A Pretty Good Crystal Set

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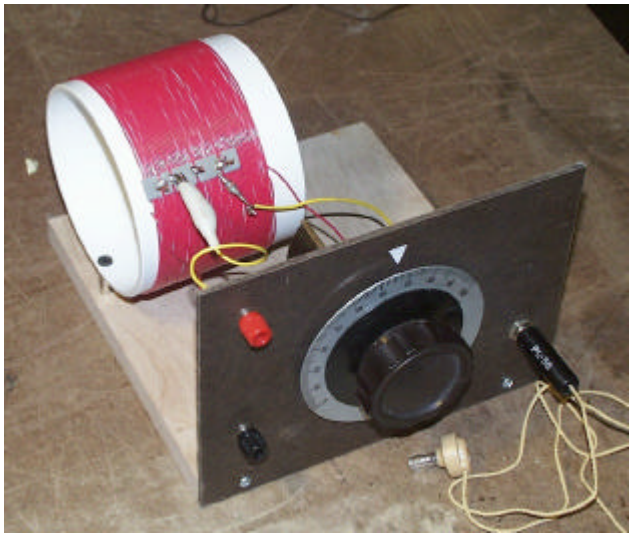
OK! It's time to build a crystal set. This time it's going to be a good one.



Countless millions of crystal radios have been built over the last 100 years, but the performance of most of these leaves a lot to be desired. The design of this radio goes back to about 1990 when I was a den leader for my son's Cub-Scout pack. I wanted the guys to have the experience of listening to a radio they had built with their own hands. However, we were in the deep suburbs of Philadelphia (actually half way to Reading). There were no strong local stations, so an average crystal set combined with the sort of makeshift antenna most families would erect, wasn't going to get the job done. The result was the Den Two Crystal Radio. (See "Crystal Set Projects," The Xtal Set Society, 1997.) This radio was based on a spider-web coil that 10-year-old hands could wind with a little supervision. It was sensitive enough to hear distant sky-wave stations at night, and selective enough that you could usually listen to just one station. Seven were constructed and at least six of those went into service at home. Everyone was duly impressed. We even had reports of hearing Radio Japan! (That was from Ontario, however.) We'll use the same circuit with a better solenoid-style coil.

First, lets deal with the headset. Look around for a traditional pair of 2000-ohm 'phones. That's the DC resistance, they'll have an AC impedance of about 10,000 ohms. Test the 'phones by putting them on your head, holding on to one of the tips and touching the other to an electrical ground such as a water pipe or the screw on an outlet plate. You should hear a click or maybe a hum. If not, they probably won't be sensitive enough for our purposes. Check the DC resistance with an ohm meter, it should be in the range of 1-5 K-ohms. Sometimes the cords are open.

An acceptable alternative to a vintage headset is one of the crystal (ceramic) ear plugs available from Mouser.com for about two bucks. It's best to install a 50-100K resistor in parallel with these 'phones to provide a DC load for the detector to eliminate audio distortion.

Modern low-impedance headsets with a matching transformer might work if you have a lot of signal strength, but most are designed to sacrifice sensitivity for flat frequency response.

Next, comes the detector. Stick to a germanium diode or the base-emitter junction of a germanium transistor for openers. A digital voltmeter in the diode position will indicate the forward voltage drop. Germanium devices will show 0.2-0.3 while

silicon will indicate 0.5-0.7 volts. You can use a modern silicon device, but you'll be giving up a lot of sensitivity. The basic germanium diode is the 1N34A, but the part number doesn't mean much. They vary widely. Dump out the junk box, try them in a radio, and pick the best one. You can move on to mineral detectors and cat's whiskers after you have a working radio.

Now you'll need an antenna, the higher, longer, and more in the open the better. Sixty feet long and forty feet high would be excellent, but wire in the attic will probably suffice, especially if you're a "city mouse." A wire to a hose clamp around a water pipe or a connection to the screw on an outlet plate (AC safety ground) will complete the antenna-ground system.

Now it's time to build the simplest possible radio: Clip-lead the diode across the headset and then connect one side to the antenna and the other side to ground. You should hear something, quite possibly three stations at once.

To make this kludge into a serviceable radio we'll add a tuned "tank" circuit consisting of a coil and a variable capacitor. The target value for the cap is 365 pico-farads (mmF or pF), but a 500 pF unit as found in some of the old battery sets will work nearly as well. You could also use the large half of the two-gang cap from a junked all-American five radio, etc.

The coil is wound on a 4-inch styrene pipe coupling from the "home center." Wire is generally expensive and hard to buy retail. I've specified #20 insulated bell wire, also from the "home center" because it is easily available. The down side is that it's twisted pair that needs to be unwound, and they make you buy 500 feet, for about 30 bucks, when you only need 85 feet for the project. Any plastic insulated wire between #26 and #20 will do, but you'll probably need to adjust the total number of turns after you get the radio going to cover both ends of the broadcast band. The best option, for maximum performance, is silver-plated Teflon-insulated hook-up wire if you have any in the junk box, but even common vinyl-insulated tinned stranded wire will work all right. Close-wound magnet wire is a bad bet, as eddy currents in the adjacent turns cause considerable loss.

Winding the coil: Tie one end of an 85-foot length of wire to a solid support. Drill two small holes 3/8 of an inch from the end of the coil form. Keep the drill and wire cutters handy. Put a strip of thin cardboard about 3/8 inch wide and 3 inches long in your shirt pocket. Lace the end of the wire into one hole and out the other, leaving about a foot protruding from the form. Grasp the coil form firmly and pull the wire taught against the tied off end. Wind 5 turns on the coil keeping the wrie close-wound and tight. Place the end of the cardboard strip under the 5th turn. Wind four more turns, sneaking them under the strip. Wind the 10th turn over the strip. Continue winding placing the 20th and 30th

turns on top of the cardboard. Wind 18 more turns for a total of 48. Clip the wire leaving about a foot to terminate the coil., drill two more holes in the form, and lace the end of the wire through them.

Use a utility knife to whittle away the insulation where the 5th, 10th, 20th, and 30th turns cross the cardboard. Wrap and solder a piece of bare wire at each of these sites to form the coil taps.

"Beadboard" the radio with clipleads or tack-solder joints to make sure everything works before committing to a physical design. The radio in the picture is built on an 8-inch square piece of ¾" plywood with an 8 x 6-inch front panel of tempered hardboard. Layout is not critical, but keep the coil in the approximate orientation shown so it can be coupled to the antenna tuner to be described in "PGXS – Phase II."