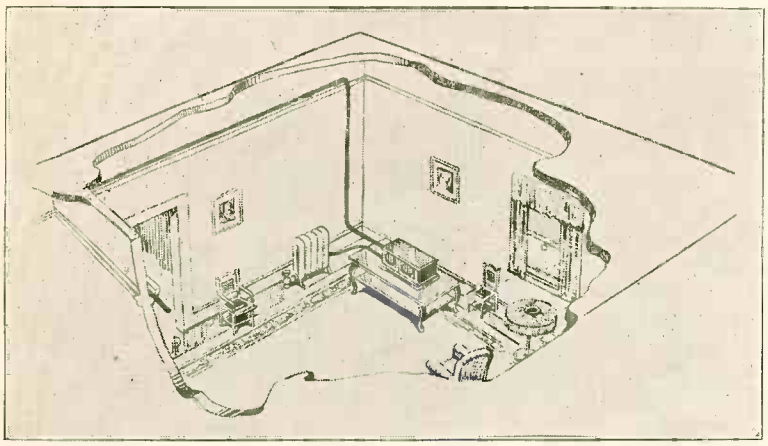

Fig. 2. An Installation for the Apartment Dweller

A typical high-grade receiver installation for country use is shown in Figure 1. With ordinary sets out in the country, a good sized antenna is useful and is not objected to. Listeners in rural locations must depend on signals coming from a distance, as of course there are no local stations, and it is therefore necessary to have a sensitive receiver, and a fairly big antenna. The lightning arrester is shown just outside the window.

Where to Put the Arrester

A word on lightning arresters will be of interest to radio users. When it is installed on an outdoor antenna according to the instructions which always accompany the unit, all insurance requirements are met and the receiving set is not regarded at all as a hazard. Actually the lightning risk in radio reception on an outdoor antenna is so ridiculously small that the writer is somewhat at a loss as to how to express it. Possibly it is about as great as the chance of your being able to pay for an elaborate meal in a restaurant by means of the pearls which you hope to find in the oysters.

In the city, and particularly if the local stations are most desired, the indoor antenna is very satisfactory. Such simple and good looking. It works much better in some locations than others, depending on the type of building in which the set is installed. If there is a great deal of steel in the building, or if the wires of the antenna run too near steel girders or electric light wires in the walls, the reception may not be satisfactory, particularly if the broadcast stations are at some distance. But in general, good results will be obtained by it, and it is a very simple and cheap matter to try out such an indoor antenna to see if it works well. If it does, then the listener can dispense with the more inconvenient outdoor aerial arrangement which, however, gives louder signals. It is well to be content with reasonably loud signals, particularly in crowded neighborhoods. Only a trial can determine whether the indoor antenna will show the desired results in any given location.

Another type of aerial wire system for trapping radio waves is the loop or coil system. It is generally a flat spiral of square outline, several feet on a side. Its terminals are connected to a tuning condenser, and to the "ground" and "antenna" binding posts of the receiving set. The coil system has its advantages and also its drawbacks. One disadvantage is that much less energy is trapped than by a long outside wire, and so the receiving set must be much more sensitive than the ordinary one used for outdoor antennas. This requires that two or three additional tubes and their equipment shall be included in the receiver. Very careful circuit design and construction is required to get good loud speaker operation on distant stations using a coil antenna, particularly if high selectivity is needed.

Pointing to Your Favorite

On the other hand, the loop aerial has several advantages. It is compact, easily carried from room to room, good looking (when properly arranged), and has a sense of direction. By this last is meant that it is possible to pick out a desired station or get rid of an unwanted one, not alone by receiver tuning, but by rotating the loop. This is because it receives most powerfully when the waves come from the direction in which the loop points; and, with a well-designed set, it hardly receives at all in a direction at right angles to the loop. Fig. 3 illustrates this point. Consequently, an undesired station can be much reduced or even cut out entirely by properly turning the loop to point in the right direction, and, of course, also tuning the receiver to the wave length of the desired station.

The coil aerial therefore represents not merely an "electrical eye," but even an "electrical telescope" or "transit" since it indicates the direction of the incoming waves as well as their existence. It is regularly used for this purpose in the United States Navy's "radio compass" stations which give ships their positions at sea in bad weather, and in the loop receivers on board ship which get special signals from the "radio light houses" of the Department of Commerce, for the same important purpose.

But radio carries not only the calls of business and usefulness, but also the beauties and pleasures of music. Let us look for a moment at the origin of this art.

Nature the First Musician

Music probably originated in nature itself. The wind whistling through the trees, the crickets chirping their evening song, the musical splash of a small wat-

erfall, and the deep boom of the thunder must have suggested to primitive man the beginnings of music. The first musical instruments were almost free from man's design; they were nearly untouched products of nature. The split reeds on which shepherds piped in pre-Athenian days, and the simple stringed instru-

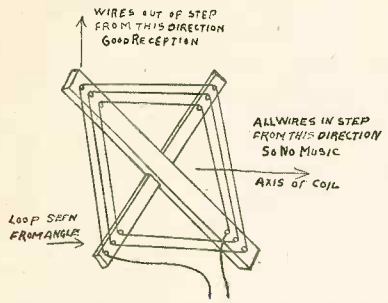

Fig. 3. How a Loop Should Point

ments of the Orient must have spoken a language which was nearly akin to the sounds of forest and stream.

Sometimes the very wind was harnessed to breathe its own song. The air-strummed Aeolian harp hung among the trees sang its melody when the vagrant breeze passed over its strings. This simple instrument, played by no human fingers, is in a sense the most natural of musical instruments, and may be taken as a symbol of the essence of music. The harp, or its cousin, the lyre, has been chosen for centuries as the emblem of music in general. The insignia of musicians in most armies and the design of music stands or musical instruments have very frequently included the lyre or the harp.

Music in Paint

A famous author once said that "All arts tend toward music." The color schemes of paintings suggest to many a musical theme, and the relation between pure music and the rhythm of poetry or the cadences of an oratorical effort is an obvious one. If music is indeed the utlimate art, broadcasting has an excellent chance of becoming its chosen medium and so evolving into the greatest instrument of the arts.

There are many good reasons for the bold claim of so big a future for broadcasting. For the first time in history the powerful agency of electricity has been successfully called to the aid of art. The voice of man can be heard only a little way, and even the greatest orchestra cannot reach more than a few thousand feet. And every local noise will help to spoil the complete enjoyment of the listener. A neighbor who coughs or a passing vehicle are enough to interrupt the flow of a composition and distract the audience. Electricity has already been able to overcome these former limitations of music. Electrically we can amplify and reproduce melodies faithfully in such volume that multitudes can listen without fear of interruption. Music has literally been lent the might of the lightning flash.

We Believe Most Anything

Electricity is the most powerful and the most subtle of physical agencies. Its powers, skillfully applied, seem so great that the public believe almost any claim for a new electrical device, no matter how extreme or ridiculous it may be. We have become so accustomed to a myriad of daily electrical marvels and engineering triumphs that our imagination is unchained as to further possibilities. The instantaneous sending of the personality of an artist, expressed in music, to the homes of a continent is a daily happening. We may even lose our perspective and not realize the meaning of such an achievement because of the apparent ease and simplicity with which it is accomplished. It is important to remember that so basic and far-reaching an artistic and social agency might work for harm as well as good, and that broadcasting, which is truly "the voice of the people," deserves their constant attention and appreciation.

Music has always been transmitted through the air, by the medium of sound waves traveling a little over a thousand feet a second. To-day we transmit radio waves, carrying music within them through the air (or through empty space, for that matter), with the speed of light, thus circling the earth in a mere fraction of a second. Radio has also been fortunate in its choice of an appropriate symbol which indicates clearly the nature of this powerful agency. The spark or lightning flash has been used since the early days of radio as a sign of the art. It is an appropriate symbol, since radio is after all tamed lightning, in a sense; and a spark—miniature lightning flash as it is—was originally used to start the radio waves on their long journeys.

Birthplace of the Wave

Today the spark is no longer used in the broadcasting transmitter, as it has been entirely superseded by the vacuum tube for the production of electrical oscillations and radio waves. But it retains its historical associations and its sentimental standing as a symbol of radio. No doubt the art will advance in still

Continued on Page 29.

Fig. 4. Harp-and-Spark Microphone at WJZ

Broadcasting is Now Four Years Old

The First Program and Station Are Described Here

FOUR years ago this month radio broadcasting, in its modern form, had its start, when KDKA, East Pittsburgh, first went on the air. The first program was the election returns that resulted in the election of the late Warren G. Harding as President of the United States.

November 2, 1920, is an anniversary date in the history of broadcasting. That was the day when a movement was started which today has resulted in the establishment of more than 500 broadcasting stations in the United States, and a radio audience which is estimated at from 12,000,000 to 50,000,000 people. A world-wide movement was set in motion which is still striding forward and which apparently knows no limits. When the first signals were transmitted from KDKA, consisting of election returns in the Pittsburgh district furnished by the Pittsburgh Post, those in charge of the station had no idea of how the new science would spread.

The First Director—Mr. Conrad

The Westinghouse Company for several years before this date had been operating from the home of Frank Conrad, in Wilkinsburg, (a suburb of Pittsburgh). This was an experimental station, from which phonograph records and addresses were transmitted every night, primarily intended for the receivers of the radio amateurs. This attempt was favorably received by this limited audience. H. P. Davis, vice president of the company, caught the radio vision and foresaw broadcasting as a public service. He had the station removed from Mr. Conrad's home, and started a regular public service from a transmitter located in East Pittsburgh, four miles away. Mr. Conrad's original station was known to radio amateurs throughout the length and breadth of the United States as 8XS. The new station was assigned the call KDKA by the Department of Commerce. These letters were culled from the calls assigned to ships, as there were no arrangements in those early days for the assigning of special radio broadcasting calls.

With these new letters and the announcement that a regular service was being instituted KDKA went bravely on the air. The first radio party, so far as is known, assembled at the Edgewood Club in Edgewood, Pa. Here was installed a radio receiver and the small party of assembled guests, for the first time in their lives, heard a radio program.

First Station Only 3 Months Old

The first program was a great success and it was decided to go forward. One improvement after another was made, which gave the transmitter a greater and greater range and continually added to its quality. These refinements are still going forward and it is a well known fact that engineers in charge of the station have repeatedly stated that KDKA has never been more than three months old. In other words, the station has been added to and changed so continually that it never has had an opportunity to acquire a settled state.

The programs in those early days consisted of phonograph records and addresses, given in a random manner. These were soon outgrown, and officials foresaw the need of a regular entertaining program consisting of a wide variety of features.

So the search for program material started, which, too, has never ended. Out of that original hunt KDKA established another record in that it first put on the air almost every known kind of radio programs. They first broadcast radio programs. They first broadcast news time signals, sporting events, church services and the many variations of the church theme, bedtime stories, vocal and instrumental selections, farm programs and many others. One event which KDKA did not send out first was radio grand opera. That honor goes to KYW.

KDKA was also the pioneer in outside pickups, as they were the first to install telephone lines to remote points, pick up the voice or instrumental selections there, and run them to the station on telephone lines.

Asleep for 3 Months

It was about three months or more after operations were started that public interest was aroused sufficiently to the point where it made itself felt. This period of inactivity was just the lull before the storm for when public enthusiasm was aroused at this wonderful new form of entertainment it knew no bounds. Those who remember the struggle to get radio apparatus in the winter of 1921-22 well know how everyone seemed to be on the lookout for radio apparatus which was nowhere to be found. The years 1921 and 1922 saw the establishing of radio stations all over the country, but equally important developments in reception were being produced. Among the most important of these was the WD-11 tube, brought out in answer to a demand on the part of the public for a tube set which could be operated at a low cost. Instead of a storage battery, which the large tubes required, this new one operates on a 40 cent dry cell.

Found the Missing Link

Early in 1922, Mr. Conrad started experimenting with short waves, foreseeing the need of some connecting link between radio stations so that one could pick up and repeat the programs of another. His experiments were carried on for a year and resulted in the building of the first short wave station as an annex to the older installation.

Since that date KDKA has made notable use of short waves. Two record making achievements were the broadcasting of the Firpo-Wills boxing bout direct from the ringside to Buenos Aires, where a loud speaker installed in the headquarters of La Nacion gave the blow-by-blow account to the waiting fans, and the more recent international radio dinner given by the H. J. Heinz Company. This was described in the last issue of RADIO PROGRESS.

Putting Piano Finish on Your Cabinet

Varnishing Work Explained for Particular Radio Fans

By W. S. STANDIFORD

LARGE numbers of radio novices throughout the United States and Canada are constructing their own receiving sets to "listen-in" to broadcast programs; many of their instruments are very good ones, and work well when used the first few times. Then the spaces between the leaves of their variable condensers and their jacks clog up with accumulated dust, and then trouble occurs. In order to make their apparatus give the least amount of trouble regular manufacturers of radio outfits inclose them in wooden cabinets, which not only add to their appearance, but also increase the efficiency.

In contrast to this, most amateur builders do not inclose their sets in a case but try to keep the dust away from the delicate parts by frequent cleaning; a process that not only wastes time, but is likely to press some wire connections too close together, and out of shape, thus causing other difficulties during operation of the set. As a general rule, most electrical experimenters can turn out fair looking containers, but through lack of knowing the necessary processes in doing varnishing, their home finished work appears very crudely done, when it is compared with the bought article. The information contained in this article has withstood the hard test of experience and there is no doubt but that the working data given here will supply a "long-felt" want of radio set constructors.

Why It Must be Smooth

Varnish is used as a base for many finishes, whether it be applied to automobiles, furniture or radio outfits. When learned, this work is very easy to do, but certain precautions must be taken if a satisfactory and nice looking job is desired. It is of the utmost importance to have a clean smooth surface in order to get a first-class finish. This is a detail that must be strictly attended to if a pleasing piece of work is expected when it is completed. A smooth exterior adds greatly to the neatness of the finish, whether your wood is to be painted, enameled, oil-finished in natural-colored woods, or stained and varnished. Another point, the smoother the surface the box has, the easier it is to wipe off any dust which is bound to accumulate to a greater or less extent.

In order that the amateur may not o astray, a list of open and close-grained woods is given below. The handling of each kind, to obtain the best results, will be described later on. Open-grained woods which are most usually used in box making are: Oak, chestnut, walnut, mahogany and butternut. These require fillers in order to get a good finish. Close-grained woods such as pine, cherry, maple, birch, cypress, whitewood, poplar, sycamore, beech, redwood and others similar to them do not require fillers to take a good polish, as staining or finishing in natural colors, as preferred, can be done by the amateur. There is one good thing about varnishing close-grained woods, and that is, a better job can be made by a novice who is not used to varnishing and polishing work than can be done on the open-grained variety, unless extreme care is taken in doing the filling operations.

Make Mahogany Out of Pine

Five operations in wood finishing are necessary, although in the case of close-grained woods, the filling process can be omitted. For varnished cabinets: (1), sandpapering, (2), staining, (3), filling, (4) varnishing, and (5) polishing, comprise the list. (1) Plane your wood as smooth as possible, then take a piece of number 00 sandpaper and tack it on a level block of wood and rub with the grain, using moderate pressure and taking care when working near the edges, not to round them. Figure 1 shows how block will look. Wipe all dust from the surface with a clean cloth free from any trace of grease, taking care that *all* the dust is removed, otherwise it will make rough spots. (2) Staining comes next. If one of the cheaper woods, such as pine or poplar is used, it may be stained to imitate the appearance of the more costly woods. By using the former, radio set cabinets can be made which will look as if expensive natural-colored lumber had been used. In wood finishing work, trouble will be avoided by purchasing the very best stains and varnishes obtainable.

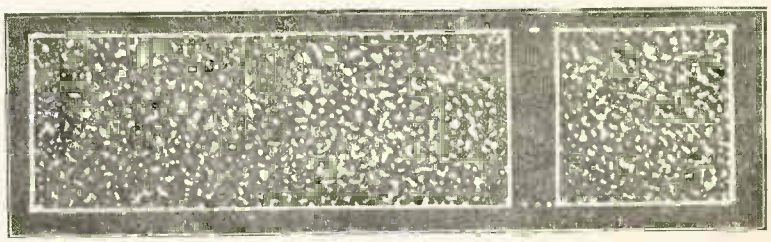

Fig. 1. Block Like This Needed for Good Work

There are two kinds of stains on the market, water and oil mixed; each one has its good points. Water stains are those in which the coloring pigment is dissolved in water. Linseed oil or turpentine is the solvent for the other kind. Use either that is available, as they are equally good.

If the amateur worker desires to use an open-grained wood such as mahogany or walnut, and wishes to use a stain

to make it deeper in color, the pores must be filled after staining, otherwise, staining can be omitted, but not filling, which is necessary. Supposing that such a wood has been stained, get a paste filler of a color to match it as nearly as possible; rub some of it on a piece of cotton cloth, and start rubbing it into the wood. As soon as the filler has dried a little (don't let it get too hard), continue to rub the wood's surface until all pores are filled up. Rub off any surplus, the idea being to have nothing but the pores contain any filler. The less filler there is on the surface of wood, the better its appearance will be when finished.

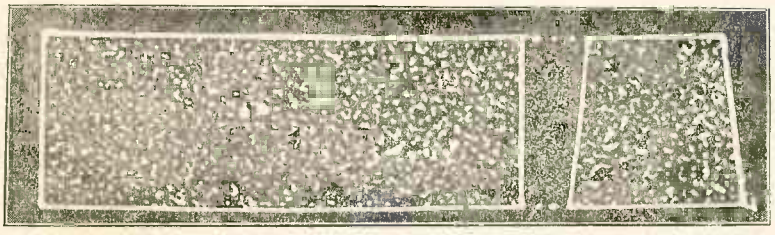

Fig. 2. Sloping Sides to Finish Corner

Why Shellac Must be Thin

After it is dry and smooth, give it a coat of white shellac which should be rather thin. Dilute it with alcohol if too thick. All surplus liquid must be wiped off the brush before applying to the surface, for if too thick a coating is put on, it will not be clear and allow the stain to show through. The first coating of shellac will take about two hours or more to dry, depending upon the dampness of the weather. After it is dry put on a second coat. Rub the dried surface with number 000 sandpaper, this grade being the finest grained article obtainable. Fig. 2 shows how to get into corners with the sandpaper. Continue the rubbing until the wood is smooth. Don't rub it too hard or the shellac will be worn away.

Varnishing comes next. Good brushes should be used, as cheap ones are generally coarse and shed their bristles. The varnish must not be too cold as this prevents it from flowing freely and so it makes streaks. Do not work in a room colder than 70 degrees Fahrenheit. Have only enough varnish on your brush to give it a level coating when it is brushed across the wood's grain. Finish off by rubbing lightly along the grain. Then let it dry for thirty hours, or until thoroughly hard. Purchase some FF grade pumice stone at a paint store, also a rubbing felt. Dip the latter into linseed oil, then in pumice stone, which will now adhere to the felt. Rub the varnished surface lightly along the grain of wood. Continue this process until all small depressions have disappeared. This may be ascertained by looking diagonally over the surface when it is held to the light. All hollow places will now show as dark spots. The surplus pumice stone should be carefully removed with a soft clean cloth.

Getting a Piano Finish

Give it a second coat of varnish and let it dry, then repeat the operation with pumice stone. The cabinet will now have a dead, non-glossy finish. Those who prefer a shining, or piano polish, can easily obtain it by dipping a piece of felt into linseed oil and then into powdered rotten stone (to be obtained at paint store), and going over the surface in the same manner as with the pumice stone. A still higher polish can be obtained on the last coat by giving it the rotten stone treatment, and then rubbing the varnish with a soft cloth dipped into linseed oil, using plenty of "elbow-grease" until a very high polish is obtained. The surplus oil should be wiped off with a soft chamois skin. The above gives a durable finish; one that will not scar easily. If all of the work has been done carefully, you will have a neat-looking cabinet that will be envied by your friends who have not learned polishing work, which is quite easy to do, after a little practice.

Varnished and polished woodwork of all descriptions ought not to have any strong soap powders applied for cleaning purposes to remove finger marks and dirt, as it will turn white in spots. Use nothing but a good furniture polish, which will be found to clean it nicely.

Some Troubles Avoided

Difficulty: The finished work has a mottled appearance, some parts being deeper in color than others. Remedy: This is due to the staining being unevenly done; some places are left lighter than others due to too much stain being used. Sandpaper the darker spots carefully and spread a little more of the stain on the lighter ones so as to make an even tint; then finish the surface as directed in article. Another rapid way to produce a fine finish on cabinets made out of close-grained woods such as pine is first to coat the wood's surface with shellac, well rubbed in and sandpapered to kill any pitch in the wood, and next put on two coats of a combined varnish-stain, the first coat to be rubbed down when dry, with pumice stone, the second coat then being applied and after drying, polished with rotten-stone and oil or left the way it is. A first-class spar varnish-stain makes a durable wearing surface, as it does not crack and will not turn white in spots after long use.

For those persons who don't want to spend much of their spare time in staining and finishing their radio cabinets, and yet would like to have a pleasing appearing container, the use of a flat-tone paint is recommended. Paint used for coating walls, steam radiators and woodwork of all kinds will make a non-glossy waterproof finish which is very durable in regard to wear and ease of cleaning, as soap and water can be used if necessary. Do not confuse flat-tone with any other kind of paint, as it is a composition that is more like a varnish, containing a large amount of color pigments. It is waterproof and dries hard; its great advantage when contrasted with other paints, is that no brush marks will show on work done carefully; a dead-smooth surface results. Under no circumstances should any paints of this description be put on a panel.

How to Pick Your Color

Owing to their composition, these flat-tone paints ought to be flowed on like varnish, and not be brushed on like the ordinary variety of paints, as they are not made to spread that way. Go to various hardware and paint stores and ask for a color card from each one; thus many different tints will be obtained

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Reflexing the Single Tube

How to Make One Bulb Do the Work of Three

By C. W. RADOS, IBFA

WITH the coming of the good radio season once more, we shall have thousands of new fans who are just breaking into the game. To these I would say, "build a set of your own first." There is no greater thrill than the first time you hear your own radio working and especially if it is a home constructed set. For the newcomer the simplest hook-up outside of a crystal is a one tube set. Of all single tube receivers the reflex is the most popular because it does practically the work of three tubes while it is no harder to handle than any one tube set. Add to this its cheapness and it is easily apparent why it is so popular.

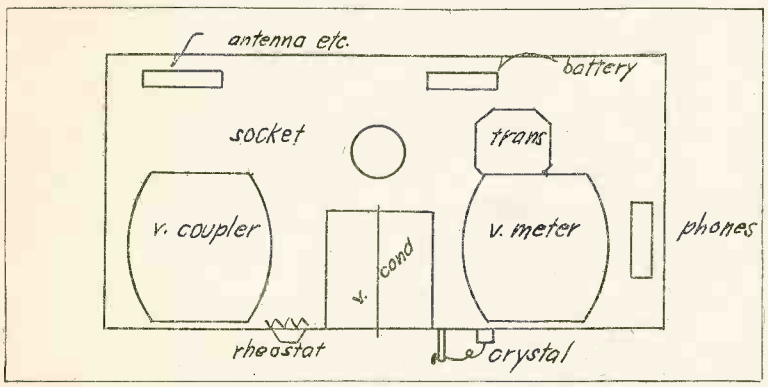

Fig. 1. General Arrangement. Note Crystal on Panel

The Theory Is Simple

In a single tube receiver, the tube first amplifies the incoming radio frequency and then passes it through a crystal detector to be rectified so that it can be made audible in a pair of head telephones. But before it reaches the phones, it goes through the tube once again being amplified still further. This is called the audio frequency amplifier. Thus the vacuum tube performs two functions; it strengthens the radio wave as it comes into the set, and again boosts it after it is changed so it can be heard. The crystal detector rectifies or reduces the speed of vibration of the radio wave so it can be heard in a pair of phones. A tube could be used here to do this but it is not so simple and then it would cost a lot more than the crystal.

Many sets using radio frequency amplification are "broad" (not sharp) tuning and so many times the program is spoiled by interference. The set to be described is not so sharply tuned that the settings must be exact. But it is selective enough so that ships and other broadcast stations not too close are not heard except when wanted. It is also non-radiating and so will not bother your neighbor. As the radio frequency stage is tuned it gives good distance and the audio stage gives good volume.

A Two Control Radio

In the set one variocoupler, one variometer, and one variable condenser are used. This makes three controls but the variocoupler is seldom changed except when very bad interference occurs, so it practically is a two control set. It is not hard to tune, and only the secondary dial is critical although the set tunes sharply.

From the photographs and the sketch in Figure 1 a good idea of the layout can be had. A 7" x 14" x $\frac{3}{16}$" panel is used as it is plenty large enough. It is also a stock size. Stock cabinets to fit this size panel are also available which makes it possible for the constructor to complete his set at a minimum of cost. Fig. 2 shows the panel layout and location of holes. The four holes with dotted lines around them will serve only for the particular make of instruments I used but all the others will be in the same position for any make of units. Before starting to drill, make a full size paper drawing of the panel. By placing this over the panel and center punching the holes in the places marked on the paper, the panel will not be scratched or injured. Use an ordinary twist or a straight fluted drill. Do not rotate it

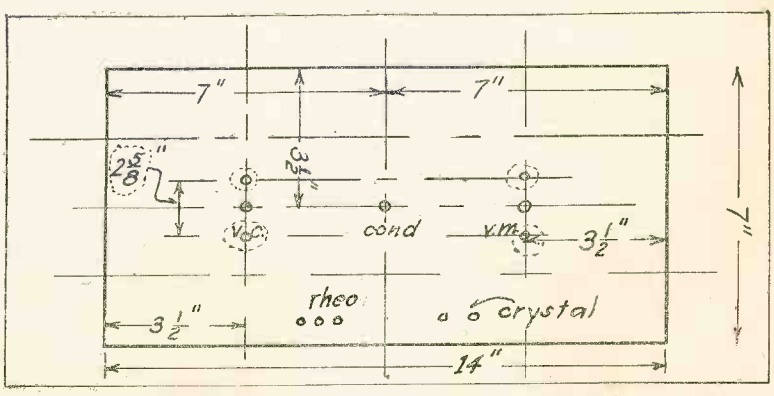

Fig. 2. Make Layout on Paper for Panel

fast enough to heat the drill. Do not bore the four screw holes in the same positions as shown unless you have the same make of variocoupler and variometer. If you use another make, the center holes are correct as shown, and the supporting screws may be located by the paper template or sketch which will accompany the units you buy.

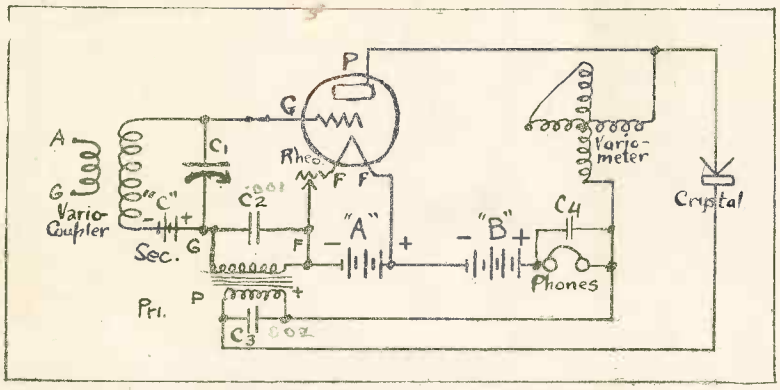

Fig. 3. Hook-up of Set. Variometer Controls Loudness

List of Parts

One variocoupler.
One variometer.
(Amrad make illustrated.)
One 10 to 20 ohm rheostat.
One .005 (23 plate) variable condenser.
Three dials.
Three strips bakelite, 1" x 3" for terminals.
7 "x 14" x 3/8" wood base.
7" x 14" x 3/16" panel.
Two brass angles for panel support.
One .00025 mica condenser.
One crystal cup and detector.
One crystal.
One audio transformer, 6 to 1 ratio.
One tube socket for UV201A or UV199.
Six 1½ inch 8-32 machine screws.
Ten binding posts.
Bus bar, screws, etc.

The coupler, variometer, condenser, rheostat and crystal detector are mounted on the panel. The other parts are supported on the base board. The transformer if of Amrad manufacture, just fits under the bracket of the variometer thus being a support, and by putting the primary + terminal in the bracket hole it completes the plate circuit. (See Figures 4 and 5.) If another transformer is used select one with the highest ratio even ten to one being very satisfactory. To wire up the set start at the antenna and follow through as logically as possible. The diagram is given in Figure 3. Two of the bakelite strips have six holes apiece, four for binding posts and two for mounting screws. The third bakelite strip has four holes. The holes are 1/8 inch diameter. The first strip has four binding posts, antenna, ground, and two for the "C" battery. The second strip has the four posts for "A" and "B" batteries. The third is for the phones or loud speaker. The antenna strip goes

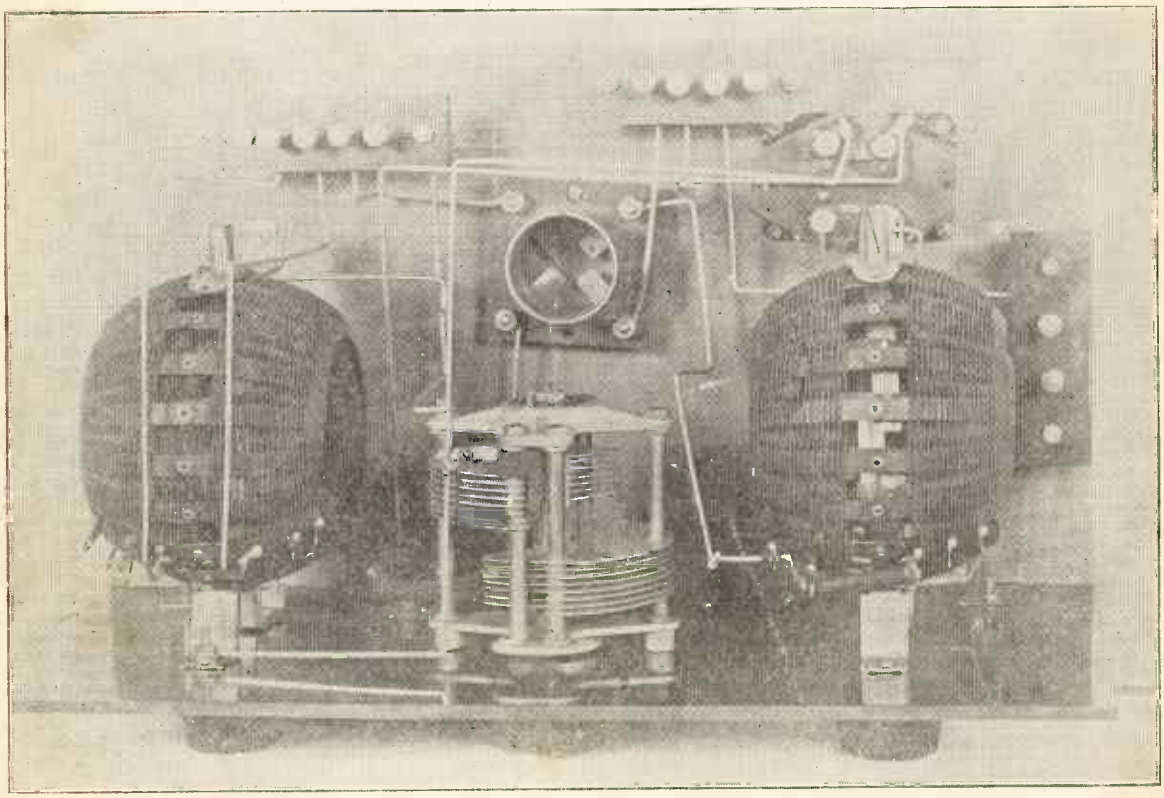

Fig. 4. Top View, Showing General Location of Units and Wiring

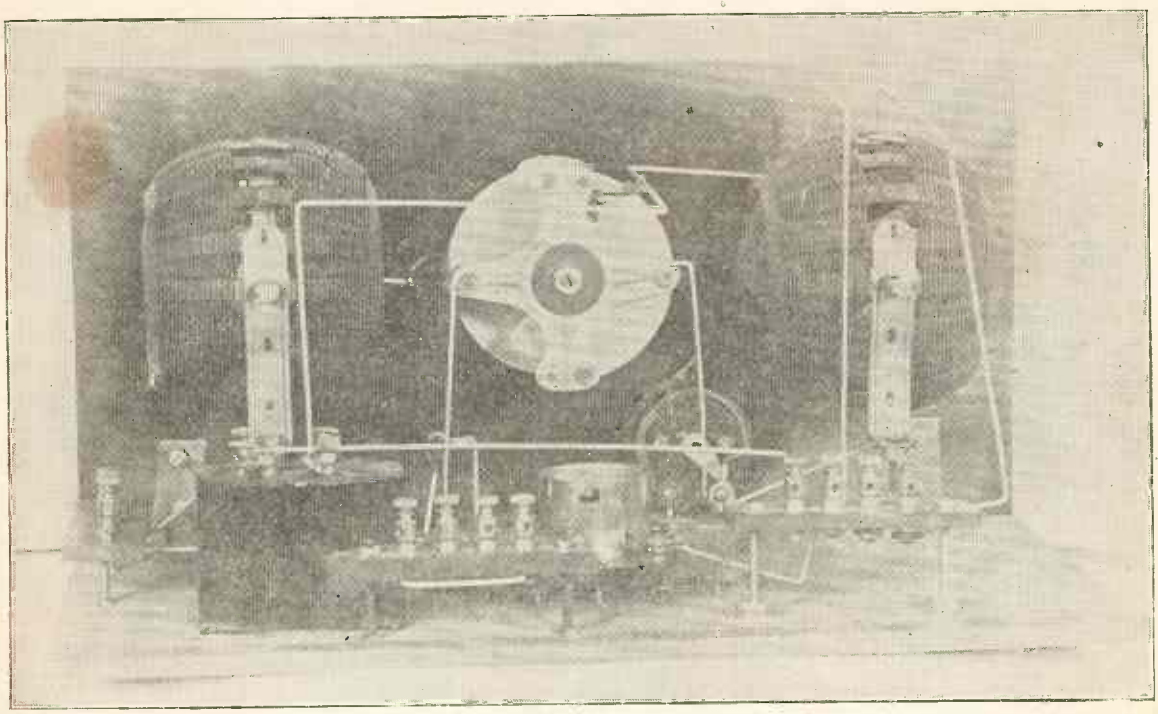

Fig. 5. Rear View. Note Mounting of Transformers and Binding Posts

just behind the variocoupler, the battery one goes between the socket and transformer, and the phone strip goes to the left of the variometer. The six 8-32 machine screws are used for mounting. This is shown in Figure 4.

The antenna coil (primary) consists of six to twelve turns of the stator of the variocoupler. The smaller the number of turns used, the more selective the set will be, whereas with a large number the volume is larger. Even twelve turns, however, give good selectivity with loud signals. These turns should be about the middle of the stator. If an Amrad variocoupler is used, it will be found that the outside winding is split into two halves. This is shown in Figures 4 and 5. At each end there is about one inch of winding with three-quarters of an inch in the centre without any wire. There are two terminals sticking up close to the edge of this space. These are used as the primary terminals.

If any other make of variocoupler is employed, it will be found that various taps allow the use of more or less turns. A pair of taps should be selected which will give a part of the winding near the axis on which the rotor turns. As stated, from six to twelve turns is about the right amount, although this winding is not critical. To get a certain amount of coupling between the primary and secondary, it is necessary to turn the rotor more or less into line with the stator. The more turns that are used on the stator, the more nearly at right angles the two coils must be to give the desired coupling.

Use of "C" Battery

If a "C" battery is included in the hook-up, it should be on the filament side of the variocoupler, as shown in Fig. 3. As usual, the negative pole runs (through the coupler) to the grid. In case the "B" battery pressure is only 45 volts, then the "C" battery should be omitted. If the potential is run up to 90 volts, it is an advantage to connect in a 4½-volt "C" battery. With 67 volts a three-volt "C" battery is enough.

For loudest results use a UV-201A tube or its equivalent. This requires a 6-volt storage battery to supply one-quarter of an ampere to the filament. In case you do not wish to invest in a storage battery, then a UV-199 tube will be best. As a radio amplifier this tube is even better than the UV-201A, and so the range of the set will be as great or greater. However, as an audio amplifier the 199 is not quite as good as the 201A, and so the loudness of the music will not be as great with the former, particularly on local broadcasting. But the difference is very slight on distant stations.

Size of Condensers

The various condensers used in the set have values as given in the list of parts. C1 should usually be 23 plates or .0005 mfd (microfarad), but it depends on the number of turns on the rotor of the coupler. The more the turns, the less the numbers of plates required in the condenser. If the coil in the rotor is a large one, then a 13 plate condenser at C1 will get up to 500 meters wave length. C2 is a by-pass condenser across the secondary of the audio transformer. If this unit is too small, it will be difficult to make the set regenerate, since the radio frequency waves can not go through the high inductance (or electrical weight) of the 10,000 or 15,000 turns of the transformer winding. If the set should be found to oscillate continuously, then, by reducing the value of this condenser, the trouble can be remedied. Ordinarily a value of .0005 mfd to .001 mfd., is right for this position. C3 is a by-pass for the high frequency being rectified through the crystal. It is not at all critical and .001 or .002 (whichever

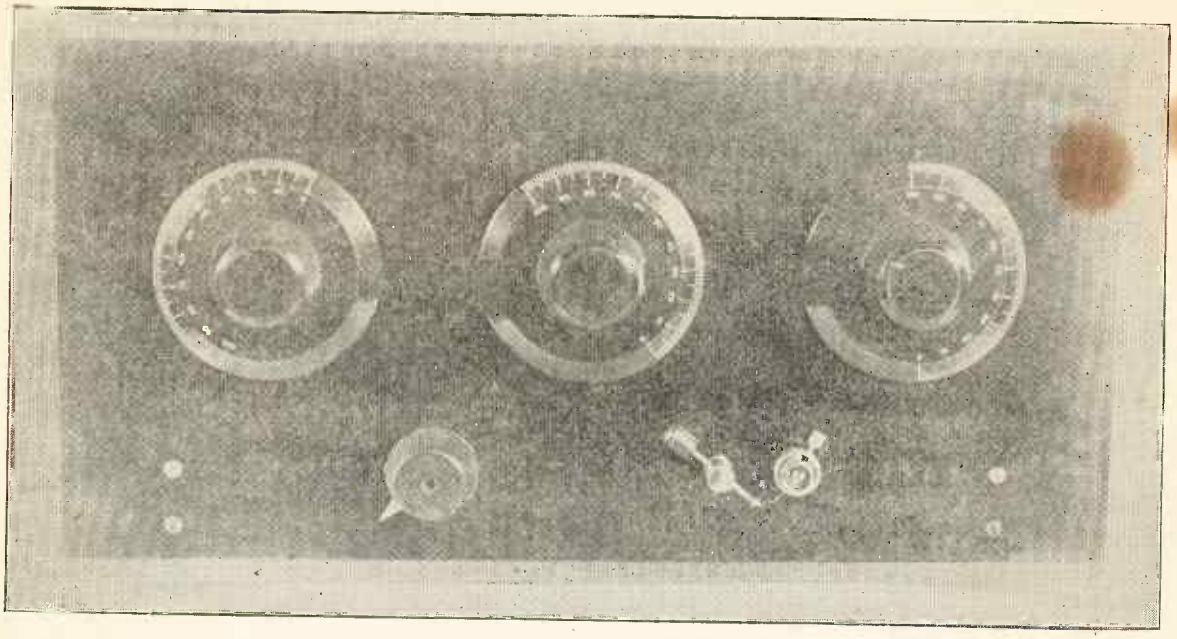

Fig. 6. Neat Appearance of Panel is Attractive. Crystal at Right

you happen to have on hand) will be right for this position.

C4 is a by-pass for the radio frequency around the telephones, and allows the waves, after threading the variometer, to return to the filament. This condenser may oftentimes be omitted, since the internal capacity between the primary and the secondary of the audio transformer is in parallel with C4. This capacity is usually big enough so that no additional condenser is needed. In that case the high frequency runs from the output of the plate P through the variometer, then direct from the primary to the secondary of the audio transformer (leakage capacity) direct to the rheostat and filament. In such a case C4 is not required, but it is shown in the drawing to make the action of the set clear.

How the Set Works

Point A on the variocoupler in Fig. 3 is connected to the aerial and G to the ground. This gives a non-adjustable primary of six to twelve turns, as already described. The energy is fed across to the rotor or secondary, and the angle between the two determines how loud or how selective this radio will be. This is the left hand dial in Fig. 4 and 6. The secondary coil is tuned by adjustable condenser C1, which is the dial shown in the center in these two photographs. One side of the secondary connects to the grid or input of the amplifier tube, and the other through the by-pass condenser C tube to the filament. Thus the oscillation, which is tuned by C1 is impressed across the grid-filament. The output from the radio amplifier comes from the plate P and divides. The audio frequency, which is rectified by the crystal detector, runs to the primary of the audio transformer, while the high or radio frequency passes through the variometer and by-pass condenser C4, through the "B" battery back to the filament. The variometer control is operated by the right hand dial in Figs. 4 and 6 tunes the output circuit, and so determines the amount of regeneration or feedback. That completes the action of the set as a radio amplifier.

The audio frequency, which as has been explained, is rectified by the crystal detector, runs through the primary of the audio transformer. It can not be short circuited through condenser C3, as the latter is too small to pass any low frequency oscillations. From there it goes hrough the phone and "B" battery to the filament. It will thus be seen that the phones are in circuit, and so the set would give some volume, even if the audio frequency amplification of the tube were not used. This completes the operation as a detector.

Increasing the Volume

As an audio amplifier the output of the secondary of the audio transformer, which has been stepped up, say six to one, (depending on the ratio of this ransformer) is impressed on the filament and through the secondary of the variocoupler on the grid of the vacuum tube. Condensers C1, C2, and the inductance of the variocoupler are all so small that they have no effect on the low frequency audio vibrations, although they did the tuning of the high frequency radio oscillations as they first came in from the aerial. The audio frequency is thus impressed on the input of the tube. The output, which has been amplified several times more, comes from the plate, P. It reaches the phones mostly through the variometer, although a small amount will perhaps be by-passed by the crystal and primary of the audio transformer. Then it passes through the phones in large volume to the "B" battery, and back to the filament. This is the complete action of the tube as an audio frequency amplifier.

If a good crystal is used on this set, the catwhisker can be dropped almost anywhere on it, and it will give good results. To find the most sensitive spot, it is necessary to feel around when a distant station is being heard. When the best spot is found it will result in louder signals. The crystal, however, is

Continued on Page 30

Saving Two Tubes by the Tropadyne

How Six Tube Are Made to Do the Work of Eight

THE super-heterodyne principle is very popular this year. In introducing the Tropadyne receiver to our readers it may be well to mention that this is not a new trick circuit. It is an improved super-heterodyne, and has been in use for several months by many radio fans, and its increasing popularity is proved by the many complimentary letters received from all over the country. Those who have built this receiver in the East, report very favorable results, some claiming reception from Pacific coast stations when using a small indoor aerial.

Such results can only be obtained from a receiver of the super-sensitive class, and are not due to freak conditions. In fact the large number of favorable reports from satisfied users are somewhat surprising when we consider that the Tropadyne was invented last July and all tests have been made under unfavorable summer static conditions. And the set is relatively inexpensive and simple to build, considering that it has six tubes. This no doubt accounts for the immediate success obtained by many who have undertaken the construction without any previous experience in set wiring.

Oscillating with Detector

Ever since the appearance of the first super-heterodyne during the World War, engineers have been trying to decrease the number of tubes required for this wonderful radio receiver. In the first place, two tubes were used for changing the wave length of the received station, one as oscillator, and one as detector. Various methods were tried without complete success for effecting this combination of detector and oscillator in the one tube, but recently the problem has been successfully solved. One answer is the Tropadyne principle invented by C. J. Fitch, of the Radio Industries Corporation.

An oscillator circuit, and a tuner circuit, are required in every super-heterodyne, and these circuits should be independent of each other, so that the tuning of one circuit will not affect the tuning of the others. In the standard super-heterodyne, the two circuits are coupled by a few turns of wire called the "pick-up" coil, and very little oscillator energy is added to the signal energy and of course the amplification of heterodyning is comparatively slight. In the Tropadyne, the entire output of the oscillator is added to the signal and the heterodyning amplification is much larger. And the two circuits, oscillator and tuner, are made independent of each other by connecting the tuner circuit to a neutral point of the oscillator circuit, which is at the center turn of the oscillator coil. Thus we not only eliminate one tube from the standard circuit but we increase the amplification and sensitivity of the set in doing so. In addition the set is made non-radiating.

What the Word Means

As the heterodyning action for changing the wave length in the standard circuit requires two tubes, and as this change is accomplished in the Tropadyne with one tube, it explains the origin of the name Tropadyne, *tropaia* from the Greek meaning change, and *dyne*, power.

Those who intend building this receiver will find the illustrations very helpful. They clearly show the location of the instruments, and the simplicity of the wiring. The following list of instruments will be required for the complete six tube set:

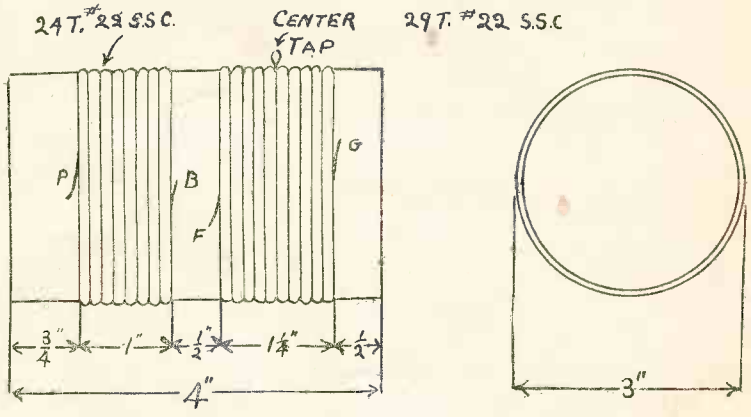

Fig. 1. Tickler (P, B) and Tuner (F, G) on One Form.

Parts to Buy

1 Panel, 7 by 30 inches,
1 Hard wood base board, 6¾ by 29 by ⅝ inches,
6 Standard vacuum tube sockets,
1 6 ohm filament rheostat,
3 20 to 30 ohm filament rheostats (optional),
1 400 ohm potentiometer,
1 Filament switch,
1 Double circuit jack,
1 Single circuit jack,
1 23 plate .0005 mfd. variable condenser,
1 43 plate .001 mfd. variable condenser,
1 Oscillator coil,
4 Tropaformers,
2 .0005 mfd. fixed condensers,
1 .005 mfd. fixed condenser,
2 Grid leaks and mountings,
1 Audio frequency amplifying transformer,
Binding posts, bus bar, etc.

The entire cost of the set without tubes or batteries should not exceed $60.00. This does not include loop aerial, or loud speaker or cabinet, which parts may be selected to suit individual taste.

First Make Layout

First drill the panel after making a layout like the photographs. These give the locations of the condensers, rheostat, etc., only. The mounting holes depend upon the construction of the instruments, and vary with different makes. After the center holes are marked, the small drilling templates furnished by the manufacturers of the instrument should be used for marking the other holes. These small templates also give the size of the holes.

The panel is fastened to the base board with flat head brass wood screws ¾ inches long. After screwing the panel to the board the various instruments should be mounted before starting the wiring. The photographic views give the locations of the instruments that are mounted on the base board.

Those who desire to wind their own coils may do so by following the general design given in the illustrations. The oscillator coil is wound on a 3 inch bakelite tube 3½ inches long. Two windings are used, marked P and B+ for the primary, and F and G for secondary. The winding P, B+ consists of 24 turns of No. 20 or No. 22 S. C. C. (single cotton covered) wire. The winding F, G, consists of 29 turns of the same kind of wire wound in the same direction and spaced ½ inch from the other winding. The winding should start ½ inch from the end of the tube. A center connection is made on this coil, which should be exactly at 14½ turns. Small angle brackets are used for mounting these coils to the base board. The letters are connected thus: P, plate; B+, "B" battery (through primary of Tropaformer); F, filament; G, grid.

Building the Transformer

Next we come to the intermediate transformer or Tropaformer. The advantages of air core vs. iron core intermediate transformers and also the advantages of high or low intermediate frequencies, have been discussed a great deal in print, but we cannot go into that here. The heart of the super-heterodyne lies in the intermediate transformer, and to obtain maximum efficiency and sharpness of tuning the three transformers must be exactly alike. Air core transformers offer quite sharp tuning if properly matched, which they seldom are, but the amplification is apt to be low. Iron core transformers used with a tuned coupler are often difficult to get into operation properly and the tuning sometimes broad.

A transformer that has successfully overcome these difficulties, the Tropaformer, is shown in the illustrations. Although designed especially for the Tropadyne and called Tropaformer, this instrument gives first class results in other super-heterodynes. Across the secondary of this unit is connected a .0005 mfd. variable condenser of the book type mica dielectric construction, so as to occupy small space. This condenser enables the transformer to be tuned sharply, so that the constructor can match his own transformers after connecting them in the set and so obtain maximum efficiency. Once tuned alike they are not to be touched again. The complete instrument comprising condenser and transformer is mounted in a moulded hard rubber case as shown in the photographs. The four terminals are lettered P, B, F and G (as already explained) to correspond with the vacuum tube connections and lettering given in the diagrams. Each transformer covers a wave length range of 3000 to 9000 meters or 100 to 33 kilocycles. They operate best at about the center setting of the dial which gives a wave length of 6000 meters or 50 K. C.

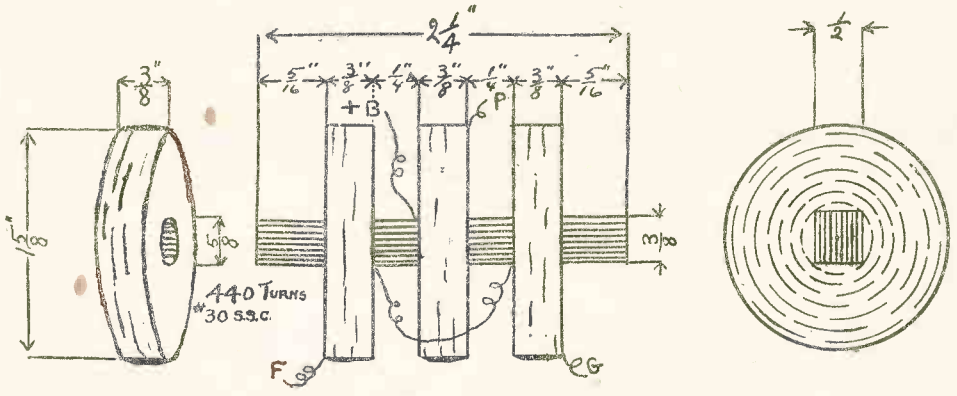

Fig. 2. Winding of Intermediate Frequency Transformer

Building Your Own

These Tropaformers may be bought complete, or if the builder wants to, he can make his own. Fig. 2 shows the construction. An iron core is built up, ⅜" x ½". The laminations may run either ½ inch or ⅜ inch with the other dimension to correspond. Ordinary transformer iron will do although it should be as thin as possible, preferably not over .010 inches thick. Three coils are mounted on the iron, as illustrated. The center one is the primary. The two outside ones are connected in series to form the secondary. Each of the coils consists of 440 turns of No. 30 single silk covered wire. The dimensions of spacing are shown in the cut.

To tune the secondary a variable condenser is connected across from F to G (in parallel with terminals). It should have a maximum capacity of .0005 mfd. This may be obtained by a 23-plate variable condenser of the ordinary type or a special book type which occupies less space. The dials controlling these transformers should not be mounted on the dial, because once they have been tuned correctly they are never touched

again, no matter what wave length you are picking up. If it were possible to wind the three coils *exactly* alike and get three fixed condensers of a capacity of about .0003 mfd. which were *identical* then it would not be necessary to use variable condensers at all. The reason for making them variable is correct for the small differences which will occur whenever a coil is wound by hand.

The Balanced Oscillator

The general scheme of operation of this set is illustrated in Fig. 3. The source of the waves is the loop, as shown at the extreme left. In this set, as built commercially, there is a jack for plugging in an outside aerial instead of the loop. This attachment, with its jack, is standard for any kind of a set which uses both loop and aerial, and so is omitted from this discussion in order to make it clearer. The principle of the tropadyne has nothing to do with this loop-or-aerial jack. The loop is tuned by the 23-plate tuning condenser in the ordinary manner. So far the set is no different from any other using the loop aerial.

One side of the loop runs to the filament of the detector—oscillator tube. But the other side of the loop, instead of running to the grid, as with most sets, goes to condenser C1, which has a value of .0005 mfd (microfarad). This acts as a stopping condenser, as will be explained later. A capacity as large as this will not hold back the high frequency radio waves, and so as they come from the loop they run through C1 to the middle point of the oscillator. As has been explained the two halves of the windings from this point just balance each other, and so the radio wave divides, one half going to the ½ megohm grid-leak (No. 1) and filament and the other half to the grid of the tube. It is this latter part which takes the input to the detector. The first half naturally has no effect on the filament.

Coils Are Very Independent

If the oscillator coil has been wound symmetrically, so that the two halves are exactly alike, then the wave in the upper half will exactly equal that in the lower, and so the voltage at the two ends of the oscillator-condenser will rise and fall exactly in step. Since the voltage from the radio wave is the same at both ends of the condenser, no current from the radio wave will flow through the condenser. That is why the setting of the oscillator has no effect on the tuning of the loop. In most super-heterodynes as the oscillator is changed in adjustment it effects the tuning of the loop itself, which of course requires a lot of juggling with dials to bring about a balance. This is one of the big advantages of this set that all effects of one on the other is eliminated. This finishes the action of the input tube.

The output runs from the plate through the tickler coil, as shown in Fig. 1. After passing the tickler, it divides, the high frequency going through the .001 mfd condenser C2 and the audio frequency to the phones and "B" battery back to the filament. The inductance of the phones is too big to pass oscillations of a million or so cycles per second (radio frequency) but lets the low speed audio wave through without difficulty. The tickler since it is wound on the same tube as the oscillator coil, has considerable coupling or magnetic effect upon it. The output of the plate is thus fed back to the oscillator tube.

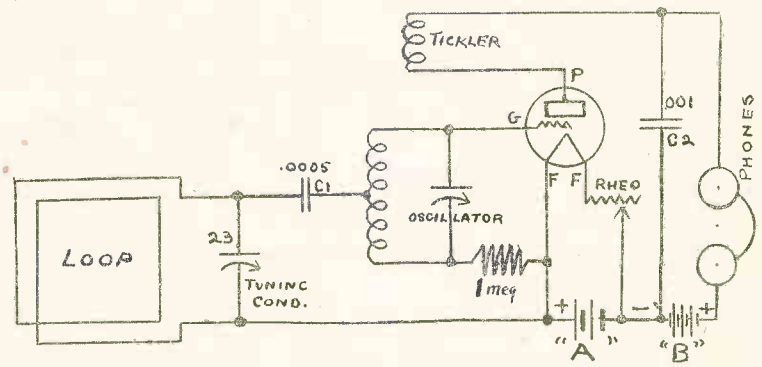

Fig. 3. Tuner and Oscillator Are Independent

Making the Tube Oscillate

It is a natural question here why the oscillator coil will work since it was explained a minute ago that it had no effect on the radio waves. Here is the reason. The radio waves come in from the loop to the middle of the coil and divide, one-half going *up* and the other half *down*. Thus they substract one from the other and so cancel, but the oscillations from the tickler go down in both upper and lower half of the coil, since the effect comes from the end and not the center. Thus the two halves will *add* instead of substracting as before. Since the two halves add, the effect from the tickler is quite powerful, and the coil and its condenser are set into strong oscillations. The frequency of this vibration is controlled by the oscillator condenser. This circuit consists only of the oscillator-condenser and the coil, and so its frequency is entirely independent of the setting of the tuning condenser. Here again we have the two controls unaffecting each other, which makes the set easy to operate.

Placing the Leak

Notice the ½ megohm grid leak is connected from the oscillator to the filament. It runs to the positive side as is necessary with a detector tube. This puts a small positive voltage bias on the grid, just like any ordinary set. Instead of being connected to the filament side of the oscillator coil it might have gone on the grid side, but the location as shown is better, since it removes this high resistance from the grid circuit of the incoming radio waves. Cutting out this high resistance naturally sharpens the tuning.

Now notice stopping condenser, C1. This is necessary to prevent a short circuit of the grid leak by the loop. If this condenser C1 were omitted, there would be a direct connection from the grid through the upper half of the oscillator coil, then through the loop back to the filament plus. In such a case the grid leak being short circuited would have no effect. This is a rather ingenious method of insulating the grid, but of obtaining the proper bias by getting the correct value of the grid leak. This completes the action of the detector-oscillator as used in this hook-up.

Six Tube Operation

The complete hook-up of a six tube

set is shown in Fig. 4. Notice that the left hand part is just the same as Fig. 3. The action is identical with what has already been explained. The first difference is seen in condenser C2. In the description of the operation of Fig. 3, it was said that the high frequency waves from "P" went through the .001 mfd condenser, while the audio frequency used the telephones as a return path to the filament. In the complete set the detector-oscillator reduces the oscillation speed to the intermediate frequency, which is still high enough to some extent through a .001 condenser. For this reason in Fig. 4 the value is reduced to .0001 mfd, or better in shown may be amplified by an audio frequency transformer and then put on a loud speaker. Owing to the high output from this set one step of audio is oftentimes sufficient. However, if the loudest results are wanted, a second step of audio may be used on top of the first like any standard amplifier hook-up.

Getting back to our intermediate steps of high frequency amplification, notice that while the end of the secondary of the tropaformers is connected to the grid of the next tube the other end runs to the potentiometer. This is to allow a variable grid voltage or bias to be adjusted to the needs of the next tube. By turning the handle of the potentiometer tery is used for lighting the filaments, as is customary with this set, then 22 volts of "B" will be correct for the two UV-200 tubes if used. If hard tubes UV-201 are employed or if dry cell operation with UV-199 tubes is planned for, then this "B" plus tap may be connected to 45 volts instead of 22. All the amplifier tubes are excited by 90 volts of "B" battery. A less potential here will work as well but the amplification will not be quite so great.

About the Rheostats

Many people prefer separate rheostats for controlling the various tubes. This is generally unnecessary, as the best voltage for operating any one style is a fixed

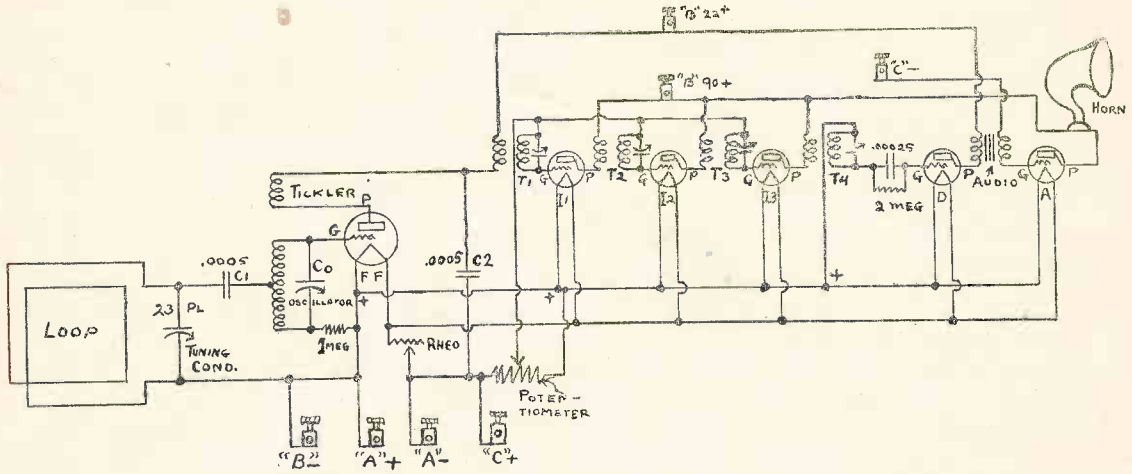

Fig. 4. Complete Hook-up. Individual Rheostats May be Added

most cases be omitted entirely. It is shown here in order to make clear how the circuits operate.

Instead of the output from the plate leading to the phones as in Fig. 3 a tropaformer T1 is used instead. This, as has been noted, is a tuned high frequency transformer. The output voltage is stepped up through T1 and applied to the grid of the first intermediate amplifier I1. The output from this tube leads to the second tropaformer T2. This action is repeated through the three intermediate tubes. The output from the third of these runs to the grid of the detector tube, through the ordinary grid condenser and leak. The action here is like any other set. Instead of grid leak and condenser, a "C" battery may be substituted.

One or Two Steps Audio

The output from the detector can be used to operate a set of phones or as

it is possible to adjust the bias to the right value so that these three steps of amplification do not break into oscillation. With such a powerful battery of amplifiers it could easily happen that radio frequency oscillations might occur which would be noticed as a howl or perhaps as bad distortion. Such a condition can be remedied by adjusting the potentiometer. The most sensitive point is found at a grid bias just before the tubes break into oscillation.

While, as just explained, tubes I1, I2, and I3 employ a potentiometer for varying the grid bias it will be noticed that the step or audio gets its control from "C" battery. For most tubes using 90 volts of "B" a 4½ volt "C" will be about right. Of course, if a second step of audio is added, its grid return will run to this same "C" minus binding post.

There are two "B" plus terminals. The one at 22 volts runs to the plates of both detector tubes. If a storage bat-

quantity and is given on the box in which the tube comes. For instance, all good UV-200 and UV-201 "A" tubes work best at just five volts, while the pressure for the UV-199 is three volts. Notice that this is correct for "good" tubes. If you happen to get a poor specimen, then perhaps some other voltage will be better but the best remedy in such a case is to turn the poor tube in and get a good one. For such use a single rheostat controlling all the sockets together is good practice.

For those who prefer to use individual rheostats for the various tubes the photographs, Figs. 5 and 6 show the correct location for four of these units. It will be obvious to any one making up a set that any one or more of them may be omitted at pleasure. The hook-up in Fig. 4 shows only one unit but the others can be added as in any ordinary kind of

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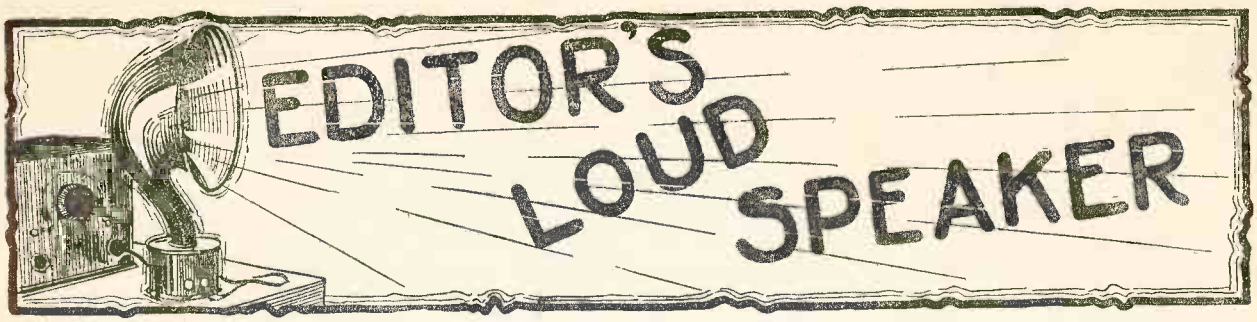


WHEN RULES ARE GOLDEN

HAVE you noticed recently how everybody is beginning to think more about the other fellow? It seems that this is being more and more apparent all the time. As an example, notice how many sets are being advertised as "Golden Rule." By that is meant that they do not radiate or squeal in the neighbor's ears.

This is a tendency in the right direction. Since the squealing variety of set, of which the single circuit regenerative is the worst offender, is probably the cheapest one to build, there are a lot of them in use all over the country. Of course even such a set will give the best performance when it does *not* squeal. When you hear a cat call right in the middle of a good program it does not mean that your neighbor has a cheap set but that he does not know how to operate it. One remedy is to show him how to get outside stations without messing up the air.

A Golden Rule Set

Since many people do not have the mechanical knack of turning the various dials so as not to disturb their neighbors the best all around way of reducing trouble in the air is to push the non-radiating sets as much as possible. Now it seems to be the spirit of the times for purchasers of new equipment to look out for this point. Perhaps half the radio prospects when looking up a new set ask the salesman, "Will it disturb my friends?" and if the answer is "yes" right away it gives that make of radio a black eye.

When it is realized that by getting a non-squealer the man himself is not benefitted but only the surrounding community, it will be seen that such a spirit is one of helpfulness without selfishness being considered at all.

Hurling One Half Kilowatts

Another case of Golden Rule is the attempt made by the big broadcasters to disturb the people in the vicinity of the sending stations as little as possible. At the present time there are several large stations, either being built or plans being drawn for outputs of 500 watts or more. When as much power as this is hurled into the ether it is impossible for any but the most expensive radios to tune out the local station and get distance unless the listeners are located at least ten or fifteen miles away from the sending aerial.

Rather than blanket a whole city with the local programs, the considerate broadcasters are building the studios where the artists perform in the big cities, where the talent can be found, but are carrying the music over long distance telephone lines to a transmitting station located twenty or thirty miles from the city itself. By such a layout all the advantage of a wealth of talent can be had, but the drawbacks of paralyzing city reception by the broadcast listeners are avoided. A station twenty miles away can be tuned out by an ordinary good set, and distances of 1000 miles or more picked up while the local station is sending.

It is from consideration of facts like these that we can see the world is still going forward along moral and ethical lines, as well as improving in technical and engineering matters like radio.

RADIO AND THE POLES

We have had a great deal of news about radio reaching to MacMillian near the North Pole. But now we have another effect, and that is radio at the polls. Everyone who lives within a range of several hundred miles of the big broadcasting stations throughout the U. S., heard one or more addresses of the major candidates for election on November 4.

There is some question as to what effect the candidates had on the broadcast listeners. Some people go so far as to say that mighty few votes were won or lost by the speakers before the microphone. It is certain anyway that some of the hide-bound party men who have voted the straight ticket since they were twenty-one, seemed to be just as anxious to hear what their opponents had to say as they were to listen to their own candidate. In such cases there is no doubt that nothing the opposition could have mentioned would have changed their politics.

Listeners Effect the Speaker

The big effect which the radio had was to our mind in the opposite direction. That is, the listeners undoubtedly had a very great effect on the candidates themselves, whereas in the past, many a man who was looking for votes has been content to throw his speeches together without any clear ideas in his mind. He would speak before a crowd in which he knew that his personal friends were in the majority, and he thought he could depend on his gestures and his personality to get away with almost anything that he wanted to put across. This last campaign has been very different in that respect. The speakers realized that it was only their words which reached the listeners

and that their personality does not modulate ether waves. As a result, they have been very careful to prepare their speeches and polish them up to a point where they hoped their listeners would not twist the dials around so as to cut them off and pick up a jazz band. This has greatly improved the level of the campaign speeches.

One thing more, as the candidates who have been elected realize that they have made promises which have been broadcast to the world, and they see that their conduct is being followed by this host of voters who will check them up, there is no question but they will feel obliged to stick a good deal closer to the promises which they have made to their electorate. No doubt radio has improved the political situation in this country.

SPAGHETTI FOR LOOKS

Just as we follow fashions in the clothes we wear, there is apt to be a kind of style in the building of radio sets. There is, of course, a natural improvement in the various units of any electrical apparatus and these continual changes for the better, are naturally followed as fast as the builder of sets finds out about them. But besides this there is the tendency for each constructor to make his set like his neighbor's.

One illustration of this is the use of spaghetti. About two years ago, there was little of it seen on the amateur's receiver. Then sud denly it came into favor and it has been widely used up until the last few months. Now its popularity seems to be fading out, and most of the wires in the ordinary set are not covered by this material.

The fact that this change is due more to style than utility, is shown when it is considered what the spaghetti does. From an electrical point of view the result of putting it on the wires is nothing at all. The advantage which it is supposed to have, is that it prevents various wires from short circuiting when they touch each other, but if the layout is well made, then there is no danger of two wires touching, since they will be spaced far enough apart to prevent it. However if two conductors show a tendency to be very neighborly and get together, then the thing to do is to use busbar wire, which is square and is stiff enough to prevent bending unless unsupported for a length of several inches.

Its Mission in Life

There is one place where this covering for wires really has a mission in life, and that is to cover the short flexible leads which run from the taps of an adjustable coil like a variometer across to the points on which the inductance switch works. It is necessary here to have a large number of wires (say six or ten) which must be confined in a close space. The tap switch, of course, works over a small part of the circle, and so there is not room to separate the wires far apart. Since these wires are crowded together it is usually very difficult to use bussbar wire, since it is too stiff to get in such confined places and make a good looking job. But by using flexible leads, and covering them with spaghetti, they can be soldered to the switch points and then bent into shape to make a pleasing appearance. This is the one spot on a set where spaghetti should ordinarily be used.

The material has one drawback. The dielectric constant, or ratio which its capacity effect has to that of air, has a value of three or four, depending on its quality. That means that two wires separated by 1/32 of an inch will have a certain capacity with air insulation between them. If one of the wires is covered with spaghetti 1/32 inch thick, this will just fill up the air gap, and so the dielectric separating the two conductors will now be the wall of insulation. The capacity between the two wires will now be three or four times as great as it was before the spaghetti was applied.

Capacity Has No Friend

In some parts of the set, namely, the condensers, capacity is needed for tuning. But along the wires nobody loves it, since in such a place it distorts the waves and so reduces the sharpness of tuning or selectivity. That is why it is best to avoid capacity or at least to reduce it as much as possible along almost every wire. Since speghetti has multiplied its objectionable quality by three it is easily seen that better results will be obtained by leaving off this covering. If, however, the space between the wires, really is as small as this, that is, 1/32 of an inch, they might easily wiggle a bit and so short circuit. The real remedy would be to move one of them to a point one-quarter of an inch or so away, and then no such extra insulation would be needed.

This disadvantage of spaghetti is becoming fairly well known, and therefore writers are advising set builders to leave it out entirely. As a matter of fact such advice is unnecessary, as in general the spaghetti does no real harm. The reason is as follows: The wall thickness is, say about 1/32 inch. If we assume a dielectric constant (as explained above) of three, then this material will make the capacity the same as if the distance from the inside to the outside wall had been reduced to 1/3 or 1/100th of an inch. We are thus losing a space of 2/100th or 1/50 of an inch by the use of this material.

If the space between wires as just pointed out should happen to be only 1/32, then it would be very bad to cut this value down by 1/50 as that would throw away the effect of two-thirds of the spacing. But on the other hand, suppose the wires were located at least one-half an inch apart. This equals 25/50 inch. If we lose 1/50 out of this amount, it cuts the effective distance down to 24/50. This is just as good for all practical purposes as the full amount. From this it may be seen that when the wires are very close, and so need the insulation most, that is the time when the capacity effect is worst. But when the conductors are separated by some distance and no spaghetti is needed then it does no harm.

Charging Your "B" Battery at Home

How an "A" Battery Rectifier May be Used for Both Units

By OLIVER D. ARNOLD

MANY of our readers use radio sets which require a storage battery for operation. It is rather expensive to have such storage batteries charged by a service station. That is why many have bought battery chargers, which may be used at home. There are a good many different makes on the market which give very good results. One of the popular ones is the Tungar.

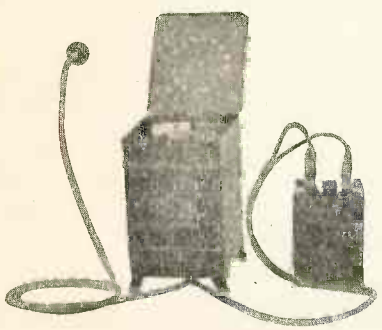


Fig. 1. Charging 6-Volt "A"

It is likely that the majority of users of this instrument do not know that it can be used for charging "B" batteries as well. The method of accomplishing this will be described in this article. The larger radio sets using from three to eight tubes, have become increasingly popular due to their wide range, power and receiving qualities. When a number of tubes are used the drain on the "B" batteries becomes proportionately greater. For this reason the storage type of "B" batteries which can be recharged are now widely used due to their economy and steady, dependable operation.

Easy to Hook Up

Fig. 1 shows how this apparatus looks when charging the "A" battery. The lead at the left hand side is plugged into an ordinary electric light socket. The two at the right run to the terminals of the storage battery. The one that is marked is connected to the positive pole. This must be put on correctly, or else the battery will be *discharged* instead. The way the left hand line is plugged into the light socket makes no difference at all, as the rectifier itself takes care of that. So far the operation is just like any other charger.

When it comes to the 24 to 48 volt "B" battery, a difference in hook-up is necessary. A "B" battery attachment is used which may be obtained from a radio dealer, or this may be made up by the user as will be described later. The attachment is a small rectangular box which is hung on the side of the metal case. This shows up clearly in Fig. 2. The short lead is clipped to the line tap in the 5-ampere Tungar, or the soldered joint on the right of the transformer in the 2-ampere unit. The long lead from the attachment is connected to the positive terminal of the "B" battery.

We are now ready to connect the pair of leads running from the charger, which ordinarily go to the plus and minus of the "A" battery. First connect the minus or negative clip of this pair to the negative of the "B" battery. The positive lead has six volts on it, which is suitable for charging the "A", and so is not used. Either wrap a piece of cloth around it, so that it will not touch any other lead, or else it may be bent back on itself and clipped to the insulated cable, so that it cannot slip down and make contact with its mate. The idea is that it will not be used at all, and must be kept out of mischief. This completes all the connections necessary for charging the "B" battery. This can be seen more clearly from Fig. 3.

Charging a Big "B"

The description which we have just given is correct when the plate voltage of your set does not exceed 48 volts. A 24-volt unit will charge at 0.2 ampere, and a 48-volt at 0.1. If you use more pressure than this on your set, it will be necessary to charge the different sections in parallel. Each additional section should have a separate attachment if you want to charge them up at the current rate just mentioned. Of course, by connecting the various parts in parallel without any change, they will divide the current between them. As an illustration of this, suppose you have two 48-volt sections, and they are charged in parallel with one attachment. As just explained the outfit will supply 1/10 of an ampere. Since this is divided between two halves, each one will take 1/20 ampere. But if two attachments are used, connected as diagram 4 indicates, then each section will get the full 1/10 ampere.

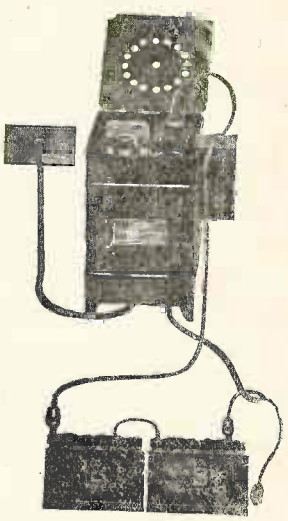


Fig. 2. Charging 48-Volt "B"

A 96-volt battery should thus be divided into halves, and the two negative terminals connected to the negative Tungar lead. The two attachments are hooked on to the frame, side by side, with the two short leads both connected

to the inside of the instrument as explained before. One long lead goes to the positive of one half the "B" battery, and the other long lead to the positive of the other half. The two negative battery terminals are connected together, and to the negative of the Tungar table.

Say it With Switches

Sometimes it is convenient instead of making all these separate connections

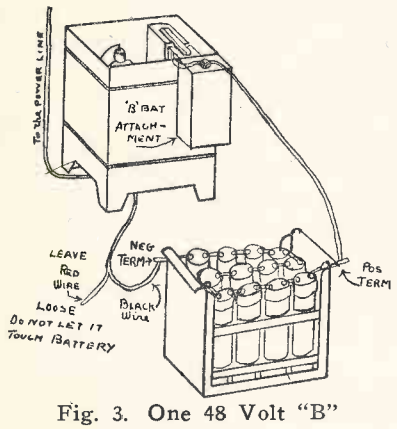


Fig. 3. One 48 Volt "B"

each time to wire up the various batteries (both "A" and "B") in such a way that throwing the proper switches will effect the correct hook-up in an instant of time. Such a layout is given in Fig. 4. There are four switches required for use with a 96-volt storage battery. Each of these four is double throw, that is, can be turned to the left or to the right. For this purpose one single pole, two double, and one triple pole switch will be needed. The diagram of Fig. 4 is easily followed. Switch No. 1 puts the six-volt "A" battery either on the charger (down) or on the radio (up.) Switch No. 2 does exactly the same thing for the "B" battery. The middle pole of this unit is for the 22-volt tap on the detector. If UV-199 tubes are employed in the set, then this middle pole can be omitted, and a double pole switch used instead. The reason is that the UV-199 tubes work as well or better with 45 volts on the detector as with 22. However. it would not be best to put as much as 90 volts on the detector. Switch No. 3 puts the two halves of the "B" battery in series (up) for use on the set and in parallel (down) for charging. That gives 96 volts output, and 48 input. Switch 3 is omitted if only 48 volts of "B" battery are used.

It will be seen that all three switches are left in the "up" position when operating the set, and all in the "down" position when charging. Furthermore, the radio is entirely disconnected from the Tungar during the charging operation. This means that there is absolutely no chance of a short circuit of any kind between the power coming in from the electric light wire and the ground or aerial on the radio. There remains switch 4, which is thrown to the left when the "A" battery is being taken care of and to the right for the "B" battery.

Theory of the Attachment

The operation of the "B" battery attachment can be easily understood by examining the diagram of connections (Fig. 2.) When charging a 6-volt "A" battery, connections are made to the positive and negative Tungar leads. The current is supplied by the left hand coil on the audio transformer, which is the low voltage side. In the case of the "B" battery, connections are made so that current is supplied by the right hand coil, which furnishes sufficiently high voltage to take care of the higher voltage battery. The "B" battery attachment is merely a resistance coil which limits the charging current to the proper value.

Instead of buying an attachment, it is possible to use a 40-watt, 110-volt electric light bulb. This should be screwed into a socket such as is used on the drop light for instance, and the two leads connected, one to the tap on the coil, and the other to the positive terminal of the "B" battery, as shown in Fig. 3. It makes no difference which is which of these two leads. The Tungar bulb, of course, is the unit which prevents the current through the battery reversing when the AC reverses. It makes no difference how high the voltage is in regard to this action. The reasons for taking off a tap at that point of the winding in the Tungar is because that is found by experiment to give the right amount of potential. If, however, the resistance of the attachment were omitted, too large a current would flow through the storage cells, and this would damage them. By limiting the current as described the "B" battery will be charged with the right amount of electricity to prevent any damage to the cells.

An overnight charge once in two or three weeks will, in general, be sufficient to keep the "B" batteries in good condition. The length of charge and further details may be obtained from the battery manufacturers' instructions.

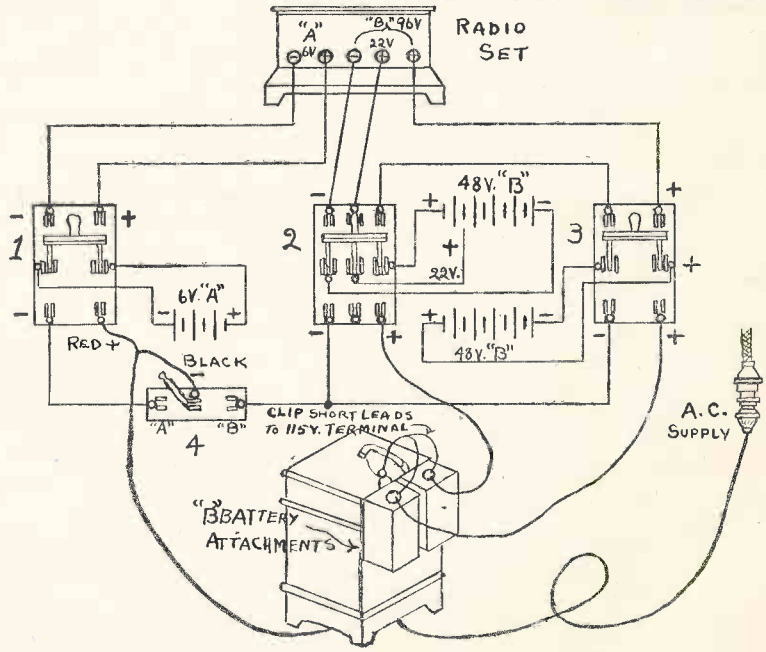


Fig. 4. Charging "A" or 96 Volts of "B"

Remarks Received from Readers

MORE ABOUT SUPER POWER

In our issue of November 1, appeared an article by Mr. Powel Crosley on "Raising the Limit on Power." In this he advocated removing the present limit of 1000 watts on sending stations. As this magazine always tries to present both sides of any argument, we are printing a letter received which gives the other side of the question.

Any of our readers who have definite opinions on this subject are asked to send their comments to the editor. The letter follows:

Citizens Radio Committee,
1449 Lexington Ave.,
New York City.

Editor RADIO PROGRESS.

DEAR SIR:—

The enclosed petition has been circulated freely throughout the New England district and constitutes the fists of the Committee in its sweeping drive against the viciousness of super power.

The Committee, composed of amateurs, dealers, owners of low power radiophone stations, and the listener-in, has definitely settled on a platform from which it will direct its fight, because the far-reaching and dangerous proposal to monopolize the air challenges the very right and individual liberty of the owner of a receiving set.

The Committee's activity and formation was the result of a series of conferences held immediately after the close of the official Washington conference, and its present and future activity will be directed toward combating vicious and drastic legislation tending to retard development of the art, assisting the government in times of national emergency, promoting citizens' interest in radio, and the utilization of radio.

The present proposal to grant experimental licenses for the utilization of increased power, namely gradual increases of 500 watts until the maximum of 5000 watts is attained, is a direct slap at the rights and liberties of the individual owner of a receiving set. Previous experiments have shown the undesirability of high power within a reasonably congested area such as New England.

The Citizens Radio Committee asks your loyal support and co-operation. It wants the opinions of the individual. It is interested in the listener-in, as he is the backbone of the Committee.

Respectfully submitted,
Joel J. Michaels,
Executive Chairman.

The petition which was enclosed is below.

Citizens Radio Committee,
1449 Lexington Ave.,
New York City.

A petition to oppose the erection and operation of "Super" Power radio broadcasting stations.

To the Secretary of Commerce:—

Whereas, The erection and operation of "Super" Power broadcasting stations will menace radio reception and cause unlimited interference and difficulty in proper reception by the blanketing of various areas with the increased power, thereby destroying the efficiency of local broadcasters.

Whereas, The establishment of "Super" power broadcasting stations means the gradual elimination of smaller stations who are not financially or experimentally equipped to combat organized industry.

Whereas, The majority of listeners-in are opposed to "Super" power, even as an experiment, as previous experiments have shown its undesirability. It has caused unbearable interference, diminished the selectiveness of receiving sets, and its real purpose is not in accord with the best interest of the public.

Whereas, Prompt and vigilant action and governmental condemnation is asked of any and all attempts to foist this monopolistic measure upon the public, on the grounds that the nation's representative radio engineers and craftsmen condemned its purpose at the radio conference held in the City of Washington.

Therefore, I, as an owner of a radio receiving set, place myself on record as being unalterably opposed to "Super" power.

PUTTING PIANO FINISH

Continued from Page 14

from which you can select the color you like best. Every manufacturer has ideas of his own in regard to various shades, some of which may not appeal to the prospective user; on this account, it is best to get a number of cards and select the desired color.

The appearance of the surface of the finished box when done with the above material is altogether different from that of a flat-rubbed varnished one and it is very pleasing to the eyes. Difficulty: The work has a lumpy and uneven appearance. Remedy: Sandpaper smooth, and dilute material in the can with a small quantity of turpentine, stirring well from the bottom of the can so as to break up any lumps. Use a small amount on the brush and flow across the grain of the wood. After drying thoroughly, apply another coat, spreading it along the grain of the wood. It is hardly necessary to state, that whatever style of finish is used, a neat and pleasing looking set will be obtained. Such a finish will sell the radio more easily should the amateur radio fan desire to dispose of it.

ORGAN MUSIC IS GOOD

Organ music as broadcast by WGY, Schenectady, is rapidly gaining favor with the radio fans. During the summer Stephen E. Boisclair was heard during the dinner program every Thursday night and at 10:30 o'clock on Tuesday evening. Fan letters, the true measure of popularity, have pronounced the organ music good. Mr. Boisclair plays on the Harmanus Bleecker Hall organ in Albany, N. Y., and the control room of WGY is connected by telephone lines.

Mr. Boisclair will be heard every Tuesday and Thursday evenings for several months to come. He will begin to play at 11:20 o'clock and his program will be a judicious mixture of popular high class compositions and the simple songs familiar to everyone.

NEW TROPAFORMER

Continued from Page 22.

set. It is sometimes an advantage to use a separate rheostat on the first tube to control the amount of oscillation.

Do Not Solder Transformers

After obtaining the Tropaformers, coils, etc., the instruments may be mounted on the base board, as shown. The set is now ready for wiring, which is the most difficult, yet interesting task, and must be done with extreme care. The hook-up is shown in Fig. 4. Bus bar wire should be used and care must be taken with the soldering iron so as to heat the joints thoroughly before applying the solder. Use as little solder and flux as possible. It is advisable to solder the socket and transformer connections, or on any other binding posts. It is much better to clamp the wire securely under the nuts as there will be no danger of softening the insulating material due to heat, and no flux will run under the screws and insulate them. It is best to make the filament connections first, and then insert the tubes in the sockets and make sure that they light properly before wiring the rest of the set.

The insulating strip that holds the five binding posts may be cut from an old panel, or one may be obtained already cut and drilled from any radio store. It is supported by brass angles. A slot is cut in the back of the cabinet through which the binding posts protrude for the battery connections.

Stopping the Squeal

In wiring the set care should be taken when placing the fixed condensers and grid leak. These are very important. The grid leak resistance, for the first tube, should usually not exceed ½ megohm. If the grid leak resistance is too high, the set will squeal, especially on the lower settings of the dials. The squeal can also be stopped by turning down the oscillator filament rheostat. A separate 20 or 30 rheostat is often used for this purpose.

Continued on Page 30

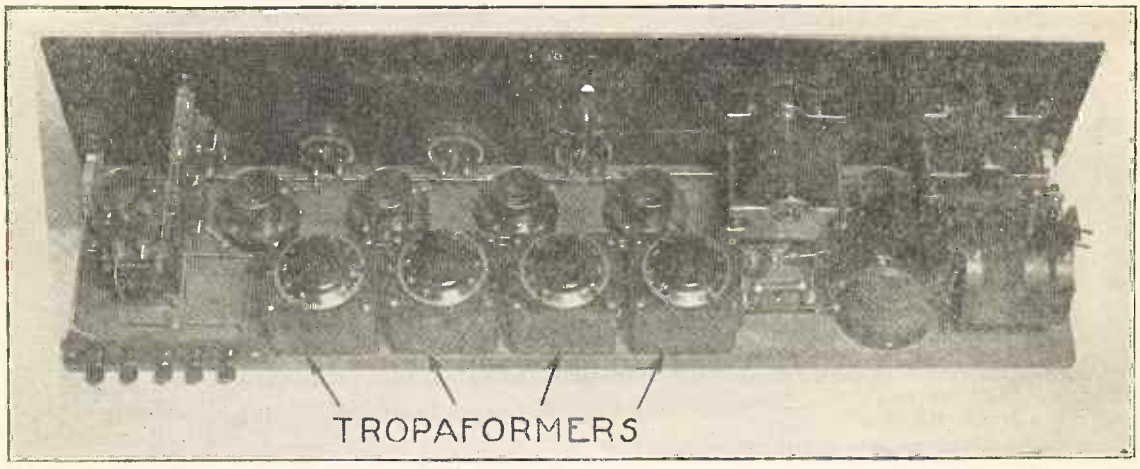


Fig. 5. Top View. This Shows Entire Layout of Units

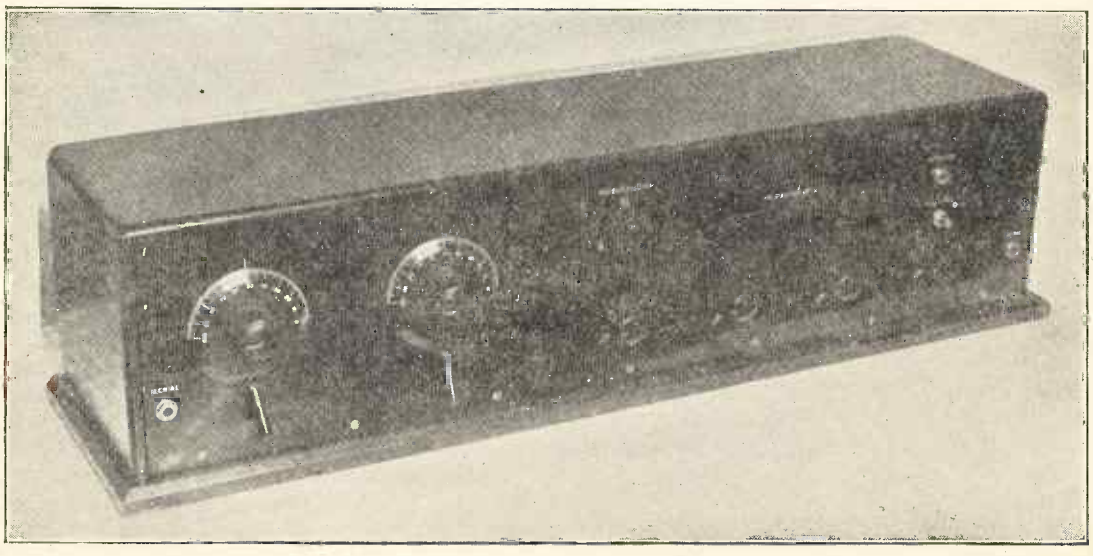


Fig. 6. Panel Arrangement is Well Worked Out and Good Looking

Rx DR RADIO PRESCRIBES.

NOTE: In this section the Technical Editor will answer questions of general interest on any radio matter. Any of our readers may ask not more than two questions, and if the subjects are of importance to most radio fans they will be answered free of charge in the magazine. If they are of special interest to the questioner alone, or if a personal answer is desired, a charge of fifty cents will be made for each answer. This will entitle the questioner to a personal answer by letter. However, if the question requires considerable experimental work, higher rates will be charged.

Question. What effect does fog have on radio signals?

Answer. There does not seem to be any definite relation between fog and the loudness of radio. Sometimes in foggy weather, reception will be better and sometimes worse. Probably the reason is that the change is due to other weather conditions which accompany the fog. In general it is found that weather which causes mists to percipitate in the air as fog is likely to cause fading and static. This is probably not due to the presence of moisture particles in the air, but to the condition of frictional electricity caused by the cloud formation.

Question. What is the specification for good Litz wire?

Answer. The principal requirement of this cable which consists of a large number of fine wires all insulated from each other is that (1) each of the various wires must be continuous through the whole length, and (2) each wire must be completely insulated from its neighbor. If the first condition is not met, that particular strand is absolutely dead, since of course, being insulated any current which tries to flow through the wire can not cross over at the end to the one next to it. If the second condition does not hold, then the particular advantage of the Litz construction is lost. Such wire usually consists of from 12 to 36 turns of enameled No. 36 wire. Over the whole cable is wound two wraps of silk as a mechanical protection and a means of holding individual wires together.

Question. Which is better as a filament switch, the round type or the oval?

Answer. As long as the switch is mechanically and electrically good, it makes no difference which of these is used. As a general proposition it is better to employ the type which requires only a single drilled hole in the panel, as this gives a much neater looking job. As to the shape of the body behind the panel, this item does not enter into consideration.

Question. Several concerns advertise their moulded dials are of bakelite. Is this an advantage?

Answer. For some locations like sockets, for instance, it is certainly desirable to use the best insulation possible. Bakelite and Condensite are two kinds which are as good as any for such parts. The dial, however, contains no current carrying parts, and does not work as an insulator. For that reason any kind of material which will hold its shape and stand up mechanically is quite satisfactory. Of course, the Bakelite dials have a high polished finish, which is quite attractive.

Any other kind of moulded material, which looks as good will be just as satisfactory for the purpose.

Question. There are several vernier dials on the market which are supposed to convert any condenser into a vernier unit. Do they work well?

Answer. The chief trouble with this style is the presence of back-lash or looseness in the parts. If the condenser itself has loose bearings, so that it rocks back and forth as the shaft is turned, then no kind of attachment on it can give a good, smooth vernier effect. This stands to reason since as the dial is rotated the plates will not only move in and out, but will also tip forward and so change the space between rotor and

PULLING IN THE WAVES

Continued from Page 11.

more complicated and specialized directions, but the original birthplace of the electric oscillation—the flashing spark—will probably reman as the symbol of the radio art. It will always recall to those who understand it, the early struggles, failures, and eventual triumphs of radio progress.

When a symbol was wanted for the new art of broadcasting, the artistic difficulties were discouraging. Finally one of America's leading sculptors, Mr. Edward F. Sanford, Jr., postponed the design of several huge pediments for the new buildings of the State of California at Sacramento, and took up the problem of blending harmoniously the symbols of music and of radio so as to have a suggestive and artistic symbol of broadcasting. The thought inspiring the combined harp and spark was "music carried by radio," but the forms of the symbols were, to some extent, antagonistic. Fortunately, by using a conventional spark, and altering the harp into a graceful shape, the two were formed into a circular emblem which itself suggests the charm of music and also the electric strength of radio.

Inspiring an Artist

This symbol faces the performers in the transmitter casings of stations WJY, WJZ, and WRC of the Radio Corporation of America at New York and Washington, and is shown in the photograph, Figure 4. Musicians are inspired when they face a symbol of the union of their art and the new science of radio. No doubt there will be in the future still other means whereby electricity will come to the aid of the arts, enriching and expanding them.

stator. Such a difference in the distance between the two elements causes a good deal more of change in the capacity than the effect of turning the plates. If, however, the condenser is a well built one, so that no looseness is to be found in the bearings and if the shaft is stiff enough so that it does not bend back and forth, then a vernier attachment such as you describe is a great convenience.

Question. What is the difference between polarized and non-polarized meters?

Answer. The difference in operation is that the former must be connected up to the battery for testing with the plus terminal of the meter running to the plus connection of the battery. If this connection is reversed, then the needle of the meter tries to go backward and no reading can be seen. The non-polarized meter on the other hand will read forward no matter which way the terminals are connected, and so no plus or minus marks will be found on such an instrument. The advantage of this latter type is that it saves time not to have to check up connections as to which way they go on. The disadvantage is that you can not tell which is the positive of the battery by its use. Oftentimes it is necessary to know which pole is which of the wires running to the radio set and of course to find out it is required that a polarized instrument be used.

Reflecting the Single Tube

Continued from Page 18

not critical. The set will bring in a loud local station even with the crystal off, but not very well. A howl is usually heard as soon as the crystal is disconnected.

Results to Be Obtained

One night while in Boston the latter part of September, the author listened for more than an hour to WSAI, Cincinnati, while three local stations were broadcasting. One of the stations was a 500-watt transmitter on 303 meters, but there was no interference while listening to WSAI on 309 meters, 725 miles away. KDKA on 326 meters (500 miles) was also enjoyed, while another local station was broadcasting on 360 meters. On another evening 15 stations were heard in one hour, the nearest being 135 miles away.

The set, connected to a loud speaker, was operated at a distance of one-half mile from a 100-watt station. Using a 67½-volt "B" battery, the music and voice could be heard one hundred feet away. Increasing the "B" battery to 90 volts gave still greater amplification. By turning the dial 5 degrees either way, the station was completely tuned out and distant stations could be heard.

Any one making one of these receivers should be able to get these results or even better.

Fone Fun For Fans

The Eternal Feminine

How I wish that some debater,
Versed in all forensic laws,
Would some happy day create a
Safe rebuttal for "Because."

—*Northwestern Purple Parrot.*

Not Even First Helping

Aunt—"And were you a very good little girl at church this morning, Sallie?"

Sallie—"Oh, yes, aunty. A man offered me a big plate full of money, and I said, 'No, thank you'."—*American Legion Weekly.*

Questions and Answers
If in Doubt Ask Us.

Q.—My neighbor says he hears London and Paris. Would you call him a radio bug?

A.—No. A humbug.

Q.—How was the first loud speaker made?

A.—From Adam's rib.

Q.—What is an aerial plug?

A.—A horse-fly.

Q.—I hear such dizzy noises on my radio. What can the trouble be?

A.—Probably your tubes are "lit."

—*Enarco News.*

Doing It Right

"What on earth are you wearing all those coats for?" asked the neighbor.

"Well," was the reply, "I'm going to paint my barn, and the directions on the paint-can say, 'For best results, put on three coats."—*The Watchword (Dayton, Ohio).*

Then It Would be the Bottom

Many beginners in golf are grievously afflicted with the malady of topping the ball. A player who had this trouble, addrest a professional with gloom in his ear and despair in his eye. "I'm hitting the ball every time right on the top. I want you to tell me a cure for it!"

"Oh," replied the professional, "just turn the ball upside down."—*The Argonaut.*

He Saved Something

Bobby was sent to a dairy to buy some eggs. A little later he came back with a crushed paper bag held tightly in his arms, and splashed all over.

"Bobby!" exclaimed his mother, "what has happened?"

"It's all right, mother," gasped Bobby "I let the eggs fall, but I only lost the juice out of them!"—*The Progressive Grocer.*

NEW TROPAFORMER

Continued from Page 28

After the set is completed it should be connected up and the Tropaformers adjusted. When completely connected and the loud speaker plugged into the jack, the Tropaformer dials should all be turned to about 50. With a few adjustments of the tuner and oscillator condensers and the potentiometer, a station will soon be heard, after which each Tropaformer dial should be slowly turned and left in the position that gives the loudest reception. They need not be touched again, but it is well to make final adjustments after a DX (distant) station is received.

Vernier adjustments are recommended on the variable condensers as the tuning is especially sharp. Vernier dials employing gears cannot be used unless there is no back-lash (looseness) in them, as the loosely meshed gears are noisy.

The complete process of tuning can only be mastered by a few nights practice. If you are familiar with the tuning of other super-het receivers you will find the process of tuning the Tropadyne is the same. The main controls are the two variable condensers and the potentiometer. The oscillator condenser will be found very critical, and as in the case with other super-heterodynes, stations will be received on two settings of this condenser.

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

Abbreviations: W.L., wave length in meters; K.C., frequencies in kilocycles; W.P., watt power of station.

		W.L.	K.C.	W.P.
KDKA	Westinghouse Elec. & Mfg. Co., East Pittsburgh	326-	920-	1000
KDPM	Westinghouse Elec. & Mfg. Co., Cleveland, O.	270-	1110-	250
KDPT	Southern Electrical Co., San Diego, Cal.	244-	1230-	100
KDYL	Salt Lake Telegram, Salt Lake City, Utah.	360-	833-	100
KDYM	Savoy Theatre, San Diego, Cal.	280-	1070-	100
KDYQ	Oregon Institute of Technology, Portland, Ore.	360-	833-	100
KDZB	Frank E. Siefert, Bakersfield, Cal.	240-	1250-	100
KDZE	The Rhodes Co., Seattle, Wash.	270-	1110-	100
KDZF	Auto. Club of So. Cal., Los Angeles, Cal.	278-	1080-	500
KFAD	McArthur Bros. Mercantile Co., Phoenix, Ariz.	360-	833-	100
KFAE	State College of Washington, Pullman, Wash.	330-	910-	500
KFAF	Western Radio Corp., Denver, Col.	360-	833-	500
KFAJ	University of Colorado, Boulder, Col.	360-	833-	100
KFAQ	City of San Jose, San Jose, Cal.	360-	833-	250
KFAR	Studio Lighting Service Co., Hollywood, Cal.	280-	1070-	150
KFAU	Boise High School, Boise, Idaho.	270-	1110-	150
KFBB	F. A. Buttrey & Co., Havre, Mont.	360-	833-	100
KFBK	Kimball-Upson Co., Sacramento, Cal.	283-	1060-	100
KFCF	Frank A. Moore, Walla Walla, Wash.	360-	833-	100
KFCL	Los Angeles Union Stockyards, Los Angeles, Cal.	236-	1270-	500
KFCM	Richmond Radio Shop, Richmond, Cal.	360-	833-	100
KFCZ	Omaha Central High School, Omaha, Neb.	259-	1160-	100
KFDH	University of Arizona, Tucson, Ariz.	360-	833-	150
KFDX	First Baptist Church, Shreveport, La.	360-	833-	100
KFDY	So. Dakota State College, Brookings, So. Dakota.	273-	1100-	100
KFEL	Winner Radio Corp., Denver, Col.	254-	1180-	100
KFEQ	J. L. Scroggin, Oak, Neb.	268-	1120-	100
KFEX	Augsburg Seminary, Minneapolis, Minn.	261-	1150-	100
KFFV	Graceland College, Lamoni, Iowa.	280-	1070-	100
KFFY	Pincus & Murphy, Alexandria, La.	275-	1090-	100
KFGC	Louisiana State University, Baton Rouge, La.	254-	1180-	100
KFGD	Chickasha Rad. & Elec. Co., Chickasha, Okla.	248-	1210-	100
KFGH	Leland Stanford Jr. Univ., Stanford Univ., Cal.	273-	1100-	500
KFGJ	Mo. Natl. Guard, 138th Infantry, St. Louis, Mo.	265-	1130-	100
KFGX	First Presbyterian Church, Orange, Tex.	250-	1200-	500
KFGZ	Emmanuel Missionary Col., Berrien Sprs., Mich.	268-	1120-	250
KFHD	Utz Electric Shop, St. Joseph, Mo.	225-	1330-	100
KFHJ	Fallon & Co., Santa Barbara, Cal.	360-	833-	100
KFHR	Seattle, Wash.	263-	1140-	100
KFPL	Dublin, Tex.	252-	1190-	
KFI	Earle C. Anthony, Inc., Los Angeles, Cal.	469-	640-	500
KFIF	Benson Polytechnic Institute, Portland, Ore.	360-	833-	100
KFIX	R. C. of Jesus Christ of L.D. Sts., Ind'p'nd'n'e, Mo.	240-	1250-	250
KFIZ	D'ly C'm'nw'h & Seifert Radio C'p., Fond d'L'c, Wis.	273-	1100-	100
KFJC	Seattle Post Intelligencer, Seattle, Wash.	270-	1110-	100
KFJK	Delano Radio and Electric Co., Bristow, Okla.	234-	1280-	100
KFJM	University of N. Dakota, Grand Forks, N. Dak.	280-	1070-	100
KFKB	Brinkley-Jones Hospital Association, Milford, Ks.	286-	1050-	500
KFKQ	Conway Radio Laboratories, Conway, Ark.	250-	1340-	100
KFKX	Westinghouse Elec. & Mfg. Co., Hastings, Neb.	291-	1030-	1000
KFLV	Swedish Evang. Mission Church, Rockford, Ill.	229-	1310-	100
KFMQ	University of Arkansas, Fayetteville, Ark.	263-	1140-	100
KFMX	Carleton College, Northfield, Minn.	283-	1060-	500
KFNF	Henry Field Seed Co., Shenandoah, Iowa.	266-	1130-	500
KFOA	The Rhodes Co., Seattle, Wash.	454-	660-	500
KFPT	The Deseret News, Salt Lake City, Utah.	360-	833-	500
KFQB	Search Light Publishing Co., Fort Worth, Tex.	254-	1180-	100
KFQC	Kidd Brothers Radio Shop, Taft, Cal.	227-	1320-	100
KFQD	Chovin Supply Co., Anchorage, Alaska.	280-	1070-	100
KFQU	W. Riker, Holy City, Cal.	234-	1280-	100
KFQV	Omaha Grain Exchange, Omaha, Neb.	231-	1300-	100
KFQX	Alfred M. Hubbard, Seattle, Wash.	233-	1290-	250
KFQZ	Taft Radio Co., Hollywood, Cal.	240-	1250-	250
KFRB	Hall Brothers, Beeville, Tex.	248-	1210-	250
KFSG	Echo Park Evangelistic Ass'n, Los Angeles, Cal.	234-	1280-	500
KGO	General Electric Co., Oakland, Cal.	312-	960-	1000
KGU	Marion A. Mulreny, Honolulu, Hawaii.	360-	833-	250
KGW	Portland Morning Oregonian, Portland, Ore.	492-	610-	500
KHJ	Times-Mirror Co., Los Angeles, Cal.	395-	760-	500
KHQ	Louis Wasmer, Seattle, Wash.	360-	833-	100
KJR	Northwest Radio Service Co., Seattle, Wash.	270-	1110-	100
KJS	Bible Institute of Los Angeles, Los Angeles, Cal.	360-	833-	750
KLS	Warner Brothers, Oakland, Cal.	360-	833-	250
KLX	Tribune Publishing Co., Oakland, Cal.	508-	590-	500
KLZ	Reynolds Radio Co., Denver, Col.	283-	1060-	250
KNT	Grays Harbor Radio Co., Aberdeen, Wash.	263-	1140-	250
KNV	Radio Supply Co., Los Angeles, Cal.	254-	1180-	100
KOB	N. M. C. of Agri. & Mech. Arts, State Col., N. M.	360-	833-	500
KOP	Detroit Police Dept., Detroit, Mich.	286-	1050-	500
KPO	Hale Bros., San Francisco, Cal.	422-	710-	500
KQV	Doubleday-Hill Electric Co., Pittsburgh, Pa.	280-	1070-	500
KSD	Post Dispatch, St. Louis, Mo.	545-	550-	500
KTW	First Presbyterian Church, Seattle, Wash.	360-	833-	750
KUO	Examiner Printing Co., San Francisco, Cal.	360-	833-	150
KUS	City Dye Works & Laundry Co., L. Angeles, Cal.	360-	833-	100
KWG	Portable Wireless Tel. Co., Stockton, Cal.	360-	833-	100
KWH	Los Angeles Examiner, Los Angeles, Cal.	360-	833-	500
KYQ	Electric Shop, Honolulu, Hawaii.	288-	1040-	100
KYW	Westinghouse Elec. & Mfg. Co., Chicago, Ill.	535-	560-	1000
KZM	Preston D. Allen, Oakland, Cal.	360-	833-	100
WAAB	Waldemar Jensen, New Orleans, La.	268-	1120-	100
WAAC	Tulane University, New Orleans, La.	360-	833-	100
WAAF	Chicago Daily, Drovers Journal, Chicago, Ill.	286-	1050-	200
WAAM	I. R. Nelson Co., Newark, N. J.	263-	1140-	250
WAAW	Omaha Grain Exchange, Omaha, Neb.	360-	833-	500
WAAZ	Hollister-Miller Motor Co., Emporia, Ks.	360-	833-	100
WABE	Young Men's Christian Assn., Washington, D. C.	283-	1060-	100
WABI	Bangor Ry. & Elec. Co., Bangor, Me.	240-	1250-	100
WABL	Conn. Agri. College, Storrs, Conn.	283-	1060-	100
WABM	F. E. Doherty Auto. & R'dio E. Co., Saginaw, M.	254-	1180-	100
WABP	Robert F. Weinig, Dover, Ohio.	265-	1130-	200
WABU	Victor Talking Machine Co., Camden, N. J.	225-	1330-	100
WABX	Henry B. Joy, Mount Clemens, Mich.	270-	1110-	500
WAHG	A. H. Grebe & Co., Richmond Hill, N. Y.	316-	950-	500
WBAA	Purdue University, West Lafayette, Ind.	283-	1060-	250
WBAD	Sterling Electric Co., Minneapolis, Minn.	360-	833-	100
WBAK	Penn. State Dept. of Police, Harrisburg, Pa.	400-	750-	500
WBAN	Wireless Phone Corp., Paterson, N. J.	244-	1230-	100
WBAP	Wortham-Carter Pub. Co., Fort Worth, Tex.	476-	630-	1000
WBAV	Erner & Hopkins Co., Columbus, Ohio.	423-	710-	500
WBAW	Marietta College, Marietta, Ohio	246-	1220-	250
WBAY	American Tel. & Tel. Co., New York, N. Y.	492-	610-	500
WBAX	Wilkes-Barre, Pa.	254-	1180-	
WBBG	Irving Vermilya, Mattapoisett, Mass.	248-	1210-	500
WBBR	Peoples' Pulpit Ass'n, Rossville, N. Y.	273-	1100-	500
WBR	Penn State Police, Butler, Pa.	286-	1050-	250
WBT	Southern Radio Corp., Charlotte, N. C.	360-	833-	250
WBU	City of Chicago, Chicago, Ill.	286-	1050-	500
WBZ	Westinghouse Elec. & Mfg. Co., Springfield, Mass.	337-	890-	1000
WCAD	St. Lawrence University, Canton, N. Y.	280-	1070-	250
WCAE	Kaufmann & Baer Co., Pittsburgh, Pa.	461-	650-	500
WCAH	Entrekin Electric Co., Columbus, O.	286-	1050-	100
WCAJ	Nebraska Wesleyan Univ., Univ. Place, Neb.	283-	1060-	500
WCAL	St. Olaf College, Northfield, Minn.	360-	833-	500
WCAP	Chesapeake & Potomac Tel. Co., Wash'gt'n, D. C.	469-	640-	500
WCAR	Alamo Radio Elec. Co., San Antonio, Texas.	360-	833-	100
WCAS	W. H. Dunwoody Ind. Inst., Minneapolis, Minn.	246-	1220-	100
WCAT	S. Dakota State Sch. of Mines, Rapid City, S. D.	240-	1250-	100
WCAU	Durham & Co., Philadelphia, Pa.	286-	1050-	250
WCAY	Milwaukee Civic Broad. Assn., Wilwaukee Wis.	261-	1150-	250
WCBC	Univ. of Michigan, Ann Arbor, Mich.	280-	1070-	200
WCBD	Wilbur G. Voliva, Zion, Ill.	345-	870-	500
WCCO	Washburn-Crosby Co., Minneapolis, Minn.	417-	720-	500
WCK	Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo.	360-	833-	100
WCX	Detroit Free Press, Detroit, Mich.	517-	580-	500
WDAE	Tampa Daily Times, Tampa, Fla.	360-	833-	250
WDAF	Kansas City Star, Kansas City, Mo.	411-	730-	500
WDAG	J. Laurance Martin, Amarillo, Tex.	263-	1140-	100
WDAH	Trinity Methodist Church, El Paso, Texas.	268-	1120-	100
WDAR	Lit Brothers, Philadelphia, Pa.	395-	760-	500
WDAU	Slocum & Kilburn, New Bedford, Mass.	360-	833-	100
WDAX	First National Bank, Centerville, Iowa.	360-	833-	100
WDBH	Worcester, Mass.	268-	1120-	100
WDBR	Tremont Temple Baptist Church, Boston, Mass.	256-	1170-	100
WEAF	American Tel. & Tel. Co., New York, N. Y.	492-	610-	500
WEAH	Wichita Board of Trade, Wichita, Kas.	280-	1070-	100
WEAI	Cornell University, Ithaca, N. Y.	286-	1050-	500
WEAJ	University of S. Dakota, Vermillion, S. Dak.	283-	1060-	200
WEAM	Borough of N. Plainfield, N. Plainfield, N. J.	286-	1050-	150
WEAN	Shepard Co., Providence, R. I.	273-	1100-	100
WEAO	Ohio State University, Columbus, Ohio.	294-	1020-	500
WEAP	Mobile Radio Co., Mobile, Ala.	360-	833-	100
WEAS	Hecht Co., Washington, D. C.	360-	833-	100
WEAU	Davidson Bros. Co., Sioux City, Iowa.	275-	1090-	100
WEAY	Iris Theatre, Houston, Texas.	360-	833-	500
WEB	Benwood Co., St. Louis, Mo.	273-	1100-	100
WEBH	Edgewood Beach Hotel Co., Chicago, Ill.			
WEBJ	Third Avenue Ry. Co., New York, N. Y.	273-	1100-	500
WEBL	R. C. A. United States (portable)	226-	1330-	100
WEEI	Edison Elec. Ill'm'n't'g Co., Boston, Mass.	303-	990-	500
WEV	Hurlburt-Still Electric Co., Houston, Texas.	263-	1140-	100
WEW	St. Louis University, St. Louis, Mo.	280-	1070-	100
WFAA	Dallas News & Dallas Journal, Dallas, Tex.	476-	630-	500
WFAB	Carl F. Woese, Syracuse, N. Y.	234-	1280-	100
WFAN	Hutchinson Elec. Service Co., Hutchinson, Minn.	286-	1050-	100
WFAV	Univ. of Nebraska, Dept. of E. Eng., Lincoln, Neb.	725-	1090-	250
WFBG	William F. Gable Co., Altoona, Pa.	261-	1150-	100
WFBH	Concourse Radio Corp., New York, N. Y.	273-	1100-	500
WFBI	Galvin Radio Supply Co., Camden, N. J.	236-	1270-	100
WFBW	Ainsworth-Gates Radio Co., Cincinnati, Ohio.	309-	970-	750

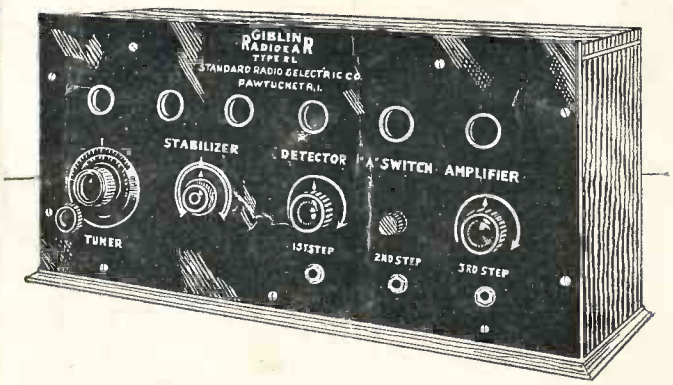
		W.L.	K.C.	W.P.
WFI	Strawbridge & Clothier, Philadelphia, Pa.	395-	760-	500
WGAQ	Youree Hotel, Shreveport, La.	360-	833-	100
WGAY	Northwestern Radio Co., Madison, Wis.	360-	833-	100
WGAZ	South Bend Tribune, South Bend, Ind.	275-1090-		250
WGI	Am. R'dio & Res'ch Corp., Medf'd Hillside, Mass.	360-	833-	100
WGL	Thomas F. J. Rowlett, Philadelphia, Pa.	360-	833-	250
WGN	Drake Hotel (Whitestone Co.), Chicago, Ill.	370-	810-1000	
WGR	Federal Manufacturing Co., Buffalo, N. Y.	319-	940-	750
WGY	General Electric Co., Schenectady, N. Y.	380-	790-1000	
WHAA	State University of Iowa, Iowa City, Iowa.	484-	620-	500
WHAD	Marquette University, Milwaukee, Wis.	280-1070-		100
WHAG	University of Cincinnati, Ohio.	222-1350-		200
WHAM	University of Rochester, Rochester, N. Y.	283-1060-		100
WHAS	Courier-Journal & Louisville Times, Louisville, Ky.	400-	750-	500
WHAZ	Rensselaer Polytechnic Institute, Troy, N. Y.	380-	790-	500
WHB	Sweeney School Co., Kansas City, Mo.	411-	730-	500
WHK	Radiovex Co., Cleveland, Ohio.	283-1060-		100
WHN	George Schubel, New York, N. Y.	360-	833-	100
WHO	Des Moines, Ia.		526- 570-	500
WIAC	Galveston Tribune, Galveston, Tex.	360-	833-	100
WIAD	Howard R. Miller, Philadelphia, Pa.	254-1180-		100
WIAK	Journal-Stockman Co., Omaha, Neb.	278-1080-		250
WIAR	Paducah Evening Sun, Paducah, Ky.	360-	833-	100
WIK	K. & L. Electric Co., McKeesport, Pa.	234-1280-		100
WIP	Gimbel Brothers, Philadelphia, Pa.	508-	590-	500
WJAB	American Electric Co., Lincoln, Neb.	229-1310-		100
WJAD	Jackson's Radio Eng. Laboratories, Waco, Tex.	360-	833-	150
WJAG	Norfolk Daily News, Norfolk, Neb.	283-1060-		250
WJAN	Peoria Star, Peoria, Ill.	280-1070-		100
WJAR	The Outlet Co., Providence, R. I.	360-	833-	500
WJAS	Pittsburgh Radio Supply House, Pittsburgh, Pa.	286-1050-		500
WJAX	Union Trust Co., Cleveland, Ohio.	390-	770-	500
WJAZ	Chicago Radio Lab., Chicago, Ill. (portable)	268-1120-		100
WJH	Wm. P. Boyer Co., Washington, D. C.	273-1100-		100
WJY	R. C. A., New York, N. Y.	405-	740-	750
WJZ	Broadcast Central, New York, N. Y.	454-	660-	500
WKAA	H. F. Paar, Cedar Rapids, Iowa.	278-1080-		100
WKAF	W. S. Radio Supply Co., Wichita Falls, Tex.	360-	833-	100
WKAP	Dutee W. Flint, Cranston, R. I.	360-	833-	250
WKAQ	Radio Corp. of Porto Rico, San Juan, P. R.	360-	833-	500
WKAR	Michigan Agr. College, E. Lansing, Mich.	280-1070-		500
WKBF	D. W. Flint, Providence, R. I.	286-		500
WKY	WKY Radio Shop, Oklahoma, Okla.	360-	833-	100
WLAH	Samuel Woodworth, Syracuse, N. Y.	234-1280-		100
WLAL	Naylor Electrical Co., Tulsa, Okla.	360-	833-	100
WLAN	Putnam Hardware Co., Houlton, Me.	283-1060-		250
WLBL	Wisconsin Dept. of Markets, Stevens Pt., Wis.	278-1080-		500
WLW	Crosley Radio Corp., Cincinnati, O.	423-	710-	500
WMAC	Clive B. Meredith, Cazenovia, N. Y.	261-1150-		100
WMAF	Round Hills Radio Corp., Dartmouth, Mass.	360-	833-	500
WMAH	General Supply Co., Lincoln, Neb.	254-1180-		100
WMAK	Lockport Board of Commerce, Lockport, N. Y.	273-1100-		500
WMAQ	Chicago Daily News, Chicago, Ill.	448-	670-	500
WMAT	Paramount Radio Corp., Duluth, Minn.	266-1130-		250
WMAV	Alabama Polytechnic Institute, Auburn, Ala.	250-1200-		500
WMAY	Kingshighway Presbyterian Church, St. Louis, Mo.	280-1070-		100
WMAZ	Mercer University, Macon, Ga.	261-1150-		100
WMC	"Commercial Appeal," Memphis, Tenn.	500-	600-	500
WMU	Doubleday-Hill Elec. Co., Washington, D. C.	261-1150-		100
WNAC	Shepard Stores, Boston, Mass.	278-1080-		100
WNAD	University of Oklahoma, Norman, Okla.	360-	833-	100
WNAP	Wittenberg College, Springfield, Ohio.	231-1300-		100
WNAT	Lenning Brothers Co., Philadelphia, Pa.	360-	833-	250
WNAX	Dakota Radio Apparatus Co., Yankton, S. D.	244-1230-		100
WNYC	City of New York, New York, N. Y.	526-	570-1000	
WOAC	Pagan Organ Co., Lima, Ohio.	265-1130-		150
WOAI	Southern Equipment Co., San Antonio, Tex.	384-	780-	500
WOAL	William E. Woods, Webster Groves, Mo.	229-1310-		100
WOAN	Vaughn C'nserv't'ry of Music, Lawrenceb'rg, Tenn.	360-	833-	200
WOAV	Penn. Nat'l Guard, 2d Bat, 112th Inf., Erie, Pa.	242-1240-		100
WOAW	Woodmen of the World, Omaha, Neb.	526-	570-	500
WOAX	Franklyn J. Wolff, Trenton, N. J.	240-1250-		500
WOC	Palmer Sch. of Chiropractic, Davenport, Iowa.	484-	620-	500
WOI	Iowa State College, Ames, Iowa.	360-	833-	500
WOO	John Wanamaker, Philadelphia, Pa.	508-	590-	500
WOQ	Western Radio Co., Kansas City, Mo.	360-	833-	500
WOR	L. Bamberger & Co., Newark, N. J.	405-	740-	500
WOS	Mo. State Marketing Bureau, Jefferson City, Mo.	441-	680-	500
WPAB	Pennsylvania State College, State College, Pa.	283-1060-		500
WPAC	Donaldson Radio Co., Okmulgee, Okla.	360-	333-	100
WPAH	Wisconsin Dept. of Markets, Waupaca, Wis.	360-	833-	500
WPAJ	New Haven, Conn.	268-1120-		100
WPAK	North Dakota Agri. Col., Agri. College, N. D.	283-1060-		250
WPAM	Auerbach & Geutell, Topeka, Kas.	275-1090-		100
WPAZ	John R. Koch (Dr.), Charleston, W. Va.	273-1100-		100
WQAA	Horace A. Beale, Jr., Parkesburg, Pa.	360-	833-	500
WQAC	E. B. Gish, Amarillo, Tex.	234-1280-		100
WQAM	Electrical Equipment Co., Miami, Fla.	283-1060-		100
WQAN	Scranton Times, Scranton, Pa.	280-1070-		100
WQAO	Calvary Baptist Church, New York, N. Y.	360-	833-	100
WQAQ	Abilene Daily Reporter, Abilene, Tex.	360-	833-	100
WQAS	Prince-Walter Co., Lowell, Mass.	265-1130-		100
WQAX	Radio Equipment Co., Peoria, Ill.	248-1210-		100
WQJ	Calumet Rainbo Broadcasting Co., Chicago, Ill.	448-	670-	500
WRBC	Immanuel Lutheran Church, Valparaiso, Ind.	278-1080-		500
WRK	Doren Bros. Electric Co., Hamilton, Ohio.	360-	833-	200
WRAL	No. States Power Co., St. Croix Falls, Wis.	248-1210-		100
WRAM	Lombard College, Galesburg, Ill.	244-1230-		250
WRAV	Antioch College, Yellow Springs, Ohio.	242-1240-		100
WRAX	Flexon's Garage, Gloucester City, N. J.	268-1120-		100
WRC	Radio Corp. of America, Washington, D. C.	469-	640-	500
WRK	Doren Bros. Electric Co., Hamilton, Ohio.	360-	833-	200
WRL	Union College, Schenectady, N. Y.	360-	833-	500
WRM	University of Illinois, Urbana, Ill.	360-	833-	500
WRW	Tarrytown Radio Research Lab., Tarrytown, N. Y.	273-1100-		500
WSAC	Clemson Agri. Col., Clemson College, S. C.	360-	833-	500
WSAD	J. A. Foster Co., Providence, R. I.	261-1150-		100
WSAH	A. G. Leonard, Jr., Chicago, Ill.	248-1210-		500
WSAI	U. S. Playing Card Co., Cincinnati Ohio.	309-	970-	500
WSAJ	Grove City College, Grove City, Pa.	360-	833-	250
WSAP	Seventh Day Adventist Church, New York, N. Y.	263-1140-		250
WSAR	Doughty & Welch Elec. Co., Fall River, Mass.	254-		
WSAV	Clifford W. Vick Radio Const. Co., Houston, Tex.	360-	833-	100
WSAX	Chicago Radio Laboratory, Chicago, Ill.	448-	670-1000	
WSB	Atlanta Journal, Atlanta, Ga.	428-	700-	500
WSOE	School of Eng. of Milwaukee, Milwaukee, Wis.	246-1220-		100
WSY	Alabama Power Co., Birmingham, Ala.	360-	833-	500
WTAB	Fall River Daily Herald, Fall River, Mass.	248-		
WTAC	Johnstown, Pa.	275-1090-		150
WTAM	The Willard Storage Battery Co., Cleveland, O.	389-	770-1000	
WTAN	Orndorff Radio Shop, Mattoon, Ill.	240-1250-		100
WTAQ	S. H. Van Gorden & Son, Osseo, Wis.	225-1330-		100
WTAR	Reliance Electric Co., Norfolk, Va.	280-1070-		100
WTAS	Charles E. Erbstein, Elgin, Ill., near	286-1050-		500
WTAT	Edison Electric Illum. Co., Boston, Mass.	246-1220-		100
WTAW	College Station, Texas.	280-1070-		250
WTAY	Oak Leaves Broadcasting Station, Oak Park, Ill.	283-1330-		500
WTG	Kansas State Agri. Col., Manhattan Ks.	360-	833-	500
WWAD	Wright & Wright, Inc., Philadelphia, Pa.	360-	833-	500
WWJ	Detroit News, Detroit, Mich.	517-	580-	500
WWL	Loyola University, New Orleans, La.	268-1120-		100

Watch for Special Hook-up Number

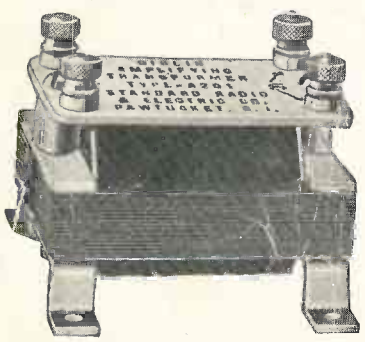
GIBLIN
RADIO APPARATUS

The Giblin Broadcast Receiver

THE Giblin Radio Frequency Broadcast Receiver makes it possible to obtain radio entertainment without the necessity of erecting outside antenna wires or using a troublesome ground wire. A small, loop aerial placed near the set will pick up signals, which, though they have come long distances, and are weakened by hills, valleys, trees and buildings, will be clear and of great volume. Many families, living in apartments where it is undesirable or impossible to erect antenna wires, can now hear enjoyable, ever-changing programs through the day and evening by "listening-in" with a Giblin Radio Frequency Broadcast Receiver.



The set comprises two stages of radio frequency amplification, a detector and three stages of audio frequency amplification. The parts are mounted on a sub-base to which a Bakelite panel is attached. It is enclosed in a handsome solid mahogany cabinet.



The Giblin Audio-Frequency Amplifying Transformer
Price $4.50

The Giblin Radio-Frequency Amplifying Transformer
Price $5.00

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STANDARD RADIO & ELECTRIC CO.
PAWTUCKET, RHODE ISLAND