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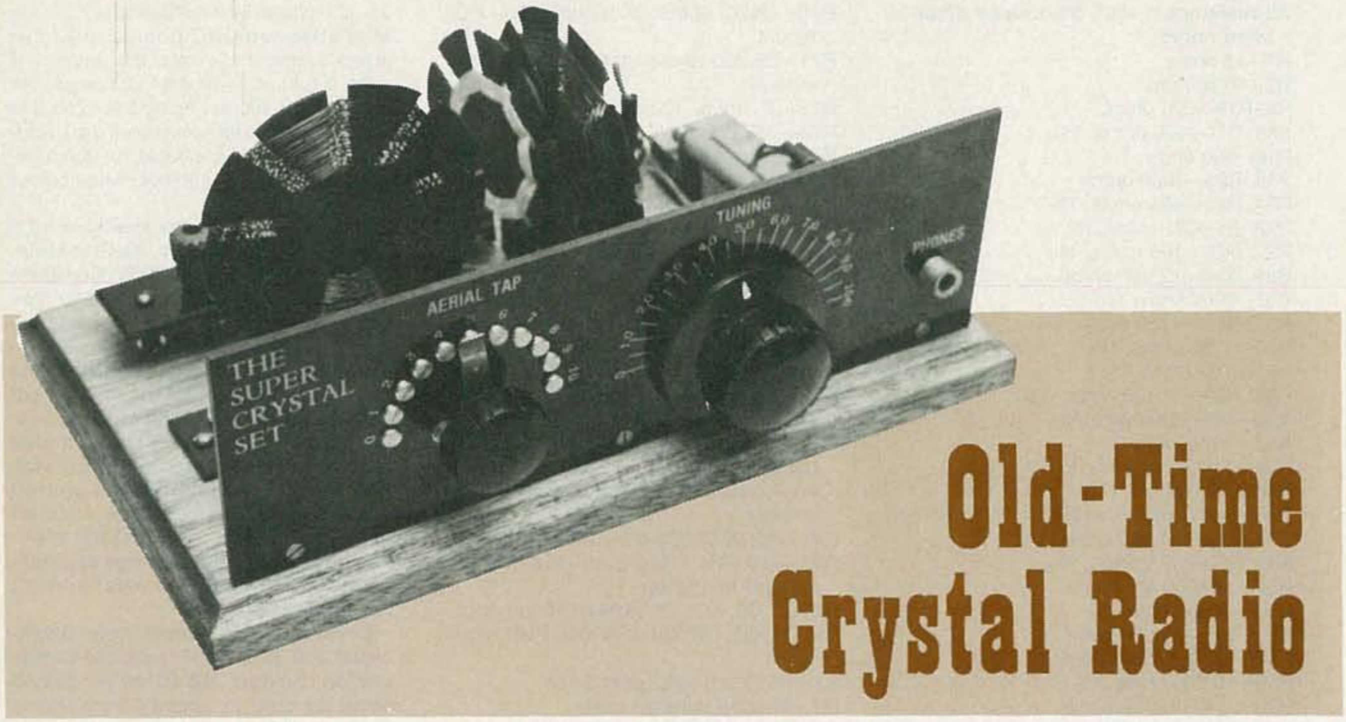

Old-Time Crystal Radio

Here's how to build a vintage-style crystal radio receiver with performance that might surprise you.

PAT O'BRIAN

EVERY ELECTRONICS HOBBYIST HAS BUILT a crystal set. What? *You* haven't? Then this vintage-style crystal radio is the one to build! It's a high-performance receiver that tries its best to remain true to its era.

Crystal radios capture the imagination because they need no power source and they bring back the days when radio was "magic." There is, of course, nothing magic about a crystal set that works well. But careful design can make a receiver something special. This design uses the signals captured by the antenna very efficiently. Of course, the attractive polished wood base helps make the receiver special, too—even to those who aren't usually fascinated by the "magic" of crystal radios.

A high-performance circuit

The schematic of the receiver is shown in Fig. 1. One of the features of the design is that the antenna-tuning circuit is separate from the main frequency-selection circuit. The antenna-tuning circuit is made up of an 80-turn, 10-tap coil (L1), a coupling coil (L2), and an optional fixed capacitor (C1). It acts as a pre-selector for the main tuning circuit. In other words, it maximizes the strength of the signals received by the antenna at a particular frequency or frequency band.

The inductance of L1 is varied by selecting one of the coil's taps. The energy from the antenna-tuning circuit is inductively coupled to the main tuning circuit via L2 and L3. The degree of coupling is variable. As shown in the photo in Fig. 2, L2 can pivot about its mounting point. The variable coupling results in a more selective receiver.

The main tuning circuit is made up of L3 and C2. RF energy from that tank circuit is tapped off by S2 and detected by D1. Switch S2 isn't a conventional switch. Instead, it is an alligator clip that is moved from tap to tap. The detected audio signals are fed to jack J1, and then to a pair of high-impedance (4000 ohm) headphones. Capacitor C3 acts to bypass RF past the headphones, which must be a high-impedance type.

Building the receiver

How you build your receiver is, of course, a personal choice. But we'll show you what we think is the right way to do it. If you lack the skills or the materials that are needed to put together an authentic-looking crystal radio, then you might be better off buying the kit that's available from the source mentioned in the Parts

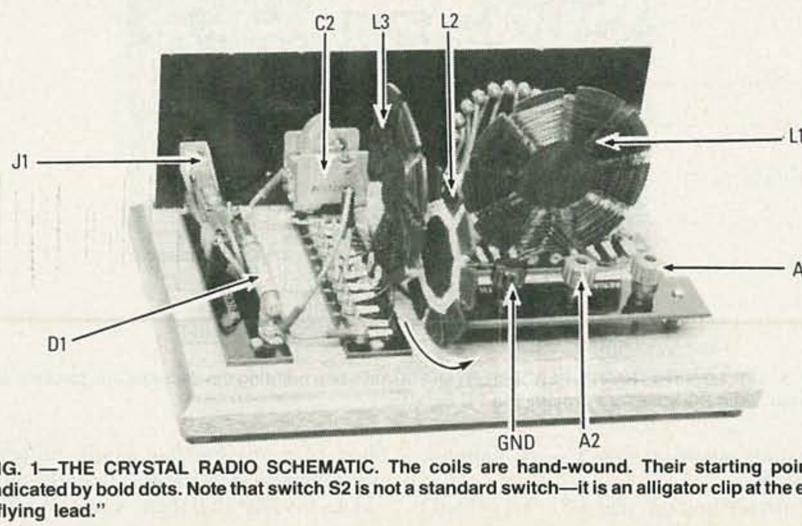

FIG. 1—THE CRYSTAL RADIO SCHEMATIC. The coils are hand-wound. Their starting points are indicated by bold dots. Note that switch S2 is not a standard switch—it is an alligator clip at the end of a "flying lead."

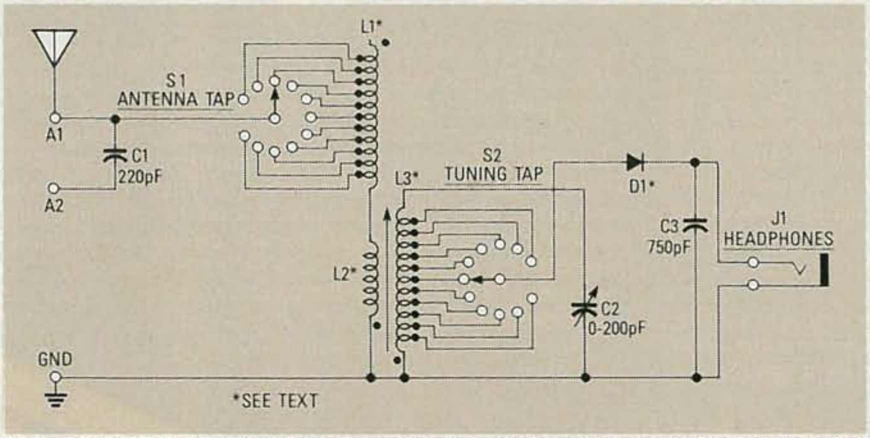

FIG 2—REAR VIEW of the crystal set shows how the components are mounted on bakelite panels, which are in turn mounted to the hardwood base. Note that the coupling coil, L2, pivots around its mounting point so that its degree of coupling to L3 can be adjusted. Also note the case in which D1, the crystal detector, is mounted.

PARTS LIST

D1—1N34A germanium. See text
C1—220 pF, mica
C2—0–200 pF, variable
C3—750 pF, mica
L1, L3—80 turns of 26-gauge wire on spider-web form. See text.
L2—16 turns of 26-gauge wire on spider-web form. See text.
J1—phone jack, ¼ inch
Miscellaneous: Hardwood base, coil forms, 26-gauge wire, binding posts, rubber mounting feet, high-impedance headphones, etc.

NOTE: A complete kit for the crystal receiver (order No. K-9002) is available from Dick Smith Electronics, Inc., P.O. Box 8021 , Redwood City, CA 94063, 800-332-5373 (orders) 415-368-8844 (inquiries) for $79.95 plus $5.50 handling. High-impedance vintage (1940) headphones (order No. C-4001) are available for $19.95 plus $2.50 shipping. California residents must add 6.5% sales tax.

List. (The receiver shown in the photos was built from a kit.) If you choose to put yours together from scratch, don't hesitate to change our layout to suit the components you find. Just try to keep the flavor of the past by following our prototype and by using using things like brass screws, DCC (*D*ouble *C*otton *C*oated) wire, bakelite mounting panels, etc.

Before we can build the receiver, we have to get all the components together. It will take some scrounging but it can be done. The best place to start is with the components you'll have to make yourself: the three "spider-web" coils.

Winding the spiderweb coils is perhaps the most difficult part of building the receiver. It's actually not that difficult if you follow our directions carefully. Two of the coils, L1 and L3, are wound identically. They consist of 80 turns of 26-gauge enamel-coated wire wound on a 9-spoke spiderweb coil form with a diameter of 4¼ inches.

The coil is wound as ten separate 8-turn coils. After they are wound, they are connected together—the connections become the taps. Figure 3 shows what your coil form should look like, and indicates some of the winding specifics.

The coils are wound from the "front" of the coil forms, which is the side where the "L" mounting brackets are attached. Start at the inside of the coil and work outward. To start each 8-turn coil, feed about 10 inches of wire through the appropriate hole from the front of the form, taking it around the right side of the mounting spoke (which we'll call the anchor spoke), and feeding it again through the same hole and pulling it tight. That anchors the start of each coil in place. Now wind the wire around the coil form, under the first spoke, over the second, under the third, and so on.

The "finish" end of the coil is pushed through the next hole toward the outside of the form, and it is anchored to the spoke by bringing the wire around the the *left* side of the mounting spoke and through the hole and pulling it tight.

The start of the next coil is anchored at the hole where the preceding coil ended. Be sure to wind the coils tightly so that a total of 80 turns will fit on the coil form, and so that you don't cover holes on the anchor spoke.

When all ten 8-turn coils are wound correctly on the coil form, you should be left with 9 pairs of wire, and two single wires (the start and end). Twist each pair together tightly, and cut to an appropriate length. Solder the 9 pairs together, and tin the start and finish leads. You'll have to apply a good amount of heat from the soldering iron because you need to melt the enamel coating. If you do it right, you won't have to scrape the leads bare. You can check your work by measuring con-

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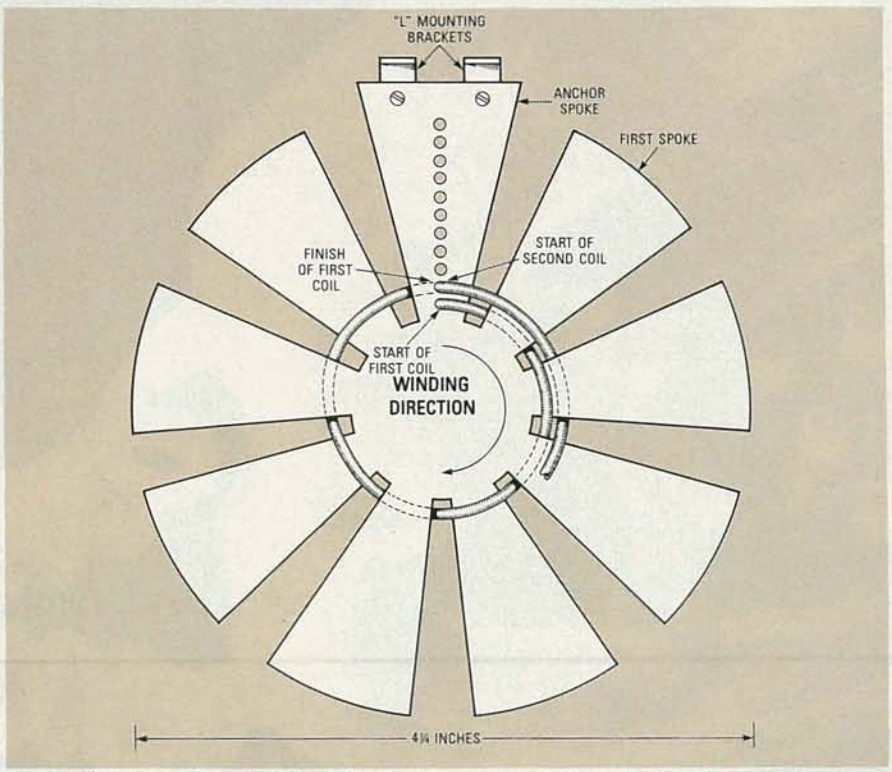

FIG. 3—THE SPIDER-WEB COILS must be hand wound. Here, shown half size, is the coil form for L1 and L3. Each coil consists of 80 turns of 26-gauge enamel-coated wire, tapped every 8 turns. However, as explained in the text, they are wound as ten separate 8-turn coils. Coil L2 is wound as 16 turns of 26-gauge cotton-coated wire on a 3¾-inch form. Use stiff, black cardboard to make the forms.

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tinuity from the beginning of the coil to the end.

The coupling coil, L2, is wound in the same manner as the larger coils, but it's wound on a smaller (3¾-inch diameter) form, and is made up of 16 turns of 26-gauge DCC wire. The anchor spoke has a single mounting point, so that the coupling to L3 can be adjusting by pivoting L2 around that point.

Diode D1 can be just about any germanium diode. But if you want to keep your crystal radio authentic-looking, you should mount it in a case like the one shown in Fig 2. Such cases were commonly used to mount fixed-contact catwhisker detectors.

The variable capacitor is a 200-pF device. It won't be easy to find, so feel free to experiment with its value. Capacitors C1 and C3 are fixed-mica types.

Perhaps the most important part of building the receiver is putting up the antenna system. For good results, your antenna should be as long and as high as possible. If you can manage to put up a 75-foot long-wire antenna, great! Just remember: your ground system is also very important. A four-foot copper pipe or rod hammered into the earth can make a good ground. If you can't manage that, try your cold-water pipe.

The wooden base shown in the photographs is about 11 by 7 inches (it's ¾ inch thick). The edges are routed for a smooth appearance. Choose some type of hardwood, such as oak or maple for the base, and sand it well. Stain it according to taste, and then give it a couple of coats of satin-finish polyurethane. *(Sand very lightly)* between coats.

If you want to finish both sides of the breadboard base at the same time, then use four woodscrews as temporary feet. (Install them where you will be installing the rubber feet.) Finish the bottom of the breadboard first, and then turn it over and finish the top and the sides. The screws will keep the bottom of the board from touching anything else. Before you give the breadboard a second coat (which we do recommend), just be sure to let the first coat dry thoroughly. Then sand very lightly with super-fine-grit paper, and apply the second coat.

When your base is finished, it's time to start mounting parts. The parts on the prototype (and the available kit), including the coil taps, are mounted on small bakelite panels which are, in turn, mounted to the base. The main tuning capacitor, the headphone jack, and the antenna tap switch are mounted to the front panel, which is, in turn, mounted to the base using small "L" brackets.

Operating the receiver

Tuning your crystal set can be tricky business until you get used to it. The first step is to set the detector tap to the midway point, and to set the antenna tap switch, S1, to 0 (minimum inductance) and adjust L2 for maximum coupling to L3. When you plug in your high-impedance headphones, you'll hear one or more stations.

Tune to a station at the lower-frequency end of the band by adjusting the main tuning capacitor, C2, so that its plates are about 2/3 in mesh. Then reduce the coupling between L2 and L3, until you can barely hear the station. Advance the antenna tap switch until you reach the peak volume for that station. When that station is tuned, you can reduce the coupling further between L2 and L3. While that will reduce the volume, it will increase the receiver's selectivity, so you can tune in other stations on nearby frequencies.

Once you get used to tuning the radio, you can experiment with the detector tap. If you are in a strong-signal area, you can probably get by with decreased inductance of L3. That will increase the receiver's selectivity also. **R-E**