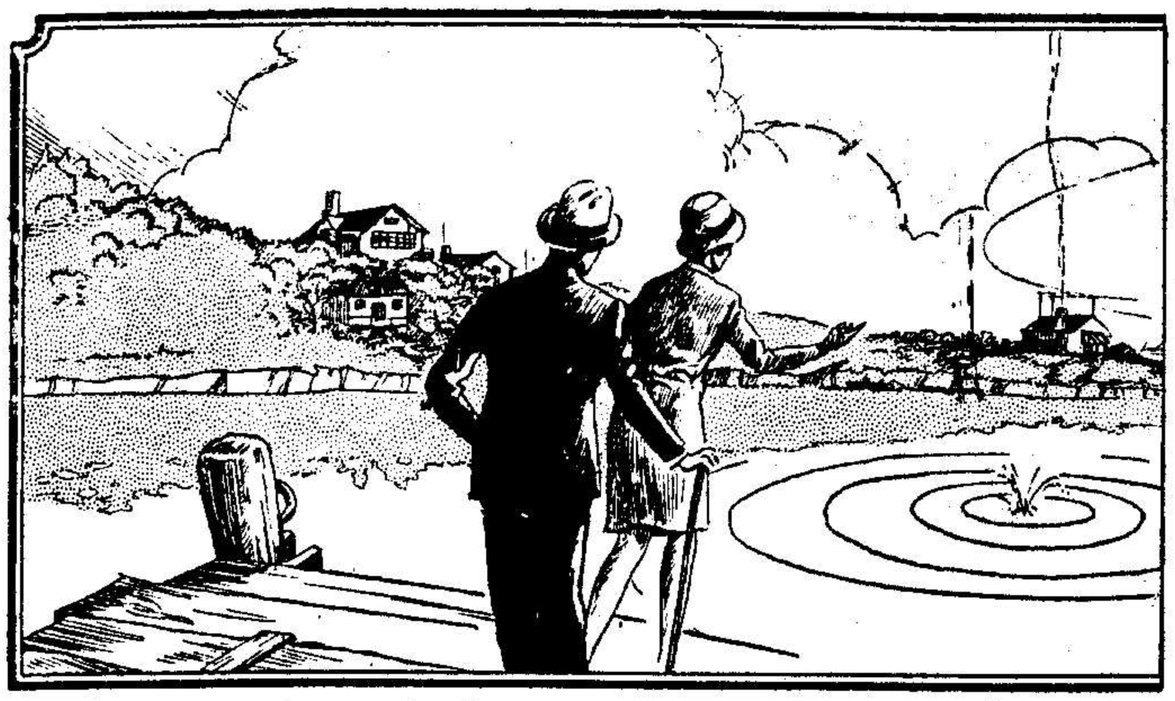
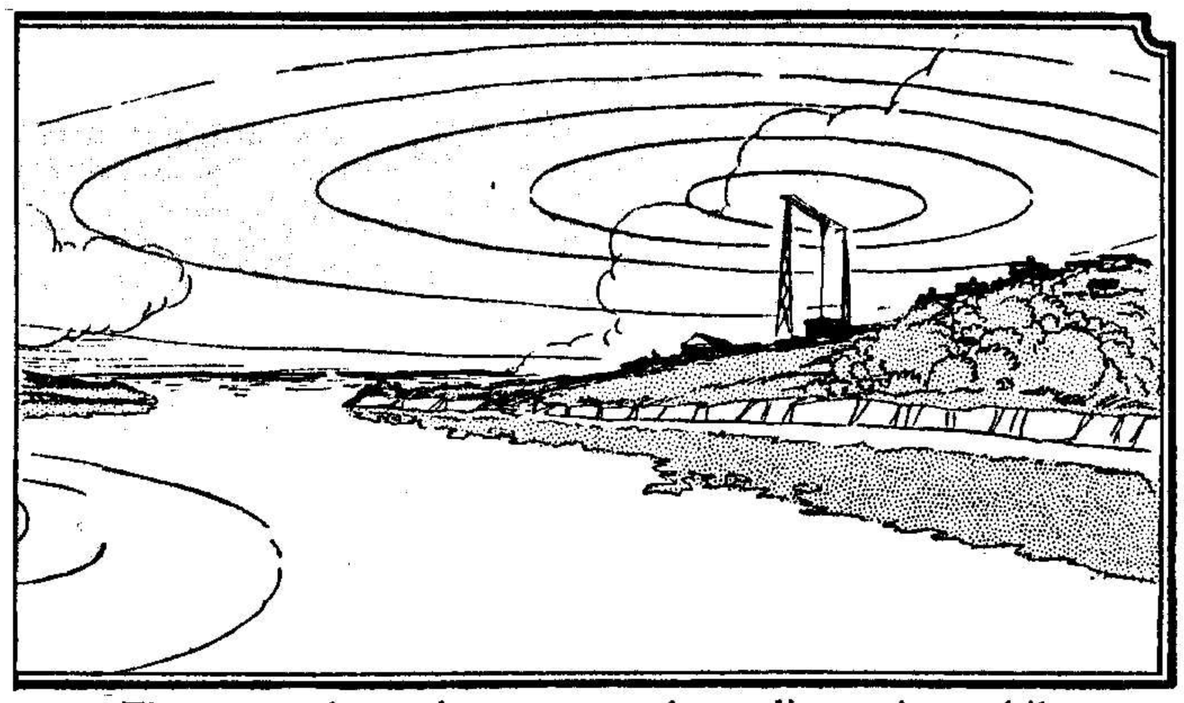


A stone, thrown in the water, causes waves to radiate in ever-widening circles



The waves from the antenna of a radio station, while not visible, are radiated in much the same manner

The Junior RADIO Guild

LESSON NUMBER SIX

The Fundamentals of Radio

ONE of the first questions which the beginner in radio is apt to ask is "how does a radio station send out its signals?" To answer this so that you will get a clear idea of the action involved, suppose we make use of an analogy for an example. Time and again this simple analogy has been employed and will serve again here. Supposing you throw a stone into a body of water, say, a lake. You will notice that as the stone strikes the water, waves of a circular form are set up and slowly expand in radius until perhaps the force of the impact is totally expended. (See the picture above, to the left).

In general, this is what happens when a signal is sent out from the antenna of a radio station. That is, the waves, carrying the signal, radiate into space, only the speed with which they travel is very rapid —186,000 miles per second.

Now, going back to our lake, supposing at some distance from where the stone struck there was a bit of wood floating quite serenely. When the waves radiated by the stone reached the wood it would bob up and down on the waves. In other words, the waves set up by the throwing of the stone have imparted a motion to the bit of wood.

Similarly, if we can have an antenna erected on our roof, then the waves set up by the broadcasting station's antenna will strike it and a portion of the wave will be absorbed and passed along to whatever receiving apparatus is attached to it.

If there are many pieces of wood in our lake, all within range of the waves set up by the stone, each one will be affected and will bob up and down. Similarly if there are many antennas within range of the waves broadcast by the antenna of the radio station, then each one will absorb a minute portion of the wave and will affect the receivers attached to them.

This, of course, will explain only roughly the general way in which broadcasting stations and receivers affect each other. There are many ramifications which enter into the rather complicated system of radio transmission, but for the purpose of drawing a simple parallel here it will not be necessary to go into the technical details involved.

THE Junior Radio Guild is an organization whose membership is composed of boys who are interested in learning more about radio.

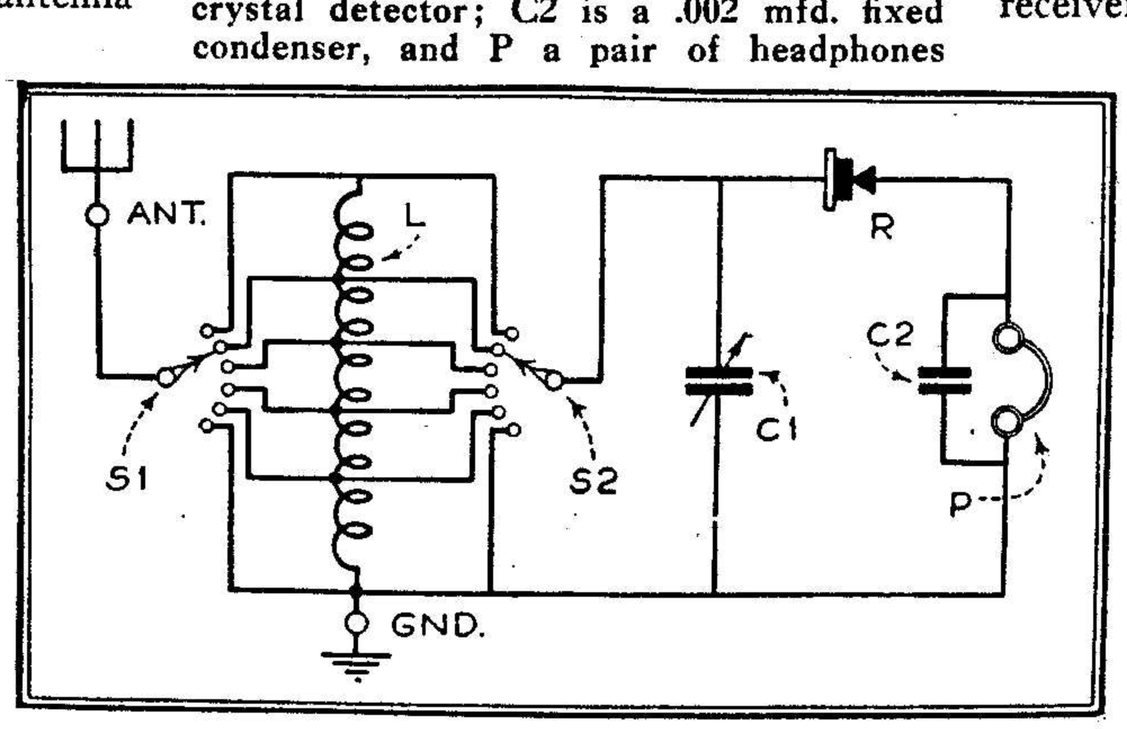
This organization, under the direction of the Technical Staff of RADIO NEWS, has prepared a series of lessons for beginners. The lesson printed here deals with the fundamentals of radio.

Future lessons will show you how to build another type of radio receiver.

If you wish to join the Junior Radio Guild, fill out and send to us the coupon on page 672.

Fig. 1

The circuit of a simple crystal receiver. S1 and S2 are contact switches; L is a coil wound as described in the text; C1 is a variable condenser of .00035 mfds.; R is a crystal detector; C2 is a .002 mfd. fixed condenser, and P a pair of headphones

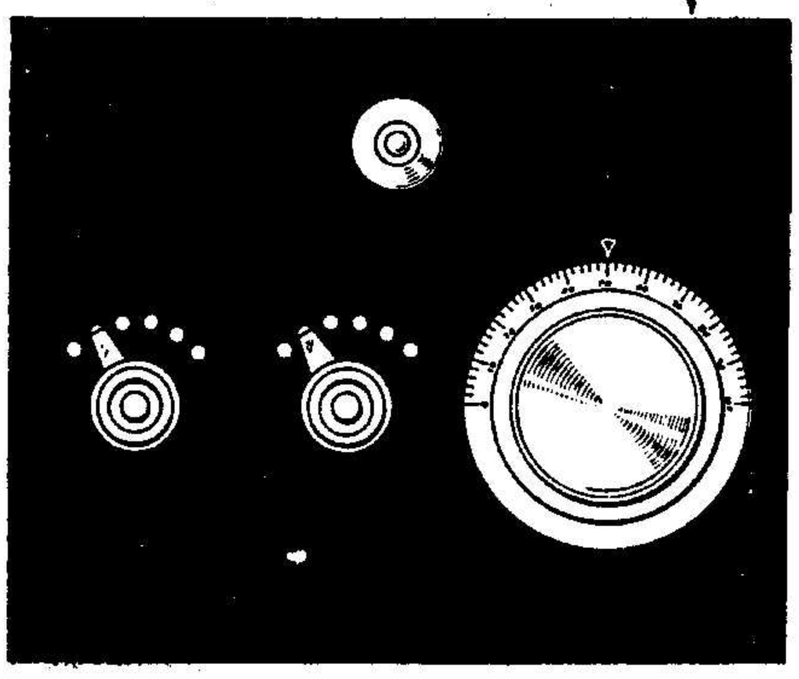


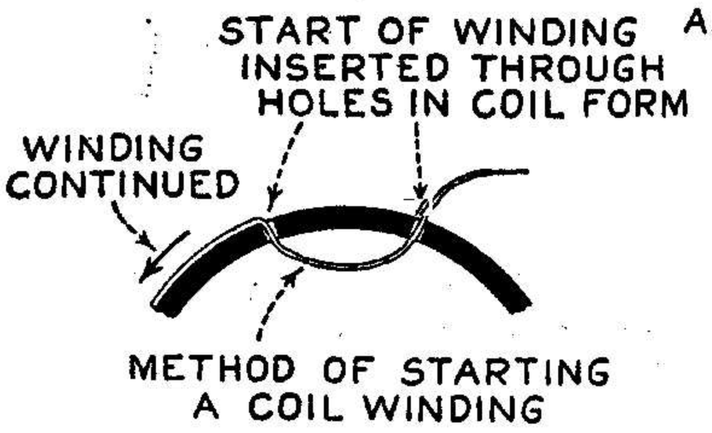
At the Other End of the Receiving Antenna

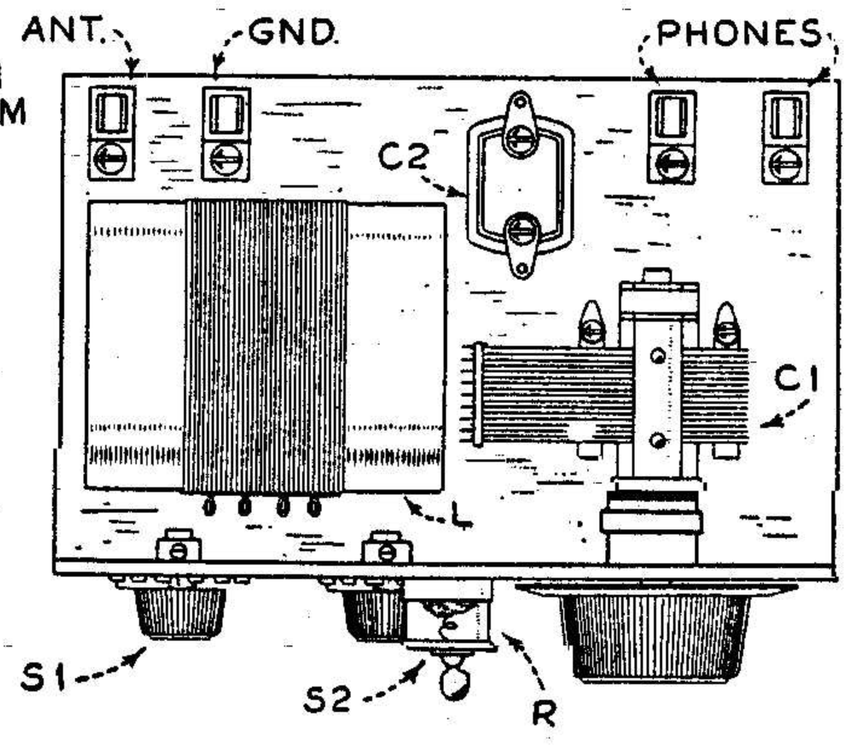
The radio signals which are absorbed by the receiving antenna are of such a nature as to be inaudible to the human ear. They are composed of vibrations which occur so rapidly that, without the proper kind of apparatus, we cannot hear them directly. Therefore, what this apparatus does is to convert these rapid vibrations into sounds that are intelligible to us. This apparatus we call our receiving set, and during all the years of progress in the radio art these receiving sets have grown from simple crystal sets to the rather complicated multi-tube receivers we have with us today.

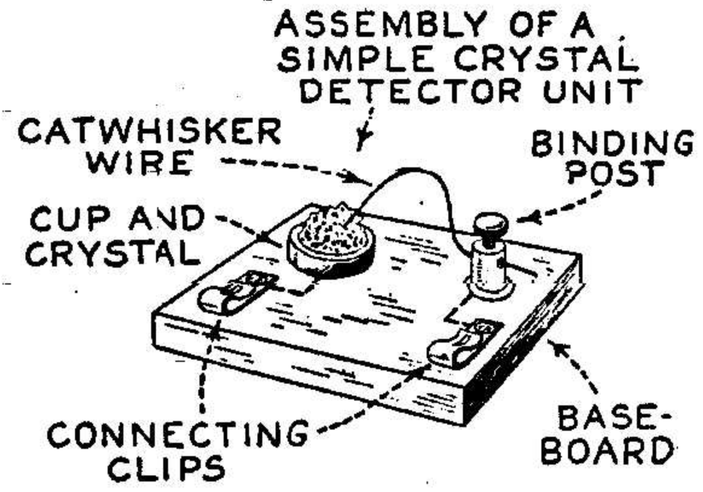
To the beginner, however, the crystal receiver, so called because it makes use of a piece of galena or silicon crystal to convert or rectify the transmitted signals so that we can hear them, still commands a great deal of interest because it is simple to build, easy to operate and requires no batteries to make it function.

The wave which is transmitted from the antenna of the broadcasting station is what is called a carrier wave. That is, it carries the voice or music vibrations, which are superimposed upon it, from the microphone which is in the broadcasting studio. The carrier









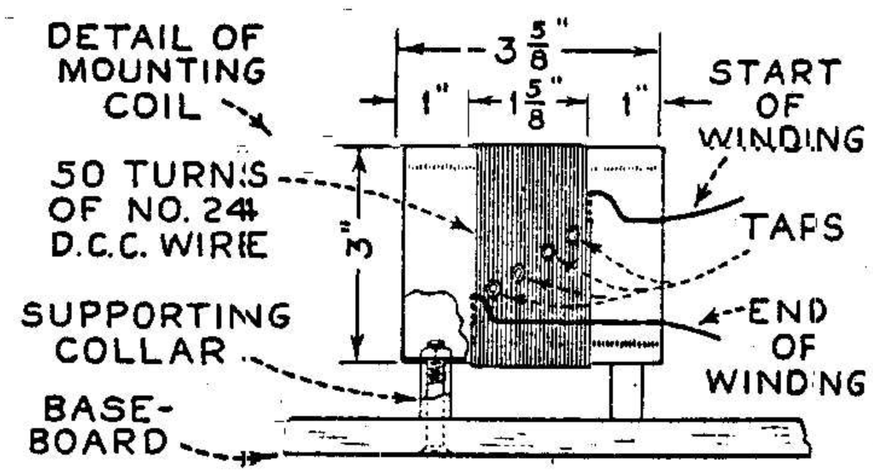


Fig. 2

All the information you need for building the simple crystal receiver whose circuit is shown in Fig. 1 is given here. If you do not wish to buy a manufactured type of crystal detector one can easily be made as shown here

wave form is shown in A, Fig. 3. Note that the amplitude, or in other words, the strength of one vibration, is as strong or equal to the others. However, when the voice currents from the microphone are passed along to it through the various amplifiers which are employed in the studio control room then the shape is varied as shown in B. Here the minute variations of current, or vibrations of different amplitude, change the shape so that there are various heights of hill and valley, so to speak, on either side of the center line.

These rapid vibrations, occurring at such a speed as to be inaudible to the human ear, are radiated from the antenna of the station and, as explained previously, are radiated into space.

When they reach a receiving antenna where the receiving apparatus, that is, the coils and condensers, have been adjusted to tune to those particular signals, they are absorbed and passed on to the crystal detector. Here, they are caused to operate the crystal detector so that, while it does not register the minute changes of each vibration, it does register the difference between vibrations, or in other words, only passes on to the phones that current which may be indicated by the envelope-shaped curve in C of Fig. 3.

The amount of signal which is heard in the phones depends largely upon first, the tuning qualities of the coil and condenser to tune only to the desired signal, and secondly, upon the sensitivity of the crystal detector. Through practice, a sensitive contact can be found on the crystal which will give the maximum amount of signal.

How to Build a Crystal Receiver

One of the simplest of these crystal receivers is described here and is represented diagrammatically in Fig. 1. Here we have a coil, L, consisting of 50 turns of No. 24 d.c.c. wire on a cylinder 3 inches in diameter by 3⅝ inches long. The actual winding space occupies 1⅝ inches, leaving a margin at each end of 1 inch.

The coil is tapped at every fifth turn, the tap being brought out to a double set of switch taps, indicated by S1 and S2. To the end of the coil and S2 is connected a variable condenser C1 which, with the two switches, tunes the receiver to the desired signal. The tuned-in signal is then rectified by the crystal R and fed to the headphone P. Across the headphones is connected a fixed condenser so as to make the signals of stronger intensity in the headphones.

All of the apparatus can be mounted on a board about 9 inches square and aranged as shown in Fig. 2.

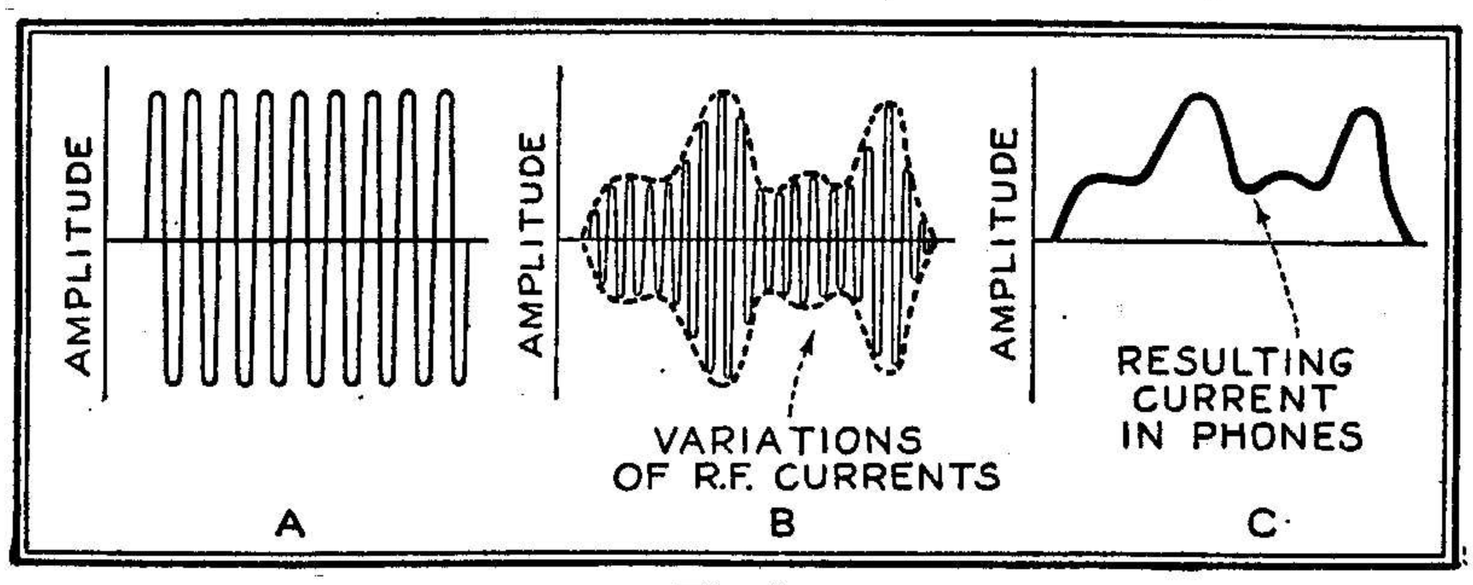


Fig. 3

At A we show the continuous wave or carrier waves set up by the oscillators at the transmitter; in B the microphone current has changed the form of this wave to conform with the variations in the speech or music which is being broadcast; at C is shown the form of the current variation which operates the diaphragm of the headphones attached to the crystal set

The coil for this simple receiver is wound as follows:

Punch two holes close together about 1 inch from the edge of the tube, pass an end of the wire through the holes to fasten it and then begin winding.

At every fifth turn, as the winding of the wire advances, the wire is twisted in a loop as shown, until all fifty turns are completed.

Connection of the various pieces of apparatus is shown quite clearly in the accompanying sketches.

To operate the receiver some random adjustment of the switch S1 will have to be made until you become acquainted with the manner of operating the set. Set switch S2 at the top of first tap and then slowly rotate the knob of the variable condenser until a signal is heard. If you have a manufactured type of crystal detector, then all that will be necessary to obtain a clear signal is to touch the fine pointed wire to various spots on the surface of the crystal until the most sensitive one has been found. The drawing shows how a home-made one can be made.

Next month the Junior Radio Guild Lesson No. 7 will describe radio symbols as used in the preparation and reading of circuit diagrams and will outline the first unit of a vacuum tube receiver which will be described in future lessons.

YOU or your friends may join the Junior Radio Guild merely by sending us the membership coupon (properly filled out) which is printed on page 672 of this issue. There is no age limit, nor do we require that you have any previous training in or knowledge of radio. Of course, if you are familiar with radio, know how to read circuit diagrams or build a set, so much the better. The lessons will then help you to review what you already know.