Add a Directional Loop Antenna to your CB or Ham Rig

By D. E. Patrick

Here's a useful project to help find a CB'er or Ham who is causing TVI, or one who is lost or otherwise in need of help!

YOU'RE SITTING AT HOME WATCHING YOUR FAVORITE TV show. Suddenly, the picture is enveloped in snow and the sound becomes distorted. What's happened is that some CB'er or ham is victimizing you with a spitting, spattering, over-powered, over-modulated, and/or off-frequency transmission. If you're lucky, he'll go away—but more than likely he won't.

Now, you don't have to just sit there and take it. Using your CB or ham transceiver's S-meter and a loop antenna, you can locate him, take away his anonymity, and a discuss the matter up-close and personal.

On a more pleasant note, the Directional Loop Antenna described here can be invaluable when searching for a CB'er who's lost or in need of help.

Going Further

A direction-finding loop antenna is a tried and proven method of finding a transmitter. The unit described here can be built with, or without, an optional preamp, depending upon the sensitivity of your receiver. It is designed for direction-finding only—not for transmission. In fact, should you desire to blow away your final amp's chips, press the talk button when the loop is connected.

As shown in Fig. 1, the antenna proper is a loop of copper tubing. It is mounted to a larger piece of PVC or ABS plastic tubing, used as a mast, and tuned with trimmer capacitors and an adjustable slider. The antenna is attached to a ham or CB receiver or transceiver. The receiver (or transceiver's) S-meter is used as an indicator of received signal strength.

When the flat surface of the loop is aimed (broadside) in the direction of a transmitter, the S-meter will provide a null indication. In other words, the direction of the flat side of the loop will indicate a line along which the transmitter is located. Adding a pointer to the unit, perpendicular to the flat side of the loop, can be a help.

Of course, if you rotate the loop 180°, you will get a second null. Therefore, at least two readings—and a map—are required, as shown in Fig. 2. With two readings, the position indicated by the intersection of the two lines is the location of the transmitter. Thus, with the aid of a map (oil company and auto-club maps are the best), you should be able to track down your quarry. However, the more readings you take, the sharper an indication of the location you can obtain.

Loop Antenna Construction

To build the loop proper, take a 30-inch length of copper tubing and start bending it into a loop around a 5-gallon paint can, or a thin telephone pole, or similar form to give you the basic shape; you can finish it up by hand (of course, a pipe bender or former is the ideal way to go). At the two open ends solder a 5- to 50-pF trimmer capacitor (C1) so it can be

30-IN. LENGTH of copper-tubing loop is cemented in place with epoxy. Trimmer capacitor C1 is soldered to bridge the loop's ends. Note coax cable taped to loop at left.

adjusted from the top side. Drill two holes through the tubing for two #6 screws that are used to mount the loop to the mast.

Attach the braid of a piece of RG-58/U or equivalent coax to the top center of the loop, with the center conductor going to a copper slider. Four inches minimum of the braid should be attached to the slider. The slider can be cut from a piece of 1/64-inch thick copper or brass sheet to approximately 7/8 × 1/4 × 1/64-inch, with a 1/8-inch screw hole, and a 3-32 × 1/2-inch screw/nut combination used as a tightener.

Preparing the Mast

The copper loop is mounted on a piece of 2-inch diameter ABS tubing or equivalent. The tubing, which is used as a mast, should be a least one-foot long. Two 7/16- × 1-inch slots are cut in the top side of the mast to receive the copper loop. A 3/8- × 3/8-inch slot is cut in the bottom side of the mast for the output coax line. Two 11/64-inch holes were drilled to hold the loop to the mast with #6 2½-inch screw/nut combinations. The actual length of the screws will be dictated by the diameter of the mast tubing used. Another 1/8-inch hole is drilled in the bottom of the mast to hold a line restraint for the output coax.

Also, two 1/8-inch holes were drilled to hold a small circuit board upon which C2, C3, and L1 are mounted; another 1/4-inch hole is drilled to allow adjustment of C2 if no preamp is used. On the other hand, an additional 1/4-inch adjustment hole is required for a third trimmer capacitor if a preamp is used.

If no preamp is required, C2, C3, and L1 are mounted on a piece of perforated construction board, with the loop coaxial cable attached to the center tap of L1 and ground, and the output coaxial cable attached to C3 and ground (see Fig. 3). Inductor L1 consists of 25 turns of #24 magnet wire on a 1/4-inch coil form, tapped 6 turns from the lower end. That is, wind 6 turns, make a ½-inch diameter loop, twist the loop and wind another 19 turns. Capacitor C2 is wired in parallel with L1 and C3 goes to the tap. The low end (end with smallest number of turns) goes to ground. The inner lead of coax from the loop is soldered to the tap and the inner lead of the output coax is soldered to the other end of C3.

Generally, well-designed receivers with at least one RF preamp stage and a good signal-to-noise ratio won't require a preamp. Further, too much gain can have the net effect of

END OF COAX BRAID is soldered to the top-center of the copper loop and the center conductor of the cable is connected to the slider that is made from a piece of copper.

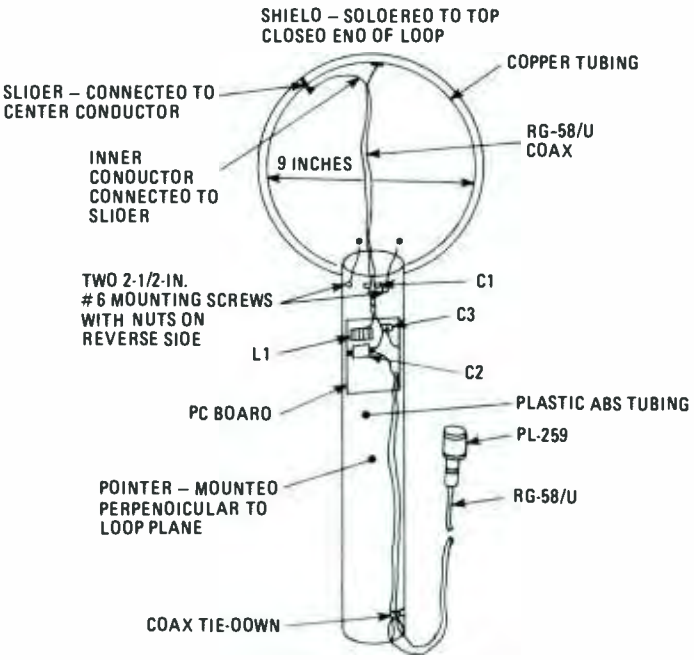

FIG 1—A LOOP ANTENNA can easily be built using some copper tubing, some plastic tubing for the mast, and a few components. It can help you locate the source of troublesome TVI, or find the position of someone who is in need of help.

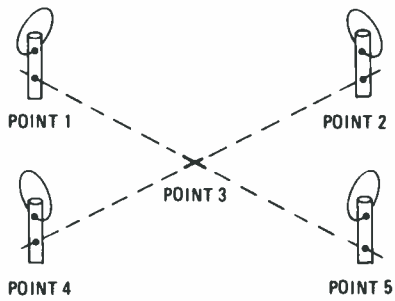

FIG. 2—TO PINPOINT a location, at least two readings should be taken. The point where the lines determined by those readings intersect is the general location of the transmitter. The more readings that are taken, the more precisely a location can be found.

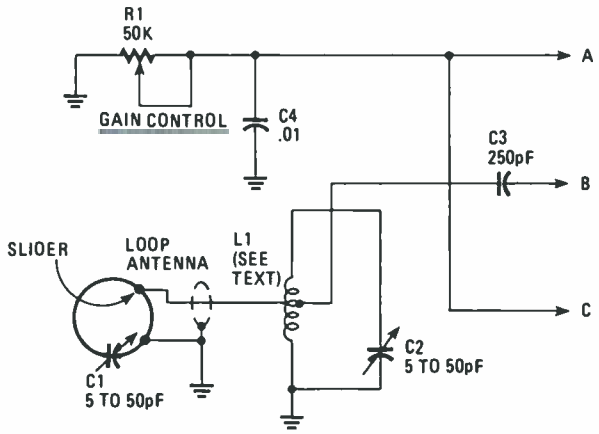

FIG. 3—THE BASIC circuit to tune the loop antenna. Coil L1 consists of 25 turns of #24 magnet wire, tapped at 6 turns from the low end, on a 1/4-inch form.

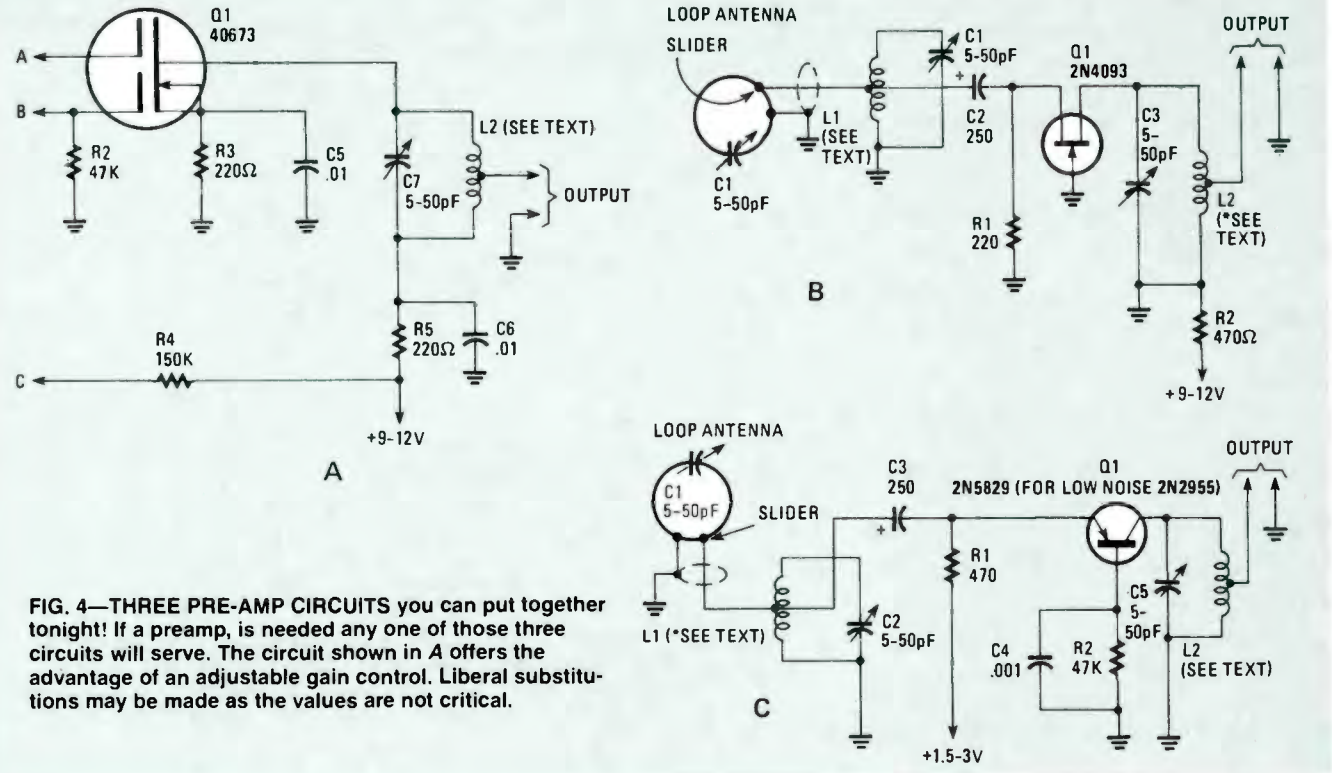

FIG. 4—THREE PRE-AMP CIRCUITS you can put together tonight! If a preamp, is needed any one of those three circuits will serve. The circuit shown in *A* offers the advantage of an adjustable gain control. Liberal substitutions may be made as the values are not critical.

overloading some receivers. Therefore, the loop antenna should be tried out first on your particular receiver without a preamp. If a preamp is used, some type of provision to bypass the preamp in strong-signal areas should be included.

In any case, all the preamps in Fig. 4 are similar. The protected dual gate MOSFET circuit in Fig. 4A is a common-source type with gain control provided by R1. The circuit in Fig. 4B is a common-gate JFET type, and the circuit in Fig. 4C is a common-base transistor type.

Coils L1 and L2 are wound the same as described earlier. The circuits of Figs. 4A and 4B require 9 to 12 volts, while the circuit in Fig. 4C runs on only 1.5 to 3 volts. All three can be built out of junkbox parts, with pretty loose substitution of parts allowed. The values shown in the circuits are not at all critical. Note that one advantage of the circuit in Fig. 4A is that it offers the convenience of gain control, which can come in handy.

Adjusting the Loop

First, let's look at the Directional Loop Antenna adjustments if no preamp is used. Connect the antenna to one receiver (or transceiver), and key a transmitter on the same frequency (not the same transceiver) using a light bulb as a dummy-load for 5-watt CB rigs. With the two units some distance apart, adjust C1, C2, and the slider on the loop with an alignment tool for a peak indication on your S-meter. The adjustments will interact, and if one or more adjustments won't peak the S-meter, try adding a 10- to 20-pF capacitor across C1.

If each adjustment still doesn't give you a peaking-type indication, perform the same procedure to C2. And if all the above doesn't work, add a few turns to L1's long side. When everything is right, C1 should be able to make the S-meter rise toward a peak and fall toward a null, then C1's adjustment range will cover the entire CB band—the source of most TVI. However, the loop can be also used to find a ham transmitter (usually less of a problem) with a little adjustment or by changing capacitor and/or inductor values.

Adjusting the unit with the preamp is about the same, except for the additional trimmer that is adjusted in the same manner as C2. However, you'll typically need a greater distance between test receiver and transmitter to avoid overloading Q1. Generally, the preamp is not required for strong signals and should be switched out of circuit or bypassed when not in use.

PARTS LIST FOR DIRECTIONAL LOOP ANTENNA

C1, C2—5–50-pF, trimmer capacitor
C3—250-pF, ceramic disk capacitor
L1—Tuning coil (see text)
Copper tubing (⅜-inch O.D., 30-inches long), ABS plastic tubing (2-inch O.D., 12-inches long or greater), RG/58-U coax, miscellaneous hardware, sheet copper for slider, etc.

Use

Tune your transmitter to the frequency of interest. Tweak up the loop antenna by adjusting C1. Rotate the loop for a null on your receiver's S-meter. That will provide you with a line along which the transmitter lies. Using a map and a compass, find your location. Draw a line on the map as indicated by the loop antenna. Drive or walk some distance away and take another reading as previously described. Draw another line on the map. The transmitter is located where the lines intersect. For greater accuracy, take some additional readings. The point where all the lines intersect is the location of the transmitter. Now, go get him! ■