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SENDING WITH RECEIVERS

E-Z RADIO

VOL. 1 NUMBER XI

Seven Hook-Ups FOR Amplifying The Crystal

By Henry M. Neely

E-Z COMPANY, Inc.

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CONTENTS

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NEW BROADCASTING STATIONS RECENTLY LICENSED

The Radio Service Bulletin, issued by the Government, gives the following new broadcasting stations in the issue dated February 1, 1923:—

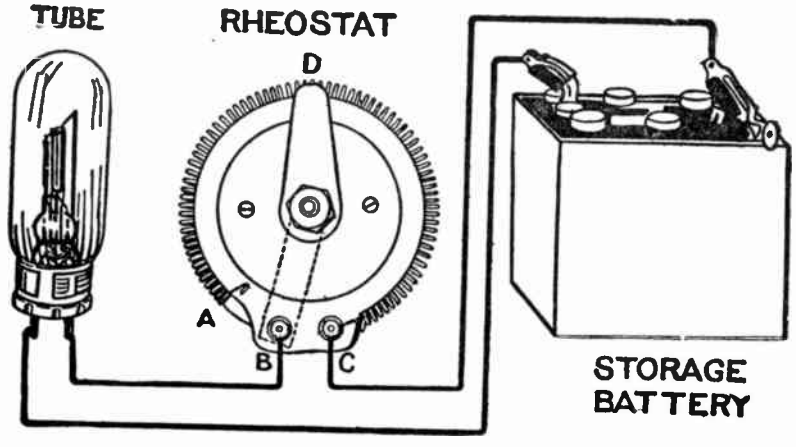
Broadcasting stations, alphabetically by names of cities.

City.	Call signal.	City.	Call signal.
Ann Arbor, Mich.	WQAJ	Memphis, Tenn.	WMC
Bangor, Me.	WPAY	Miami, Fla.	WQAM
Boise, Idaho	KFFB	Muncie, Ind.	WQAR
Cape Girardeau, Mo.	WSAB	New York, N. Y.	WQAO
Charleston, W. Va.	WPAZ	Ogden, Utah	KFCP
Colorado Springs, Colo.	KFFQ	Pittsburgh, Pa.	WRAJ
Denver, Colo.	KFEL	Pueblo, Colo.	KFGB
Galesburg, Ill.	WRAM	Sandusky, Ohio	WQAF
Houston, Tex.	KFCV	Scranton, Pa.	WQAN
Lexington Ky.	WQAH	St. Louis, Mo.	WRAO
Marietta, Ohio	WSAA	Waterbury, Conn.	WQAD
Marion, Kans.	WRAD	Yellow Springs, Ohio	WRAV
Mayville, N. Dak.	WRAC		

Stations broadcasting market or weather reports (485 meters) and music, concerts, lectures, etc. (360 and 400 meters), alphabetically by call letters.

Call signal.	Station operated and controlled by	Location of station.	Wave lengths.	Power to antenna (Watts)
KFCP	Ralph W. Flygare	Ogden, Utah	360	25
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360	50
KFEL	Winner Radio Corp.	Denver, Colo.	360	150
KFFB	Jenkins Furniture Co.	Boise, Idaho	360	10
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360	10
KFGB	Lowenthal Bros.	Pueblo, Colo.	360	10
WMC	Commercial Appeal	Memphis, Tenn.	400, 485	500
WPAY	Bangor Radio Laboratory	Bangor, Me.	360	20
WPAZ	Dr. John R. Koch	Charleston, W. Va.	360	20
WQAD	Whitall Electric Co.	Waterbury, Conn.	360	10
WQAF	Sandusky Register	Sandusky, Ohio	360	5
WQAH	Brock-Anerson Electrical Eng. Co.	Lexington, Ky.	360	20
WQAJ	Ann Arbor Times News	Ann Arbor, Mich.	360	300
WQAM	Electrical Equipment Co.	Miami, Fla.	360	250
WQAN	Scranton Times	Scranton, Pa.	360	100
WQAO	Calvary Baptist Church	New York, N. Y.	360	100
WQAR	Press Publishing Co.	Muncie, Ind.	360	10
WRAC	State Normal School	Mayville, N. Dak.	360	50
WRAD	Taylor Radio Shop	Marion, Kans.	360	10
WRAJ	M. H. Pickering Co.	Pittsburgh, Pa.	360	500
WRAM	Lombard College	Galesburg, Ill.	360	100
WRAO	Radio Service Co.	St. Louis, Mo.	360	100
WRAV	Antioch College	Yellow Springs, Ohio	360	200
WSAA	B. S. Sprague Electrical Co.	Marietta, Ohio	360	25
WSAB	S.E. Missouri State Teachers Coll.	Cape Girardeau, Mo.	360	100

THE IMPORTANCE OF RESISTANCE



The flow of electrons in the tube is governed by the amount of resistance included in the rheostat from the storage battery. The current passes from the storage battery to C then around the resistance winding to D and so down to B and to the bulb. As the blade is moved the amount of resistance wire between C and D is varied, and thus the flow of electrons is controlled as explained in the accompanying article

Few radio amateurs realize when they are turning on their rheostats to light the electric bulb in their set how important this one operation is to the correct reception of signals. To them a rheostat is simply some instrument by which they turn the light on or off.

As a matter of fact, the rheostat plays an extremely important part in the clarity and strength of the received signal. Most people know that a rheostat is a resistance and most people are also under the impression that when you place a resistance in a circuit you interfere with the flow of an electric current through that circuit. Therefore, they have the impression that to place resistance in the circuit of a radio instrument is a disadvantage.

As a matter of fact, resistance is one of the most important phases of tuning a set and receiving clear signals on it.

An electric current has three features which are of importance. The first is the pressure of the current, or as we call it the "potential," and this potential is expressed in volts.

Another feature is what we might term the "quantity" of electricity that is flowing under a certain pressure, and this quantity we express is amperes.

Another feature is the resistance which must be overcome by these other two phases, and this resistance is measured in what we call "ohms."

By one of the fundamental laws of electricity, known as Ohm's law, these three phases of an electric current must be taken into con-

sideration jointly before we can really know what the resulting current is.

Ohm's law tells us that if we put in a circuit carrying 110 volts potential an electric lamp whose filament has 220 ohms' resistence, the current that passes through this resistance will be 110 divided by 220, or one-half an ampere. In other words, volts divided by ohms equals amperes.

In considering the importance of the rheostat in this connection, we must remember something about the action that goes on inside the audion bulb.

When the filament of the bulb is lighted to a certain point, it throws out in the space about it a constant stream or shower or bombardment of the tinest particles known to science. These particles are called "electrons" and they are really minute particles of negative electricity. It is because of the action of these electrons in crossing the space inside the bulb and striking the plate that the positive B-battery currents on the plate are enabled to cross the space in the bulb, go to the filament and so circulate around the circuit which includes the A-battery, the B-battery and the phones. It is the circulation of these pulses of current that causes the diaphragm in the phones to vibrate and give us the signals.

The quality of signals which we receive will depend entirely upon the nice adjustment of the flow of these electrons from the filament to the plate, and this flow will depend entirely upon the amperage that is passing through the filament.

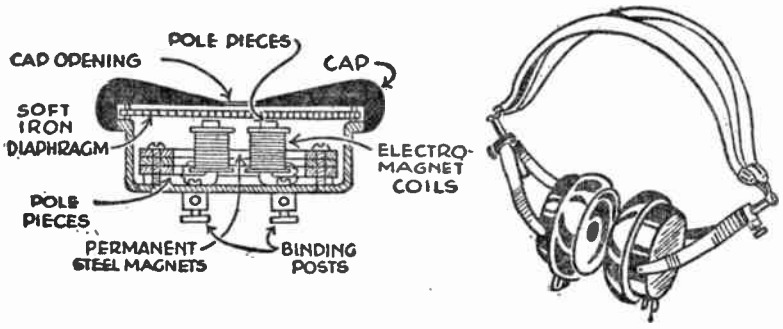
Some signals with certain B-batteries and certain conditions of the A-battery, and other conditions of the set, will come in best when there is a certain flow of electrons and other signals will come in best with a different flow of electrons. It is, therefore, necessary to govern this flow of electrons, and the only way to govern it is by governing the therefore, necessary to govern this flow of electrons, and the only way to govern it is by governing the amount of current or amperage that goes through the filament.

As our bulbs burn on a storage battery which gives a uniform voltag or potential of 6 volts, this is not an easily controlled element, and the only way that we can control amperage with a definite voltage is to vary the resistance. Then by Ohm's law that volts divided by ohms equals amperes, we can, by varying the ohms' resistance, vary the amperage and therefore change the number of electrons that are shot out by the filament to govern the B-battery current from the plate through the head telephones.

That is what we do when we turn the handle of a rheostat. The switch blade on the back of the panel passes over successive turns of resistance wire in the rheostat and so cuts down or increases the amount of this resistance wire in the circuit and therefore the resistance. It is for that reason that a rheostat, having a vernier on it, is likely to give better adjustment on fine tuning than one which has not, because with a vernier we not only have the rough adjustment of the flow of electrons, but the very finest kind of adjustment, and are, therefore, able to tune sharply to any quality of signal desired.

A TALK ABOUT TELEPHONES

Nothing seems to bother the intending purchaser of radio ap-



This illustration will give you an idea of what is inside the rubber casing of your head phones

paratus more than the choice of head telephones. He goes into a store and finds himself confronted with a great variety of head sets of all kinds and he hears the salesman talk glibly about 2000 ohms and 3000 ohms and he comes away with some sort of a pair of telephones, but with really no knowlelge whatever as to whether they are good ones or bad ones.

In the old days when radio was simply called wireless and when every one who went into it in an amateur way made a study of it and knew what ohms meant, it was not so difficult to purchase a pair of telephones because they were all made by standard manufacturers who had been in the business of making telephones for land lines for many years, and the purchaser was fairly certain that a pair of phones which was rated at 2000 ohms would be almost the same as any other pair of phones rated at 2000 ohms, with the exception of the differences in the design which mark the various kinds.

Since the modern craze for radio, however, many manufacturers have sprung up and all kinds of head telephones are being placed upon the market. These phones are always spoken of according to ohms, but unfortunately the standards have not been maintained and the ohmage of most phones means nothing whatever as regards the prime requisite of sensitiveness.

To understand just how important this rating in ohms is, you must know something about how the head telephones work.

Within the hard rubber case which you place against your ear there is a magnet shaped more or less like the letter U. Around the two prongs of this magnet are wound hundreds and hundreds of turns of very fine insulated wire.

The permanent magnetism in these two prongs of the magnet holds the diaphragm just a slight distance away from the ends of the magnet and in a constant state of tension toward the magnet. That is to say that the magnet is always pulling the diaphragm toward it.

When the pulsating currents of electricity from the B battery are sent around these coils of fine wire, they set up around themselves a strong field of magnetism, and this field sometimes assists the magnetism in the magnet and sometimes resists it.

This assistance and resistance is done of course in unison with the signals being sent out from the transmitting station.

When the coil magnetism assists the permanent magnet, the metal diaphragm is drawn toward the magnet; when the coil magnetism resists the permanent magnet, the diaphragm is permitted to spring farther away from the permanent magnet than it would ordinarily be. In this way the diaphragm of the head telephone vibrates in unison with the diaphragm at the transmitting station and produces in our ears the same sound that actuates the diaphragm in the sending station.

Naturally in going around these many hundreds of turns of wire the electricity must overcome a certain amount of resistance, and this resistance is greater the greater the number of turns of wire.

We measure resistance in what we call ohms and in the early days it was found most convenient to speak of the rating of a head telephone in ohms.

As a matter of fact, however, it is not the ohms that cause the effect that we desire to get; it is really the field of magnetism built up by these coils that causes the telephones to be sensitive. We ought better to rate telephones by what we call ampere turns, because it is the ampere turns that build up the field of magnetism.

However, as the early manufacturers rated their phones in ohms, and as we have been taught to consider a 3000-ohms phone a better instrument than a 2000-ohms phone, modern manufacturers have adopted the same method.

Unfortunately they have not followed the old standard of making the turns of wire of the correct grade material and design. Nowadays a 3000 ohms pair of phones may have 3000 ohms resistance without the desirable ampere turns and they may not be nearly so good as a standard pair of 2000 ohms phones.

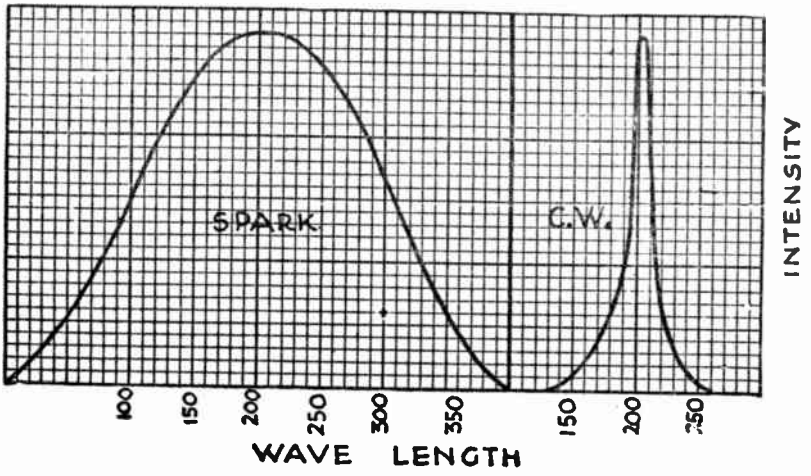
It is better not to buy a pair of head phones for radio without knowing that they are manufactured by a firm whose name has been synonymous with standard products for many years. Some of the new phones are undoubtedly excellent, but it is hard to tell one from the other, and the only way to do, if you are figuring on buying a pair of phones made by a recent manufacturer, is to find out from somebody who has used them whether they are really sensitive or else to make the salesman in the store put them on a receiving set in competition with some head set with whose work you are familiar.

THE OUTCAST SPARK TRANSMITTER

Having given a series of lessons in the dot and dash wireless code, I have a feeling of guilt because I know that thousands of ardent listeners-in to broadcast concerts will feel that this is going to encourage the hated spark set which so often interferes with their enjoyment in the evening.

Let me say in the very first place that I heartily agree with these concert fans in detesting the spark transmitter.

Personally, I think that the amateur spark set should be outcast by law. It is not possible for an ama-



These two curves show the difference in intensity between signals sent out by the spark method and by the C. W. method and show also how broad the spark signal is and how sharp the C. W. signal is

teur to build a spark transmitter that will not interfere very seriously with concert reception by all his neighbors within several miles of his station.

As a matter of fact, I do not see why any amateur who wishes to practice dots and dashes should bother with a spark set anyhow. It is perfectly possible by means of several hook-ups to use a bulb receiving set or at least to use all the instruments in such a set as a transmitting set which will be much more efficient and cover a greater distance than a spark set of similar power would do.

The ordinary amplifying bulb used in receiving will make an extremely satisfactory transmitting outfit and dots and dashes sent on such an outfit by means of what we call C. W., can be tuned so sharply at the transmitting station that they will not interfere in the slightest with people who are listening in to the broadcast concerts.

Let us consider for a moment the difference between the kind of radio waves sent out by a spark set and the kind sent out by a bulb set which operates on C. W. or continuous wave.

In the illustration I am showing what we call graphs, illustrating the difference between these two methods of transmission. Let us assume that the horizontal line on which the curves are based is the zone of silence. Then the higher the curve goes the stronger the signal is.

On the curve which shows the spark signal we will assume that the signal is being sent out on 200 meters. You will notice, if you listen in on 200 meters, as represented by the central vertical line, that this spark reaches its maximum intensity right on the 200-meter line.

But go along the lines to the right or left of the 200-meter line and assume that we are listening in on either 150 meters or 250 meters. We do not get the spark signal at its maximum intensity, but you can easily see that we get it very loudly. Let us go still farther to either side of this and assume that we are tuned for receiving 300 meters or 100 meters. In either case we still get a great deal of sound from that spark signal. Going still farther to 350 meters or to fifty meters, we still get enough of the spark signals to interfere with any signals we are trying to tune in on that wave length.

Of course, the diagram given here is very much exaggerated. A spark signal can be tuned sharper than this, but it cannot be tuned so sharply that it will not interfere with quite a considerable band of wave lengths on each side of the wave length to which it is supposed to be tuned. Thus we see that a spark signal which is not very accurately tuned will be a nuisance to anybody listening in on a wave length anywhere near the wave length of the spark.

Let us take the other illustration, however, which shows the intensity of a C. W. or a continuous wave signal sent out by a bulb. Here we see that we get maximum intensity on 200-meter wave lengths. Going on fifty meters on either side of this, to 250 meters or 150 meters, we see that there is no sound of the signal there.

A C. W. signal can be tuned so sharply that a difference in tuning of only about seven meters can totally eliminate it and it will not interfere with any receiving set, even a nearby one, which is tuned a few meters off the length on which it is being sent.

As the law requires amateurs to confine their wave lengths to about 200 meters, it can easily be seen from this that if all amateurs used C. W. they could occupy the entire band of wave length between 150 meters and 250 meters or even up to 300 meters and still would not interfere in the slightest with the people who are listening in to concerts on the regular broadcasting wave length range from 360 meters to 400.

I strongly urge all people who wish to practice the dot and dash code to make up their minds not to make themselves nuisances by using spark, but to use C. W., and I am giving in this issue several hook-ups showing how an ordinary bulb can be used for this purpose.

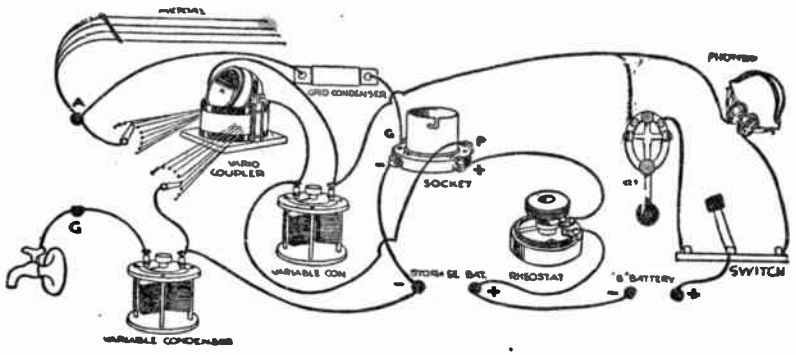
TRANSMITTING WITH YOUR RECEIVING SET

1. The Single Circuit

Many times in these articles, when dealing with regenerative sets, I have said that when a man gets his tube oscillating as indicated by a loud whistling in the phones, the receiving set becomes a transmitting set and this whistle can be heard for quite a distance away from the aerial.

You will often hear when you are tuned in to a broadcast concert a whistle in your receivers which is caused by a nearby set oscillating in this way and becoming a transmitting set.

After you have learned the dot and dash code and have mastered it sufficiently to get an amateur's transmitting license you can use any regenerative set as a sending set for short distances and then



This hook-up shows how to turn your single circuit regenerative receiving set into a low-powered transmitting set for using continuous waves

have a lot of fun and good practice and at the same time, if you are careful, you will not annoy your neighbors.

But do not forget that, if you attempt to do this before Uncle Sam has given you a license for yourself and also a license for your station, you will get yourself in trouble and be liable to severe penalties.

It is a very simple matter to turn a receiving set into a low-powered transmitting set.

I am showing here the ordinary single circuit regenerative receiving set with a switch and a sending key attached to the telephones in such a way that it can be used for either sending or receiving. This set sends continuous waves or, as the amateur calls it, C. W., and if you are careful of the wave length on which you are transmitting you will not interfere with people who are receiving broadcast concerts.

Amateurs must keep very close to the 200-meter wave length when they are transmitting. The best way to do this, if you are going to adopt this hook-up, is to tune your set until you are getting clear reception from some amateur whom you know to be on 200 meters. Then you know that your set is adjusted to send out this wave length also.

In that case you simply move the knife switch to the left. This cuts the telephones out of the circuit and will not endanger them by making the signals pass through them. With the switch on the left you then simply use your key and each time you press it down you permit the current from the B battery to flow around your tickler and to the plate of the bulb, and in this way send out the dots and dashes as you wish to.

First, of course, it is necessary to tune in as I have said, and then to adjust your rotor in such a way that you get the necessary whistling in the phones. This shows that your tube is oscillating violently and this whistling will be transmitted from your aerial.

Do not leave the rotor in this way with the phones on, but immediately change the switch to the left-hand side and this will disconnect your phones and will stop

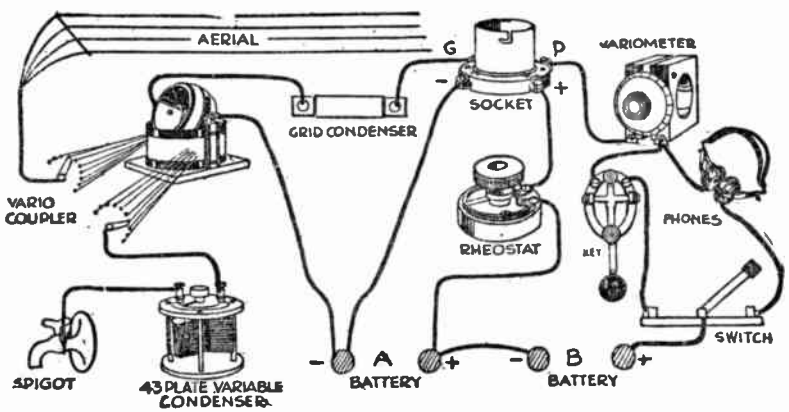
the whistling because the key will be open. Each time you press the key down this whistling will start again, and so you can make your dots and dashes and spell out the words as you wish to.

In order to be sure that you are not sending on a wave length longer than 200 meters, it is best to tune in a 200-meter station and then to reduce the number of turns on your vario-coupler until you almost lose the signals that you are tuning in by.

With the set thus tuned to a wave length lower than 200 meters, you move the dial of your rotor until you get the whistling. This means that you have made the coupling between the rotor and the primary much closer, and that in itself will bring your wave length up again to just about where you want it, that is to around the 200-meter mark.

This idea, of course, is not intended for anybody who wishes to transmit at a great distance. It will send signals for a mile or two and will do very well for a practice outfit, and it is given for that purpose only, but I wish to warn you again not to use it on any conditions until you have license from Uncle Sam.

TRANSMITTING WITH YOUR RECEIVING SET



By means of this hook-up and the instructions given in the accompanying article a double circut set with one or two variometers may be changed into a fairly satisfactory transmitting set for continuous wave signals

2. Sending by Variometer

The greatest trial of the man who uses the short-wave regenerative set or a double circuit set with a variometer in either plate or grid lead, is the constant tendency of such a hook-up to whistle and howl.

If, however, this man has been studying dot and dash wireless code and is able to pass an examination for an amateur license for himself and for his station, he will find such a hook-up the best for sending out messages on low power without any additional expense in the matter of apparatus.

Here again we use the simple switch connected to the plus side

of the B battery so that we can switch the circuit over to the telephones for receiving and also for tuning in to the proper sending wave length or we can switch it over to the key after tuning in and use the key for sending.

Here again we go about the process by virtually the same method. In order to be sure that we are down to the regulation 200-meter wave lengths, which are the ones allowed to amateur transmitting stations, we must first tune in some amateur until we get him at maximum strength. If we are fairly certain that he is sending at about 200 meters, we know that when we have him at maximum strength in our receivers we have the circuit of our set adjusted to the same wave length.

Therefore, if we use the circuit as adjusted in this way for sending we will also be sending out on the same wave length.

In this case, as in the one in the last article, it is better after we have got the 200-meter amateur tuned in sharply, to reduce slightly the number of turns of the variocoupler so that we almost tune him out. This will mean that we have got our set down to considerably below the necessary 200 meters.

Then the idea is to move the dial of the variometer so that the windings of the rotor are much closer to and parallel with the windings of the outside. This means that the coupling is much closer and the regeneration becomes so strong that the whistling begins in the phones.

This accomplishes two objects. It makes the bulb oscillate and gives us the whistling by which we are going to signal, and the closer coupling also adds somewhat to the wave length on which we were tuned and brings us up again from the shorter to the 200-meter wave length.

In doing this tuning it is wise to keep the head telephones in the circuit until we hear the whistle becoming quite loud and violent. Then we know that the tube is oscillating and that the signals will be sent out properly. With the whistle almost too loud for us to stand in the telephones, we throw the switch over to the left, and then every time we press the key down, the circuit is closed from the B battery to the variometer, and each time it is closed the whistle is sent out over the aerial.

It must be remembered that this is not a high-powered set and that it will not send signals to any considerable distance. If you are able to work regularly at a distance of one mile with a set of this kind you will be going very well.

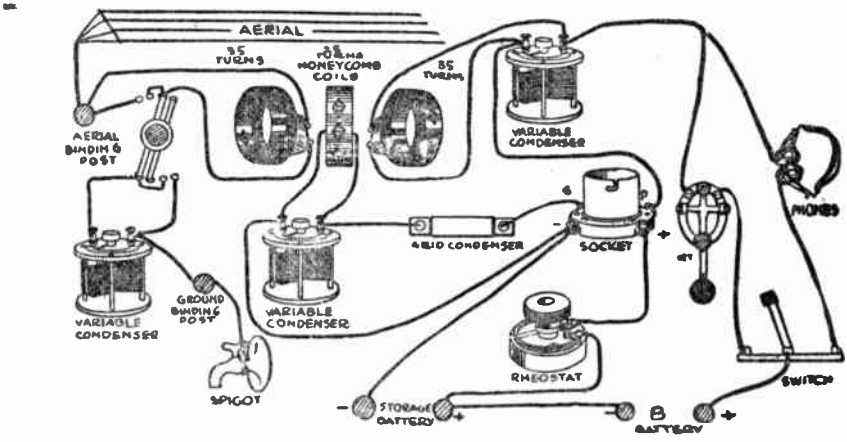
It is also well to remember that it is possible to get better results with a transmitting outfit by using more B battery voltage for sending than you do for receiving. This B battery voltage will vary with the make of tube that you are using. If you are using one of the tubes which burns its filament at a very white brilliancy, you will know that the danger point in applying B battery voltage is reached when the tube begins to turn blue.

It will almost always be found better in using this set as a transmitter to have the rotor of the variocoupler coupled just as closely as possible to the primary or outer windings. This means that the windings of the rotor should be parallel to and as close as possible to the windings of the outside coil.

With the rotor set in this way the 200-meter station should be tuned in by means of the variable condenser and the variometer, and then the rest of the process is just as I have described it.

Let me warn you once more not to attempt to use this or any other kind of transmitting set until Uncle Sam has licensed you and your station. Otherwise you will get yourself into trouble.

TRANSMITTING WITH YOUR RECEIVING SET



By means of this diagram and three smaller size coils, the regular three honeycomb coil receiving hook-up can be transformed into a fairly efficient and satisfactory sending set for continuous waves

3. Sending With Three Honeycomb Coils

The man who is using three honeycomb coils for receiving broadcast concerts can use his set for transmitting after he has secured a license from Uncle Sam, but, before operating it as a sending station, it will be necessary for him to buy two more coils.

In receiving the concerts on 360 or 400-meter wave lengths, he would use a seventy-five-turn coil as primary, a fifty-turn coil as secondary and a thirty-five-turn coil as tickler. This will give him, with his variable condensers, all of the wave lengths from about 250 meters up to something more than 600 meters.

But when he attempts to use his set as a transmitting set, he must remember that the Government will not allow him to use a wave length of more than 200 meters. Consequently he will have to use the size honeycomb coils that produce waves of this length either for transmitting or reception.

This will require a thirty-five-turn coil for primary, a twenty-five-turn coil for secondary, and another thirty-five-turn coil for the tickler. Each of these coils should have a variable condenser in its circuit, as shown in the accompanying diagram. It will depend upon your aerial whether

you have the primary condenser in series or in parallel with the primary coil.

Users of this hook-up for receiving know that when you bring the tickler coil very close to the secondary coil there will be a very violent whistling or howling in the head telephones. This shows that the bulb is oscillating and these oscillations, whether you intend them to do so or not, are being sent out from your aerial and are almost certainly interfering with the reception of concerts by any neighbors you may have.

If, however, you change your coils to the other sizes which I have given, this whistling will not interfere with those who are tuned in on 360 or 400 meters, but will only annoy those who happen to be listening in on exactly the wave length on which you are sending out the signals.

As this set sends out the continuous waves or, as we always call it, CW, the waves will be very sharp and nobody will be annoyed unless he is tuned to the exact wave length that you are using. This is not likely to happen, and that is why continuous waves are not much annoyance to others. Half a dozen amateurs may use waves within a wave length band of less than fifty meters without one interfering with the other.

With the coils named above, there is no likelihood that your set, when used as a transmitter, will bother the concert liseners-in, because those three coils will not produce wave lengths sufficiently long to interfere with concerts.

The method of using this set for transmitting is the same as those given in the two previous articles. There is a double throw single pole switch connected to the plus side of the B battery, and when the blade is on the right-hand side you can listen in on your head telephones. When the blade is on the left-hand side your telephones are disconnected from the circuit and every time you press down the key you sent out the whistling from your aerial.

To get the bulb oscillating you should have the switch blade over at the right and should listen in until you tune in some amateur sending on about 200 meters. This will show that you have your set adjusted to the proper legal wave length. Then turn down the primary variable condenser until the signal you are tuned to is just barely audible, and then bring your tickler up close to the secondary until it begins to whistle loudly.

As soon as this whistle is as loud as you can make it, throw your switch over to the left, and go ahead with your sending on the key.

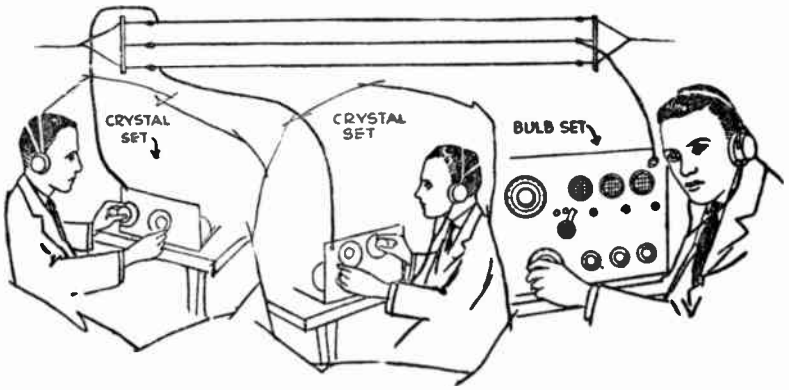
It must be remembered that this set, like the two previously given, is not a powerful one and will not send signals very far. It is designed only for practice with friends who are nearby and should not be expected to work more than a mile or two.

Its great advantage is, of course, that is does not require the expense of extra apparatus which is built particularly for transmitting stations, and which costs a considerable sum of money.

A couple of sets like this, situated within a half mile or so of each other, will give two amateurs plenty of enjoyment and excellent

practice in code work without annoying anybody around them. The only thing to be particularly careful is that you do not attempt to press down this key without Uncle Sam's license hanging in a neat frame on the wall of your room. Otherwise, if you should happen to annoy a nearby amateur who can read your signals, he will very quickly locate you and report you to the radio inspector and you will have yourself in a nice peck of trouble.

"RE-RADIATION" AND THE CRYSTAL DETECTOR



By this hook-up of a three-wire aerial, two men with crystal sets can hear distant stations re-radiated from the bulb set that uses the central wire

With so many users of crystal detectors claiming to hear regularly stations at a distance of from fifty to 150 miles it is interesting to take up here briefly some of the facts connected with reception of this kind.

Under ordinary conditions it must be distinctly understood that a crystal must not be expected to give good signals in the head telephones over a distance of more than about twenty-five miles.

In spite of this well-known fact it is unquestionable that many fans with only small crystal sets have frequently and fairly regularly heard radio stations at a distance of 200 miles or even more. When this happens, naturally they are very jubilant and they go out among their friends boasting of the ability of their crystal sets.

Not long ago a friend of mine and I tried an interesting experiment with one of these young crystal users. He had ben boasting to us one evening about the number of times that he had heard the station at Schenectady, N. Y., on his crystal set located at Riverside, N. J. This is a distance of considerably over 200 miles, and my friend and I were somewhat skeptical.

During the course of the conversation we discovered that almost every time he had heard Schenectady, we, too, had been tuning in on that station. This naturally led us to explain to the crystal user that he was getting the signals by

what radio engineers call "re-radiation."

Re-radiation is due to the fact that when a two or three-bulb regenerative set is tuned closely to a concert or a broadcasting station, it is acting as a small transmitting station itself and while giving the signals in the head telephones or the loud speaker of the receiving set, it is also sending them out again just as it receives them. This sending out again is naturally not done with a very great amount of energy, yet the signals thus sent out are strong enough to be heard on any aerial located very near to the receiving aerial.

The Riverside boy who was using the crystal was naturally not willing to accept this explanation because it meant that all of the boasting that he had done about his set was unfounded. So we arranged to try an interesting experiment with him.

We looked up Schenectady's next program and decided that we, with our four-bulb set, would tune in on Schenectady at 9 o'clock that night and would tune out again at 9.15. The boy with the crystal set was to listen in all evening and try to get Schenectady and was to let us know when he got the station and when he lost it.

The experiment turned out just as we expected it to. We tuned in at 9 o'clock and got Schenectady, and it was at 9 o'clock precisely that the boy with the crystal set got it also, though he had failed to get it during the previous part of the evening.

When we tuned Schenectady out at 9.15, Schenectady also disappeared from the telephones of the lad with the crystal set.

In this way we proved to his satisfaction that the signals which he was receiving apparently from over 200 miles were really re-radiated from our aerial by the four bulbs on which we were receiving them.

This matter of reradiation can very cleverly be used by two or three neighbors if one of them has a bulb regenerative receiving set.

I am showing in the sketch with this article a method by which three neighbors can do this. The man with the bulb set uses the centre wire of a three-wire aerial and the other two men with crystal sets use the two outer wires.

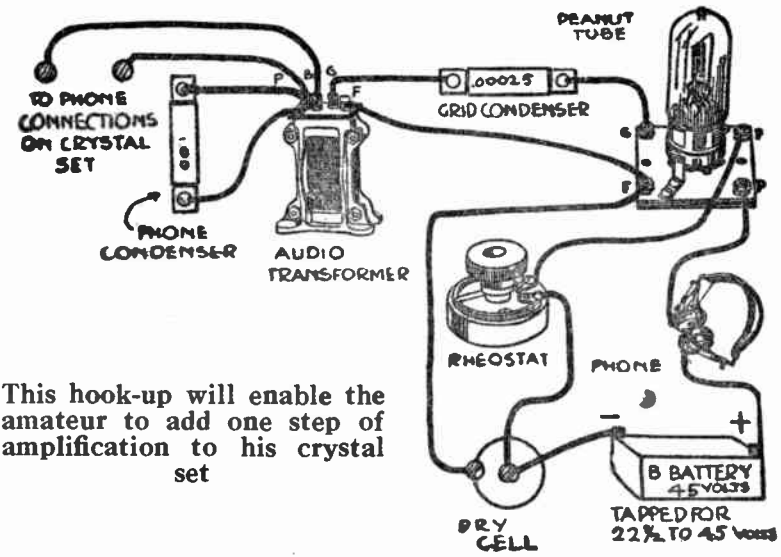
Naturally these wires are not connected to each other. Each wire is a separate aerial.

When the man with the bulb set is receiving a distant station and if he has it tuned in at maximum strength, the two men with the crystal sets will almost certainly get very good satisfaction receiving the same station on their crystal sets by means of re-radiation from the man with the bulb set.

AMPLIFYING THE CRYSTAL

1—One Stage for all Sets

Every one who has worked for any length of time with a crystal receiving set within a reasonable distance of a broadcasting station has learned to love the purity of tone that the set produces and the lack of sound distortion which is virtually always present when an audion bulb is used as a detector.



This hook-up will enable the amateur to add one step of amplification to his crystal set

In the "old" days of a few months ago, when it was necessary to have an expensive storage battery to light your bulb, there was not much use attempting to amplify the signals received on a crystal because of the outlay of money that it involved.

Now that it is so easy to get a little peanut tube which lights from an ordinary dry cell, it is perfectly possible for the man of average pocketbook to build up his crystal signals so that he can use a loud-speaking device with a very fair amount of satisfaction.

Just here it is well to caution the user of the crystal not to expect too much in the matter of getting distant signals. Adding audio frequency amplification will increase his distance of reception to a certain extent, but he must remember that the only thing that audio frequency amplification does is to build up the strength of signals that are already audible through the crystal.

The possibility of increasing distance to a certain extent lies in the fact that there are many signals received through a crystal so faintly as not to be understandable, but two or three stages of amplification will bring them up to the point where they can be heard quite distinctly in the phones, though it will not be possible to put them on a loud-speaking horn.

For those who already have their crystal set installed, I am giving here a hook-up which will be found very satisfactory.

To use it you simply remove your phones from the place where you now have them connected on the crystal set and in their place you connect two wires from the points on the transformer usually marked B and P. On some transformers both of these points are marked P and the other two are marked S.

Many experimenters find that the peanut tube requires more B

battery voltage than the ordinary tube and so it is wise to get a tapped 45-volt B battery and try the various connections on either the plus or the minus side until the best signals are received.

The material and approximate cost for this one step of amplification follow:

Audio frequency transformer	$ 5.00
Grid leak and condenser	.35
WD 11 tube socket	1.25
W. D. 11 tube	6.50
Rheostat	1.00
Dry cell	.40
Forty-five-volt battery	5.00
One phone condenser	.35
	$19.85

In operating this set you must remember that you now have some extra problems to face. You still must be sure that the cat whisker is on a sensitive spot on your crystal. Then you must vary your rheostat until the brilliancy at which the filament burns gives you the greatest strength of signals.

It is really wise to connect this outfit to your crystal set by means of a four-bladed phone jack, which is known in the stores as a "double circuit" jack. The two outside blades of this jack are wired to the phone connections on the crystal set and the two inside blades are wired to the B and P posts on the transformer.

Then when you plug your phones into the jack you disconnect your amplifier, and you can test your crystal for a sensitive spot to be sure that the signals are coming in there.

When you pull the phones out of that jack the blades automatically spring together and connect up your amplifying outfit and you can tune in for the proper B battery and dry cell values.

In this case it is also necessary to have an ordinary phone jack in place of the phones shown in the diagram so that you can plug your phones in there to use the whole outfit.

AMPLIFYING THE CRYSTAL

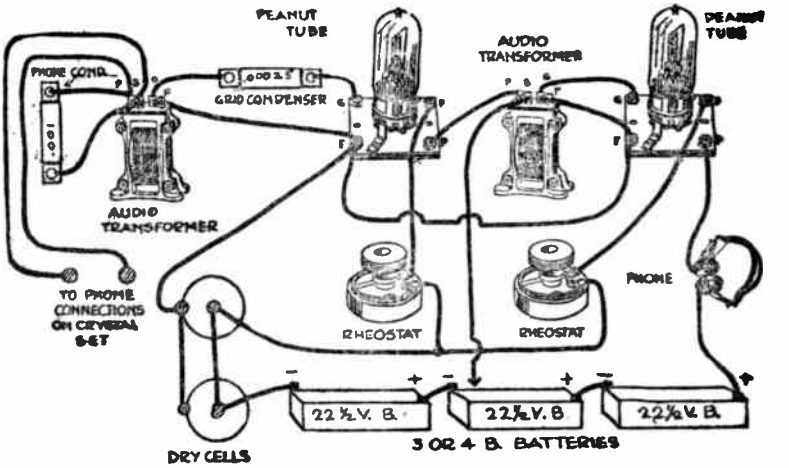
2—A Two-Stage Outfit

For satisfactory results in a loud-speaking horn the fan should really have two stages of amplification on his crystal set, even if he is quite close to a broadcasting station. One stage will be very fine to build up signals in the phones so that a singer will sound as if he were in the next room, or it will be excellent if you are going to use four or five pairs of phones together.

But you must remember that even an expensive loud speaker requires signals so strong that they would be unpleasantly loud if you had the phones in that place.

As a general rule, if you are getting fairly satisfactory results on the crystal set with phones you can depend upon getting really good signals in a loud speaker with two stages of amplification hooked-up as shown in the illustration on the next page.

If your signals are somewhat weak with crystal alone you will have to add an extra step of amplification, making three in all, before you can entertain a room full of people.



This hook-up shows a two-stage amplifying outfit that can be added to any crystal set

With this outfit, the wiring becomes more complicated than for the one stage, but there is nothing about it that should discourage even a schoolboy. A little care in following out the various lines and a little more care in seeing that all of your connections are screwed down tight will give you the results that you want.

Here again it is wise to use the plug and jack system in order to be able to test out each separate element in the circuit. To do this you will have to buy a plug to screw on the end of your phone wires; two double circuit jacks and a single circuit jack.

One of the double circuit jacks then would have its outside blades wired to the connections to which you have your phones attached on your crystal set at present. The two inside blades of that jack would be connected to the two wires at the left-hand side of the illustration running to the P and B binding posts in the first transformer.

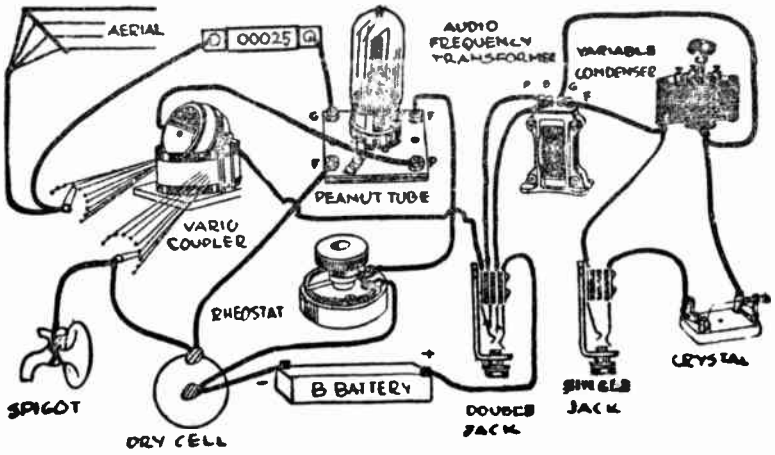
The other double circuit jack would be inserted between the first bulb socket and the transformer.

You would disconnect the wire leading from the P binding post on the socket to the P binding post on the second transformer and also disconnect the wire from the B battery shown here connected to the B binding post on the transformer.

The single circuit jack would be put in, in place of the phones shown in this illustration.

Then when you plugged your phones into the first jack, all of your amplifying outfit would be cut out and you would be using your crystal detector alone. With the phones in the second jack you would be using crystal and one stage. With the phones in the last jack, you would be using the whole outfit.

AMPLIFYING THE CRYSTAL



Here is an interesting hook-up for inserting a "single-circuit regenerative" set ahead of the crystal detector

3—One Way of Increasing Distance

For the fan who is at present using a crystal detector with a variocoupler there is an interesting method of increasing the distance over which he can hear. This is by putting a bulb ahead of the detector just as we do in radio frequency amplification, although this hook-up is not radio frequency.

In fact, it is merely putting the standard "single circuit regenerative" hook-up ahead of the crystal, and then, by means of the regular audio frequency transformer, building up the signals to somewhat greater strength and receiving them through the crystal.

Some amateurs who have tried this method are very enthusiastic about it and it is well worth the trouble of disconnecting your set and hooking it up according to the diagram. Even if it does not give you the result that you wanted, you will not have wasted any money because all of these parts can be used again.

They are the same parts that were used in the first article in this series for one stage of amplification to be added to any crystal set.

In this hook-up I am showing a double circuit phone jack and I strongly advise the amateur to use this and a plug on the end of his phone cords.

Then a single circuit jack can be used in the part of the hook-up that is connected to the crystal.

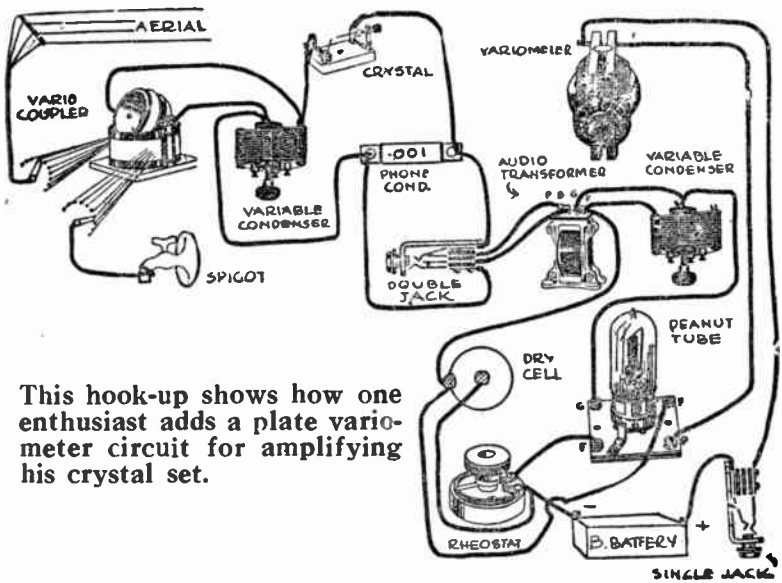
When the phone plug is inserted in the double jack the crystal and the transformer are disconnected and the operator will then be using the bulb set alone in the well-known "single circuit regenerative" hook-up. This is a very efficient arrangement and gives considerable distance if properly handled.

Once the signals are tuned in sharply on this part of the circuit, the plug is pulled out of the double jack and put in the single one.

This places in the circuit the transformer and the 23-plate condenser and the crystal.

The transformer builds up the signals received in the bulb set and sends them through the crystal with increased strength. The variable condenser is necessary to tune your crystal circuit into resonance with the other circuit.

AMPLIFYING THE CRYSTAL



This hook-up shows how one enthusiast adds a plate variometer circuit for amplifying his crystal set.

4—A Regenerative Amplifier

One of my readers sends an enthusiastic account of the results that he has had with an original and very logical form of amplifier for his crystal set.

In his method, which is shown in the accompany diagram, he virtually adds the bulb circuit which is known as the double circuit hook-up with the plate variometer. He uses his audio frequency transformer in place of the variocoupler and keeps his variocoupler where it was with his crystal.

This is another method of amplifying a crystal which is very well worth trying and it has the advantage of not making it necessary to throw any apparatus away when you have decided to use another hook-up in this series.

Here the crystal hook-up is the standard one that is used with either a variocoupler or a loose coupler. You simply insert a double circuit jack in place of the phones on the crystal, wiring the two outer blades of the jack to the present telephone connections and

wiring the two inner blades to the two primary binding posts of your transformer. If these binding posts are not marked P to show that they are primaries, they will be marked B and P.

The other two binding posts will be marked S to show that they are secondary or else they will be marked G and F.

You will need another 23-plate variable condenser to get proper tuning of the grid circuit in this hook-up, but the phone and the plate circuit is tuned by means of a variometer shown in the illustration. The variometer also has the ability to build up signals.

I am again using two phone jacks in this circuit and I cannot too strongly urge the fan to use this method with a plug on his phone cords because wherever a crystal detector is inserted in a radio circuit there is always a chance that the cat whisker is not on a sensitive spot and it is only by means of a plug and jack that you can test out the various parts of the hook-up one at a time to find where your trouble is.

If you want to add another step of amplification to this outfit you can use the same hook-up given in the first article in this series.

In that case you would use a double circuit jack instead of the two-bladed jack shown in this illustration. You would wire the two outer blades of the double jack in the same way as is shown here to the plus of the B battery and the variometer and would then wire the two inner blades to the first two connections shown in that hook-up for one stage of amplification.

AMPLIFYING THE CRYSTAL

5—One Step of Radio Frequency

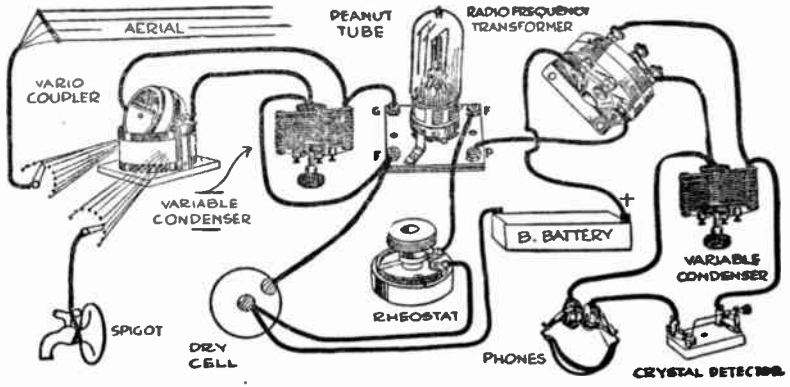
Many enthusiastic amateurs who insist on sticking to the crystal detector have claimed wonderful results in increasing distance by use of one stage of radio frequency amplification employing a peanut tube and one of the smallest type radio frequency transformers.

I am giving in this illustration the standard form of hook-up for this purpose and I suggest it as well worth trying without absolutely guaranteeing your results. Success will largely depend upon the type of transformer you use, and I think that you will get most satisfaction from one which does not have a very high ratio.

This hook-up uses an ordinary variocoupler for the tuning of the circuit in which the bulb is included and several experimenters have told me that they got better results with the peanut tube by taking off about five windings of the rotor.

This, however, will depend upon the particular make of variocoupler which you are using. Some couplers have as high as fifty or sixty turns of wire on the rotor, and in this case I think it is well to take some of them off in using the peanut tube.

Even if you remove too many, you can very largely compensate for it by the twenty-three plate



This hook-up shows how to use the peanut tube with one step of radio frequency amplification ahead of the crystal detector

variable condenser which is connected to the rotor.

The variable condenser in the crystal circuit connected to the transformer and the crystal and phones should be even smaller than twenty-three plates, although the twenty-three plate type will do.

I am showing here a 45-volt B battery. In most cases the full voltage will be found best. It is wisest, however, to have this battery tapped by means of the contact points and switch blade, which I gave in the February issue because you will find that the amount of B battery that you put on your bulb will have a very great influence upon the proper reception of signals in this radio frequency outfit.

The variable condenser shown is not absolutely essential, but it is very wise to have it because all radio frequency transformers are not wound in the same way by any means and some of them will not give you as sharp tuning on the signals as you will want.

This variable condenser enables you to have more flexibility of control and is very well worth while.

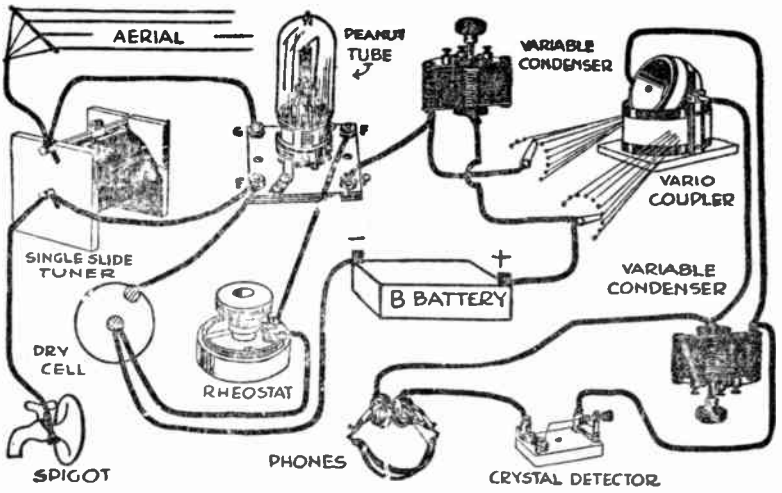
A nine-plate or an eleven-plate condenser is best, though, as I have said, a twenty-three plate will do.

AMPLIFYING THE CRYSTAL

6—"Tuned Plate Radio Frequency"

There has been a great deal written, both in magazines and books, about the advantages of radio frequency amplification for any kind of radio hook-up. Theoretically, there is no question about it that radio frequency ought to increase the distance over which signals can be received.

There is also no doubt that the design of a radio frequency transformer presents problems which we must admit have not yet been fully and satisfactorily solved. There are one or two very fair radio frequency transformers on the



This diagram shows the best method of adding tuned plate radio frequency amplification ahead of a crystal detector

market, but all are not adaptable to all hook-ups and all do not seem to give perfect satisfaction to everybody.

There is, however, one method of radio frequency amplification which anyone can try and which, at least in my own experience, has not yet failed to be an improvement upon any hook-up in which it was correctly used.

This form of radio frequency amplification is known as the "tuned plate" method. The tuned plate is merely a circuit going from the B battery to the plate of the amplifying bulb and in this circuit we hook-up a coil of the correct number of turns and a variable condenser. The coil and the variable condenser are placed in what we call parallel with each other and the pair are connected between the plate connection on the socket and the plus of the B battery.

In this method we use a single slide tuning coil or some sort of coil and a variable condenser for the purpose of getting a first fairly fine adjustment of the wave length which we send into the amplifying tube.

In the hook-up, which I am giving here and which I have found to be very satisfactory, I am showing a single slide tuning coil. This type of tuning coil permits of a very easy adjustment to the wave lengths that are used by broadcasting stations.

Merely by getting the correct position for the slider on the tuning coil, we send the proper wave length to the amplifying bulb. Then, by adjusting the number of turns of the coil in the plate circuit and also by setting the variable condenser to the correct point, we tune this circuit so that it is in resonance with the circuit which contains the single slide tuning coil. By doing this we greatly amplify the signal.

This method of radio frequency amplification seems to lend itself

better to the peanut tube than does the method using a regular radio frequency transformer.

In this hook-up, it will be seen that we use an ordinary variocoupler. A loose coupler will do just as well.

By means of the tap switches on the primary or outer coil of the variocoupler, we adjust the circuit to the correct number of turns, and then the turning of the knob of the variable condenser gives us the fine adjustment necessary for maximum strength of signals.

The secondary or rotor of the coupler is connected to the crystal circuit in the ordinary way.

Those who are using a variocoupler with a crystal at the present time can examine this circuit and see that it is almost exactly the same circuit which they are using. If we consider the wire coming from the plate as the aerial and the wire going to the B battery as the ground we see that it is nothing but the ordinary hook-up for a crystal using a variocoupler for tuning.

By using this method we receive the incoming signals and tune them by means of a single slide tuning coil. Adjusted in this way, they are led to the grid of the bulb and also through the A and B batteries up to the coil and variable condenser and then to the plate. This makes them very much stronger, because the incoming signals act as a trigger, and release the very strong current of the B battery and permit them to operate upon the plate and in doing so they go through the windings of the primary of the variocoupler or the loose coupler.

These signals, going through the primary and being very much stronger than they were when they came in through the aerial, are transferred to the secondary of the coupler and thence go to the crystal detector and through the telephone.

By means of using this hook-up, we get all of the advantages of long distance reception which radio frequency amplification gives us, and we also build up the weak signals coming in until they are sufficiently strong to operate our crystal detector.

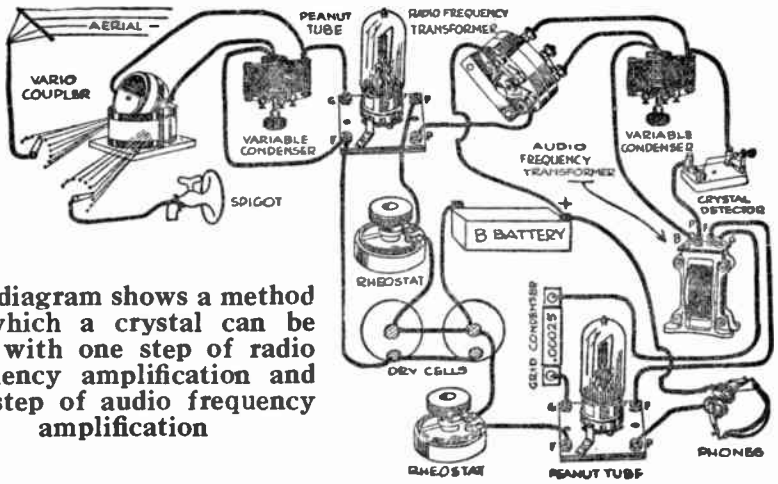
Thus a crystal can be made to receive and to rectify signals which come in from distant stations.

For the man who does not want to use a single slide tuning coil, because of the difficulty of mounting it on a panel, I wish to suggest that a seventy-five turn honeycomb coil or a coil wound around a salt box or an oat-meal box for about fifty or sixty turns and connected in the place of this single slide coil will do very well. In that case, however, it will be necessary to place a forty-three plate condenser in series with the wire going to the ground. That is to say that the wire from the spigot would go to one connection of a variable condenser and the other connection of the variable condenser would be wired to the end of the coil.

AMPLIFYING THE CRYSTAL

7. Both Radio and Audio

It is perfectly possible to use a crystal detector with both radio frequency and audio frequency amplification. The radio frequency method, as most readers know, is designed to give greater distance



This diagram shows a method by which a crystal can be used with one step of radio frequency amplification and one step of audio frequency amplification

over which signals can be received. The audio frequency method is designed to give greater volume of sound to the signals received through the crystal. The combination of both, theoretically at least, gives the benefit of both methods and enables the users to hear long distance signals with a very satisfactory volume of sound in the phones.

The hook-up in the illustration with this article is a combination of three hook-ups, all of which have been given in past articles in this series.

We have first the ordinary type of radio frequency amplification using a variocoupler for tuning and a standard radio frequency transformer to transfer the signals to the circuit which contains the crystal detector. After that we have an audio frequency transformer to take these signals from the crystal and build them up to much greater strength and then put them into the audio frequency amplifying bulb from which they are sent into the telephones with redoubled strength.

For the man who does not want to use a radio frequency transformer, I recommend that the step of "tuned plate" radio frequency given in the last article in this series be used here instead of the one given in this diagram. In that case, the user would have a single slide tuning coil in place of the variocoupler given here and he would transfer this variocoupler to the place occupied in this diagram by the radio frequency transformer. He would then be using the tuned plate radio frequency step ahead of his detector circuit. In my own opinion this is a much better method of doing it, but I am giving this diagram because so many experimenters seem to want this particular kind of hook-up.

By the other method, however, the amateur can use the entire hook-up given in the last article and simply add to it the diagram given a few pages back for one stage of audio frequency amplification adaptable to any crystal set.

Whichever one of these methods the amateur uses, it will be necessary for him to have two dry

cells connected in parallel as shown in this illustration. Parallel connection means that you wire together the two positive posts and also connect the two negative posts. Remember that the central binding post on a dry cell is the positive or plus and the side binding post is the negative or minus. Wired together in this way they can be used as though they were one battery.

Users of the peanut tube will find in almost every instance that a plate voltage somewhat higher than that used for the standard tube will be better. As a detector the peanut tube seems to function best with about 38 volts on the plate.

For the purposes shown in this illustration, both radio frequency and audio frequency, I advise putting a full 45 volts on the plates of both tubes.

All three of the variable condensers shown in this hook-up should be the .0005 mfd. or twenty-three plate type. The grid condenser shown in the audio frequency amplification circuit should be .00025 mfd. and the condenser shunted across the telephones should be .001 mfd.

In concluding this series of articles on amplifying the crystal, I cannot refrain from giving my own personal opinion that it is not worth while doing. I am only giving these hook-ups because there seems to be such a wide popular demand for hook-ups of this kind.

The only advantage which the crystal detector has over the audion bulb is that the crystal gives much purer signals and virtually no distortion. The tube, whether used as a detector or amplifier, is guilty of some distortion, though if properly used this distortion will not be very noticeable.

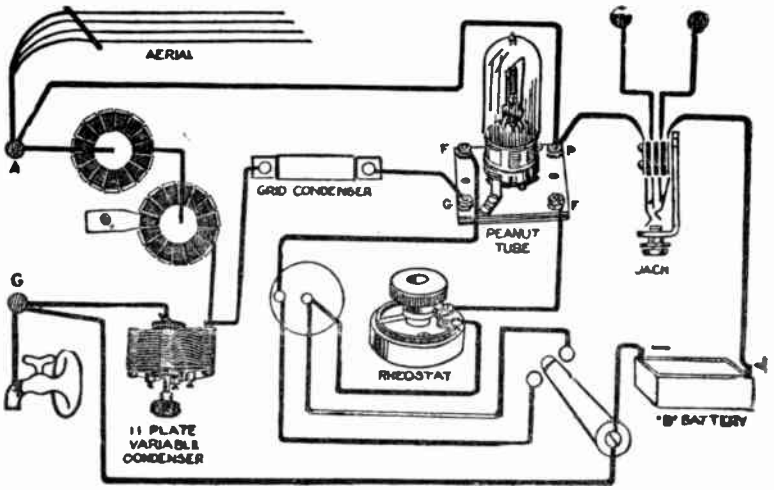
When the crystal is used alone, there is no question that the signals are much purer. When, however, we attempt to amplify these crystal signals, either by means of radio frequency or of audio frequency, we introduce into the circuit whatever distortion the tubes are guilty of and we, therefore, lose the advantages which the crystal detector alone possesses.

I am personally of the opinion that if we are going to use tubes for amplification at all, it is much better to use a tube for detector also, and thus get a much stronger signal than we would have by having the crystal in the set.

A COMPLETE OUTFIT FOR $15

Not long ago I became interested in a problem which one of my youthful readers brought to me and our solution of it seems to me to be of sufficient interest to other fans of limited pocketbooks to justify telling them how we solved it.

This boy had been bothering his father for months for money with which to get a tube set which would enable him to receive stations at a distance from his city. The father, who was not too plentifully supplied with the world's goods, finally gave the boy $15 and told him that was all that could possibly be spared. The boy looking over catalogues for bulb sets began to realize that he was up against a problem and wrote me asking if it were not possible to put together a complete outfit including aerial,



This is a diagram showing a hook-up that can be got for $15, and this price will include everything needed for the set, including aerial, insulators, batteries, bulb and phones

phones, batteries, bulb and everything for his $15.

I am showing here the hook-up which we finally got together on and I will later show how we mounted it and solved all the difficulties. We got all of our stuff at low prices by watching the advertisements of the cut-price stores in the newspapers, and it happened that the total cost of the complete installation came to exactly $15.

The prices were divided as follows:

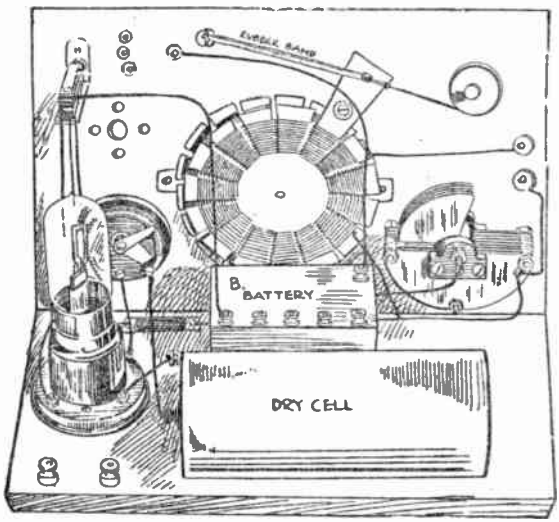
WD 11 tube	$5.50
Socket	.75
Coils	...
Grid condenser	.10
Eleven-plate variable	1.00
Rheosat	.75
Dry cell	.35
22-½ B-Battery	1.00
Switch blade and points	.05
Double jack	.50
Head phones	3.00
Plugs	.75
Aerial, insulators, etc.	1.25
Total	$15.00

The hook-up which we used is shown in the diagram herewith. The tuning apparatus was two fifty turn spiderweb coils, wound on a two-inch hub with No. 28 double cotton covered wire. These coils were connected in series as shown in the diagram, that is, the outside wire of one coil was soldered to the inside wire of the other coil and one coil had an extended spoke used for pivoting so that the coils could be moved farther apart or closer together to vary their coupling.

This is the Gibbons hook-up adapted to the two spiderweb coils and the WD 11 tube, and it is one of the most efficient little pieces of tuning apparatus that I have seen yet.

The switch blade revolving over the three contact points is used to try out on various signals whether reception is better with the minus side of the B-battery connected to the minus or plus sides of the dry cell.

MOUNTING THE $15 SET



These illustrations show the method by which the $15 bulb set was mounted for operation

It is not at all difficult to mount the $15 set described in the last article. Nothing elaborate is required for this and no further expense need be involved.

For all ordinary purposes, a set mounted upon a good panel of hardwood, such as oak, will be quite as efficient as one mounted upon the more expensive bakelite or hard rubber. This particular set was mounted upon a panel made from a piece of wood from an old desk and as this wood was thoroughly dried out by long standing in an attic, it was ideal for the purpose.

The illustration explains almost everything about the method of mounting this set, except the means by which we altered the coupling between the two spider web coils. By altering the coupling, of course, I mean changing the position of one coil relative to the other.

In the diagram of the hook-up of this set, I showed one spider-web coil without any of the spokes extended longer than any of the others. The other coil, however, had one spoke longer than the others.

In mounting, the first coil without any long spoke was simply screwed flat against the back of the panel. The other coil was placed over this and a hole was drilled in the extended spoke to permit us to put through it into the panel a short wood screw which would act as a pivot and by means of which it was easy to swing this coil up and down across the other coil. It is necessary for best results in this hook-up, let me explain, that, when the two coils are in identical positions, or in other words, when the coupling is closest, one should rest up fairly snugly against the other.

Our means of operating this movable coil was simply an ordinary shaft with a dial on the front of the panel. On the back of the panel we slipped an ordinary thread spool over this shaft and made it fast by drilling a small hole in it and screwing up a wood screw tight

until the spool was firmly fixed to the shaft. Then whenever we turned the dial on the front of the panel this shaft turned the spool behind the panel.

We slipped a small piece of string around the spool, tying one each of it to the screw for an anchor, and then brought this string across to the top of the extended spoke of the movable coil. On the other side of this coil, we placed an elastic band, fastening this in such a position that there was always a certain amount of tension on it.

Then, when we turned our dial, the string or thread winding around the spool would pull the extended shaft over to one side and thus by means of the pivot would move the movable coil away from the fixed coil. When we turned the dial in the opposite direction, the pull of the rubber band would bring it back again and would let it rest in the position of full or maximum coupling, with the two coils close over each other.

In conjunction with the diagram printed with the last article, it will be perfectly easy to make all connections on this set.

We found that we could mount the whole thing on a panel seven inches high and something less than twelve inches long, with a baseboard of the same dimensions. This baseboard gave us room for the WD 11 tube, the variable condenser, which in this place was an eleven plate one, a small twenty-two and one-half volt B-battery and an ordinary dry cell. This comprised the entire works of the apparatus and was later mounted in a neat little cabinet which was built for the purpose.

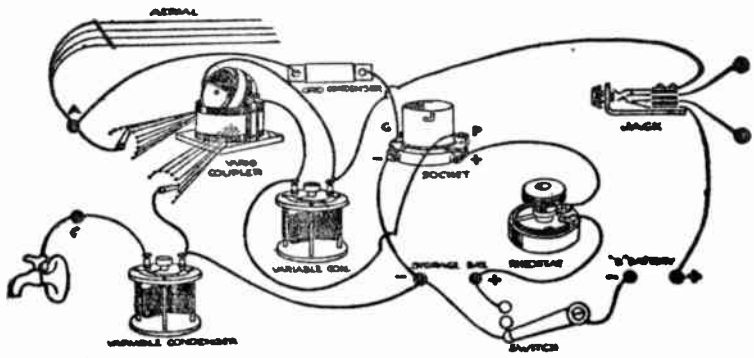
The set as it stands in this illustration can be used just as it is with detector tube alone for those who do not care to spend any more money. For those who do, however, it is quite easy to place two amplifying bulbs and two transformers upon another small panel seven inches high and seven inches wide. Stand this panel alongside of the first one, connect across two binding posts, and so have a complete outfit of three tubes at a very reasonable price.

IMPROVING YOUR SINGLE CIRCUIT HOOK-UP

The "single circuit regenerative" hook-up which I have given in considerable detail has the very great advantage of being extremely easy to operate because there are only two dials to be turned. With a variocoupler that has been correctly designed for the reception of the broadcasts on 360 meters, these two adjustments are all that is necessary.

All variocouplers, however, are not the same size, nor are they wound with the same wire, nor are they correctly designed and a further variable element enters into consideration now that the Government has established the Class B stations working on 400 meters.

For all these reasons the man who wants to get the very best that he can out of radio will find it worth while to add one more instrument to this single circuit set and this instrument is a twenty-three plate (.0005 mfd.) variable condenser. This condenser is hooked up across the rotor of the variocoupler.



The addition of a twenty-three-plate variable condenser as shown in this hook-up gives much finer tuning to the single-circuit regenerative set

In this particular hook-up the rotor is used as what we call a "tickler," and it is because of this use that the set becomes what we call "regenerative."

In tuning for various wave lengths and various kinds of transmitting stations, it is often desirable to have some means of changing the tuning of the tickler and, as there are no taps on the rotor of the variocoupler, this cannot be adequately done with the single circuit as given in my previous article.

The addition of the variable condenser makes the hook-up printed in the illustration with this article capable of much finer tuning and this finer tuning means frequently the elimination of the tube noises and hissing and annoying roughness of sound which frequently mars reception of radio signals.

I do not want to give the impression that the first hook-up is not a good one. For all ordinary purposes and for the man with a limited pocketbook it will be found very excellent, but there is no question about it that better results can be obtained by the addition of this condenser in the tickler circuit and it also helps considerably in tuning out interfering signals.

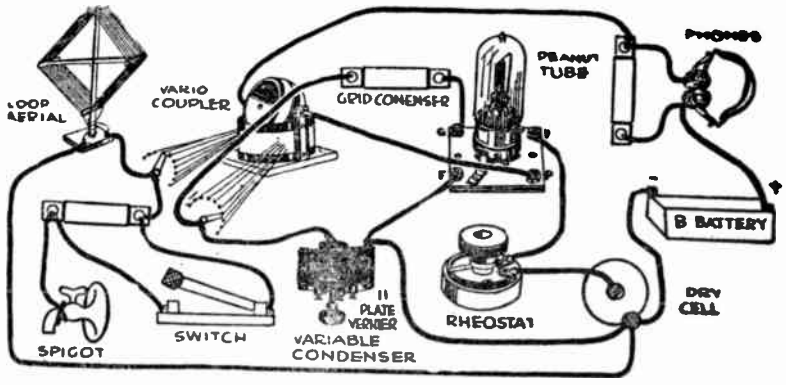
Adding this second condenser will naturally mean a larger panel than the one previously given, but three inches additional will take care of the size of the best makes of variable condensers.

This condenser should be placed between the variocoupler and the rheostat given on the last panel and the completed panel then shows three dials and a rheostat knob for tuning.

AN UNUSUAL LOOP HOOK-UP

Amateurs who live in apartment houses and who find it impossible to install aerials outdoors, but who do find it easy to get a ground connection for their set, have developed some very interesting hook-ups for the use of indoor aerials or for loops.

Here is one which is an interesting adaptation of the single circuit regenerative set, but its modifications and its application to



This diagram shows an interesting hook-up by which a loop aerial and a variocoupler can be used with a ground connection

the loop aerial and ground make it of special interest to those who find it difficult to get wires strung up outside.

In the digram which I am printing with this article I am using a vario-coupler, but I am told by several experimenters that they get better results by using an ordinary small variometer and separating the windings of the stator from the windings of the rotor.

In that case the lead-in wire from the loop aerial goes to one end of the stator and the other end of the stator goes to the grid condenser and the variable condenser as shown. Then the two connections of the rotor would go to the plate connection of the socket and to the telephones.

Let me explain that the "stator" is the stationary outer windings and the "rotor" the ball inside which turns on the shaft.

When this hook-up is used with the peanut tube, it is necessary to have a vernier condenser in the circuit and it should not be more than a twenty-three plate condenser. An eleven plate condenser is still better.

The loop to be used with this hook-up should be four feet on a side and consist of eight turns of wire, placed one-half inch apart.

If this size is too large for your purpose, however, make a loop three feet on a side and use twelve turns spaced three-eights of an inch apart.

There is an unusual arrangement attached to the ground or the cold water spigot in this hook-up. This is a regular phone condenser of .001 mfd. shunted by an ordinary knife switch. When the switch is open, the condenser is in the circuit. When the switch is closed, the condenser is out of the circuit.

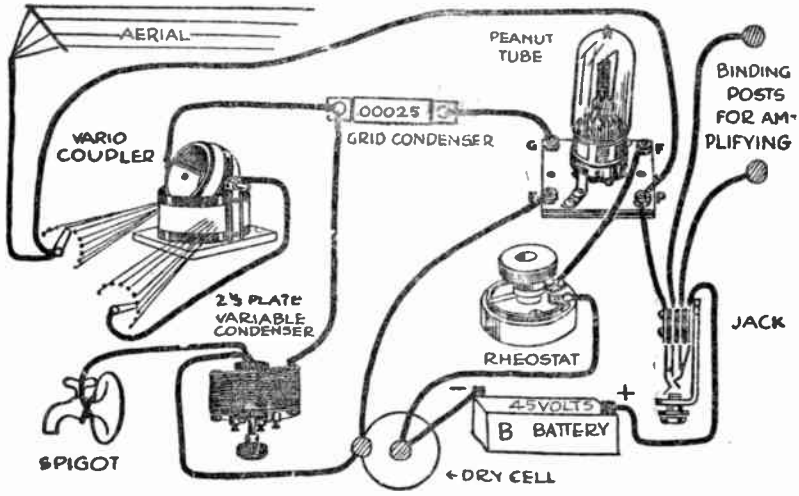
The grid condenser should be .00025 mfd, and the condenser across the telephones should be .0005 mfd.

While this hook-up is adaptable to the peanut tube, there is no question but that it works better with the regular size UV tube. In that case a storage battery should be substituted for the dry cell here and the wire which leads here to the side binding post of the dry cell should lead to the minus connection of the storage battery

and the centre binding post of the dry cell shown here would be the plus side of the storage battery.

Aside from that, all of the other connections in this hook-up stand as they are.

THE VARIOCOUPLER WITH THE GIBBONS HOOK-UP



This arrangement shows a very efficient use of a variocoupler in the Gibbons hook-up

So much interest has been aroused among the fans by the remarkable results achieved with the Gibbons hook-up that I have been besieged lately with letters asking me how to hook this circuit up to various types of instrument.

Most amateurs seem to possess a variocoupler and a twenty-three plate variable condenser. The standard hook-up for these two instruments is what is known as the "single circuit regenerative" set, and this in itself is a very efficient hook-up. Still there is no question in my own mind that the Gibbonds hook-up gives better results and more selective tuning, and I have been experimenting for some time to get a method by which a variocoupler could be used in this combination.

The arrangement shown in the illustration here solves the problem. This I believe to be the best method by which a variocoupler and a twenty-three plate condenser can be used in radio broadcasting reception.

By this means you really turn your variocoupler into a variometer and have the advantage of being able to use any number of windings on the outer coil that you wish.

In giving previous arrangements of the Gibbons hook-up, I have advised you to fasten various wires to three little metal strips for convenience in wiring up. Many beginners seem to find difficulty in doing this, so I have laid out this arrangement to eliminate the metal strips and to make the

hooking-up just as simple as it is possible to get it.

In order to be sure that you have everything all right, I will give you a check-up list of the wiring so that you can go over your arrangement, wire by wire, and assure yourself that you have made no mistake. This, then, is the check-up list:

The aerial lead-in goes to the units switch blade of the variocoupler.

A wire goes from this same switch blade to the plate binding post on the tube socket.

Another wire goes from the same binding post on the socket to the telephones or to the double circuit jack, if you are using one. Let me say that I decidedly advise using this jack so that the two inside blades can be reserved for an amplifying addition later.

The other outer blade of this jack or the other connection of the phones is wired to one of the plus connections of the B battery and here let me advise you to use a 45-volt B battery, because the peanut tube seems to function best with about thirty-eight volts on the plate. In case you are not using the jack you should hook the telephones up in the place of the jack shown in this arrangement.

The minus side of the B battery is wired to the centre, or plus, post of the dry cell. Right here let me say that sometimes results seem better with the minus of the B battery connected to the side post of the cell. Try both.

The centre dry cell post is wired to one side of the rheostat and the other side of the rheostat to one filament connection on the socket.

The other filament connection of the socket is wired to the side or minus binding post of the dry cell.

This side or minus binding post of the dry cell is also wired to one binding post on the twenty-three plate variable condenser and that same binding post on the variable condenser is wired to the ground.

The other connection of the twenty-three plate variable condenser is wired to one side of the grid condenser and that same side of the grid condenser is wired to one of the binding posts on the rotor of the variocoupler. The other side of the grid condenser is wired to the grid binding post on the socket.

The other binding post on the rotor is wired to the tens or rough switch blade of the variocoupler.

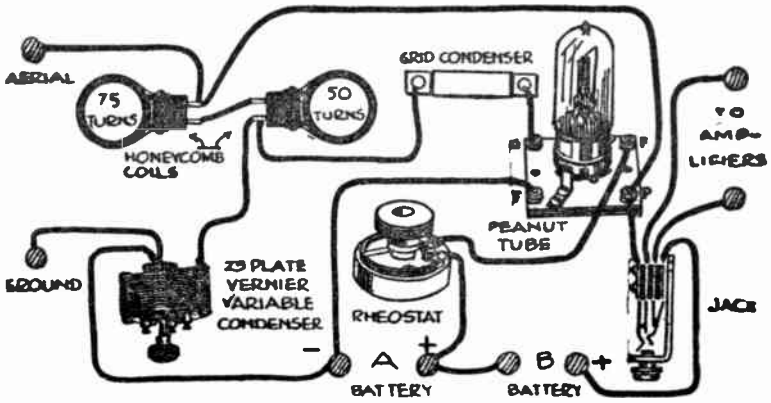
This completes the circuits and will give you one of the most selective outfits which you could put together, as well as giving you probably the cheapest method possible for efficient use of the peanut tube.

The grid condenser should be .00025 mfd.

It is very well worth while to use a vernier condenser in this circuit, because the tuning is extremely delicate.

TWO HONEYCOMBS IN THE GIBBONS HOOK-UP

No writer on radio likes to put himself on record as favoring any one hook-up more than any other, but I have had so many inquiries from readers lately asking me what hook-up I would advise them to use, that I am taking a chance in this article and giving the hook-up which I think I have found most efficient.



It would be hard to get a more efficient radio hook-up than this adaptation of the Gibbons arrangement, using two honeycomb coils for tuning

This is nothing more nor less than the Gibbons hook-up, which we have discussed quite frequently in these articles, but in this arrangement I use two honeycomb coils instead of the usual tuning apparatus.

There is scarcely a book or a magazine or a newspaper devoting attention to radio which has not had recently some form of this hook-up contributed by somebody who claims the credit for having invented it himself.

The first time that I gave this hook-up, several months ago, I stated then that it was taken from the pages of "Radio," a magazine published on the Pacific Coast, and that the writer of the article was David Gibbons. That was the first time that I had ever seen the arrangement given and I said that it struck me as being such a "freak" that I tried it out merely to see whether it would work or not.

Since then I have used it in almost every form in which it has appeared and have settled upon the hook-up given in the illustration with this article as being the most efficient and the most satisfactory arrangement I know of for a simple hook-up for radio apparatus for all purposes.

As I write this article I have just tried a very interesting experiment to convince myself that I really do consider this the very best hook-up.

I have had three sets hooked up and by means of switches have been able to switch any one of them to the aerial and ground.

One hook-up was the standard three honeycomb coil arrangement, the other was the regular single circuit regenerative hook-up, the third one was the one given in this illustration. In each case I had two stages of audio frequency amplification.

I found that the three honeycomb coil hook-up was the most selective, but the most difficult to manage, that the single circuit regenerative set was the easiest to manage, but not sufficiently selective to be satisfactory, but that this Gibbons hook-up was remarkably selective, was even easier to

manipulate than the single circuit, and that signals given with this arrangement and the two stages of amplification were at least twice as loud and clear as those with the single circuit regenerative set and a great deal louder and clearer than those given with the three honeycomb coil hook-up and two stages.

For concert work I use two honeycomb coils, one of them seventy-five turns and the other fifty turns.

I use a twenty-three plate variable condenser with a vernier attachment and find that, with the two coils only about one-eighth of an inch apart, the 400-meter class B broadcasting stations come in with the variable condenser set at about fifteen.

The setting of the reheostat in this hook-up also seems to be quite critical and it is important to have the filament at just the right brilliancy to avoid unpleasant noises and to bring you the signals at maximum strength.

The grid condenser should be of .0005 mfd., if you are using a standard size six volt bulb, or, if you are using a peanut tube, it should be of .00025 mfd.

I am showing here the hook-up as it should be placed upon a panel with binding posts taking the place of aerial, ground and batteries.

You will notice that I am using a double circuit jack in place of the phones, and this I consider very well worth while because it is almost a certainty that the amateur who once uses this set will later add two stages of audio frequency amplification.

In that case he merely connects his first audio frequency transformer to two binding posts shown on the right of this illustration. Then when he plugs his phones into the jack shown here he cuts out the amplification and listens in on the detector bulb alone.

In the case of the peanut tube, you simply connect your dry cell in the place marked "A battery" in this diagram, wiring the center post of the dry cell to the plus binding post shown here and the side binding post of the dry cell to the minus binding post shown here for the A battery.

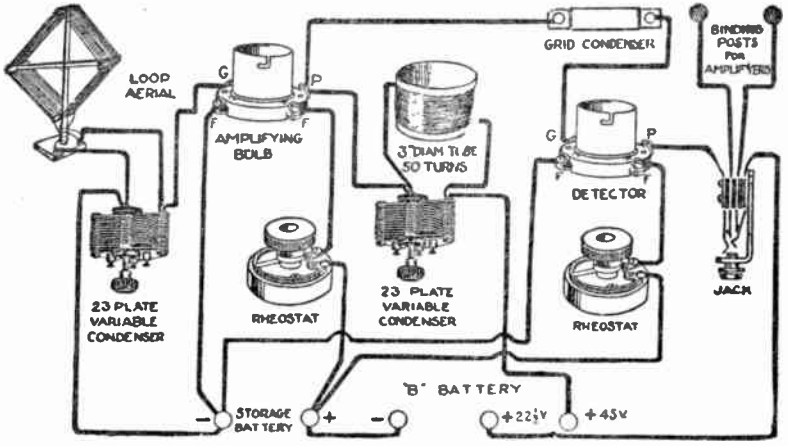
If you are using the peanut tube, do not forget that it will require a little more B battery voltage than the standard size tube. Usually this B battery voltage will be about thirty-eight.

TWO BULBS WITH A LOOP

Tuned plate radio frequency amplification given recently in these articles, lends itself particularly well to the use of an indoor loop aerial for the man who cannot put up a wire outside.

I am giving here a diagram of a very neat little two-bulb circuit which will work efficiently with a loop aerial for any man who is within a reasonable distance of a good broadcasting station, and it is perfectly possible later to add one or two stages of audio frequency amplification to put the signals on a loud speaking horn.

With an outfit of this kind any man should be able to get broadcasting stations within a hundred miles or more in the head tele-



Here is a very efficient hook-up for two bulbs and a loop aerial, the circuit using one stage of radio frequency amplification by the tuned plate method

phones and two steps of audio frequency amplification will then be all that he needs.

The diagram is self explanatory, with the exception of the coil used in conjunction with the second variable condenser shown in the picture. This coil can be very easily made at home. Get a pasteboard or bakelite tube about three inches in diameter, wind on it fifty turns of No. 22 or No. 24 double cotton covered or silk wire and that is all that is necessary.

For the man who likes to get different wave lengths for receiving dot and dash signals this coil can very well take the form of a honeycomb coil. It is possible to buy in the stores at a reasonable price a little single mount into which honeycomb coils can be plugged, and with this mount and a loop aerial on which you can vary the number of turns that you use you can cover quite a wide range of wave lengths with this hook-up.

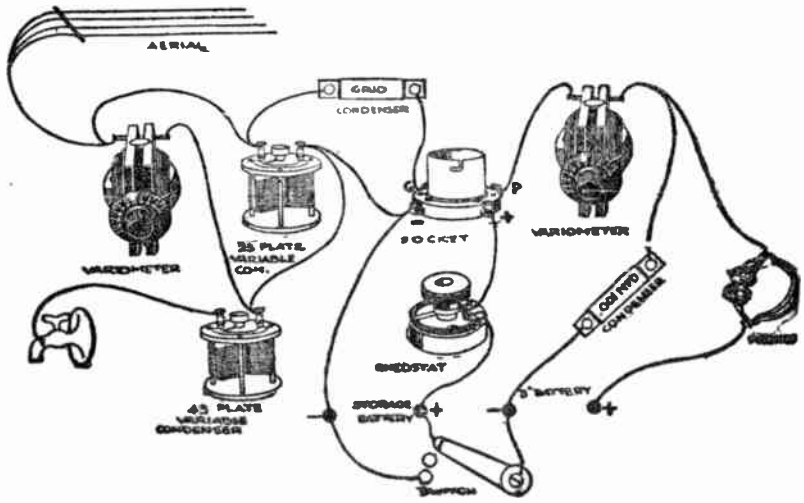
For reception of signals on the ordinary broadcasting wave lengths the loop in this hook-up should be three feet on a side, wound with about twelve turns of wire not smaller than No. 20; or if you wish to make a smaller loop only 2 feet on a side, it should be wound with from sixteen to twenty turns. In both cases these wires should be placed one-half inch apart.

In both places where the variable condenser is used it should be the twenty-three plate kind, and it is better to use a vernier condenser connected to the coil. The tuning on this particular condenser will be very critical, and the finer you are able to get it the better results you will have.

The double circuit jack shown on the right-hand side of the illustration is to enable you to use telephones plugged in at this place, if you are going to use only the two tubes, and the two inner blades of the jack are connected to binding posts which are intended to go on the right-hand side of the panel. Later, when you wish to add your audio frequency amplification, the

primary of the first transformer connects to these two binding posts, and then when you pull the telephone plug out of this jack your transformer is automatically connected in the circuit and your signals will come in on your amplifiers.

A HOOK-UP WITHOUT A COUPLER



Here is a hook-up for the man who does not want to go to the bothersome job of tapping his coupler

The beginner in radio seems to dread using a coupler because it involves the necessity of "tapping" the outside coil and this means the trouble of soldering if good results are to be obtained. I do not know whether the dread of this necessity is caused by an objection to the trouble it takes or by the fact that many people lack the skill with tools necessary to do the work, but I do know a great many letters have come in recently asking for a hook-up for a good receiving set without a coupler.

It is quite possible to use two variometers without the coupler and to get good results on the wave lengths used in broadcasting, but if you are going to adopt this hook-up, you must realize that this band of wave lengths is limited and you will be fortunate if you can get signals on as high as 600 meters.

Still, as these long waves are used almost exclusively for dots and dashes this will not be a disadvantage.

It is advisable to use two variable condensers with this hook-up if you expect to have any satisfaction with it, and so it will not save you any money, but it will undoubtedly save you a great deal of the trouble you would have in tapping a coupler and mounting two sets of contact points on a panel for it. This hook-up can be used without a panel with all of the instruments screwed down to a board if you use what is called the "table type" of variable condenser.

The check-up list for wiring for this hook-up is as follows:

The aerial lead-in goes to one side of the first variometer and that same side of the first variometer is wired to one side of the twenty-three-plate condenser.

This same side of the twenty-three-plate condenser is wired to one side of the grid condenser. The other side of the grid condenser is wired to the grid screw on the bulb socket.

The other side of the first variometer is wired to one side of the forty-three plate condenser and that same side of the forty-three-plate condenser is wired to the other side of the twenty-three-plate condenser and thence to the minus filament screw on the bulb socket.

The second side of the forty-three-plate condenser is wired to the ground connection.

I am showing again the switch blade passing over three contact points, which changes your B battery connection to either the plus or minus of the storage battery, with the middle tap of these three left without any connection, so as to prevent a short circuit.

With this switch installed, proceed with the wiring as follows:

A wire from the minus filament screw on the bulb socket to the binding post for the minus connection of the storage battery and another wire from that same binding post to one of the outside contacts of your three point switch.

A wire from the other outside contact of this switch to the binding post for the positive connection of the storage battery and another wire from that same positive binding post to one side of the rheostat and a wire from the other side of the rheostat to the plus filament connection on the bulb socket.

A wire from the shaft of the blade of your switch to the binding post for the minus side of the B battery.

A wire from the binding post for the plus side of the B battery to one side of the telephones and another wire from the other side of the telephones to one side of the second variometer.

A wire from that same side of the second variometer to one side of a phone condenser (.001 mfd.), and a wire from the other side of the phone condenser to the minus B battery binding post.

A wire from the other side of the second variometer to the plate screw on the bulb socket.

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