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RADIO PROGRESS

"Always Abreast of the Times"

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How and Why of a Radio Filter

Special Article by H. V. S. Taylor

"C" Battery Lives on Hill

Radio on Army World Flight

Cutting Down the Losses

Make a Good Cabinet for Your Radio

WATCH FOR OUR HOOK-UP NUMBER

YOU WILL UNDERSTAND THIS MAGAZINE--AND WILL LIKE IT

PUBLISHED TWICE A MONTH

Special Features for the October 15th Issue of Radio Progress

A big sending station shoots music into the air. Do you know how it reaches your aerial? There are two paths by which the waves may reach you and sometimes one is better, and sometimes the other. See "RADIO WAVES THROUGH SKY AND GROUND," by Dr. Alfred N. Goldsmith in the next issue.

When you look at a variable condenser and see the plates turn around and around, doesn't it seem foolish that these can switch the music from New York to Chicago and from Chicago to San Francisco? How does it accomplish so much in such a little space? It is simple when you read about it in "HOW CAPACITY WORKS IN A CONDENSER," by Horace V. S. Taylor.

Many fans have superheterodynes or are thinking of building this very popular set. Many articles have explained the detailed workings of the various parts, but it isn't everyone that can trace the path of the music through one tube after another, particularly when some of the tubes are reflex, as in the Radiola Model. A road map and description of the path of the program through the set will be given in "TRACING THE MUSIC THROUGH A SUPER-HET," by Oliver D. Arnold.

Are some of your friends good natured liars? If not, why is it that they can get so much more than you can with a cheaper apparatus? Some pointers on getting the best out of your set and also hints on checking up to see whether your friends are speaking the truth will be found in "WITH A GRAIN OF SALT," by Harry A. Nickerson, in the October 15 issue of RADIO PROGRESS.

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

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RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

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How and Why of a Radio Filter

They Smooth the Hum Out of Sending and Receiving

By HORACE V. S. TAYLOR

A GREAT deal is said these days about omitting "A" and "B" batteries from a receiving set. Of course, it is a great advantage if these expensive and troublesome units can be done away with. Most of the schemes so far proposed give pretty good results, except for the fact that the hum, which is caused by the alternating current, is heard quite distinctly in the phones or loud speaker. The whole idea of a filter as used in such a device is to kill this hum.

Another place where a filter always has to be used is the generator circuit of a sending station. Generators are used instead of batteries to supply the plate current for transmitting tubes, as the pressure is so high, several thousand volts, that a tremendous number of cells of "B" batteries would be required if these were used. Sometimes an "A" battery is employed to light the filaments of the tubes, but since considerable money is tied up in batteries large

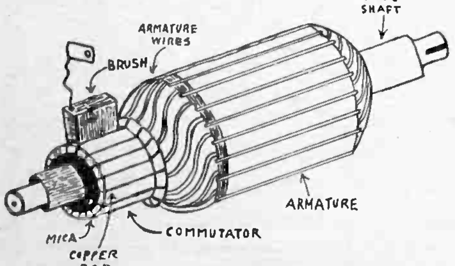


Fig. 1. Cause of Sending Hum

enough to run the big filaments of the sending tubes, it often is found best to use a generator for this purpose also. In either of these positions a generator causes a certain amount of noise, owing to the so-called "commutator ripple."

What the Commutator Does

The commutator of a generator consists of a large number of copper bars, insulated by strips of mica, as shown in Fig, 1. As these rotate under the brushes which carry the current in and out of the armature, there is a slight disturbance every time a bar leaves contact with the brush, and the constant procession of these ripples, one after the other, causes a hum which is broadcast along with the music. It is the function of the filter to suppress this undesirable noise.

The two uses of this device which has just been mentioned are for the purpose of keeping a steady, direct current supplied to a device, rather than one which fluctuates slightly. Still another use for a filter is in conditions where a certain speed of vibration of alternating current is desired in one circuit, but not in another. For instance, a wave trap is a form of filter. The differences between it and the first kind mentioned is that on direct current there is no particular tuning needed, whereas, when used with high frequency alternating current, it is necessary to tune the circuit to the particular wave length in question.

Like Moving a Clock

To show the general way a filter works, we may refer to the analogy of transporting a clock on moving day. We have a very expensive timepiece which we are afraid to take on the moving van with the rest of the goods for fear the vibration may damage the works. As an improvement on placing it in a bureau draw, we can put it down on the mattress and spring of a bed as shown in Fig. 2. This is quite a help, as the spring will absorb a lot of vibration which would otherwise be carried to the delicate mechanism of the clock. Such a way of protecting it removes almost all of the rapid vibrations which the moving van causes.

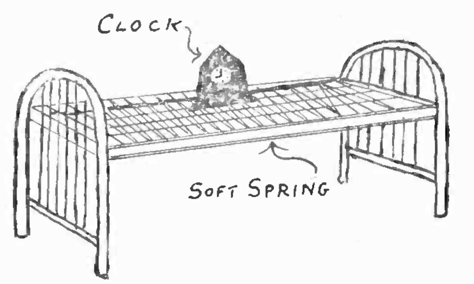


Fig. 2. Springs Absorb Shocks

The clock is a rather light weight, and so it will get some banging around even when mounted on the spring as just shown. The small and very rapid oscillations will be filtered out by the spring before they reach it, but the slower vibrations, which are perhaps stronger, will still cause a lot of jouncing up and down when the truck runs over a rough place in the road. How can this be avoided? The obvious way to do is to put a heavy block of iron down on the springs of the bed and then place the clock on top of it, as shown in Fig. 3. This mass of iron is, of course, quite heavy and it will not take up the bouncing and throwing about which the clock, owing to its light weight, was absorbing before. The combinations of the weight of the iron and the spring of the bed makes an ideal arrangement to filter out the vibration which would otherwise reach the pendulum of the timepiece. Notice here that there are *two* things necessary to filter out the vibration, first the springs, which absorb the oscillations easily, and second the weight, which repels the vibration. It is only when these two elements are combined that the best results may be obtained.

Filtering Out an Earthquake

The same principle is made use of in the apparatus which measures the form and strength of an earthquake. This instrument, called a seismograph, is illus-

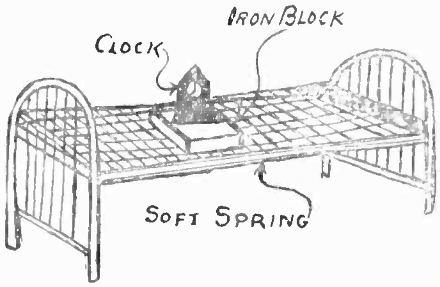


Fig. 3. Weight Helps Spring

trated in principle in Fig. 4. It consists of a spiral spring which carries at its lower end a heavy weight. The spring is supported from the ceiling of the room in which the apparatus is housed. At one side of the weight is a pen point, which bears against a strip of paper. In the actual construction, the pen is not fastened directly to the weight, but is attached to it through a system of levers which magnifies the motion perhaps a hundred times. The strip of paper

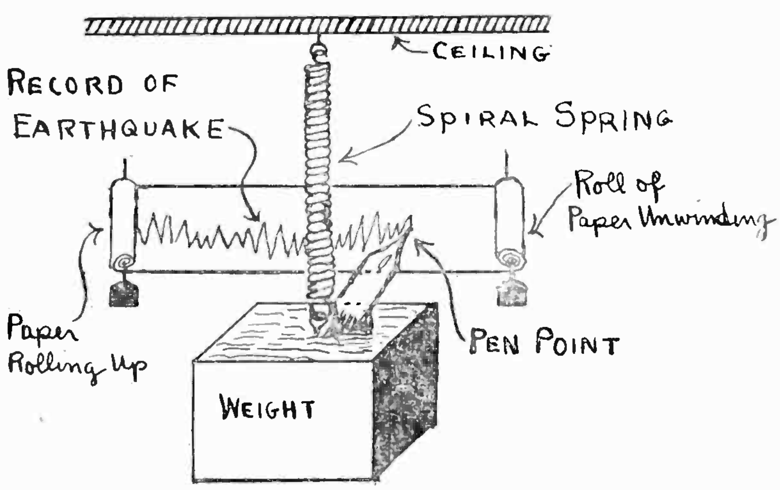


Fig. 4. An Earthquake Signs Its Name

against which a pen rests is unwound slowly from a big roll and winds up on a drum, which is driven by clock work. The strip unwinds quite slowly so that only a few inches pass every hour. The paper rolls are carried on a framework which is bolted securely to a strong masonry slab sunk deep in the ground.

The way this instrument works is as follows: The roll of paper, being as just explained, carried by the frame which is solidly attached to the ground will naturally take up any vibrations which the earth is having. If an earthquake happens, then the paper will fluctuate violently up and down at the same time it is slowly pulled along by the clock work. On the other hand the spring and weight make up a filter which removes all vibration from the pen point. The spring absorbs the vibrations and the weight repels them with the result that the pen is quiet in space without any motion at all. Since the paper is vibrating up and down, and the pen is not, the latter will leave a wavy continuous line on the strip.

When no earthquake or other motion of the ground is occurring then the pen will trace a perfectly straight line on the paper roll, but as soon as a tremor in the earth is felt, then the paper wiggles up and down and the stationary pen leaves a very wavy line, as shown in our diagram. Of course, the more severe the disturbance, the greater will be the height of the mountains which show on the record. Since the motion is magnified very greatly by the levers, (which are not shown here), it is possible with this instrument to detect an earthquake which may have occurred half way around the globe. The first news of the Japanese earthquake was received on a seismograph in Washington, D. C., a few seconds after the event occurred.

What Makes an Electrical Filter

Just as in both these cases it was necessary to have two parts, a spring and a weight, so when we get to the electrical circuit, there are two separate elements. The spring is represented by a condenser, while the weight is reproduced in a form of a coil or inductance Just as the weight of the block of iron is measured in pounds, so the electrical weight of the coil is measured by its inductance. The unit of inductance is the

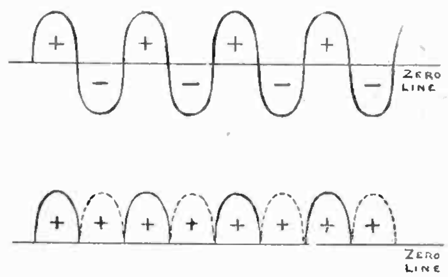


Fig. 5. Current from Rectifier

millihenry. The combinaton of condenser and a coil acts electrically just as our mechanical filter does; that is, the condenser absorbs the electrical oscillations, and the inductance repels them.

Suppose we have a rectifier which we want to use to supply current to the filament. If we ran a 110 volts A. C. through a transformer to step the potential down to six volts, and then feed that to the tube, the shape of the current wave would look like the upper curve of Fig. 5, that is, there will be a positive loop and then a negative loop. This means that if we put a volt meter across the terminals of the filament and the meter were sensitive enough to record such rapid changes, that the needle would first swing over six volts to the right and an instant later six volts to the left. This change back and forth would happen 60 times every second. Of course, this would give a terrible hum in the telephones. The usual city current is 60 cycle frequency.

But instead of connecting the secondary of the transformer right to the filament, suppose we run it through a rectifier, like a Tungar or a vibrating rectifier, or perhaps a chemical style, which uses two plates dipping in a solution of salts. If this instrument were the style which uses both half of the waves and reverses the negative so as to add up with the positive, then the curve would look like the lower half of Fig. 5. If a quick reading volt meter were connected across the filament with this style, then the needle would flicker violently from zero up to six, and then back to zero again.

This would not be much better than before, because there would still be a terrible racket in the phones.

What the Filter Does

As the next step let us assume that a filter is cut into the circuit in the way which will be described in a minute. If this is a good filter, it will change the current to a fairly continuous flow, as shown in the upper part of Fig. 6. Here we have continuous current (as shown by the waves being entirely above the line) but on top of this steady current is a ripple. This resembles a river, which in calm weather will flow steadily toward the sea, at say, three miles per hour. In rough weather, when a heavy wind is blowing, the river continues to move with a speed of three miles toward the ocean, but on top of this the wind kicks up a lot of waves which may have a bigger effect than the main flow of the current itself.

Such a form of current when fed to the tube will give pretty fair results, but some noise will still be heard. In order to reduce this further, we can do either one of two things. One way is to connect a second filter in the line and the other is to use a larger unit from the first filter, that is, more plates in the condenser and a larger number of turns on the winding of the coil. If we make either one of these changes, then the wave on top of the direct current will be cut down very considerably, so that the curve will look like the lower half of Fig. 6. This is like our river when the wind has died down quite a lot and the waves have dropped to mere

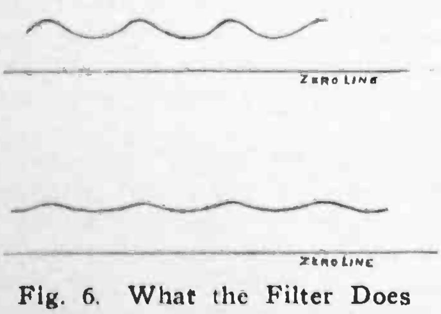


Fig. 6. What the Filter Does

ripples on the surface. If this still causes too much hum in the telephones, the cure is to go farther with the treatment. In other words, the coil and condenser should be further increased in size.

What the Filter Looks Like

Fig. 7 shows a hook-up for the filter, and also the shape of the wave of current which passes through the various parts of the circuit. The two wires running to the left are connected to the rectifier and those at the right go to the radio set. It will be observed that the upper line runs right through from the rectifier to the radio. The condenser, which is shown connecting the two lines will have a capacity of one or two mfd. Notice that this is one thousand times as big as the .001 mfd. which is in common use as a phone condenser and also for other purposes in the ordinary radio set. The reason for this large size is because that while the radio condenser is fed by a frequency of several hundred thousand up to a million, the one in the filter has to work on a frequency of only 60 cycles per second, and this slow speed requires a much larger capacity in order to pass sufficient current.

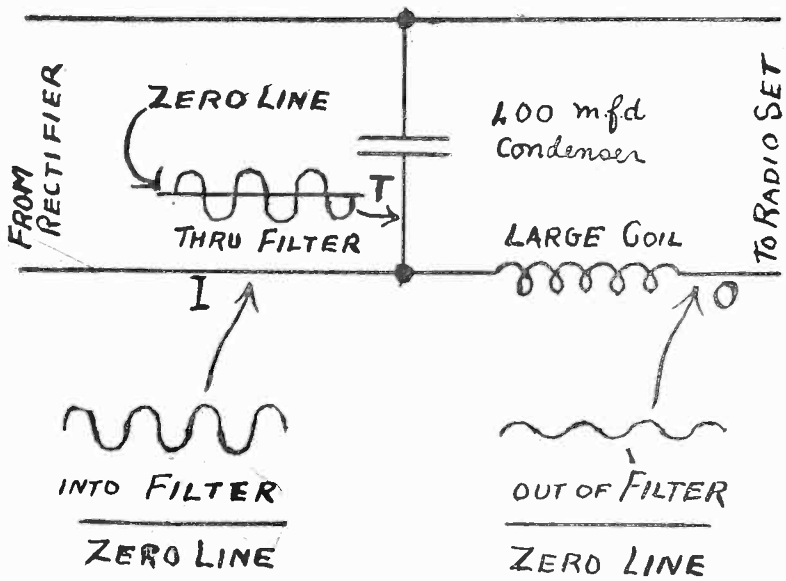


Fig. 7. Current In and Out of Filter

The coil, which is shown connected in the lower line, is built on an iron core and will have several thousand turns. An ordinary audio transformer would have enough turns, but the wire in this latter is so small, that it would burn out in attempting to run one or two amperes through it to light the filament. The wire for such a coil should be at least as large as No. 26 and should be larger if more than four tubes are to be used in the set.

Cutting Out the A. C. Waves

You will see that the filter is really a very simple device, consisting only of the condenser and coil. The condenser is just exactly like the spring that we showed in Fig. 4, and the coil resembles the weight. Just as the spring allowed the oscillations to pass and the weight prevented them, so in Fig. 7 the condenser lets the ripple on top of the wave run right through from the upper to the lower line in Fig. 7 and so it does not pass through the radio set, while the coil acts like the weight and opposes any wave motion or in other words repels it, while the direct current can pass through it quite easily.

This is illustrated by the curves which accompany the diagram. First look at the lower left hand corner which shows the direct current coming from the rectifier or from another filter, showing a very pronounced ripple in the direct current. This shows that if a volt meter were connected to the filament terminals of the vacuum tube the needle would flicker back and forth between 4 and 6 volts, changing from one to the other and back again very rapidly. This fluctuation would be heard in the phones as a musical hum. Now remember that the condenser is like a spring. A spring will easily vibrate back and forth and so the current through the condenser will vibrate back and forth just as shown in the upper part of the sketch. You will notice that it goes from plus one to minus one ampere and lies on both sides of the line since direct current cannot go through a condenser.

Only Small Ripple Through Coil

Now look at the shape of current wave through the coil. Since it is like a heavy weight it cannot be shaken back and forth very fast (this shaking is not mechanical, but electrical it must be remembered). So the current, which it passes on to the set, will be in one direction only and will have only a very small ripple. As already explained in Fig. 6 this will be so small that it probably will cause no trouble in the telephone. If it does, however, the remedy is to use a larger coil with the condenser.

It may seem from this description that it is not possible ever to get an absolutely smooth wave by using any number of filters. As a matter of fact, this is the truth—we can never get a line which is theoretically smooth. The best we can do is to reduce the hum to such a low value that it does not bother us. If your ears are better than mine, then you will need a larger filter to quiet the set than I will. But if John Smith's ears are better yet, then he will object to the ripple which you do not notice. Of course, if the hum is reduced to such a low value that we cannot hear it, then it does no harm at all, even though we know it must be there still.

Hooking Up the Set

The scheme of connections for a filter is shown in Fig. 8. We have here two vacuum tubes, which may be detector and amplifier, or perhaps two steps of amplification. The grid and plate circuits are not shown since they may be used in any kind of a set from a single circuit squealer to a nine tube superheterodyne. The filaments are shown connected each with its separate rheostat although one might just as well serve the purpose of controlling both tubes at the same time.

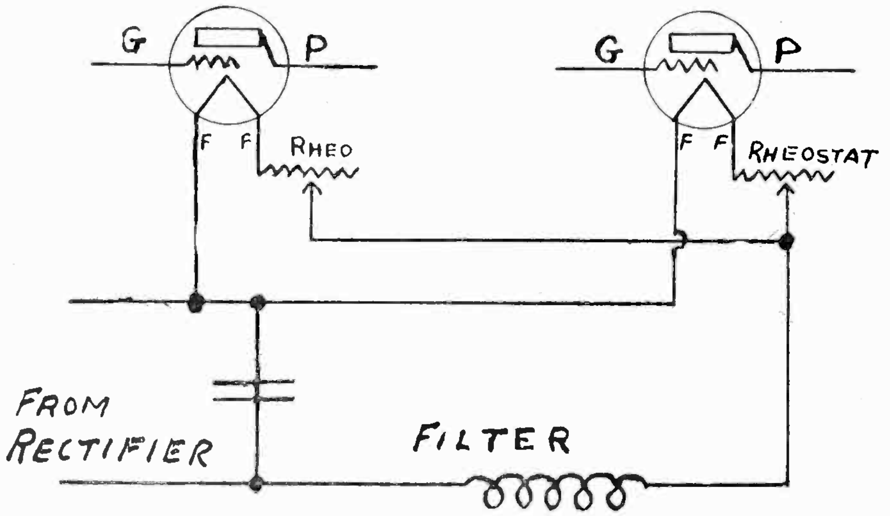


Fig. 8. Applying Filter to Radio Set

The filter is connected just as it was in Fig. 7 with the supply at the left and the tubes at the right. The top connection runs direct from the rectifier to the tubes and in the diagram the first filament connection is purposely shown at the left of the condenser. This is to illustrate the point that the output may be taken off this line at any point. The condenser and coil play the same part here that they did in Fig. 7, that is, the condenser passes or short circuits the ripple on top of the direct current while the coil repels this ripple and allows only a steady current to flow. It is this latter which lights the filaments of the tube.

In using such a device it is well to place both condenser and coil at least a foot or more away from the radio set itself. This is to prevent the magnetic action of the former from affecting the coils of the set.

Doing Without a "B" Battery

The same idea which is shown here connected to the filaments of the tube may be used on the plate circuit. The difference in construction will be this: Whereas the filaments will take from one to two amperes at a small voltage, say five or six, the plate, on the other hand, requires 22 up to 90 volts and the current is very small, only a few thousandths of an ampere (a few milliamperes). That is why the coil for use in the plate circuit filter must be wound of a very large number of turns and since the current is small the wire may be No. 30. The condenser here will have to be insulated so that it can stand the full plate voltage, whereas in the former case a paper insulated unit that will withstand six or eight volts is all that is required.

As a matter of fact, very many of the schemes at present on the market for using no "B" batteries are built on the principle of transformer to give the proper voltage, connected to a rectifier which makes pulsating direct current out of alternating and then a filter to strain off the ripple on top of the direct current. These devices are successful in overcoming the noise in the phones provided the filter is large enough. Of course, such units cost money, and the tendency is to cut them down as small as can be used to give good results.

"C" Battery Lives On Hill

It Gives Out No Current But Is Quite Important

By OLIVER D. ARNOLD

IN days of old a 22-volt "B" battery was often all that was used to operate the single tube sets which most fans owned. But in these enlightened times it is not at all unusual to find 90 or even 120 volts applied to the plates of the amplifiers in a five to eight tube set. When 22 volts was the total of the "B" pressure there was no advantage at all in using more than two different batteries, the "A" and the "B". But with the advent of the high pressures on the plate, it is very desirable to use a "C" battery in addition to the other two.

Many users and even builders of sets do not seem to understand fully the advantage of using a "C" battery. As just explained there is no benefit from using one on a set having only 22 volts of plate pressure. Even when 45 volts are used it is doubtful whether this extra battery will be worth the increase in complication from connecting it in the set. When the plate voltage is run up to 67 or above, then this additional unit is well worth the bother and expense of installing.

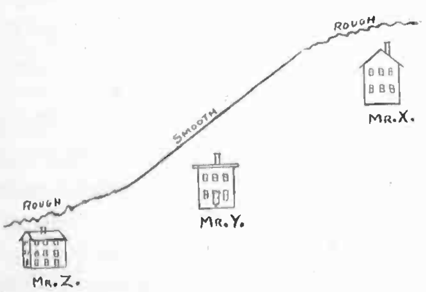


Fig. 1. Y's Children Have Advantage

Living on a Hill

To illustrate the way this device works let us refer to Fig. 1, which represents a hill with three houses on it. Mr. X lives at the top, Mr. Y. half way down, and Mr. Z at the bottom. Each family has children who like to slide on their sleds in winter time. Their mothers, however, are a little bit timid about letting them go very far from home, but allow them to slide only on the part of the hill which is in front of their house. Let us also assume that the children are obedient.

In such a case it is quite clear that the "Y" boys will have the advantage over the other two families. In the first place the road opposite their house is smooth, whereas at the other two houses the highway department has carelessly let the road become quite rough. The pleasure of sliding at "Y" will for that reason be considerably greater than at either "X" or "Z". Besides, notice that the hill is a good deal steeper at the center than it is at the top or bottom and so the sliding will be a great deal more efficient there.

The conditions as represented in this diagram are just like what occurs in a vacuum tube. The hill is represented by the "Characteristic Curve," which is the name given to the drawing showing the performance at the tube. Such a curve Fig. 2. represents the amount of current flowing through the plate (this is the output of the tube) compared with the voltage of the grid, (the input.) This is shaped just like the hill in our picture. When near the top at "X", the plate current will not increase very much no matter how much pressure we put on the grid. Besides this, the line is not straight, but it bends over sharply to the right. This is like the roughness of the hilltop.

Best on Center of Curve

At point "Y" the line is straight and slopes quite sharply. This shows that as the grid voltage is changed up and down by the high frequency radio waves coming in through the tuner, then the plate current is varied in the same proportion, and it is this variation of the plate current which we hear through the telephones. At point "Z" again we run into the two bad features—lack of straightness and also a small change of plate current (output) with the varying input.

Take a look at Fig. 1 again. How can the boys of the "X" family enjoy a smooth coast on the steep part of the hill? The only thing they can do is to change their location from the top to the middle of the hill. By moving down half way they strike the smooth part which is also the steep part. The same thing exactly applies to the radio tube. Unfortunately the ordinary amplifier happens to work around point "X" when a large

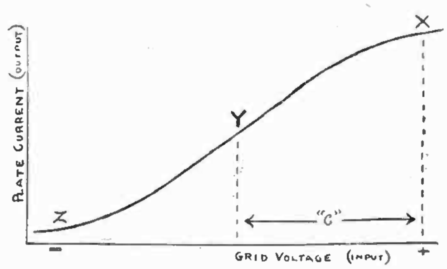


Fig. 2. Voltage Slides Down Hill

"B" battery voltage is applied. The disadvantage is that we get distortion, owing to the roughness or curvature of the line, and besides, the amplification is not as great because the curve is not very steep at that point. To get better results we must take a leaf out of Mr. X's book and move half-way down the hill. How shall we do it? The method is to apply a voltage or so called "bias" to the grid equal to the amount of "C" battery shown in Fig. 2. This will move the whole operation of the tube bodily from point "X" to point "Y".

There is one further advantage in this case which is obtained. Up at the top of the hill the height is great and this height represents the amount of plate current. This plate current, it will be remembered, comes entirely from the "B" battery, and if this is high it means a great strain on the "B". By applying voltage "C" we have reduced the height to about one-half. This cuts the plate current down in the same proportion and doubles the life of our "B" battery. As a matter of fact, the more blocks of "B" battery we use the greater will be the advantage of this shift. In a five tube neutrodyne for instance, which uses 120 volts, it is sometimes possible to save more than three-quarters of the "B" battery current by conecting in a "C" battery.

Three Advantages Of This Unit

To review the reasons for the extra complication of a "C" battery, the following changes in the operation of the set will result as just explained.

1. Distortion is reduced, which means that music and speeches will come through clearer than before.

2. Amplification is increased, with the result that there is more volume of tone.

3. "B" battery current is reduced, which prolongs the life of these expensive units from two to five times.

How Connections Are Made

If you are using more than 45 volts of "B" battery and decide to improve your set by inserting a "C" you will

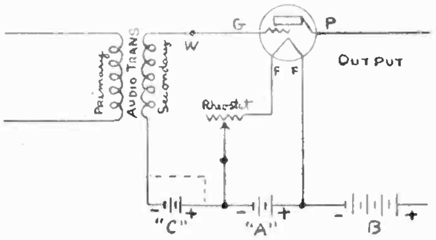


Fig. 3. Connecting C Battery

need to make only a few changes in the hook-up. The theory of the connection is shown in Fig. 3. Here we have an amplifier tube with the grid connected to the secondary of the audio transformer as usual. The "A" battery is connected to the filament through the rheostat, which is in the negative side of the line, that is, it is the minus of the "A" battery which runs to the rheostat and the plus goes direct to the tube. Before the "C" unit is connected the dotted line represents the wire from the transformer secondary to the "A" battery. In order to insert the "C", it is necessary to break only this one connection. Take out the wire between the transformer secondary and the "A" battery. In its place hook up the "C" with its minus to the transformer and its plus to the minus of the "A" battery. Of course, the dotted line will now be omitted, as this wire has been removed.

Let us see what happens after making the change. The output from the previous tube (which may be the detector or the first step) is impressed on the primary of the transformer. It is stepped up through the secondary and one terminal carries the energy to the grid "G". The other terminal connects through the "C" battery to the filament. This allows the audio oscillation to vibrate back and forth between the grid and the filament and so affect the input to the tube. So far there has been no change since before installing the new unit.

Sliding Grid Down Hill

When we consider the voltage on the grid, however, we must notice that one side of the "C" battery, the negative, is connected directly to it, through the transformer winding. For this reason the grid has a negative voltage of 3, 4½, or whatever the value of "C" battery we use. The effect is to slide it down the hill, as shown in Fig. 2 from the point "X" to "Y". It is now on the smooth steep part of the curve, and the benefits which we have already listed will improve the operation of the set. The reason why it must be the *negative* pole of the "C" which is connected to the grid is this—notice that the tubes as manufactured happen to have a location at the top of the hill. Of course, this could not be predicted beforehand, but it is found to be true by experiment. Since we want to move *down* the hill we must apply a negative voltage.

Some diagrams show the "C" battery connected at point "W". As has been explained in a previous issue of RADIO PROGRESS it is not such a good place to locate this unit. To be sure it puts a negative bias on the grid and for that reason works just as well. But a further action takes place. Since the "C" battery is now in the grid lead the latter can not be as short as desirable, and besides this the zinc cases in which the cells of battery are packed will have a capacity effect distorting the signals somewhat. When it connected as shown in Fig. 3 this capacity action to ground is missing, since the "A" battery is already at ground potential.

A Complete Hook-up

If you understand the theory of the connection shown in Fig. 3, you will be able to follow the wiring diagram of Fig. 4. Here is indicated the hook-up of a complete two step amplifier, which may be added to the detector of any set. That is, a single circuit regenerative radio uses the same kind of audio amplifiers as does the most expensive super-heterodyne. Even a crystal set can be connected to this amplifier with the result that its output will work a loud speaker with great volume. We do not recommend using a two step amplifier on a crystal however. The objection is that all the amplifier can do is to repeat in a loud voice what was whispered in its ear. Since the crystal detector is able to get music only from local stations, then the complete set will have no further range. If you are going to use two tubes it will be considerably better not to use the crystal detector at all but to employ the first tube as a regenerative detector and the second as an audio amplifier.

At the left of the diagram you will see two leads labeled "from output of detector." These run to the detector jack. If your set already has a jack then of course, another one is not needed at this position but if binding posts are used, then the two wires to the binding post represent these two that are shown. The jacks illustrated have only three springs. If your are using four spring jacks then it is better to leave the third spring disconnected and hook it up as shown. This was discussed at greater length in the article, "Judging Jacks for Real Results," in the September 1 issue of RADIO PROGRESS. If you prefer to use all four springs it will not affect the hooking up of the "C" battery in any way.

Two Tubes on One "C" Battery

As you trace through the connections you will find that the scheme is the same as followed in Fig. 3. Only one "C" battery is needed, however, to operate two amplifier tubes. Indeed the same battery can be connected to any number of amplifiers, radio or audio. The grid return from each of the tubes after passing through the secondary of its transformer reaches the "C" minus binding post. After going through the "C" battery it reaches the filaments by way of the "A" battery. All the other units of the set are standard in every way.

The reason it can operate without being consumed is because it works like the expansion tank of a hot water heating system. If you go down into your basement and look at the hot water furnace, you will notice a gauge on top which will read 12 or 15 pounds, or perhaps it may be calibrated to read the height of the water in the pipes, which will be 20 to 30 feet, depending on how tall a house you have.

Where Does Pressure Come From?

This water pressure in your heating system is on all the time, winter or summer, even after the fire goes out. How is it maintained? You will discover this if you go up to the top floor of the building where you will see a large expansion tank. When first installing the heater the plumber runs enough water into the boiler and radiators so that the water level rises up into the expansion tank. A glass at the side shows that the water level is about one-third of the way up. When a fire is built in the furnace it heats the water and this causes it to swell or expand slightly. The extra volume is taken up in the tank, and so the water level rises to three-quarters full.

When autumn comes each year it is best to inspect the expansion tank and make sure the water level is about one-quarter or one-third of the way up. This often requires that a small amount of extra water be run into the system from the city water main. This is called the "make-up" water. It is needed to replace the small amount which has been lost during the summer by leakage and by evaporation out of the overflow pipe which connects the expansion tank to the air.

Notice that the pressure on the system is say fifteen pounds per square inch all the time. It falls very slightly, of course, if there is any leakage from the radiators and when the make-up water is added it will rise again a fraction of a pound. But the point is that it does not require a *current* of water to keep up the force on the boiler and radiators—that is maintained by the water at rest.

It Uses No Current

We all know that the life of the "A" battery depends almost entirely on how much we use our set. It may last a week or a month, depending on whether we listen in until one o'clock, or are content to say "good-night" at ten P. M. In the same way the "B" battery dies more from use than from old age, although the latter factor has some effect, especially if we do not use the radio very much. In other words, we could not use the set only one hour a week and expect the "B" battery to last ten years. It would have perished from old age long before that date. But here is a surprising thing. The "C" battery gives out no current and so it will die just as soon whether we use our set or not.

No Circuit Through Battery

Referring once more to Fig. 3, observe there is no complete circuit through the "C" battery. The plus side, to be sure, is connected to the rest of the set, but the minus runs through the secondary to the grid. There is no outlet from that point. Of course, the high frequency alternating current operates the grid like the trigger of a gun to control the output of the plate. Such high radio frequency of about one million cycles per second, or even the low audio frequencies of a few hundred will pass through the capacity of the tube. Direct current on the other hand will not run through the capacity of a condenser at all. It is blocked by the break in the circuit. Direct current always must have a complete path in order to flow and when no path is provided no flow occurs. That is why the "C" battery has no output.

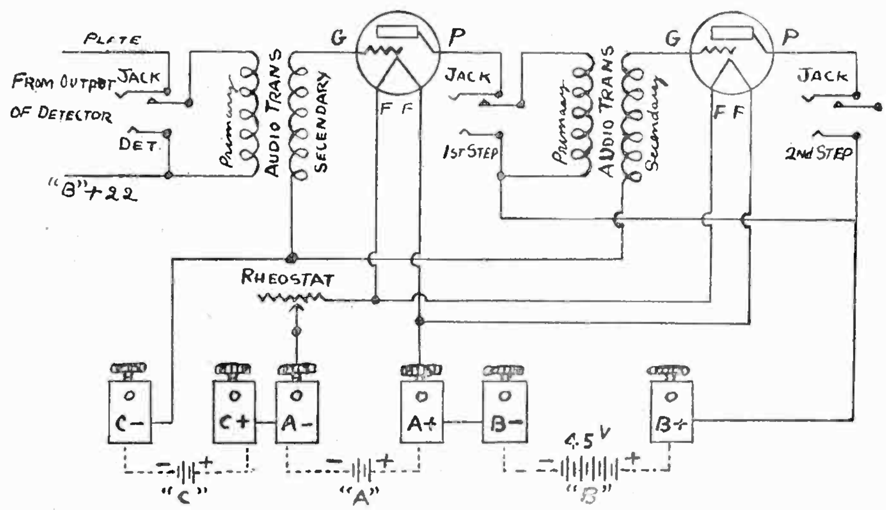


Fig. 4. A First-class Two Stage Amplifier

As one further analogy of the action we may compare the foundations of a building. Suppose we have a two story house resting on brick foundations. These bricks support twenty tons for a period of ten years and yet they have no "output," that is, they do no real work. Now we decide to raise the house five feet and build higher foundations. We get a building mover to bring his crew of workmen and with pulleys and jacks they raise the twenty tons to a distance of five feet. They are doing real work and they have an output which could be measured in horse power or in watts. When they get the building up to its new height, the stone masons build up the brick foundations to the new level and from this time on they will support the weight of the building. Again they have no output and are doing no work. That is the difference between the direct current "A" and "B" batteries on one hand which give out current and do the work and the "C" battery, which supplies pressure but no energy.

RECEIVING A RADIO ROW

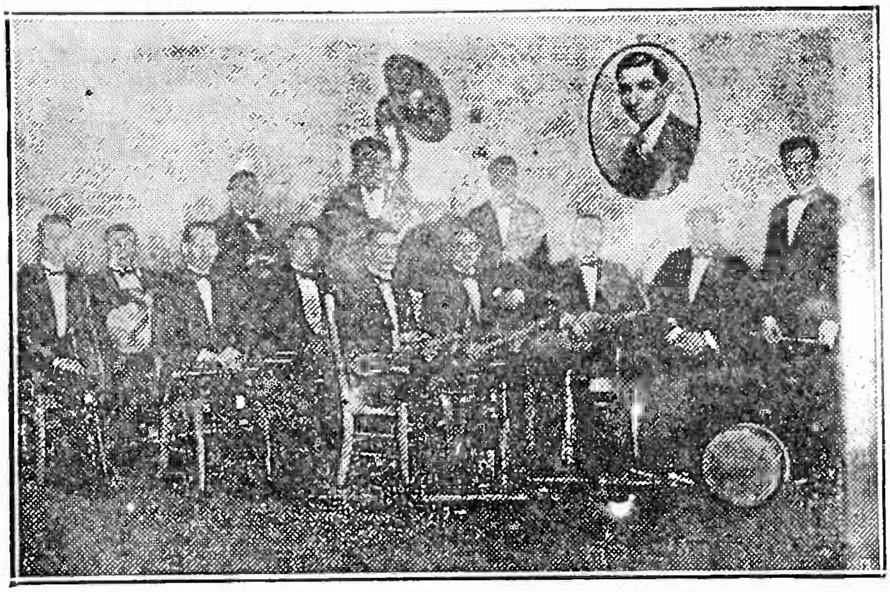
A fan in Rochester, N. Y., was listening to the play "A Night Off," which was coming in pretty loud from WGY. The scene in which Mary Ann is ordered to her room began to come through. The voices were so clear and could be heard at such a distance that he had to tune the volume down almost to a whisper for fear the neighbors would think his own family were having a row.

POLO PROVED POPULAR

Station WJZ, New York, transmitted the first direct-from-the-field description of a polo game on the occasion of the opening match of the International Polo Games, held at the Meadowbrook Club on September 6th, and through the use of the Western Union wire-link between the WJZ studio and station WGY, Schenectady, the latter station simultaneously broadcast the description.

EVERY ROOM CAN HEAR

A $2,000,000 apartment hotel—to be the finest in the South—is to be erected at the corner of Church street and West End avenue, Nashville, Tenn., in the near future, and every room in this building will be equipped with a radio receiving set.



Roger Wolf's Cascade Dance Orchestra

PICTURES OF POPULAR PERFORMERS

We show here the photographs of two different orchestras, which are apparently great favorites, judging from the comment which is received on applause cards. The first is the Cascade Dance Orchestra, which broadcasts every Tuesday evening from the Biltmore Hotel. Station WJZ puts this on the air at 455 meters. The portrait of Mr. Roger Wolf, who directs this group of players, appears in the medallion.

A new addition to the list of famous New York orchestras is Orlando's Roosevelt Hotel Concert Orchestra. They are new to the New York public as they appeared for the first time on September 22 during the official opening of the new hotel. These musicians were engaged by E. C. Fogg, managing director of the new hotel, after a careful selection of the leading classical organizations in the East.

IDO, THE RADIO LANGUAGE

The Fourth International Idist Congress took place in Luxemburg from the 8th to 12th of August. The preceding international conventions occurred as follows: Vienna, 1921; Dessau, 1922, and Cassel, 1923. The representatives of 16 countries assembled in the historic capital of Luxemburg. All of the conferences and meetings employed only the International Language, Ido.

In many European countries the interest in Ido is increasing with the speed which follows genuine enthusiasm. Considering that this enthusiasm is likely to spread throughout every civilized country of the world, it takes no wild flight of imagination to picture an international conference of the League of Nations being radiocast to every city, village and home in the world in a manner similar to that which made the broadcasting of the American Republican and Democratic Conventions so spectacular a success *in a language intelligible to all.*

The bureau of information for Ido in France is located at l'Ido-Kontoro, 83, rue Rochechouart, Paris, IX.

HEAR PRESIDENT COOLIDGE'S BAND

WEAF's audience is occasionally privileged to hear a program by the United States Navy Band, played at the Sylvan Theatre under the direction of Charles Benter. This orchestra is composed of sixty-seven musicians and represents the United States Navy in Washington, D. C. It is detailed to play for the President whenever he cruises on the Mayflower, as well as on official occasions in public parks, government hospitals, and at the Capitol.

This band was selected by the late President Harding to accompany him on the U. S. S. Henderson on his trip to Alaska. It was the only band in the funeral procession permitted to play. It is unique in that each of its members can play both string and band instruments.

They Are Out of Stock

A bulletin issued by Stern & Company, Hartford, Conn., reads:

To avoid confusion, the stock clerk asks that we advise you we do not stock and cannot furnish these articles:

Oscillating Crystals.

Regenerative Galena.

Ohms in packages or bulk.

Kilocycles in any dimensions.

Umbrella antennas.

Ground saturators.

Amplication Constants.

Orlando's Orchestra

Radio On Army World Flight

Troubles That Round-the-World Air Planes Met

By LEE H. BAKER, Ensign, Radio Officer of the U. S. Coast Guard.

IN an official announcement on the World Flight the war department stated the purpose of the expedition in these few but sufficient words, "To show the ease with which aerial communication may be established between the various continents and to obtain information about the operation of present type aircraft in various climates of the world."

An Army officer, in close contact with the flight, has stated that one of the greatest lessons of the trip has been learned upon communication. If the Pacific is to be crossed as a regular business, then better communication must be established along the Aleutian Islands (off the west coast of Alaska). Between Dutch Harbor Naval Radio Station and Japan there is not a single radio station.

Radio was imperative and vital to the success of the flight. There were three principal reasons:

Why Radio Was Imperative

First, the planes were hopping from three to seven hundred miles on each jump. It was necessary to know the weather conditions along the line of flight. These conditions had to be known early in the morning so that the trip could start as soon as possible.

Second, if one plane fell during a hop, the others were to proceed to the nearest radio station and drop a note telling about the accident. This made it possible to send assistance within a very short time.

Third, publicity. The flight would be of little value if the people of the United States were not informed of its progress. This news was wanted at once by all the various news organizations of the country. Radio was the means of getting the news out.

These three reasons caused the radio work in connection with the World Flight to assume extraordinary proportions. Most of the radio work through the Aleutian Islands was done by the Coast Guard Cutter Haida.

This article will not attempt to outline the progress of the flight. That side of the work has been covered by other reports. It will be necessary, however, from time to time to give the positions of the planes and to note their movements in order that the radio work may be seen from a clearer viewpoint.

Lieutenant Clayton Bissell, Advance Officer for the first division of the flight, and Major W. E. Blair, weather observer for the trip, were on board. These two officers had frequent messages to send. The expected news of the flight in progress kept the ship strictly on edge as far as receiving was concerned.

the Haida for suggestions. He evidently was pleased with our ideas as he embodied them in the plan. One of the suggestions we made was to let the Coast Guard operators do the entire work. The Air Service had secured permission for Naval Operators to be used wherever needed. They were especially to be used at the shore station. We believed our operators could handle the work and secured permission to go ahead. This permission placed the final word on making the shore location a Coast Guard station in every respect. A splendid system of relaying reports was organized and plans were perfected for a search in case one of the planes should go down. The whole thing was well done and it would have been interesting to have seen it placed in operation. The complete plan was never used, as it was not needed.

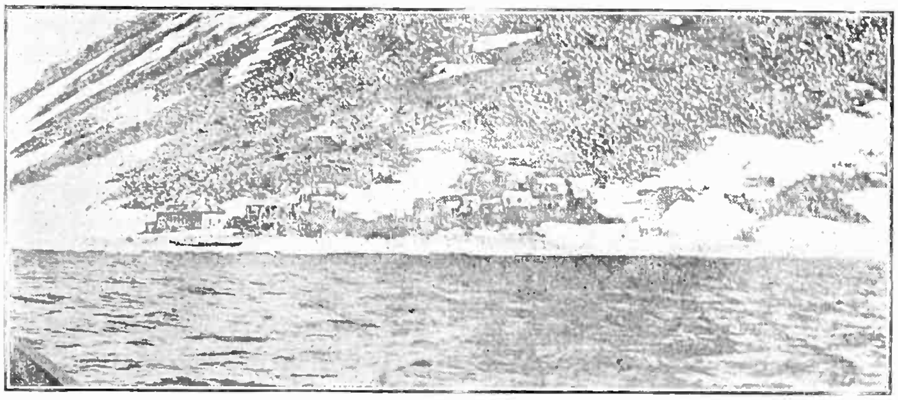


Fig. 1. Land Like This Surrounds Alaska Station

Distant Landlocked Harbor

On several occasions we secured permission from the Dutch Harbor Naval Radio Station and opened up on the two kilowatt arc and sent press direct to Estavan Radio Station on Vancouver Island, British Columbia (V A E). Inasmuch as the vessel was moored in a landlocked harbor the results at sixteen hundred miles were pleasing.

The section through the Aleutians represented the hardest part of the World Flight. Figure 1 shows the character of much of the ground covered. Distances were carefully calculated. The cruising radius of the planes and assisting vessels was considered. The radio equipment of the vessels was considered. Definite stations were assigned for each hop. The details were largely worked out by the Advance Officer, who submitted them to the Radio Department of

Major Martin's Plane Falls

An accident to Major Martin's plane upset our calculations. With the assistance of the Algonquin he had succeeded in reaching Chignik. The only report received was from Chignik, telling that he had left. For hours the Haida and Dutch Harbor listened in for news. The other points had not seen the plane. This meant that he had not passed the first reporting station, King Cove. The plane must have fallen between Chignik and King Cove.

The Algonquin was in that vicinity and at once started a search calling for assistance from the cannery vessels near-by. The Haida, carrying the Advance Officer, left to assist in the search.

For three days the heaviest radio traffic poured in and out of the Haida,—false reports and reports containing no news, directions, orders, and suggestions for a better search. And through the whole work the inevitable press dispatches had to be sent out nightly to Estavan. The world was interested and dependent on Coast Guard Cutters for news. The Haida on this press work used the half kilowatt spark set and successfully worked Estavan at a distance of fifteen hundred miles. It was not until the fourth day that Major Martin was located and rescued.

Describing the Apparatus

In order to understand this work it is necessary to outline the radio equipment of the participants. The radio equipment of the Haida is the same as when she was originally commissioned. The main transmitting set consists of a two kilowatt arc. The arc has proved extremely satisfactory on high wave lengths. When used on low wave lengths results have not been noteworthy. This type of set for a cruising cutter on Coast Guard duty is not desirable, in as much as most of the messages sent are of few words. For the flight work, especially press, the set came through splendidly.

The auxiliary transmitting set is a half kilowatt spark. We secure ten amperes radiation on this set. The spark has been used as the main transmitting set practically ever since the vessel has been in commission due to difficulties with the arc on the lower wave lengths.

The antenna of the Haida is largely responsible for the results on the flight work. This aerial is as originally installed. Insulation has been carefully watched. The trouble usually arises from leakage at the lead-in insulator when the arc is in use, but this trouble has been eliminated by giving the insulator an occasional paraffine bath.

Chicken Coop and Clothesline

Another set in use to the westward was the shore station at Atka. When the Haida reached Atka we found an old radio set which the Algonquin installed some years ago for the Bureau of Education. The set was more or less of a wreck. The Edison batteries had been exposed and almost ruined. The power plant was a hopeless wreck, due to the fact that some enterprising native had used it as a chicken coop. Water had leaked in and damaged the receiver. The antenna was being used by the Aleuts as a rack for drying fish and as a clothesline.

The Haida charged and cleaned the batteries, sent a spark coil ashore for use as a transmitter, fixed up the receiver, cleared fish and clothes off the antenna, installed new insulation, and in other words placed the station in operation. For an operator we used one of the school teachers who knew Morse Continental code and all messages between the Haida and the shore station were sent in that code.

Six Wire Squirrel Cage

The transmitting set was built by the Haida on the way north. It consisted of four five-watt tubes in parallel. For an antenna we constructed a squirrel cage, six wires about sixty feet long. We figured in case of necessity that we had enough battery power to maintain the station continuously for forty-eight hours. We used thirty-six hours as the safety margin. We found that with the available power we secured best results using two tubes, rather than four. We also had an auxiliary transmitter consisting of a spark coil operated by dry cells.

Stretching Ears 100 Miles

By the time the Haida reached Atka the Eider, another Coast Guard vessel, was five hundred miles distant. The weather reports from Major Blair had been received and it was quite some work. The first day brought our operators nearly to the fighting point concerning the Eider. She was sending to her full capacity, four hundred miles, and we were stretching our ears and receiving the other hundred of the distance. The Eider's signals were so weak that at times it was necessary to stop every motor on the Haida in order to eliminate all possible ship noises. The signals of the Eider were then heard by moving the tickler coil to nearly the limit and causing the tube to whistle continuously. The tube thus acted as an oscillator.

This system of reception had been tried before on this vessel and it had been found that we could read signals with the tube in the regenerative stage which we could not detect with the tube in ordinary oscillation. This is not given as a hint to other operators because we do not ordinarily use it here. The whistling noise does anything but soothe nerves. When you have received long weather reports with the tube whistling six or seven times a day, and you have a group of flyers lined up behind you all the time, you forget nerves.

Six Nations Sent Signals

The weather information from the Eider was the most important radio work the Haida carried on in that it had to do directly with the progress of the flight. Due to the difficulties of communication with the Eider and the possible chance of the flyers being without reliable weather information, the Haida established a supplementary weather service. This was accomplished by getting in communication with all trans-Pacific ships on the great circle route. This route comes north and nearly touches the Aleutians. We were receiving hourly weather reports from six vessels of varying nationalities. The co-operation and interest of these foreign vessels made this factor of the work very agreeable. The vessels did all possible to assist the Haida in working the Eider but were not of material assistance as relay vessels.

Well Pleased With Work

San Francisco is twenty-six hundred miles from Atka. The Haida maintained a daily schedule with San Francisco (KFS). The average press message contained two hundred words. The Haida received an acknowledgment immediately on every message. In no case was it necessary to repeat any part of a message. San Francisco reported strong reception. The Associated Press sent the Haida a radiogram of congratulation on the speed, dispatch, and accuracy with which this press work was handled.

The information contained in this report will undoubedly be instructive to all who are interested in the Air Service. It explains the great need and vital importance of radio communication in connection with any project which has to do with the establishment of regular air routes for inter-continental travel.

Feeding Music to the Air

Inside a Sending Station With Up-to-date Equipment

By ALFRED N. GOLDSMITH, B. S., Ph.D., Fellow, I. R. E.;
Director of Research, Radio Corporation of America

IT seems to many broadcast listeners that their nightly concert arrives like rain from heaven, and there is little inquiry into its source. The actual origin of the evening's entertainment is, however, in a most interesting electrical masterpiece, namely, the broadcast transmitter. It may truly be said that a more carefully designed and better working piece of equipment than the sending transmitter can hardly be found. The actual wiring and circuits of the transmitter are somewhat complicated, but the main parts and their various functions are easily understood and worth looking into.

A broadcast station must send out a continuous stream of radio waves of proper frequency, and these must be controlled in such a way that they carry the speech or music accurately to your radio set, and with enough power to give good signals at reasonable distances.

Changing the City Power

Of course there must be an electrical power supply for the sending station, and this is usually obtained from the local power company. But the customary 110 volts of the city electric company is not suitable for most of the electrical equipment of the transmitter, and so more apparatus must be used to produce electricity at the right voltages, or electrical pressures, to operate the various radiotrons in the transmitter. Accordingly, there is frequently a storage battery charger, consisting of a motor which drives a generator, the generator in turn charging the storage batteries which are required for the station. The battery charger unit is much like the small lighting plants now so widely used on the farm, except that it is driven by an electric motor instead of a gasoline engine. Suitable storage batteries, usually supplying pressures around ten or twenty volts, are generally used to light the filaments of the large radiotrons or vacuum tubes which are necessary for sending.

These radiotrons also require voltage for both grid bias and plate, just like the vacuum tubes in your receiving set. The grid bias voltage is readily obtained from dry cells or from a small generator, being about forty or sixty volts. The plate pressure is much higher, and it is necessary to supply several kilowatts of power at two thousand volts for the largest radiotrons in the stations. A large motor of several horse power drives a powerful generator which furnishes the necessary 2000-volt supply. Such high voltages are dangerous to life, and the circuits have to be carefully guarded against accidental contact. That is why the transmitters are generally enclosed to a large extent by panels and grills.

Filtering Out the Hums

In order that the current furnished to the transmitter radiotrons shall be perfectly steady and free from any variations or ripple which would cause unpleasant sounds in the receiving set, special circuits called "electrical filters" are arranged through which the currents

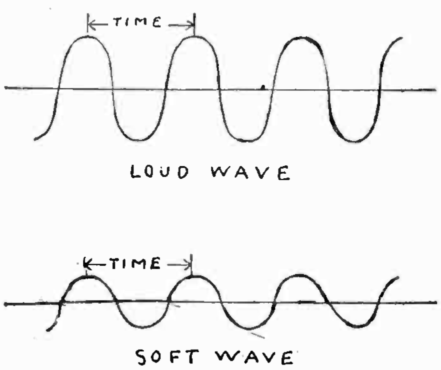


Fig. 1. Waves from Oscillator

pass to be smoothed out before they get to the transmitter. These are described in another article in this magazine. They are expensive devices, but on their efficiency depends the quietness of the radio when no music is being sent out. If hey are not designed right, an annoying hum will be heard all the time in the receiving set.

There are generally four large radiotrons in the transmitter in the Class B 500-watt stations. Two of these vacuum tubes are called oscillators, and the other two are termed modulators. The oscillators produce a continual series of electrical vibrations of very high frequency

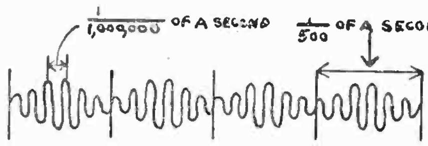


Fig. 2. After Wave is Modulated

and considerable power. They are, in fact, devices for converting the high voltage direct current which is supplied to them into an alternating or vibrating current of very high frequency (about 1,000,000 cycles per second), and the ease, regularity, and smoothness with which they accomplish this is very remarkable. The output of an oscillator tube has a wave which is shown in Fig. 1. Both loud and soft waves are indicated.

What the Modulator Tubes Do

The modulator radiotrons have a different purpose. They control the alternating current produced by the oscillators in such a way that the speech or music being sent from the station is impressed on the output of the oscillators. See Fig. 2 for the effect of modulation on the wave shown in Fig. 1. This carrier wave oscillates 1,000,000 times per second, the modulated wave 500 times. It is as if the oscillators produced a steady stream of energy, and the modulators controlled this flow in accordance with the sound waves originating in the broadcast station studio. Or to put it in another way, in the form of a rough analogy, the oscillators produce a flow of energy which the modulators control and work into a signature of the music going out of the station.

The oscillators act like an electrical pump, producing smooth and steady pressure, which produces no sound in the receiving set. The modulators are a sort of controlling hand at the throttle of the valve through which the oscillator power flows, and they impress on this flow the music which is heard by the listener. Either set of tubes alone would be useless; it is only in combination that they can produce the controlled electric waves which carry the entertainment.

Stations Look Complicated

Of course this production of alternating currents by the oscillator radiotrons and the control of such currents by the modulators require a great deal of electrical apparatus to be connected to these tubes, and accordingly the rear of a broadcast station transmitter is a complicated mass of electrical devices, all of which have to be thoroughly tested to ensure reliable operation of the station. In the case of the transmitter shown in the accompanying photograph, Fig. 3, which is the type used in stations WJY, WJZ, and WRC of the Radio Corporation of America at New York and Washington, "tank circuits," so-called, or filters, are provided to make sure that the waves sent out by the station are entirely of one frequency so that they will not cause interference at other frequencies, and thus disturb other communications.

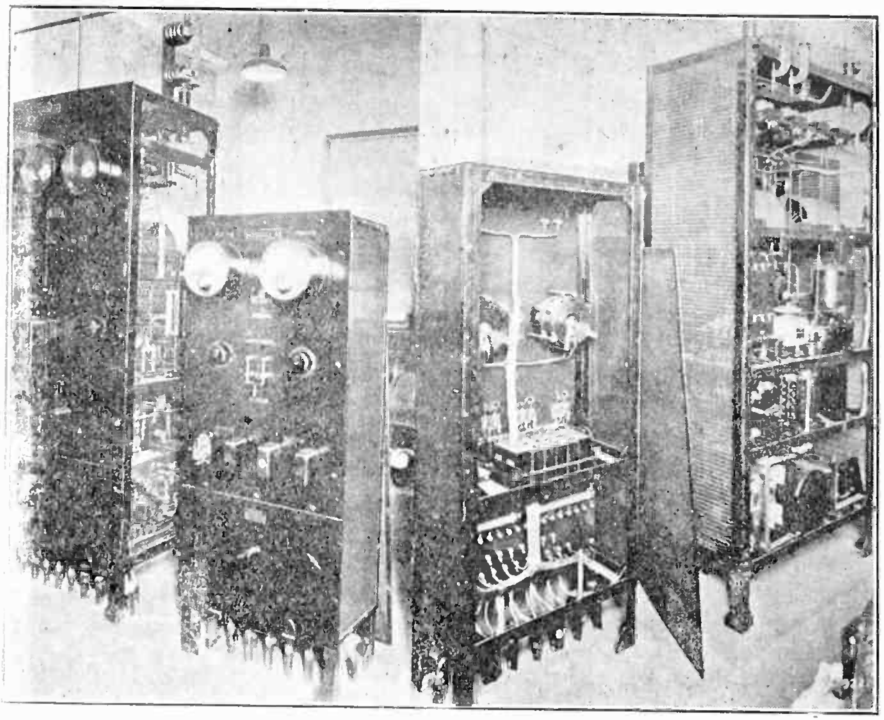


Fig. 3. Transmitter with "Tank" Circuit

are connected to the combination of oscillator and modulator tubes and are fed by them. That is, the oscillators and modulators together supply the electrical power to the antenna and ground, from which this power is then sent out as radio waves, which travel outward in all directions.

Taking a Radio Sample

While the power is being sent out, a small sample of it is taken in the sending station and sent to the control room, where it is run through an oscillograph. This piece of apparatus shows the control of the outgoing waves by the music in the form of a complicated waving line of light. This flickering line is observed by the engineer to make sure that the control is both sufficient and accurate. This modern method of watching the quality of the broadcasting is very helpful in obtaining high-class reception. Besides this, the control room engineers listen to the performance on a radio while they are sending, so that the station is checked by both eye and ear, and so is kept up to standard.

In the stations just mentioned, in order to make sure that the programs are not interrupted, all the transmitting equipment which has been described is provided in duplicate. Then there are electrical relays, by which one transmitter or the other can be instantly thrown "on the air" in case of need. It requires only the touch of a button to switch from a disabled transmitter to the spare one, which is always ready to take up the work. This is another great step toward turning broadcasting into a public service of the most reliable sort. Fig. 4 is a drawing which shows how the parts are related.

When you remember that spare radiotrons, batteries, meters, etc., must be supplied for an up-to-date transmitting station, it will be seen that the radio concert is the result of great expense and constant care, and that broadcasting mission is not to be undertaken lightly.

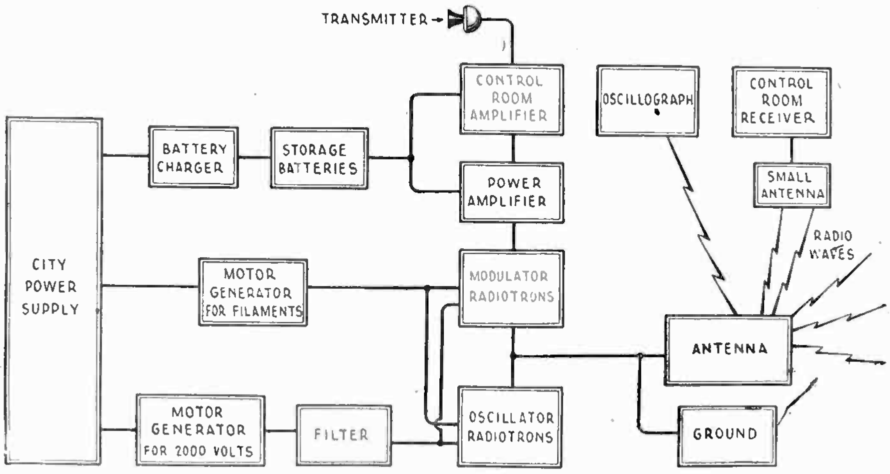


Fig. 4. Diagram of Relations Between Parts

The actual radiation or "throwing-off" of the radio waves is accomplished by an aerial wire system, that is, the antenna, and a ground connection. They

Cutting Down the Losses

How to Make Your Receiver Follow Trend to Low Loss Receivers

By C. WILLIAM RADOS

THIS article is intended to help the reader improve his radio set or to build a new one correctly. It does not describe, nor is limited to, any one receiver. These remarks apply to any and all receivers, from a 98-cent crystal set to a 10-tube super-het. As all these points are of about equal importance, we shall start at the antenna and follow through to the phones as logically as possible.

Sharp Antenna Circuit

Beginning with the antenna, therefore, we want this circuit to tune sharply for two reasons. One is that it cuts out more interference, and the other is that when we couple a low resistance circuit to it, the latter will not suffer loss in loudness, caused by trouble in the aerial. To have a low resistance antenna, one should use a continuous stretch of wire from free end to lightning arrester or set, and it should be well insulated. More than one wire is unnecessary, as a one-wire antenna will get practically everything that two or more will. Of course, if the length of the aerial is quite short, owing to the fact that your back yard is small, then there is sometimes an advantage in using two wires, if they can be spaced fairly far apart. For instance, if the greatest length of wire you can get is, say 40 feet, then additional volume can be got in your set if you will use two 40-foot wires, spaced at least four or five feet apart. If they were strung only a foot apart, the added amount of energy received would be negligible. Each wire may be thought of as receiving practically all the radio waves within a distance of several feet, and that is why when they are too close together they do not help each other.

Porcelain, quartz, or glass insulators are among the best. Composition insulation is always to be suspected because it may absorb water. If possible, do not string aerial over trees or bushes, etc., as they cause losses, particularly when wet. A good ground is quite satisfactory, but a two or four-wire counterpoise is often better. All back yards are different, and fortunately the shape does not matter much, but all wires must be of equal length and also well insulated. It is good practice to bring each wire up to the receiving set. The height above ground is not important, from 1 to 10 feet being satisfactory.

Primary

The antenna condenser, if used, need not be larger than .00025 mfd. (microfarads), that is, 11 plates, as very few antennas require more than this capacity. In fact, if the primary or antenna coil has several taps, a condenser half this size (five plates) will do. The advantage in using a small condenser here is twofold. First, we spread the tuning out over the whole condenser scale, and second we may get greater signal strength. Vacuum tubes are voltage operated devices, which means that the more the input voltage, the greater the output voltage. The larger the coil we have in circuit the greater the antenna voltage across it, and so we get louder volume of music and voice. Large sizes

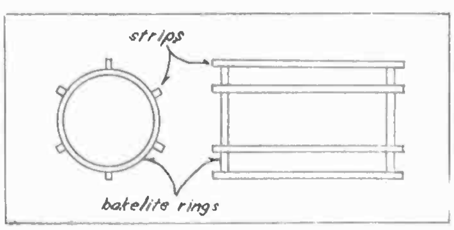


Fig. 1. Low Loss Winding

of wire, up to No. 14 dcc (double cotton covered) can be used here.

Secondary

If we are using a double circuit tuner (separate coils for primary and secondary) the secondary should be wound on the same form or tube as the primary, but an inch away. This will help reduce radiation, which squeals in your neighbor's set. All coils to be most efficient should be wound on forms having as little solid dielectric (insulation) as possible. A thin cardboard tube is good. Basket weave coils (such as Amrad) are very good as they contain very little dielectric. The ideal coil would be wound

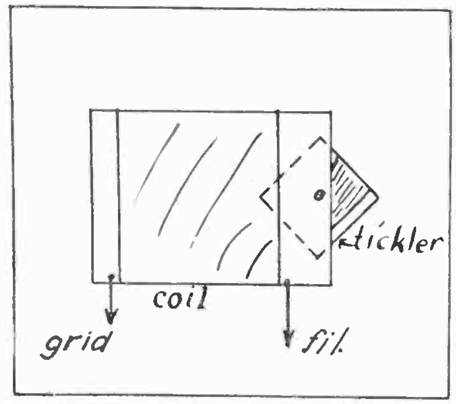


Fig. 2. How to Place Tickler

on air, but practically the wire has to have some support. A sketch of a low loss form is shown in Fig. 1. Use no varnish or other "dope" as they increase the losses of the circuit. Bore small holes in the ends, and pass the ends of the wires through, making them secure in that manner.

Well built low loss condensers are available now and are absolutely necessary. For examples of real low loss condensers, see the new Acme, Premier, and General Radio condensers. There are many others, also. Among other things necessary, the connection to the rotor should be through a pig tail instead of a friction contact, or else a stiff spring; the insulation should be hard rubber or genuine bakelite, and the vernier should be a mechanical affair instead of a small separate vernier condenser. Separate vernier condensers introduce additional losses, so it is much better to use a mechanical vernier, friction or gear drive, or the style with an extra plate on the main condenser. For cutting down the bad body capacity effect, the secondary condenser must be connected with its rotary plates hooked up to filament, which is grounded.

When a condenser is used in the aerial, as in a single circuit tuner, then the rotor plates go to the aerial and the stator to the grid. This is in line with the universal rule that the stator always goes to the grid. The reason for this

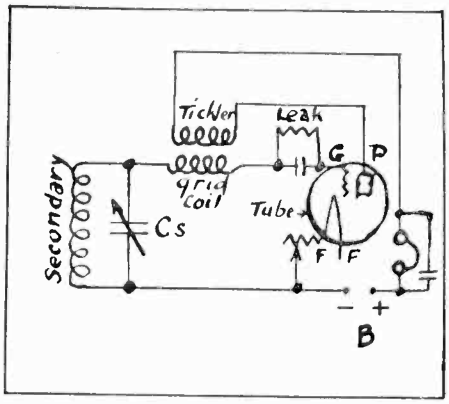


Fig. 3. Split Secondary Coils

was explained in the September 15 issue of RADIO PROGRESS.

The Grid Leak and Condenser

Needless to say, for good results we must have a good grid leak and condenser. Pick out the sizes recommended for your particular tube and use well-made apparatus. Cartridge and graphite leaks are good. Keep the lead to the grid up in the air away from everything, and as short as you can. Also mount the grid leak and condenser on bus bar so they will not touch against panel or cabinet. The socket is best made of hard rubber, porcelain, or bakelite. Sockets with metal shells are not quite so good as they introduce some extra capacity. If a cheap "molded mud" socket is used, it probably provides you with another grid leak and so spoils the operation of the set. When using UV-199 or WD-11 tubes, use the proper sockets; adaptors, especially with the UV-199 tubes, rob the tubes of much of their radio frequency advantages. Fibre panels are to be avoided because they may absorb moisture. Cabinets should not be too small. The sides and cover should be at least an inch away from the parts inside, if possible.

Plate Circuit Adjustment

Tickler regeneration is better than variometer tuning because the movement of the tickler does not affect the wave length of the set so much. The tickler for minimum shift of wave length should be about half the diameter of the coil inside of which it is placed, and should have as few turns as possible. The way to find out how many turns to have is to pull off turns one by one, until, at the highest wave length to which the set will respond, the tube will just oscillate when the tickler is at maximum. See Fig. 2 for proper placing of tickler. It is set at the filament end of the coil so as to keep it as far as possible from the grid. By this location the effect of the tickler on the grid in the way of changing the wave length is greatly reduced.

Advantage of Split Secondary

Fig. 3 shows a "split secondary," which allows movement of the tickler without affecting the tuning or wave length. The grid coil should be about 15 turns on a 3-inch tube and the tickler about 27. The grid coil should be at least five inches from the secondary coil. Fig. 4 shows how this arrangement is mounted up. Fig. 5 shows a fixed tickler which is easier to mount up and make. This also varies the regeneration without varying the secondary tuning. Condenser Ct brings the tube in and out of oscillation very easily.

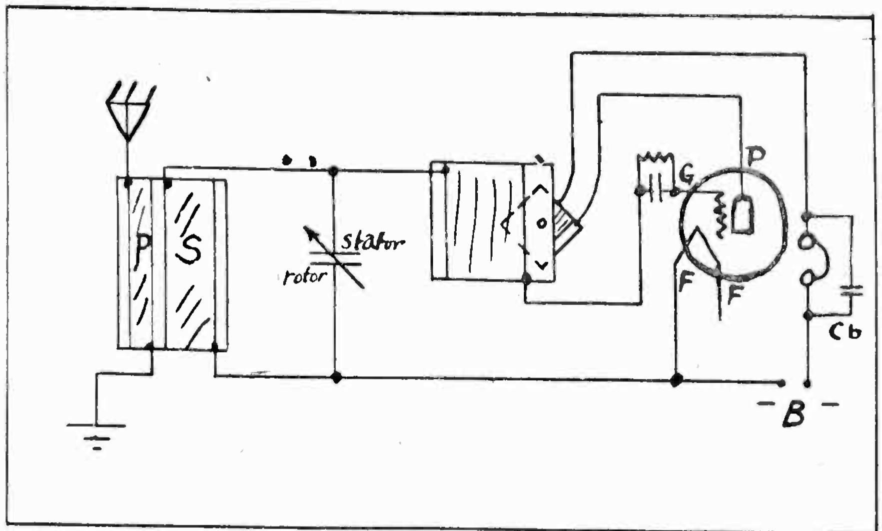


Fig. 4. Mounting and Hook-up of Split Secondary

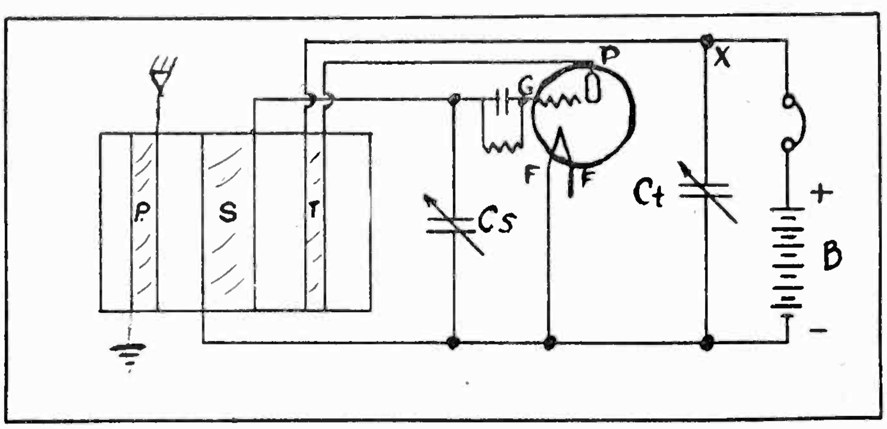


Fig. 5. Fixed Tickler Coil for Regeneration

The way the set operates is this: The secondary, which is tuned by condenser Cs, feeds its energy through the grid condenser to the grid of the tube. The output energy from the plate goes through the tickler coil and over to point X, where it divides. The low, or audio frequency, cannot pass through the small capacity of Ct, which will consist of 11-plates. It can, however, flow through the telephones, where it is converted into music in the diaphragm. The radio frequency, on the other hand, which also has come from the plate through the tickler coil, is unable to flow through the heavy inductance of the phones. High frequency will pass a small condenser, however, and so its path is from X through Ct, back to the filament. The

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High Powered Station Will Open Soon

WLW Cincinnati Will Soon Have a First-Class Transmitter in Action

THE new five-kilowatt transmitting station, WLW, of The Crosley Radio Corporation, Cincinnati, Ohio, will be placed in operation about Christmas time. This new super-power station will be the latest radio achievement of The Western Electric Company, containing all of the improvements known to the radio engineers.

Radio's progress is marvelously rapid. Beginning with the five-watt transmitting equipment of only a few years ago, the power of the transmitter gradually has increased until it is now necessary to remove the sending station outside of the city limits in order that no interference will occur when WLW is "on the air."

Located on Highest Point

After a careful survey of the counties surrounding the WLW studio, a point outside of Cincinnati was selected by the radio engineers for the erection of two 200-foot antenna towers, and the broadcasting station. The design will be unique and contain not only the powerful broadcasting equipment, but in an adjoining building the resident operators will live. From the top of the towers, located on a knoll at the highest point for miles around, a marvelous view of the surrounding country and three states may be had.

Heavy wires lead from the antenna through the dome of the station, the roof of which has been designed after a famous observatory. The tall towers piercing the sky will be an inspiring sight above the white, massive station and house. Heavy stone walls surround the buildings, but the large gate will always be open to visitors. Landscape gardeners already are busy with their plans for beautifying the grounds, and gravel walks will be lined with shade trees and gorgeous flowers.

Why the Squirrel Cage

In the photograph you will notice that the towers are graceful structures of steel. The aerial and lead-in are of the type known as the squirrel cage. They consist of a dozen wires strung evenly around the edge of an insulating disk. The advantage of this type of construction is this. As is well known, high frequency waves of several hundred thousand vibrations per second have a very pronounced tendency to crowd to the outside of a wire. Over 99% of the current flows in a thin skin only a few hundredths of an inch thick and the entire central part of the wire carries no current at all. Of course, this increases the resistance considerably and cuts down the amount of the current, and so reduces the loudness of the program transmitted. By using the squirrel cage construction, the copper is distributed all on the outside of a good sized circle. The center part of the squirrel cage is entirely missing. Since all the copper is on the outside the current flows through practically the entire volume of the metal, and this reduces the resistance to a very low value. The lead-in, of course, is in the circuit and so it is constructed in the same manner.

The aerial is of the well-known T shape. This gives a transmitting efficiency practically the same in all directions. For a station located near the center of the present interest in radio, this is a good feature. The lead-in is tied to all of the wires in the aerial at the center point, although this does not show very clearly in the picture.

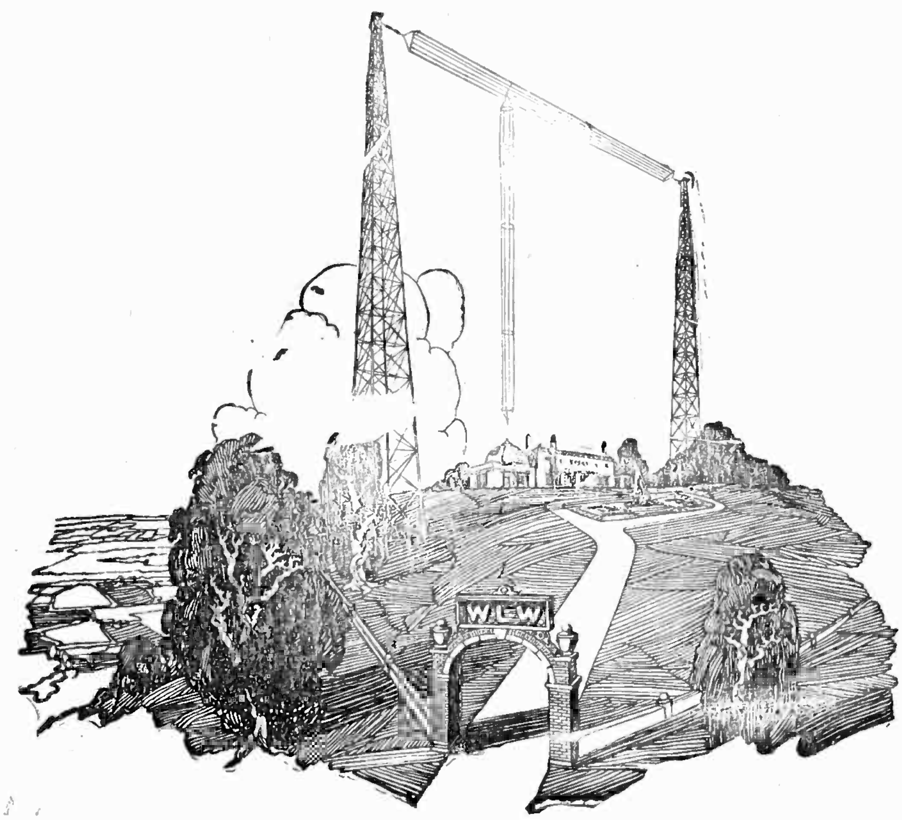

Fig. 1. Notice Special Aerial and Lead In

Just Push the Button

Operation of this new station will be automatic. Within five seconds after a button has been pressed in the broadcasting studio, located in the administration

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Third Radio Conference Coming

This Will Have Big Effect on Interference

SECRETARY HOOVER of the Bureau of Commerce has just called a national conference for the voluntary regulation of radio. The date originally announced was September 30, but this has been changed to October 6. Two conferences like this have already been held, one in February, 1922, and the other in March, 1923. Both of these were well attended by the representatives of the various organizations who were interested. You will remember that when Congress adjourned last June, the Control Bill, which was before the House, was lost in the rush of unfinished business.

The result of the two previous meetings has been a decrease in the misunderstanding and trouble through the voluntary co-operation of the broadcasting stations, the manufacturer and the public. Because of this, interference has been reduced and the service generally improved. Secretary Hoover states that experience has well demonstrated that even the most expensive and elaborate receiving sets cannot be depended upon to get the distant stations with very great regularity. The future of radio, he thinks, lies in developing local stations or those within a few hundred miles, rather than the fad of trying to pick up 1500 to 3000 mile distances. If this trend is kept up, then interconnection will be a very important factor in the future.

Radio Service Bulletin

The growth of radio, and particularly the multiplication of broadcasting stations and the consequent congestion of the air, has made necessary a consideration of many subjects and perhaps a revision of some present methods. Some of the matters which will be discussed and considered at the conference are: Revision of the present frequency or wave length allocations to reduce interference. Use of high frequencies or short waves. Classifications of broadcasting stations; possible discontinuance of class C stations. Interconnection of broadcasting stations. Limitation of power; division of time; zoning of broadcasting stations. Means for distinguishing the identity of amateur calls from foreign countries. Interference by electrical devices other than radio transmitting stations. Relations between Government and commercial services. Such other topics as may be proposed by the conference.

To help the work of the conference a representative will be asked from each of the various groups who are interested in radio. These representatives will meet to form an Advisory Council. One representative is now being invited from each of the following: Listeners, marine service, broadcasting (one from each inspection district); engineering, transoceanic communication, wire interconnections, manufacturers, amateurs, point-to-point communication, and the Government departments. The committee so formed will hold public hearings. All persons or organizations having any suggestions to make or views to express upon any features of radio activity are urged to attend and will have full opportunity to be heard.

Some of the matters suggested for consideration are not within the regulatory control of the Secretary. As to such matters, any conclusions reached by the conference can become effective only by voluntary adoption by the interests affected. As to the features falling within the powers of the Secretary the recommendations of the conference will be advisory to the department.

HIGH POWERED STATION

Continued from Page 19

building in Cincinnati, the voice of the artist will be sent into the ether and perhaps heard in Cape Town, South Africa, as was a similar station equipped for experiment.

Remote control will be used, making it possible to have the microphones in either the studio, theatres or other places miles away from the station. Special wires will be used to carry the music from the artists and studio director to the transmitting station. By means of line-amplifiers, which are like your audio steps, the music is kept at the same quality that would be found if the broadcasting were done in the same room with the artists.

Monk's Cloth Hangings

A research into the accoustical qualities of the different broadcasting studios resulted in planning of the new WLW parlors along the best lines. At the recommendation of Dr. D. C. Miller, heavy monk's cloth will be used to drape the walls, while the ceilings will have a special membrane treatment. Noiseless ventilators keep the temperature of the studios at the proper degree, regardless of the atmospheric conditions. The polished hardwood floors will be covered with heavy rugs to prevent unnecessary noise.

Plate glass will permit a view of the artists in both studios from the auditorium where the guests will find comfortable seats. A triangular-shaped amplifying control room is located between the solo and group parlors, where the studio director and his assistants will work. Several improvements will be found for the convenience of the artists which will make the waits between program numbers but five seconds.

DON'T DISTURB THE CHOIR

The appreciation of the aged for radio broadcasting is illustrated by the letter of Mrs. Helen M. Laird of Mohawk, N. Y., to WGY, Schenectady, recently. Mrs. Laird is eighty years old and for two years she has been a shut-in. Referring to a broadcast church service, she said; "I could not refrain from joining last night in the singing of the good old hymn, 'Come let us join our cheerful songs,' and if I made discord to disturb the choir, I must apologize."

Broadcasting Over Phantom Line

How This Is Done by a Big Chicago Station

By WALTER G. EVANS, Announcer of KYW, Chicago

IT is well known by this time that many events which are broadcast do not occur in the studio at the sending station, but take place in their natural haunt. For instance, it would not be very practical to transport a church into the studio in order that the Sunday services could go on the air.

Since the place where the program occurs is some distance, perhaps several miles from the sending aerial, it is of course necessary to connect these two spots with a telephone line. This line should be particularly good because any noise or humming would go out through the air to the whole surrounding country. The natural thing to do would be to pick out a particularly good pair of telephone wires and use them for transmitting the music to the studio. As a matter of fact, however, the sending company does not use an ordinary telephone line at all, but rather a "phantom line," which does not really exist, to send a great deal of their performances. Just how this is done and how the switching from one line to another is carried out, will be explained.

Picking One Out of Thirty

For instance, you will hear the announcer, say, "And now we'll switch you back to the Congress Hotel for a half hour's dinner music." Have you ever wondered just what takes place during the two or three second interval while the program is shifted from one location to another? It is almost disappointingly simple. The thirty-odd lines from the different points from which KYW broadcasts end in a telephone switchboard not unlike the one you see every day in your outer office. Both broadcast and talking circuits come through this board, and by means of plugs and cords any line or combination may be conducted to the broadcasting set, or to the station operator's telephone.

An outside or "pick-up" operator is stationed at the end of each line over which a program is to be transmitted. For him radio holds no thrill, no mystery. He passed through that stage long ago aboard some ship watching the sun come out of the ocean in the days when radio was called wireless.

The pick-up man checks his watch to the second with the operator in the station, and as time approaches for his program to begin he adjusts his amplifiers and microphones and notifies the announcer to stand by. When the program is ended at some other place, the station operator pulls the plug and inserts it in the next line, and tells the new operator he has the circuit. The outside operator tells his announcer to "shoot" and the switch-over has been completed.

When Seconds Are Minutes

Every effort has been made to reduce the time element in switching from point to point for at the receiving end a silence of ten seconds will seem like as many minutes. For this reason all schedules must be run on a split second basis and everything must be in hair trigger readiness.

Six men are employed at KYW to maintain and operate the outside pick-ups. All of the equipment is inspected daily, batteries kept in top notch condition and lines tested for noise or cross talk. Microphones may, in the language of the operators, "go south" over night due to temperature changes, moisture, or mechanical jar. At practically every point duplicate equipment and batteries are installed to insure against interruption of your program.

The Phantom Line

One of the tricks of the trade in use at KYW permits us to talk to the outside operator over one line while we are broadcasting music or speeches over the same line without interference between the two. Not a trace of cross talk can be distinguished between these two channels over the same line. In the parlance of the telephone companies this trick is known as the simplex to ground or phantom circuit and in the broadcast field KYW has been the first to take advantage of this method.

Fig. 1 is a diagram showing how connections are made for this particular circuit. Telephone A is an ordinary instrument and talks along the line to a subscriber at the other end, whom we will call A′. B is a similar instrument. Either one of these phones may be the one which you use in your own house. The phantom line is connected in through the "repeat coils" as shown. These are nothing more than induction coils, with a tap or connection taken at the middle point of the windings. The two taps form the connections for the two lines running to phantom P. At the other end of the wires there are two more P coils connected in exactly the same way and another telephone P′.

Louder Tone with No Wires

It will seem a surprising thing, but the phantom line which uses no individual wires gives clearer and louder speech than the regular circuits do. The reason is because instead of having a single wire to carry the current each way, it employs two. The direction of the current is shown by the arrows. Of course the direction changes several hundred times every second in all the lines, the exact speed of oscillation depending on the pitch of the note which is being sounded. For instance, Middle C has a period of 256 vibrations per second. The arrows show the current direction any one instant. A small fraction later of course, they will all have reversed. The arrows shown in heavy line give the information in regard to the main lines, A and B. It so happens at the instant considered the current is flowing out through the upper line and in through the lower one. This direction also holds for telephone B.

The direction of current flow into phanton is illustrated by arrows drawn dotted. Assuming that it is down at the left and up at the right, then the current in each case divides at the repeat coil. One half will go up and the other half down. It is necessary in building

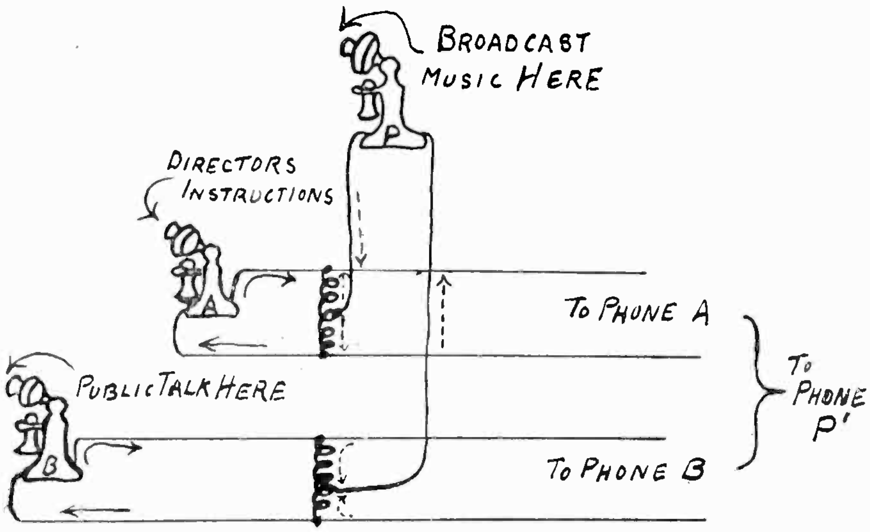


Fig. 1. How a Phantom is Connected

these coils to balance them, that is, make them equal with the greatest precision, so that exactly half the current goes each way. When this condition is obtained then the current from P has no affect at all on either phone A or B because it is exactly balanced. It is just as if two friends tried to make you move. If one pulled North with exactly ten pounds, and the other South at the same instant, with precisely the same pull of ten pounds, then while it might hurt your arms you would not move in either direction.

Current Not at All Confused

When a current reaches the other end of the line you might think that it would get mixed up, since there are only two pairs of wires for three instruments. However, the electricity is not a bit confused. Current that circulates in one line and out the other affects phone A′. The same is true of phone B′ in its line. And current which goes to the right in both lines of A and to the left in both lines of B affects phone P. In this way no cross talk at all is heard with such a combination.

In the picture the phantom phone is shown as being used for broadcasting. This, as has just been explained, is because it will give the clearest and best reception of the three. The other two can be used for any purpose at all. The top one is here described as being reserved for the director to use in giving his introductions. If the event, which is being sent out is a particularly important one, like a message from the President of the United States, then it is quite likely that line B will be held as a spare, and in that case if either A or P should fail, then B could be pressed into the service to take its place.

Putting on the Soft Pedal

Another development which was originated at KYW permits the music at outside pick-ups to be actually tuned to balance at the station. If for example, the high notes from a dance orchestra are predominating the operator merely adjusts a rotary switch until the lower toned instruments come through with sufficient volume to give the desired quality. If low notes are too loud it can be similarly adjusted to increase the volume of high notes until they balance.

In picking up programs from more distant points such as the recent Radio Show at Milwaukee, or the football games at Urbana the procedure is about the same, although repeaters, or boosters are sometimes inserted in the line to keep the volume up to standard.

THE LADIES FROM HELL

To receive a letter from one of the "Ladies from Hell" would startle any calm-minded individual. To learn that a radio program had been enjoyed by this "lady" in her super-heated environment, might show a remarkable feat of broadcasting.

The man who reads the thousands of letters received by WGY, Schenectady, noted that the "lady" gave "her" address as "Care Groton Country Club," of Groton, Mass., and he recalled that during the war one of the most famous fighting units in the allied forces received the blunt, yet complimentary, designation of "The Ladies from Hell."

The letter verified his conclusion that it was from a former soldier, who had listened to the New York Philharmonic orchestra and also a radio drama. "Please extend to them the thanks of our small family," he added. "These concerts mean a lot to ex-service men trying to regain their health."

STRINGS PROBABLY ARE BEST

There is considerable debate among radio listeners as to which instrument transmits by radio with the greatest fidelity but, so far as a group of instruments is concerned, string instruments deserve the laurels.

UNIVERSITY WILL BROADCAST COURSES

With the opening of the University of Pittsburgh in the fall, radio fans will be entertained from time to time by the broadcasting of various courses of instruction by KDKA from the educational studio which was established last March at the University of Pittsburgh. Two educational series were sent out during the spring term. A course on Political Parties was broadcast due to the great interest in politics as shown in the recent national party conventions, and whenever possible similar courses about national affairs will be put on the air. Outlines for each of the courses to be broadcast will be printed and distributed to those who are interested.

THAT MESSAGE FROM MARS

THE papers have been full recently of mysterious messages. These are supposed to have been sent out from the planet Mars, which is now at the nearest point of its approach to the earth. The peculiar thing about the messages is the very long wave length, several times longer than the slowest vibrations used in regular radio communication.

There does not seem to be any very substantial reason for supposing that these waves came from Mars—it appears something like the argument of the fellow who knew he must be listening to San Francisco because the words sounded like Chinese. It has not even been proved that the vibrations can come from outside the earth and even if they did it is a far cry to Mars. The idea seems to have taken the popular mind because naturally there is so much curiosity about what is going on in our neighboring planet.

Frankly, we very much doubt whether these signals had any such origin, and furthermore, it seems very unlikely that the earth will ever get into communication with Mars. First of all there is the practically impossible problem of getting radio waves out into space in any quantity. If we all have the greatest trouble in getting England, (except the liars), which is only a few thousand miles away, we shall have to go some to pick up a place a few hundred million miles away. The radio waves as we know follow along the surface of the earth and do not dart out into space.

Besides this, there is the very practical difficulty of translating the signals when they arrive. The messages were supposed to consist of dots and dashes. Suppose you go down to a telegraph station and listen to the ticker grinding out click-click, click, how long do you suppose it would take you to guess what they were saying if you don't know code? It is doubtful whether any one could learn the code just by listening to the clicking in a hundred years and furthermore it is going in English, a language which you know. All the detective stories of deciphering a code have assumed that the detective knew the language in which the code was written. If you were so lucky as to guess the meaning of dots and dashes, would you be able to read a message coming through which was written, say in Russian? And then, how about its being written in Martian? (if that is what they speak on Mars).

As a final point, even assuming that we could get to the point where we understood what they were saying and could talk back and forth, what messages would we send? After a few months' description of the place it would simmer down to the question, "How is the weather up there?" On the whole, we do not feel very much excited about messages from Mars.

TWO RADIO GAMES

WHEN you talk about "playing the game" it often means sticking with the thing until it is done and being fair about it. In this case, however, we are referring to two radio amusements, which have been proven rather popular at social gatherings in the evening.

There are various modifications of them, but we will describe the form that seems easiest. In the first one the knowledge of outside stations and the announcers' voices is very important. The company assembles in a large room with a loud speaker in it. The latter is connected up to play the music for the crowd, but the master of ceremonies has a telephone head set which he wears and which he can plug in at an instant's notice on the detector or first step, so as to cut off the music from the loud speaker. Of course, there are some sets which are not provided with more than one jack, and in such a case it is considerably more bother to work the scheme than where there are two or more of these units provided. However, it can be done even in that case.

The operator, with his phones on, tunes in to some station. He need not know what it is, but he must adjust the set until music comes in good and clear, then he pulls out his phones and so lets the music fill the room through the loud speaker. The piece is allowed to continue until it gets to the end and the announcer starts making his little speech. Just at that instant when he says, "This is Station———" the operator plugs in his phones, so that the company does not hear what station it is, but he gets it himself. The guests are all provided with slips of paper, which have numbers down the side and they each write on their slips the call letters and city which they think fits the station they have just been listening to.

Of course, the operator makes a note on his slip of the correct answer, which he has just heard. In case the piece was too short, or for any other reason, the same station may be allowed to play a second time before tuning to a new one. When satisfied that a new one is wanted the man at the radio set tunes to another broadcaster with his phones and again throws it on the loud speaker to be guessed. This continues until the company have had enough, when the slips are collected and compared with the true list, which was made out by the man with the phones.

It is surprising how quickly some of the more popular announcers are recognized by the listeners. The various broadcasting companies have naturally picked out men with personality in their voices to occupy such responsible positions, and because of this the radio fans who are on the air very much of the time seem to be able to tell them right away. It is, of course, the announcers rather than the individual artists who are recognized as one singer may give a concert from several different stations.

The Tuning Game

The second entertainment, which is sometimes had with a radio set, is different from the first in that it is not suitable for so large a crowd and that it requires greater knowledge of radio than the one just mentioned. It is played like this: Each person in turn is given a certain length of time at the dials of the radio set; five or ten minutes is the usual length, depending on the number of players. In his five minutes the player tries to see how many different stations he can bring in clearly.

It is not fair to require that he wait for the announcer to tell the name of the station, because some broadcasters do not give out this information oftener than once in every fifteen minutes, but as soon as the music becomes clear, the dials are logged (the readings are written down on a piece of paper) and such a station counts one toward the final score. The host usually acts as referee to decide when the reception is good, or, if preferred, the whole company can act in this way.

It is surprising how different various people are in their ability to get sharp tuning quickly. Some seem to have the natural knack and are able to pick up one station after another and make them sound well, while others do not seem to get beyond the local broadcaster with any real clearness. The next time you have a party at home you will find your guests are interested in one or both of these radio games.

CUTTING DOWN LOSSES

Continued from Page 18

amount of radio frequency current passing through Ct will depend on the setting of the dial. When the capacity is small, only a small amount of high frequency can flow through condenser Ct, and this will reduce the amount of regeneration. When Ct is turned up, it allows a large amount of radio frequency to flow through it, and this gives a large amount of feedback.

If the plate bypass condenser Cb (Fig. 4) is across the B battery, it should not be a paper condenser as it may leak and might even "blow" or short circuit. Use a mica or other well constructed condenser. Howling is often due to excessive plate inductance. To remedy, make the tickler smaller as previously mentioned. Excessive tuned circuit resistance causes the set to go in and out of oscillation with a "plop." The remedy is to use low loss condensers and coils. Incorrect grid leak adjustment may also cause a howl. The remedy here is obvious.

Odds and Ends

Wooden panels are satisfactory if dry, but condensers on the panel should be connected so that the filament end is connected to the panel. Keep the wires separated as far as possible from one another and other objects. Run them at right angles when crossing, and try to keep them short. Keep a distance of two inches between separate parts in a set. Use as small amount of spaghetti as you can get along with. When two wires come quite close together and there is some danger of their short circuiting, then spaghetti may be used, but it should not be put on insulated wires just for looks.

Conclusion

To sum it all up—use the best parts your pocketbook can afford and do not crowd everything together. A Phord will take you as far as a Phierce Harrow, but they who can afford it have the latter.

If a real low loss efficient tuner is desired, all hints should be carried out. It will be of no use to substitute a good coil or condenser in a poor set because the set will still be poor even if it has one good part. Only a little poison is needed to kill a man. But when these suggestions are carried out, a big improvement will be noticed in long distance reception.

Fone Fun For Fans

Those Candid Friends

The Author (posing)—When I write far into the night I find great difficulty in getting to sleep.

The Friend—Then why don't you read over what you've written?—Klods Hans (Christiana.)

Poor Kids

Mrs. Dee—"Are you all settled in your new home?"

Mrs. Holbrooke—"All but the children. They can't sleep a wink. My husband hasn't had time yet to connect the aerial for the bedtime stories."—*Two Bells (Georgia).*

A Minnow for the Reader

Fair Patient—Oh, doctor, what do you recommend for a tired, fagged-out brain?

Doctor—Well, fish is a great brain food.

Patient—What kind of fish?

Doctor—Why, for you, a couple of whales might be about right to start with.—*Brown Jug.*

Good Sets

Customer—"But if you are selling these radios under cost price, where does your profit come in?"

Assistant—"We make our profit out of repairing them."—*London Opinion.*

Make a Good Cabinet for Your Radio

Radio Woodworking for the Wireless Fan

By W. S. STANDIFORD

LARGE numbers of amateur radio fans throughout the United States and Canada are constructing their own sets to "listen-in" to broadcast programs. Most of their instruments are very good ones and work well when used the first few times, until the spaces between the leaves of their variable condensers, jacks and other parts of the outfits clog up with dust. Then trouble occurs. It is of the utmost importance to the working of receiving and broadcasting sets that a clear path for the electrical energy (which at its best is very weak, owing to distances traveled) should be provided, so that no buzzing sounds due to accumulated dust, are heard along with the signals.

In order to make their apparatus give the least amount of trouble, manufacturers of radio sets enclose them in wooden cabinets. This not only adds to their appearance, but increases their efficiency. In sharp contrast to this, many fans do not enclose their outfits in a case but try to keep 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 or out of shape, thus causing other difficulties during operation.

Home Made Cabinets Crude

As a general rule, most radio fans who do construct their own wooden cabinets, fail to make neat-looking ones through a lack of knowledge of the processes and tools needed to do a good job, rather than because of any carelessness in this work. The weak point where most amateurs fall down in carpentry work is in making neat-looking joints; the result being that the box looks crude when it is finished. By constructing the joints of your wooden container on the plan outlined in this article, a fine-appearing cabinet will be the result. But care must be taken to cut all grooves in the end posts to an even depth, and also to have the ends of all boards cut as squarely as possible. At the outset, before any work is started, assemble your set in position on a table and measure its width, length and height; allow sufficient wood to project on all sides so as to prevent the instruments of your radio outfit from touching the inside parts of the case. It is much better to have plenty of room for the devices in your container than to make one having just barely enough space to house them.

In these days of frequent changes of radio receiver designs, the advantage of having a sufficiently large sized box will, in many cases, render unnecessary the construction of extra ones with their additional expense of construction, as all that the radio enthusiast has to do is to disconnect the parts from its interior and lift out the panel which holds the other instruments, and then slide in to the box's grooves, a bakelite or hard rubber panel having its holes cut to conform to the desired pattern.

Panel Held Without Screws

It will be observed that the method of holding the panel in this style of construction is different from that of the usual course adopted; that is, of using brass screws to secure it in place. The panel slides in grooves, and depends upon the weight of the panel and its attached appliances, also the friction between tight fitting panel and its grooves to hold it down solid. This not only results in ease of removal but a very fine looking box with sharp corners. The appearance of the cabinet is shown in Figure 1. The use of four square posts, one on each corner, gives additional strength and makes a rigid container, one which will hold the apparatus in its interior without any bending of the box when it is lifted up.

The first thing to do is to decide what kind of wood your box is to be made of, whether of soft or hardwood; each class having its advantages and disadvantages. Soft woods like pine, are easier to work than the harder varieties such as oak, but a case constructed of the latter will be far stronger than one made out of pine wood. On the other hand, soft woods (which are close-grained) require less work to be done on them in the final varnishing operations, and furthermore, they can be made to imitate the more costly woods.

Cutting Groove in Posts

By using pine or poplar, a radio cabinet can be constructed which will look as if an expensive natural-colored wood were used, it also being cheaper to make than a hardwood one. In the construction work, a choice of two methods can

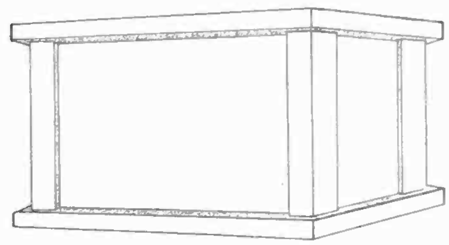


Fig. 1. Striking Appearance Shown

be adopted, both producing good results. All grooves in the four end posts can be either cut in by the amateur woodworker with the aid of a tongue-and-groover plane (which can be bought at any hardware store) or he can have this work done at a planing mill and thus save a lot of work.

Supposing that the latter course is adopted, proceed as follows: The tools needed will be a block plane, saw, small hand drill, stock, and also a 1/16 inch diameter drill to fit the stock, brad awl, a square having a 12 inch blade, vise, and a cheap wooden mitre-box. The latter will not be needed if the constructor can saw to straight lines. A piece of sandpaper tacked on a block of wood can be used for squaring the sides at right angles to one another, although, it will take more time in construction Other needs are screwdriver, 2-dozen flat head brass wood screws (don't use iron or steel ones in radio work as they may interfere with reception), about 7/8 inch long, also two wood screws 1¼ inches long, a can of liquid glue and sufficient wood having a thickness of ⅜ inch after planing, to make the sides and top of your container. Make the wooden base out of ½ inch thick stock, as this imparts greater strength and stiffness than a ⅜ inch board.

If a set is over 18 inches long, a hardwood baseboard can be used; in fact, hardwood makes an excellent bottom for any radio outfit. The square slotted posts that form the right and left corners should have their grooves planed out, while the wood is in one long strip, they being afterward cut to their required length. In using one of these pieces for the right-hand side back corner post it will be necessary to turn the wood over, bottom side up, thus making one slotted face to the left. The right side front corner section should be reversed in a similar manner.

How to Save Time

It will readily be seen that by this method of making the grooves a saving of time is effected, for otherwise each small post after cutting to the correct height would need its slots cut in on different sides separately, a tedious job when done on small pieces. Have the base of sufficient length and width so as to extend ¼ inch over all the way around (½ inch longer over all), measurements being taken from the outside corner of one post to another. This makes a neater looking box. Details of construction show in Figure 2.

Make your top cover the same size as the bottom in regard to length and width, but use ⅜-inch lumber instead of ½-inch thick stuff. Having the wood planed smooth and cut to the desired size, we are now ready for glueing it together. All wooden sides should be made to fit rather tightly (but not too firmly, as splitting may occur) into the slots where they are designed to go. A few remarks about the amount of glue used on the joints will not be out of place, as success or failure depends, to a large extent, upon how it is done.

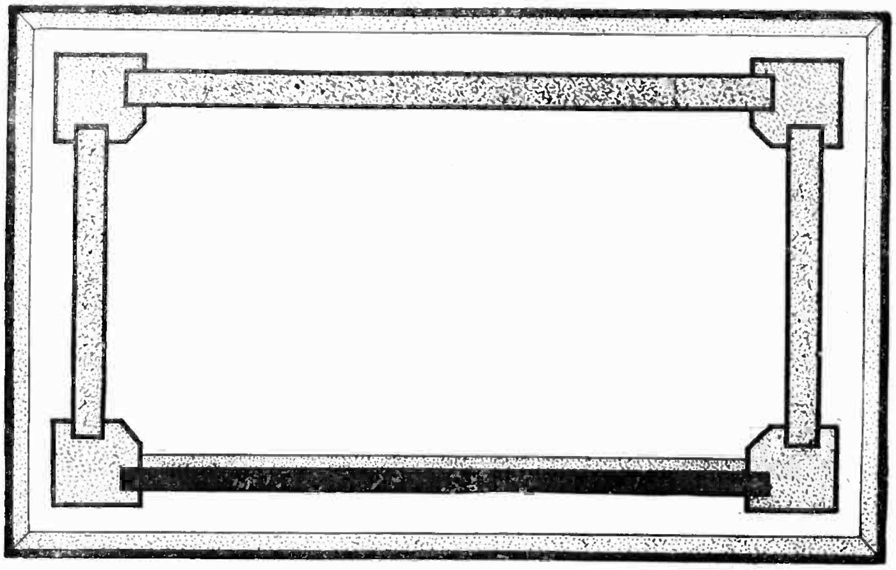


Fig. 2. Plan of Cabinet with Panel

Hardwood requires different treatment from the softer varieties. The liquid glue should have a consistency of thick cream; if too thick or strong, dip the bottle in warm water or place near the fire, thinning if necessary with a few drops of strong vinegar.

How to Glue the Parts

Parts made of hardwood which is not very porous, need one thin coat applied on to edges to be united. Let it dry for five minutes, then press the wooden side and post firmly into contact. Porous lumber, such as soft wood, requires one or two thin coats on each joint to fill up their pores. In about 10 or 15 minutes after all glue has been absorbed, apply another thin coat and press the sections into position, allowing them to dry for at least 24 hours. Keep all traces of grease away if you expect your work to remain inseparable. In construction work on radio cabinets of this type it is advisable to glue the longest section first. The ends of the boards should make a driving fit into all post slots. Taking one post of the back section, lay it with its slot facing upwards; then put some glue into the groove and also on the end of your board that is to go into it.

Put them together by placing one end of the board in the slot, then lay a block of wood on the other end and hammer it down in position; take care to see that the bottom of the groove and the end of the board are in contact. Wipe off any surplus glue that exudes out and fasten the other end post in the same way. Next lay your board with its posts down upon a level surface, placing a thick plank over the two end posts, weighting it down and leaving until dry.

How to Prevent Warping

This weighting down prevents any warping taking place due to moisture in the glue while the wood is drying. It also keeps the sides of posts and the board's end at right angles to each other, thus making them dry in that position. After the glue has set, fasten both right and left sides of your box in the same way, hammering with blocks placed on the front posts. It will be necessary to put a board (which is not to be glued) having the exact length of the panel, into the latter's slot; this is to keep the short ends of the box from collapsing inward until your cabinet is finished and screwed upon its base. After the two front posts are glued, turn the rectangular frame over, having the two front posts facing downwards. The short ends should be tied together tightly with strong cord so as to make them press firmly against the board in the panel slot. This prevents the end sections from spreading before the glue has set. Now rest your thick board (bottom) on top of rectangle turned upside down, and weight it down without glueing.

When the glue on the sides has set, remove the weights, take off the baseboard and turn it over so as to have its top face upward. Then lay the frame on it, and after seeing that the margins of the base are spaced equally from all sides, weight the frame down to prevent moving out of place; take a sharp pointed pencil and mark lines on the

Continued on Page 27

American Radio Relay League

AIRSHIP TALKS TO LEAGUE

Desiring to test out the new short wave transmitter on the big navy airship Shenandoah while it is in flight, navy officials have requested the American Radio Relay League to have amateur radio telegraph operators stand a twenty-four hour watch while the big craft is passing over the western part of the country from Fort Worth to Seattle by way of San Diego. October 3rd was the date set for the start of the transcontinental trip.

The arrangement between the navy department and the A. R. R. L. called for at least six daily schedules during which amateurs will be practically the only means of communication that the airship will have with navy officials and the public. Both official messages and press dispatches will be received and forwarded by amateurs.

The short-wave set was added to the Shenandoah's radio equipment because storage batteries are the only source of radio power, and the short-wave transmitter requires less energy for its operation and is regarded as being of greater practical efficiency. The government stations are not equipped at present to operate on short wave, but the amateurs are highly skilled in their use.

Navy Recognizes the Amateurs

The navy has been interested in short wave transmission for some time, and the present incident is another example of the co-operation between navy officials and the amateur organization in this particular field of radio work. Amateurs are the recognized leaders in short wave radio transmission.

Immediate preparations are being made by the A. R. R. L. to have amateurs along the route west of Forth Worth on duty. The wave lengths and other data are being supplied them. At least three qualified amateurs in each State that the airship passes over will be held responsible for communication with her. A correspondent of the Associated Press who is to be on board will send his news dispatches by way of these amateurs.

WINS BOOMERANG BY 500 MILES

The world's record for amateur radio long-distance two-way communication was captured from a South American operator when W. B. Magner of 464 Sixth street, San Pedro, Cal., made contact with Frank D. Bell of Waihemo, New Zealand, a total distance of 6,900 air miles. The previous world's record established by Carlos Braggio of Bernal, Argentina, was 6,400 miles. The North American amateur wins the transmission honors by 500 miles.

The new record was made during the transpacific tests arranged by the American Radio League for communication between amateur operators of the United States and Canada with those in Australia and New Zealand. Magner has been informed that he wins the Australian boomerang offered to the first radio amateur of North America to establish communication with Australia.

K. L. Riedman of 243 Euclid avenue, Long Beach, operator of amateur radio station 6CGW, was notified of the gift of a pair of green suspenders as a consolation prize. Riedman exchanged messages with the New Zealand operator about half an hour after the local amateur made the contact that broke the record. All communication was accomplished between 12:20 and 2:20 a. m.

Amateurs in this country have been trying to beat the South American record ever since Braggio announced that he had "worked" Ivan O'Meara of Gisborne, New Zealand. This happened on May 22 of this year during the Pan-American amateur tests and was regarded as especially remarkable on account of the barrier made by the Andes mountains.

A GOOD CABINET

Continued from Page 26

bottom board, taking care not to move the sides of the frame out of position. Mark around inside and outside of frame. By having pencil lines on the bottom board drawn on both inside and outside of the frame it enables the constructor to have all screws (which hold the bottom to the sides) spaced at equal distances and in the center of the wood, thus avoiding splitting.

Putting in the Screws

Remove the frame, then bore holes for your flat head wood screws in the baseboard, spacing all holes about two inches apart on the back and sides of the box. These holes are bored from the marked side, down. The bottom part facing the front posts which holds the panel should be secured with 1¼-inch flat head brass wood screws. All others are ⅞ inch long. All screw holes are to be slightly countersunk on the reverse side to where the centering lines were drawn. This is done to keep all screw heads flush with the level of the bottom of the cabinet, which will prevent marring any polished surface upon which your container is placed.

We are now ready to fasten the bottom of the box to its sides, which is easily accomplished by means of the screws. Then remove the board from the panel slots and also all cords from the sides of the frame, as they are not needed now. Get from any grocery store a piece of thin wood about 3/16 inch thick. Boxes that contain oranges usually have sides of the above thickness. Cut a narrow strip about ⅜ inch wide and of sufficient length so as to make a good fit when placed lengthwise inside of the box. Glue it into place with its straight outside surface flush with the inner sides of both panel slots. The object of this strip is to help keep the panel with its instruments in an upright position. A piece of dark colored canton flannel with its woolly side facing outward is to be glued on the bottom of the box to avoid scratching any polished surface.

Screwing on Cover

Make a cover of the same width and length as the base, but 3/16 inch thick instead of ½ inch. The cover may be held in place by four screws, one on each corner. By having a cover which is screwed down after the instruments are adjusted and inside of the cabinet, all dust is effectually kept out. Most people prefer hinges, however, which allow easy inspection of tubes. It is now ready for varnishing, which can be done by using any good varnish or a combined varnish stain as preferred. If all work is carefully done a most unusual and attractive appearing radio cabinet differing from the usual run of boxes will be the result.

Sending Station Stories

WHEN ICEBERGS SINK

WHEN Explorer MacMillan was returning from the frozen North to the town of Wiscasset, Maine, recently, he got his radio going some time before he arrived and the stories which flew over the air to the listeners in his home town were very interesting.

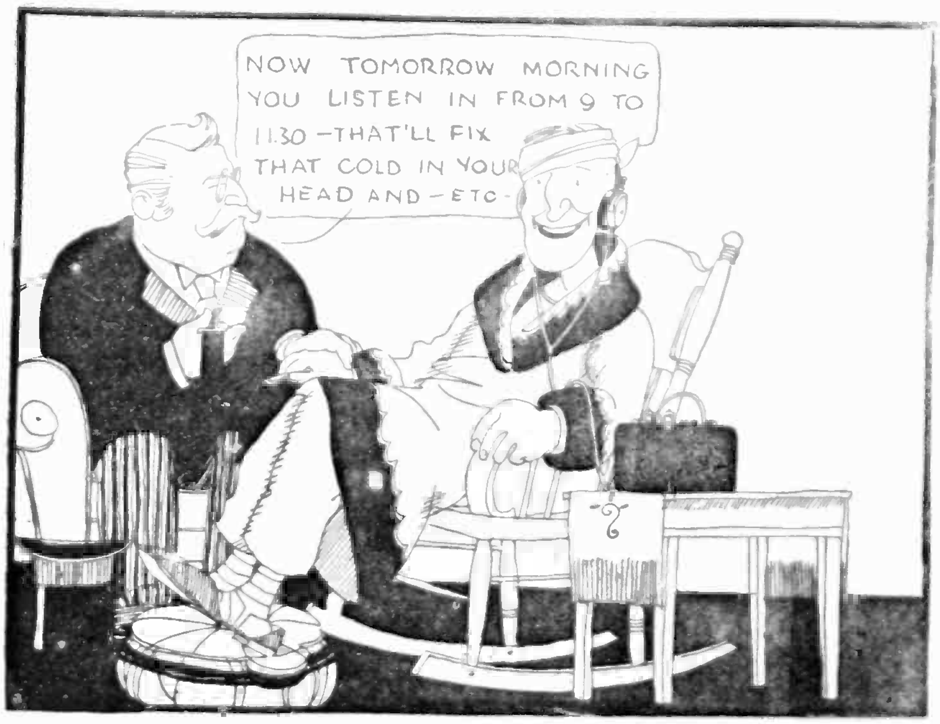
For instance, he told of a Newfoundland fisherman, who almost convinced the famous Arctic explorer that icebergs drifting from the far north finally become water logged and, with much bubbling, disappear below the surface.

The explorer insisted that ice, whether it be frozen in the shape of a great berg, or just a plain cake, will always float, but the fisherman was equally insistent that he had not only watched the bergs go under, but he had actually seen them at the bottom. MacMillan saw that further argument was useless and demanded proof.

This was what the fisherman had been looking for, but first he wanted to work up a little more interest in the matter by making it the subject of a wager. MacMillan finally agreed that he would stand treat if the other would point out a real honest iceberg, in a place where ice is never found, at the bottom of the sea.

A little sail boat was by the shore and the explorer was invited to step inside. The wind took the sail and, in a short time, the voyagers were several miles out from land. "Now then," said the fisherman, " look down there and tell me what you see."

MacMillan peered over the edge and sure enough he saw an iceberg resting solidly on the bottom. The fisherman grinned triumphantly as they headed the boat back to shore. MacMillan paid the wager like the sportsman that he is, but did not have the heart to say that in the center of the ice he had seen a boulder weighing many tons.



BROADCAST BILL CURES A COLD

The latest thing in radio
Is how to cure a cold.
It is the way, the doctors, say,
To stop from getting old.

The music starts activities
Of our lymphatic glands;
The glands begin, when listening in
To orchestras and bands.

And that is why the radio
Will help you every day.
It's good for warts, and other sorts
Of trouble, doctors say.

And so next time you're feeling sick,
Just do like Broadcast Bill—
Put on your phones—'twill stop your groans
And cure you when you're ill.

—*By Del.*

ROUTING OUT THE FIRE CHIEF

A radio message broadcast by Station WBZ at Springfield, Mass., fooled a fire chief completely when he tried to get away from everything for a few weeks and to avoid all means of communication with the busy outside world.

"I thought I had succeeded in getting away from everybody and was at the tail end of the earth," describes the confidence of the subject of our story. But a flash by radio, a description of the person, the help of co-operative citizens, short tie-overs by telephone and train to fill in gaps in the line of communication, canoe trips, portages and tramping through miles of untracked forests—all these were necessary to the delivery of the call of duty.

John C. Moran, Chief of the Fire Department of Hartford, Conn., is the gentleman whose vacation plans were spoiled by the WBZ radio message. But the call to duty was urgent. The assistant fire chief had died suddenly and the Hartford Fire Department was without a leader. Chief Moran had left on a hunting trip in the northern Canadian woods, 200 miles north of Quebec.

Precisely

"How would you classify a telephone girl? Is hers a business or a profession?"

"Neither. It's a calling!"—*London Mail.*

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. In building the Rice Neutrodyne described in your issue of August 1, I have difficulty in getting the higher wave lengths. 470 meters seems to be about the upper limit. How can this be raised?

Answer. Most of the sets constructed, according to the data given on this neutrodyne, have been able to reach about 500 meters. In your case it must be either that your condensers have not quite as large a capacity as those tested out, or else, owing to the spacing of the wires or the size of the coils, they have not as much inductance as other coils. In either case you can increase the wave length of the set in one of two ways—substitute a 15 or 17 plate condenser for the 11 plate recommended, or else wind ten additional turns (five on each end) on the secondary coil.

Question. In the July 1 issue of RADIO PROGRESS the article, "Regeneration and Reflex," did not explain how regeneration occurred.

Answer. This particular part of the operation of the set is controlled by handle 3, which slides coil 3 back and forth. When the handle is pulled out, it brings this coil close up against coil 9, which is the stator of the variocoupler, leading to the detector. When handle 3 is pushed in, it separates these two coils.

When they are close together the energy received from the plate, through coil 3, is fed back by magnetic action into coil 9, which impresses it on the grid. This is like the action in any ordinary tickler coil regeneration except that most sets use a turning coil rather than a sliding one to control the amount of energy transferred from the plate back to the grid. Pushing in on this handle separates the two circuits far enough apart so that the amount of feedback is greatly reduced. This is a simple way of controlling the tickler action, although personally we prefer to turn a handle rather than to push and pull it.

Question. I have seen advertised a lamp used as a loud speaker. What is the advantage?

Answer. There is no particular advantage in this construction, except as a matter of looks and convenience. Some people think that a loud speaker horn is rather ugly, and by concealing it in the form of a lamp it improves the appearance. Of course, it also avoids another large device which would otherwise have to be put on the table with the radio set. As far as the electrical and sound characteristics are concerned, there is no difference at all, except that perhaps the electric light wires running through the lamp might possibly cause a slight amount of hum in the radio set nearby. However, it is doubtful whether this would be a serious matter.

Question. Some hook-ups I have seen recently have shown a "C" battery right next to the grid of the vacuum tube and some in the same circuit, but near the "A" battery. Why is this difference made?

Answer. A "C" battery is always connected to the grid. The positive pole runs to the "A" battery and the negative to the grid.

The bias voltage, which is the pressure which this battery gives to the grid, does not depend on the location of this unit. As far as operating the set is concerned, it makes no difference in which place the "C" battery goes. However, it is better to put this device right next to the "A" battery and connect it to the tube through the coil. The coil referred to is the tuning coil, if a detector is being connected, or the secondary of the radio or audio transformer, if an amplifier is meant. These coils, of course, are in the circuit anyway, whether the "C" battery is used or not. This location has one considerable advantage. It puts the "C" battery at ground potential as far as the high frequency current is concerned. This is because it is connected directly to the "A" battery, which is grounded. It also allows a short grid lead direct from the coil to the tube.

When it is located next to the tube, a short direct grid lead can no longer be used, as the wire runs from the transformer to the "C" battery and from there to the grid, instead of going direct, and of course this puts the "C" battery at high potential as regards the alternating current. The alternating current referred to is the radio frequency, if it is a radio amplifier, or the audio frequency, if it is used after waves have gone through the detector. Wherever you see a hook-up with the "C" battery next to the grid, you will know that the author has not considered the fine points of radio building. In such a case just take it out of that position and insert it next to the "A" battery.

Question. What is the advantage of making the jars of glass in a storage "B" battery?

Answer. There are two reasons for the use of this material. One is that it allows inspection of the plates inside the cell, and so it can be determined whether they seem in good condition or not. The other reason is that while glass is just as good material as hard rubber or moulded compositions for the purpose, still it is a great deal cheaper than the latter, and it is also easy to mould. Some of the newer storage "B" batteries are using a screw thread moulded into the top of the glass jar, and the cover screws on to this. Such a construction works out very well in practice.

Question. How close is it safe to have the adjustable air condensers to the tuning coils of a detector?

Answer. This depends somewhat on the relative position of coils and condenser. The coil causes an alternating field of magnetism or magnetic lines to oscillate back and forth through the center of the tube on which it is wound. These lines of force induce a voltage in any piece of metal which they strike and the voltage circles round in the same way that the wires do; that is, they spin around the axis of the tube. If the condenser plates are located in such a position that they lie parallel to the various turns of wire, then there is a great tendency for eddy currents to be formed, which reduce the volume of the music and cut down the selectivity of the set. Such a position would be one where the condenser was mounted right at the end of the coil with its shaft in the axis of the coil. If it is necessary to have such a position for these two units then the spacing between them should be at least three and preferably five or six inches.

In case the condenser and coil are mounted side by side, instead of end for end, it is safe to put them a lot nearer together, although usually they should not go much closer than one inch or two apart. Eddy currents will not be formed with this location and the only objection to having them too near together is that there will be some loss owing to the capacity between the two. This is not a very serious matter, however, and it is not nearly as bad as the eddy current loss just mentioned. In spite of the serious objection to the end-to-end mounting, you will notice a good many combined units on the market which are constructed in this way. Such devices should be avoided.

Question. Which are better, brass bakelite, or sockets, for vacuum tubes?

Answer. These brass sockets have bases of porcelain or moulded composition. If the moulded composition happens to be bakelite or its equivalent, then no losses will be experienced at this point. But if it is of some of the cheap materials, which have sometimes appeared on the market, then serious losses may occur in the base. One test for this is to dip the whole socket into boiling water. If it does not melt or soften, it is probably of bakelite or equal, and if so it is satisfactory. On the other hand, if it softens it is more apt to be the cheap composition, which will not be satisfactory. While this test does not prove that it is undesirable, still it is well to discard such sockets, as there are plenty of good ones on the market at reasonable prices which will stand the boiling water test.

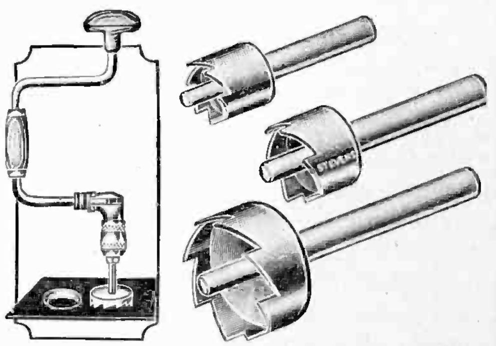
As to the brass shell, it has no effect on the audio frequency amplifiers. When used for radio frequency or detector tubes it may have a very slight capacity action, as it is assembled so close to the elements inside the tube. If there is any such condenser action it will be undesirable, although small, and for this reason we usually recommend sockets without the metal shell for radio amplifiers.

Question. What is meant by a "full wave" rectifier?

Answer. A rectifier is used only for converting alternating current to direct. The electricity which comes into your house from the central station, if alternating, consists of a positive loop and then a negative loop. That is, the current reverses in direction and runs first in one way and then the other, as is represented in the upper half of Fig. 1. A rectifier works like a valve and suppresses or cuts out every other loop. It may be connected so that it passes only the positive loop, or by reversing the leads it will suppress the positive lead and leave only the negative. Referring to the lower half of Fig. 1. a rectifier connected to pass the positive half of each wave would give a curve of voltage like that shown by the full line. That is, it gives a half wave of voltage and then nothing at all for a short time. This is repeated indefinitely. When the connections are reversed it will give a voltage as shown by the dotted lines. Either of these will charge a storage battery quite rapidly. Such a device is called a half-way rectifier, because that is all that reaches the storage battery. The other half wave is not used, but it does not register on your meter, and so you do not have to pay for it. It will, however, take twice as long to charge a battery with a bulb which passes two amperes as it would if the whole wave could be used. A full wave rectifier consists of two parts each just like the other, but one having reversed leads. Then the voltage supply to the battery is shown by the continuous line plus the dotted line in Fig. 1. Here the battery gets the full advantage of the entire wave, and so it can be charged in half the time using a given size of the bulb. More information on this subject was given in the article, "Building Your Own Rectifier," in the August 15 issue of Radio Progress.

PUTTING PEEP HOLES IN PANELS

In order to get a smooth hole in the panel about an inch in diameter, so that one may see whether the tube is burning properly or not, it has been customary to cut the opening with a drill and then enlarge this to size with a knife or file. This is a rather slow job, and it is not very easy to get a hole that is smooth and round.



A tool has recently appeared on the market which cuts the hole straight and true. First a 3/16 pilot hole is drilled in the panel right in the center of the place where the peep hole is to go. The pilot or projecting end of the Stevens panel cutter is inserted in it and the cutter rotated by an ordinary carpenter's bit stock or brace. The operation is very rapid and the resulting hole is true. The tools come in three sizes, ¾ inch, 1 inch, and 1½-inch diameters. The ¾ inch size sells for 75c.

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	360	833	150
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
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	Daily C'm'nw'lth & O.A.Heulsm'n, 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	341	880	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
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	500
KNT	Grays Harbor Radio Co., Aberdeen, Wash	263	1140	250
KNV	Radio Supply Co., Los Angeles, Cal	254	1180	100
KNX	Electric Lighting Supply Co., Los Angeles, Cal	360	833	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	Valdemar 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
WBAA	Purdue University, West Lafayette, Ind	283	1060	250
WBAD	Sterling Electric Co., Minneapolis, Minn	360	833	100
WBAH	The Dayton Co., Minneapolis, Minn	416	720	1000
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	750
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
WBBG	Irving Vermilya, Mattapoisett, Mass	248	1210	500
WBBM	Frank Atlass Produce Co., Lincoln, Ill	255	1330	200
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
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
WDBK	M. F. Bros. F., H. & Radio Co., Cleveland, O.	248	1210	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	360	833	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
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
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.	360	833	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
WHA	University of Wisconsin, Madison, Wis.	360	833	500
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
WHAH	Rafer Supply Co., Joplin, Mo.	283	1060	250
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
WIAS	Home Electric Co., Burlington, Iowa	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
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

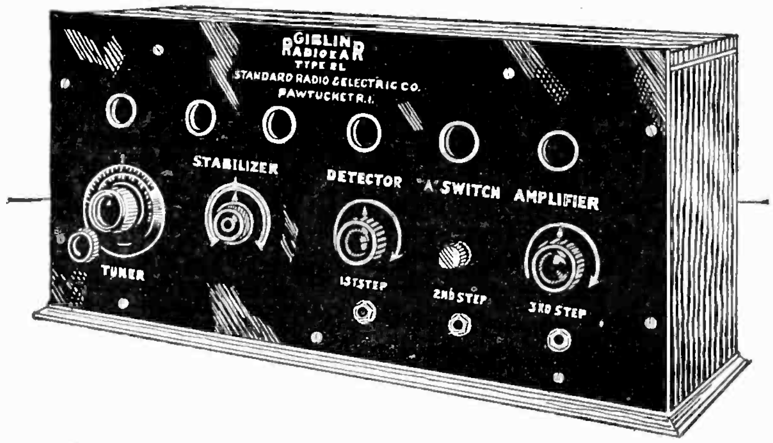
		W.L.	K.C.	W.P.
WKY	WKY Radio Shop, Oklahoma, Okla.	360	833	100
WLAG	Cutting & Wash. Radio Corp., Minneapolis, Minn.	416	720	500
WLAH	Samuel Woodworth, Syracuse, N. Y.	234	1280	100
WLAL	Naylor Electrical Co., Tulsa, Okla.	360	833	100
WLAN	Putnam Hardware Co., Houlton, Me.	283	1060	250
WLBL	Wisconsin Dept. 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
WOAG	Apollo Theatre, Belvidere, Ill.	273	1100	100
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
WPAL	Avery & Loeb Elec. Co., Columbus, Ohio	286	1050	500
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	333	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
WSAB	S. E. Mo. State T'chers' Col., Cape Giradeau, Mo.	360	833	100
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
WSAY	Irving Austin, Port Chester, N. Y.	232	1290	100
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

* Changes and additions.

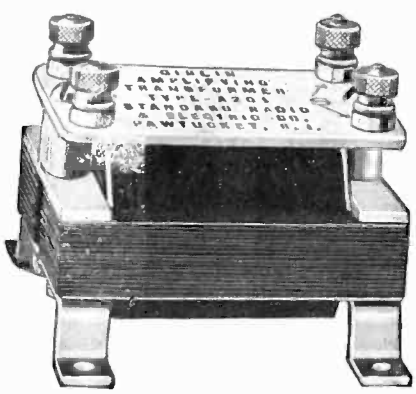
GIBLIN
RADIO APPARATUS

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.



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