

BENJAMIN AND DAVID GOLDENBERG 'S VERY-FINE

OLD-TIME CRYSTAL RADIO

Parts List:

Item	Qty.
PVC pipe, 1" outside diameter (3/4" size) x 4" long	1
Aluminum or steel sheet metal, 0.5" wide x 5" long	1
Coil wire (#24 magnet wire)	36 ft
Hook-up wire (#22)	25 ft
Crystal earphone (GC electronics, cat. no. 30-5302)	1
Jack for the earphone plug	1
Crystal diode (1N34A)	1
Capacitor, 470 picofarad	1
#8 sheet metal screws	8
8-32 machine screw, 1" long	1
8-32 nuts	2
flat washers	6
Ring terminal	1
Board, 3/4" thick, approximately 7" x 9"	1

What else you need:

Vise-Grip pliers
Wire cutters
Soldering iron and solder
Drill, with 1/8", 3/16" and 3/8" bits
File or motorized grinder (e.g. Moto-Tool)
Screwdriver
Scotch tape

Instructions

I. CONSTRUCTION OF SPECIAL PARTS.

The following steps involve making a few special parts for the radio. Some of these steps are most easily performed using power tools and some involve soldering. This work should be done by someone old enough and knowledgeable enough to handle these tools safely. Once these parts are made, however, the rest of the project requires only hand tools and can be completed by nearly anyone.

1. Coil Form

The coil form is a piece of PVC pipe, 1" in diameter (outside) and 4" long. (For reasons fully understood only by plumbers, pipe of this diameter is referred to as 3/4".)

To facilitate mounting the coil to the board, drill two sets of holes, on opposite sides of the form. On one side of the form, drill two holes, 3/16" in diameter and 3/8" from the ends. Directly opposite from these holes, drill two more holes 3/8" in diameter. Screws will be placed through the smaller holes, while the larger ones make it easy to reach the screws with a screwdriver.

2. Slider

Drill two 3/16" holes in the piece of sheet metal, each 1/4" from an end. After the holes are drilled, place a bend in the metal 3/4" from each end, as shown in the figure on page 3. Use a vise or pliers to bend the metal. Use a file to smooth all of the edges and corners of the metal.

CAUTION: Drilling sheet metal can be very dangerous! If the bit catches on the metal, you can have a very sharp edge flying through your hands. Hold the metal firmly with a pair of pliers (preferably Vice-Grip type), not with your hands! Also, place a piece of wood under the metal as you drill. This will help keep the metal from tearing and grabbing the bit as the passes through.

3. Pointed screw for slider

Using either a file or a grinder, grind a point on the 8-32 machine screw. The point doesn't need to be very sharp; about like the tip of a medium ball-point pen is ideal.

4. Earphone jack with wires.

Cut two pieces of hook-up wire 2" long. Remove 1/4" of insulation from one end of each wire and solder the wires to the terminals of the earphone jack. Remove 1/2" of insulation from the other ends of the wires.

Note: Headphone jacks often have more than two terminals. Make sure that the terminals you solder to are the ones that will be connected to the tip and side of the plug when it is inserted.

5. Ring terminal with two wires.

Cut two pieces of hook-up wire, one 7" long and the other 2". Remove 1/4" of insulation from one end of each wire. Solder the two wires to the ring terminal. Remove 1/2" of insulation from the other ends of the wires.

6. Board

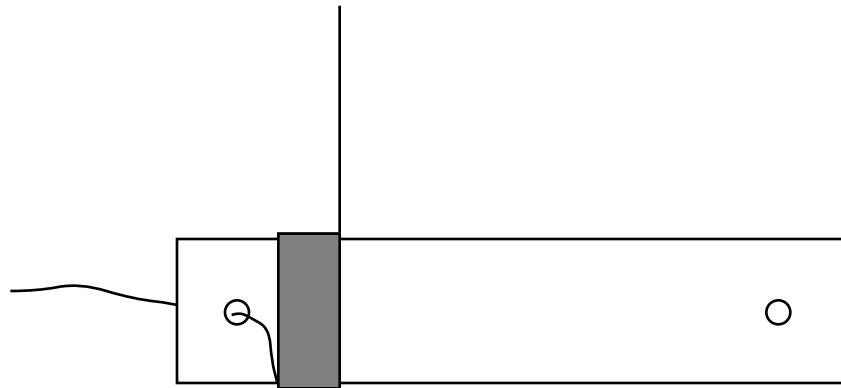
Tape the layout template (the last page of this document) to a board, approximately 7" x 9", and drill a 1/8" hole at each position marked with a cross.

II. ASSEMBLY

1. Wind the coil.

The coil is made by wrapping the #24 magnet wire onto the coil form, which is made from a piece of PVC pipe. The magnet wire is the wire that looks like it has no plastic insulation on it. But, it is actually coated with a thin layer of enamel. This coating must be removed from the ends of the wire before making any connections.

The best way to wind the coil is with two people, one to hold the wire taught (the holder) and the other to wind it onto the coil form (the wrapper). First, thread the end of the coil wire from the outside of the form through one of the large holes and out the end of the form. Leave about 4" of wire going out the end. Hold onto the other end of the wire and begin wrapping it around the form, starting right next to the hole. After you have wound a few turns on, push the wire together so it is nice and neat and put a piece of Scotch tape over it. The coil should look like this:



Now, the "holder" should hold the spool of wire loosely while the "wrapper" walks across the room unwinding the wire. Then, the holder should hold the spool very tightly so that the wrapper can wind the wire onto the pipe evenly. Each turn should be wrapped on right next to the previous turn, but shouldn't overlap. As the wire is wrapped, the wrapper slowly walks across the room keeping the wire tight. When the wrapper reaches the holder, hold the wire that has been wrapped onto the form tightly, while the holder lets the wire on the spool unwrap. The wrapper then walks back across the room unwinding the wire from the spool, and the same procedure is repeated.

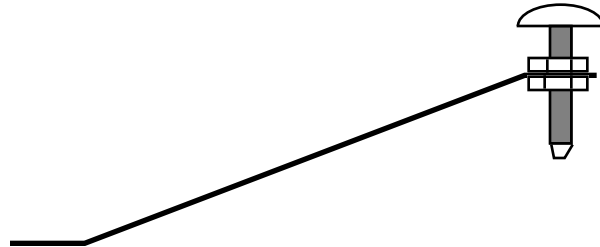
When the coil is within about 1/8" of the holes at the other end of the coil, stop winding. Put a piece of Scotch tape on the end of the wrapping, and cut the wire a few inches from the end of the coil. Thread the end of the wire through the large hole in the form.

2. Attach the coil to the board.

Use two of the #8 sheet metal screws to attach the coil to the board, using holes B and C that you drilled. Place the screws through the small holes in the coil form from the inside. You can then use the large holes on the other side of the form to reach the screws with a screwdriver. Make sure the coil is attached snugly to the board.

3. Assemble the slider.

Find the slider, the 8-32 screw and the two 8-32 nuts. Thread one of the nuts onto the screw until it is about 3/8" from the head of the screw. Put the screw through one of the holes in the slider and thread the other nut on, so that the slider looks like this from the side:



Tighten the second nut against the slider and the first nut with a wrench.

4. Attach the slider to the board.

Find a sheet metal screw, a washer and the ring terminal with two wires attached to it. Put the screw through the ring terminal, the washer and finally the open hole in the slider assembly (from the top of the slider as shown above). Attach the entire assembly to the board with the screw at hole E. Tighten the screw so that it is snug but still allows the slider to move back and forth. The pointed end of the machine screw at the other end of the slider should press firmly against the wire on the coil. If necessary bend the slider so that it makes firm contact with the coil but can still move.

Move the slider back and forth on the coil to scrape the enamel insulation from the coil wire where the pointed end of the machine screw touches it. The screw should be able to make an electrical contact with the coil wire at any position along the length of the coil.

5. Put the remaining screws in the board.

Screw the remaining sheet metal screws into holes A, D, F, G and H, with a washer on each screw. Do not tighten the screws yet.

6. Wire the components of the radio together.

Use the circuit drawing as a guide. For each connection, make sure that the insulation is removed from the end of the wire. Wrap the bare ends of the wires around the screw between the screw head and the washer underneath.

- a. Wrap the two wires from the earphone jack around screws F and H. Do not tighten these screws yet.
- b. Take the short wire from the slider and wrap the bare end around screw F (which should already be attached to one of the earphone jack wires). Do not tighten the screw yet.

- c. Take the long wire from the slider and wrap the bare end around screw A. Do not tighten this screw yet.
- d. Find the crystal diode, the small cylinder with two bare wires attached to it. Wrap one of the wires around screw H (attached to the other earphone jack wire), and tighten the screw.
- e. Take the other wire from the diode and wrap it around screw G. Do not tighten this screw yet.
- f. Find the capacitor, the small disc with two bare wires attached to it. Wrap one of the wires around screw F and tighten the screw.
- g. Wrap the other wire from the capacitor around screw G, but do not tighten this screw yet.
- h. Cut a piece of hook up wire about 6" long and remove about 1/2" of insulation from each end. Wrap one end around screw G and tighten the screw. Wrap the other end of the wire around screw D, but do not tighten this screw yet.
- i. Take the wire from the right hand end of the coil and remove the insulation from about 1/2" from the end of the wire. To remove the insulation, either lightly scrape the wire with a knife or use a small piece of sandpaper. Wrap the bare end of the wire around screw D, but do not tighten the screw yet.

7. Connect the radio to ground.

In order to work, the crystal radio must be wired to a good ground connection. Often, the easiest way to make a ground connection is to use the grounding circuit for the house's electrical system. Cut a piece of hook-up wire long enough to reach from the radio to a nearby electrical outlet. Remove 1/2" of insulation from each end of the wire. Wrap one end around screw A of the radio and tighten the screw. On the electrical outlet, loosen the screw that holds the plate on the box. Wrap the other end of the wire around this screw and tighten it.

CAUTION: Be sure not to let the wire or anything else touch the 120 V socket!

Alternatively, you can use a cold water pipe to connect the radio to ground. Remove a few inches of insulation from the wire from screw A of the radio and wrap the bare end around a cold water pipe.

8. Connect an antenna to the radio.

Use the rest of the hook-up wire to make an antenna. Remove 1/2" of insulation from one end of the wire and wrap it around screw D. Tighten the screw. Unwind the wire from the spool and try to place it as high as possible in the room.

In areas with many powerful radio stations nearby, an inside antenna should be adequate to receive a few stations. If you have trouble hearing anything, it may help to

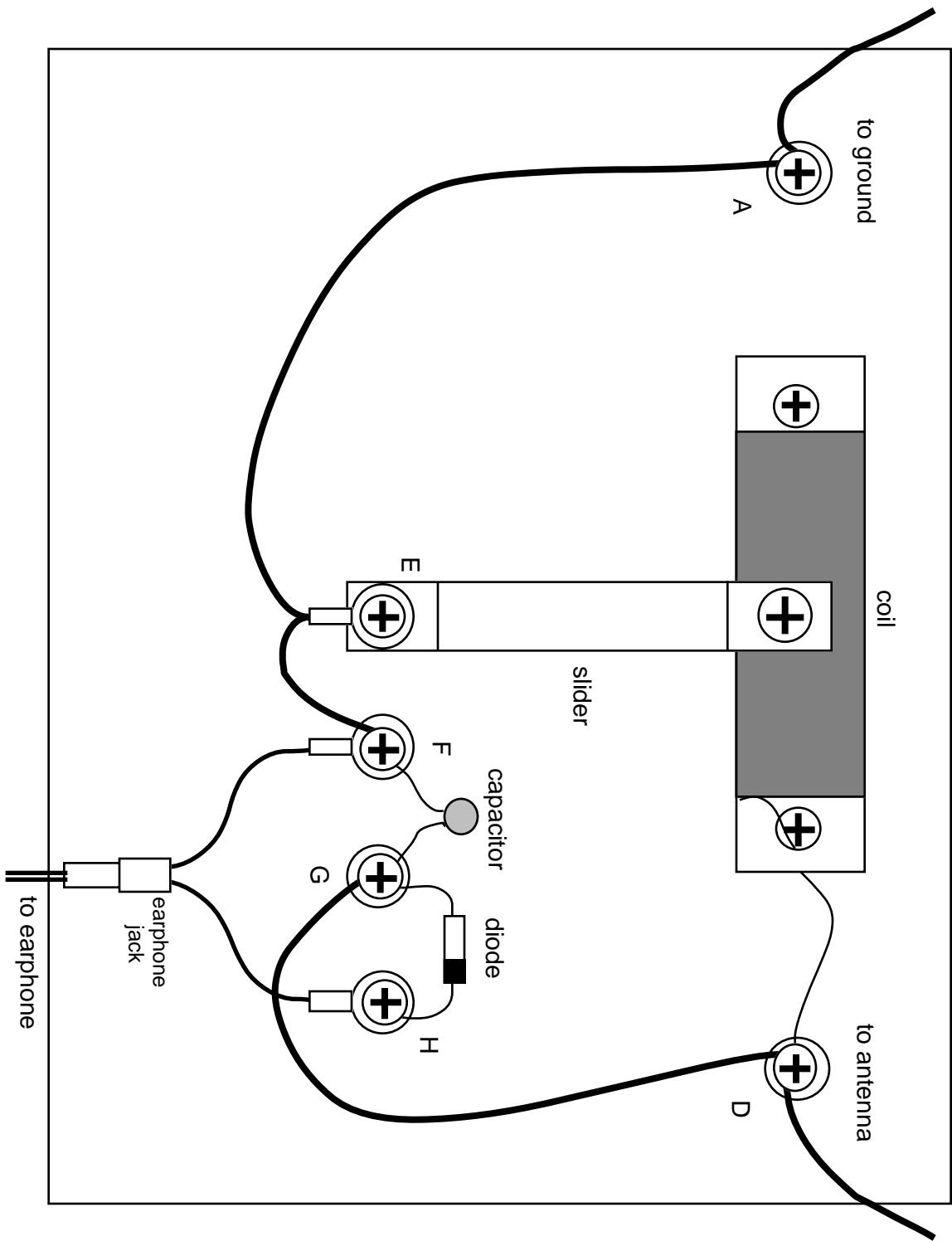
set up a long outside antenna. Radio Shack sells a kit with the necessary wire and other parts (cat. no. 278-758).

9. Try the radio!

Plug the earphone into the jack. Listen to the earphone and slowly move the slider across the coil. Try to find the position where a station is loudest. You should be able to hear a few different stations with the slider at different positions.

10. If the radio doesn't work, check the following:

- a. Make sure all of the connections are correct and that the insulation has been removed from the wires where they are wrapped around screws. Also check that there aren't any short circuits between the screws or bare wires.
- b. Make sure that you scraped the insulation from the coil wire with the slider so that the slider can make good contact with the coil.
- c. Make sure that you have a good ground connection. Try a different electrical outlet or a cold water pipe.
- d. Place the antenna higher up or try a longer wire.



A +

B +

C +

D +

E +

F +

G +

H +