How to Build a Crystal Set

This Simple Receiver Will Help You Get Started Right in Radio

By Alfred P. Lane

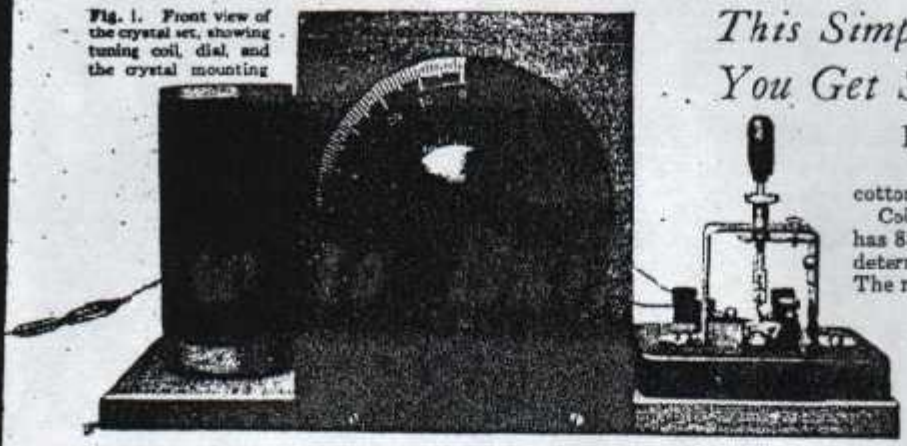


Fig. 1. Front view of the crystal set, showing tuning coil, dial, and the crystal mounting

THERE are many millions of people in this country who live within five miles or less of a powerful radio broadcasting station. And, judging from the total sales of complete radio receivers and the parts from which to make them, a surprisingly large number of these people have not yet taken any interest in radio.

Building a simple crystal radio receiver is a mighty good way to get started in radio. You can build such a set at a minimum of expense and the upkeep cost is practically nothing. Then when you decide later to build a vacuum-tube radio receiver, the whole subject will be much less mysterious and difficult.

A friend of mine started in radio by way of the crystal-receiver route, and while he now possesses a remarkably good five-tube receiver, the old crystal set still is kept in commission and he uses it a great deal. He lives within a mile or two of one of our best broadcasting stations and when he happens to be alone at home and wishes to listen to the program from the local station, he dons the ear phones, adjusts the crystal until he finds a sensitive spot, and settles back in his armchair to enjoy the music while he reads the evening paper.

AS HE puts it: "Why should I wear out my tubes and use up my batteries just to hear station WXYZ when the crystal set brings in the music with perfect quality and the ear phones shut out all the street noises?"

The crystal radio receiver shown in Figs. 1 and 4 was designed and built to show how simply and easily a good set of this type can be constructed. No tools were used other than those to be found in every household, such as a small wood saw, a gimlet, a penknife, and a screwdriver. No soldering-iron was used and all the connections were made with the same wire used to wind the tuning coil.

Here are the parts of the set as indicated by letters on the illustrations:

A and *B*—tuning unit; *C*—variable condenser, .0005 mfd. (23-plate); *D*—crystal detector; *E*—fixed condenser, .0005 mfd.; *F*—wooden panel for variable condenser; *G*—wooden baseboard, 6 by 11 inches; four binding posts, dial for variable condenser, screws, etc.

You will have to buy about a quarter-pound of No. 22 double silk-covered wire for the tuning unit *A-B*, and of course you also will have to purchase the variable condenser *C*, the crystal detector *D*, the fixed condenser *E*, and the binding posts and dial for the condenser.

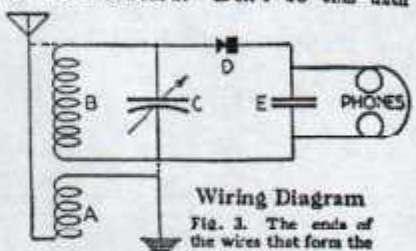
It is a mighty good idea to buy a really good variable condenser and dial, because these parts can be used later in a vacuum-tube receiver. Get a dial of standard make so that you will have no difficulty in matching it if the vacuum-tube design calls for more than one dial.

THE rest of the parts can be of low-priced type and of course the baseboard and the panel for the variable condenser can be cut out of an old packing-case or any stray half-inch board that happens to be handy.

The tuning unit *A-B* is wound on a piece of cardboard tubing two inches in outside diameter and four inches long. There is no magic in this particular size, however. You can use smaller or larger tubing if it happens to be convenient, although you will have to change the number of turns of wire to correspond. The larger the tubing, the fewer the number of turns of wire needed. Cotton-covered wire or enameled wire can be used if you prefer. Use more turns with cotton-covered and fewer with enameled wire.

Coil *A* consists of 30 turns of wire and coil *B* has 85 turns. The number of turns in coil *B* is determined by the variable condenser you use. The number of turns in coil *A*, on the other hand, should be adjusted so that you will get the proper degree of sensitiveness and selectivity, and these factors are in turn governed by the distance from the broadcasting station and the size of your antenna.

Two small holes are punched through the cardboard tubing at the point where each coil begins and ends. The coils are wound as close together as convenient. The end of the wire is passed in one hole and out the other, leaving a long end that can be connected directly with the other instruments. The completed coil is held in place by a small brass right-angle bracket in the model receiver, but it is equally satisfactory to glue the end of it to the baseboard. Don't do this until you are sure that you have the windings right for your particular conditions.



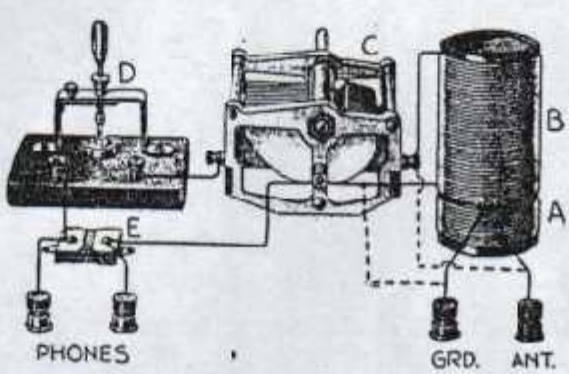
Wiring Diagram

Fig. 3. The ends of the wires that form the tuning unit are connected directly with the binding posts of the other parts. No soldered joints are used

IF YOU are very close to several broadcasting stations and you can put up a long outdoor antenna, you may have to cut down the number of turns in coil *A*. I would suggest that you wind the specified number and then take off turns until you can separate the different broadcasting stations.

Perhaps you are as much as five miles away from the nearest station. In that case you should increase the number of turns in coil *A*, or you can decrease the number of turns in coil *B* and connect binding posts Nos. 1 and 2 directly with the ends of coil *B*, thus eliminating coil *A* altogether. How to do this is shown in dotted lines in Fig. 2.

The reason for decreasing the number of turns in coil *B* when coil *A* is eliminated is because in the latter case the antenna and ground become part of the tuned circuit and their capacity is added to that of the variable condenser *C*. Eliminating coil *A* also is desirable if you have to use a



Pictorial Wiring Diagram for Beginners

Fig. 2. Dotted lines indicate connections when very short antenna is used or when broadcasting station is far away

short antenna of, say, 40 feet or less. You cannot expect to get good reception with any crystal set, however, on such a short antenna unless you are within a mile of the broadcasting station.

I AM giving these possible variations so that you can adapt the crystal set to your own particular needs. If you are in doubt about how to do it in your own case, I shall be glad to advise you if you will let me know the actual distance to the nearest broadcasting station and the length and height of antenna you can put up.

After the coil *A-B* is wound, study Figs. 1 and 4 and mount the rest of the instruments as shown.

The wiring is extremely simple. The wire from the upper end of coil *A* goes to binding post No. 2 and the other wire from coil *A* goes to binding post No. 1. Then scrape off the insulation on the wire from the lower end of coil *B* so that you can connect it with the binding post that is on the metal framework of the variable condenser *C*. This wire continues to one side of the fixed condenser *E* and then to binding post No. 3.

Now connect the top end of coil *B* with the binding post on condenser *C*, which is fastened to the stationary plates of the condenser. Many types of variable condensers have a binding post at each end of the stationary plates. If yours is of this type, connect the other binding post on the stationary plates with one terminal of the crystal-detector stand.

COMPLETE the wiring by connecting a wire from the other terminal of the crystal detector stand with the remaining terminal of fixed condenser *E* and continue it to binding post No. 4.

The antenna should be as long and as high as you can get it and should be insulated at every point where it touches any support. Connect it with binding post No. 1. Then connect binding post No. 2 with the nearest cold-water pipe.

The head phones should be connected with binding posts Nos. 3 and 4. Buy good head phones. The quality of your reception depends on them and they always will be useful, even with a vacuum-tube set, for tuning in distant stations and for listening in late at night when you do not want to disturb the neighbors by running the loudspeaker.

Most head phones are adjusted so that they will clamp tightly on the smallest size of head. You will find much more comfort in wearing them if you will bend the frames very carefully until they will just stay in place on your ears. Additional comfort may be secured by bending the headbands so that they touch your head evenly for several inches instead of just at one or two spots.

To get the set into operation after everything is connected properly, check up the radio program in your daily paper and make sure that the station you want to hear actually is broadcasting. Place the head phones on your head and with one hand turn the dial of condenser *C* back and forth very slowly, while with the other hand lightly touch the fine wire, called the "catwhisker," to the surface of the crystal at various points. Eventually you will find a sensitive spot and you will hear music or speech in the head phones.

JUST as soon as you hear the faintest sound in the head phones, stop adjusting the crystal detector and turn the dial of condenser *C* until the signal is as loud as possible. Then let the dial alone while you readjust the cat whisker until the music or speech is as loud as possible. The next step is to write down on a piece of paper the number on the dial at which the signal is being received.

The crystal will stay in adjustment for as much as several days at a time if it is not accidentally jarred out of position. It is well, therefore, to locate the receiver where you are not likely to strike it with your arm in moving about the room, and it also is worth while to set the whole outfit on a soft pad of cloth to take up vibrations that may be transmitted to it from the table.

You will find there is a great difference in the sensitiveness of different crystals. Some are very much better than others. As a general rule, the fixed type of crystal detector is not so sensitive as those in which an adjustment can be made to find the extremely sensitive points.

WHEN you finally locate a really sensitive crystal, it should be treated carefully. Protect it from dust and do not handle it with your bare hands. Use pliers to pick it up or use a piece of dry cloth over your fingers.

Since this crystal radio receiver will be your first introduction to radio at first hand, you probably will be a bit curious as to how the radio signals that come down the antenna are converted into sound waves that you actually can hear.

To begin with, the radio waves are oscillating back and forth at enormously high frequencies. At a wave length of 200 meters they are sliding up and down your antenna and through the *A* coil of your receiver at a rate of 1,500,000 times a second. This current, moving back and forth through the wire in the *A* coil, sets up a rapidly changing magnetic field about the coil and the changing lines of force cut through the turns of wire in the *B* coil and induce a current in them. This current in turn flows back and forth through the wires of coil *B* to the plates of variable condenser *C*. Turning the dial

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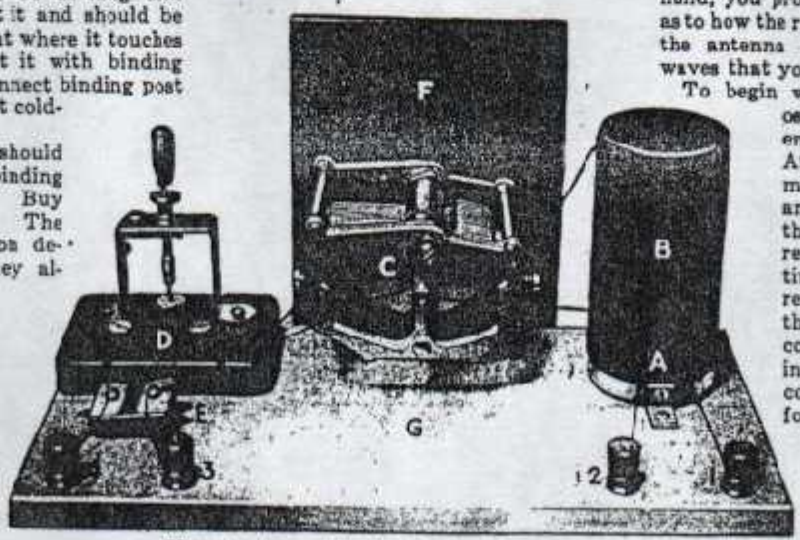

How to Assemble the Parts on Baseboard

Fig. 4. This view shows how to assemble the instruments on the baseboard and wooden panel. Note that the connections from binding posts to the fixed condenser *E* are made by means of 6-32 brass screws passed through the holes in each eyelet as illustrated

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of condenser *C* alters the electrical capacity of the condenser and when the signal becomes loud, it is because the capacity of the condenser has been so adjusted that the combination of coil *B* and condenser *C* has been tuned so that the current flowing back and forth can keep time with the changes in the current in coil *A*.

Naturally you cannot hear vibrations in the air that are changing as rapidly as 1,500,000 times a second. In fact, the highest note the human ear can hear has about 30,000 vibrations a second.

The voice or music going into the microphone at the broadcasting station has the effect of chopping the radio wave into sections and the sections are in time with the music. This is where the crystal detector comes in. Its function is to block off half of each radio wave so that the whole group of rapidly changing waves that form one vibration of the music will act together to pull the diaphragm of the head phone in one direction. Then the next group of radio waves comes along and gives it another pull, so that it moves back and forth in time with the music and you can hear it.

The reason that a crystal radio receiver will bring in music only from short distances is because the sound in the head phones when you use a crystal set actually is produced by the energy of the radio waves themselves. In a vacuum-tube receiver, on the other hand, the radio waves simply are used as triggers to release relatively far more powerful bursts of energy from your batteries. And this explains why reception with a crystal receiver is so true to life. There is no chance for distortion to creep in, due to faulty vacuum tubes or batteries.

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