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Build a Crystal Radio: Electronics Series - Part I

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ELECTRIC GUIDE SHEET
OUTLINE A-21 (Advanced)

BUILD A CRYSTAL RADIO

ELECTRONICS SERIES — PART I

Electronics is a fascinating hobby or a profitable lifetime occupation.

Radio, a part of electronics, had its beginning about 1895 when Marconi succeeded in transmitting a "wireless" message over a distance of a mile and a half.

Marconi did not invent radio, nor was he alone in its early work. However, from that small beginning radio has advanced until today its influence is felt in every phase of our lives.

Through radio and television the world's greatest entertainers, educators, and politicians virtually step into our living room. Electronics provides communications across continents, oceans and into outer space. It aids police in enforcing the law, guides airplanes along the skyways and brings automation to our factories.

Many people regard radio and television as a deep mystery. By learning about electronics from the beginning, a step at a time, you can easily unravel whatever mystery it holds for you.

What to Do

Begin learning about electronics by building a crystal radio.

Figure 1

How Does Radio Work

Most radio transmission and reception makes use of waves. There are sound waves and radio waves. Sound waves travel slower and not nearly so far as radio waves.

Radio waves travel extremely fast. They also travel great distances although they do get weaker the farther they travel.

Let's trace a sound wave from a radio studio to your radio receiver and to your ear. See figure 2.

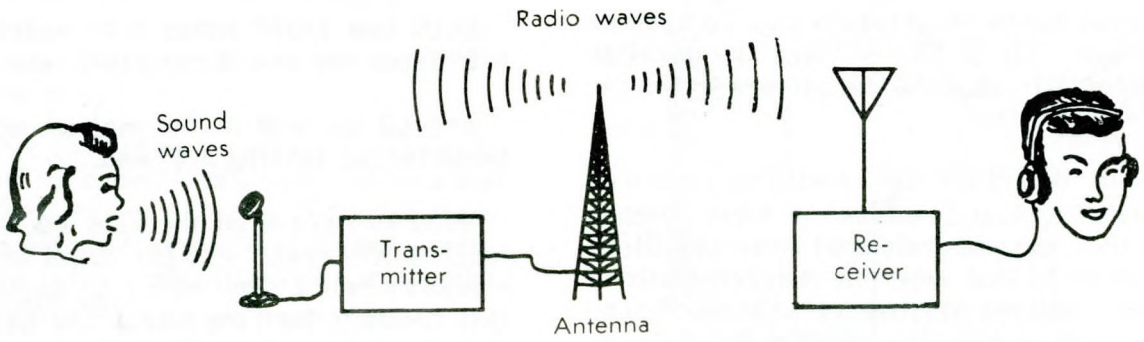

Figure 2—Following a signal from the studio to your earphones

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Basic Radio Parts

Radio receivers have many parts but the four basic ones are (1) antenna-ground (2) tuner (3) detector and (4) reproducer. The crystal radio you will build has these four parts. Another part that you may study later is the amplifier.

1. The antenna-ground system collects the radio waves. If you string a copper wire with one end up in the air and the other end connected to an electrical ground you have an antenna-ground system. Radio waves from a broadcasting station, striking this wire will cause a small electrical current to flow up and down the wire.

2. The tuner, made up of a coil and a condenser selects one radio wave and rejects all others. Using a variable condenser you can select various radio wave frequencies from different broadcasting stations, one at a time.

3. The detector takes the energy which the tuner has selected from the antenna and transforms it into electrical impulses that can operate a reproducer.

4. The reproducer changes the electrical impulses from the detector into sound waves that you can hear. In the earphones that you will use the electrical impulses flow through an electromagnet causing a diaphragm to vibrate and set up the sound waves.

Crystal Detector

Several kinds of crystals can be used as detectors. All of them have the peculiar characteristic of allowing current to flow in only one direction.

Crystal detectors are variously known as crystal diodes and semiconductors. Sometimes they may be referred to as rectifiers all because of that inherent characteristic of allowing current to flow in only one direction. By this means they change an alternating current to a pulsating direct current.

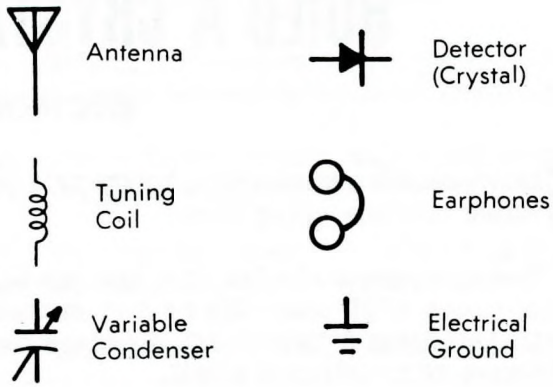

Figure 3—Radio symbols you should know

Materials You Will Need

1 - Piece of wood 3/4" x 5-1/2" x 5-1/2"
1 - Paper tube 1-1/2" x 4"
4 - Fahnestock clips, with solder lugs
2 - Pieces sheet metal 1/2" x 1-1/2"
1 - Variable condenser, 15 to 400 mmf.
1 - Crystal diode, 1N34 or 1N66 or equiv.
60' - Magnet wire, enameled 24 gauge
50' - Antenna wire, stranded bare copper
3' - Thermoplastic hook-up wire 20 gauge
1 - Pair earphones, 2000 ohm
1 - Steel corner angle 1" x 1" x 1/2"
1 - Grounding clamp
1 - Cap screw, 6-32 x 1/4"
2 - Bolts and nuts, 6-32 x 1/2"
6 - Brass wood screws, #6x1/2" round head
2 - Screws, flat head, #4x1/2"
1 - Knob for variable condenser

Coil and Board Assembly

Drill two 1/16" holes 1/4" apart in tube 1/2" from one end of the paper tube.

Thread the end of the magnet wire thru these twice, leaving a 4" end.

Wind 20 turns on the tube so each loop touches the next. Put the spool of wire in a drawer held closed with your knee and use both hands to turn the tube. The harder you push the drawer the tighter the loops of your coil will be.

Make two more holes 1/4" apart right next to the 20th turn. Cut off the wire with about 6" left over. Thread this end thru the two holes twice.

Drill two more holes about 1/8" away from the 20 turns and start the next coil similar to the first one.

Wind 30 turns, twist a small loop in the wire and continue winding 80 more turns. Finish off the coil the same way, with about 6" of wire left over.

To mount the coil bend the pieces of sheet metal (cut from a can) into a Z shape. Drill a 5/32" hole in each end. Drill holes in each end of the tube so that when mounted the wire ends will be on the side. The 20 turn coil should be to your right.

Fasten each Z strip to the tube with a 6-32 x 1/2" bolt and nut. Fasten the Z strips to the wood block with #6 x 1/2" brass screws. Drill 3/32" holes to start the screws. Center the coil on the left side of your board.

Next mount the variable condenser at the right top corner. Fasten the corner angle to wood with flat headed screws. Fasten the variable condenser to corner angle with the 6-32 x 1/4" cap screw.

Fasten four Fahnestock clips to the board with #6 x 1/2" brass screws. Consult figure 4 for locations.

Mark the clip at the top ANTENNA, the one at the bottom GROUND and the two at the right bottom EARPHONES.

Your crystal radio is now complete. Check all the soldered joints. Move the wires so they do not touch each other, and double check your circuit against the schematic wiring diagram.

Provide a good ground. Attach the grounding clamp to a metal water pipe or to a rod driven 8 feet into the ground. Fasten a piece of antenna wire to the grounding clamp screw. Attach the other end of this wire to the clip marked GROUND.

For a temporary antenna, stretch out about 30 feet of antenna wire. Do not let it touch the ground, or any conductive material in contact with the soil. You can use dry wood posts or stakes. Connect the wire to the ANTENNA clip.

Now fasten the earphone leads to the two clips in the right hand lower corner. Turn the variable condenser slowly and you should be able to hear one or more local stations.

Electrical Connections

Follow the schematic wiring diagram, figure 5 and check with the sketch, figure 4.

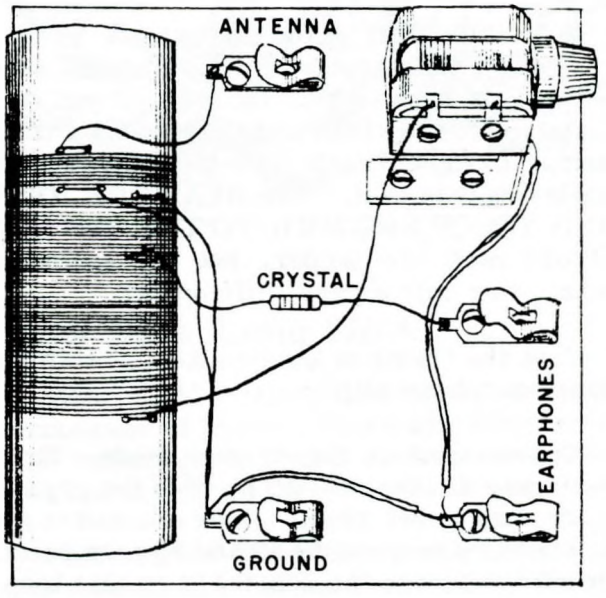

Figure 4—Crystal radio

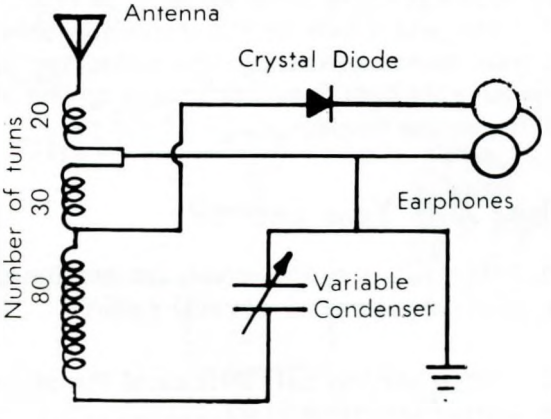

Figure 5—Schematic wiring diagram

Each coil end wire should be pulled to its point of connection, measured for length and cut off. Scrape the enamel from 1/2 inch at the end, bend the wire and hook it onto the solder lug. Solder after all wires are hooked on.

The wire from the top of the 20 turn coil goes to the ANTENNA clip. The other end of the 20 turn coil and the beginning end of the big coil go to the GROUND clip.

The bottom of the coil is connected to the insulated terminal of the variable condenser.

Cut a piece of hook-up wire, bare the ends, connect the GROUND clip and the lower EARPHONE clip together.

Now solder all of the joints made so far, except on the earphone clip. Another wire will go on here later. Be sure all metal to metal joints are clean and tight. Dab a little solder paste on each joint and touch the hot soldering iron to it. Now HEAT THE JOINT AND TOUCH SOLDER TO IT. The joint should melt the solder, not the soldering iron. Use only a very little solder.

Hook the frame of the condenser to the lower earphone clip.

Now connect in the crystal diode. Since heat may be harmful to it, hold the crystal diode with a wet cloth. Hook one end to the twisted loop between the 30 and 80 turn coils. Be sure to scrape the enamel from this loop.

The wire from the other side of the crystal diode goes to the upper earphone clip. You may need a piece of hook-up wire to reach it. Keep the wet cloth on the diode for several seconds after removing the soldering iron to be sure the heat does not travel up the wire and harm the diode.

What Did You Learn?

1. How many radio broadcast stations did you receive with your crystal radio?.....

2. What are the call letters of the strongest station you received?..... Frequency?.....Kilocycles. Power? .....Watts. Distance.....Miles.

3. Radio is a form of (sky travel) (wireless communication) (television).

4. When a person speaks he creates (sound waves) (radio waves) (electrical impulses).

5. The coil you wound was used as part of the (detector) (tuner) (reproducer).

6. The crystal detector 1N34 is (a rare mineral) (a transmitter) (man made).

7. The earphones (reproduce) (amplify) (detect) the sounds made in the broadcasting studio.

8. An antenna-ground system (detects) (collects) (tunes in) radio waves.

9. The variable condenser is part of the (reproducer) (tuner) (detector).

10. An electrical ground is made by (attaching a wire to a metal water pipe), (covering one end of the antenna with dirt) (soldering a copper wire to a steel wire).

Demonstrations You Can Give

Show others your crystal radio. Let them listen. Then explain to them what happens in each of the four parts.

Exhibits You Can Make

To show your crystal radio at a fair, construct a large card (about 18 inches square) that will stand behind the radio and describe it in words. You can stretch ribbons between the words and the appropriate parts of the radio.

For More Information

There are many books and pamphlets available. Look for titles like "Basic Electronics", "Getting Started in Electronics", "Dictionary of Electronic Terms", "Elements of Radio" and so forth.