BY KENT BRITAIN,* WA5VJB

More on Small Loop Antennas

As we covered in the March issue in this column, a lot has been written about the low noise, or noise reducing, characteristics of small loop antennas. Loop antennas pick up the magnetic portion of the electromagnetic spectrum, or radio waves. Thus, loop antennas tend to reject local noise, which typically is radiated in the electrical, or E, field.

A lot of this E-field noise comes from AC power lines. Therefore, it is best to position your loop antenna away from power lines in the house. Sometimes moving a loop just a few feet can really drop the noise floor. If you can, try different spots around your QTH.

All small loops have a figure-8 pattern, as shown in fig. 1, with the nulls in the direction of the broad side of the loop. These nulls can be very handy. By turning the loops, you can often put a noise source in the null. The null can also be very effective to null out strong QRM stations. Also, if the loop is small enough, you would hardly be the first ham to just set it on top of the rig so yu can quickly twist the antenna to a null. I have never tried putting a loop on a small TV rotator, but that is certainly one way to do it. Simply twist the rotator for best reception.

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Just connect your receive loop to your HF receiver and start looking for those weak signals. The first thing you are going to notice is that signals are three or four S-units down from what you are used to. This lower signal level is typical, but have you noticed that the noise floor is down five S-units? Try a few different locations, rotate the loop in a few different directions, and you probably can bring that noise floor down even more.

A Simple Loop to Build

Here is a simple low-noise loop antenna you can build easily (photo A, figs. 2 and 3). Also, by sending some DC power back up the coax, you can tweak the tuning for your favorite part of the band.

I took advantage of a spectrum analyzer with a tracking generator into a resistive bridge to tune up this loop. However, if you build it close to the dimensions given in the figures, just find a good steady signal and peak on it. If you have a trimmer capacitor in the 150–300 pF maximum range, it makes a good tweaker across the diodes.

Photo A– The loop antenna and the diode bias supply.

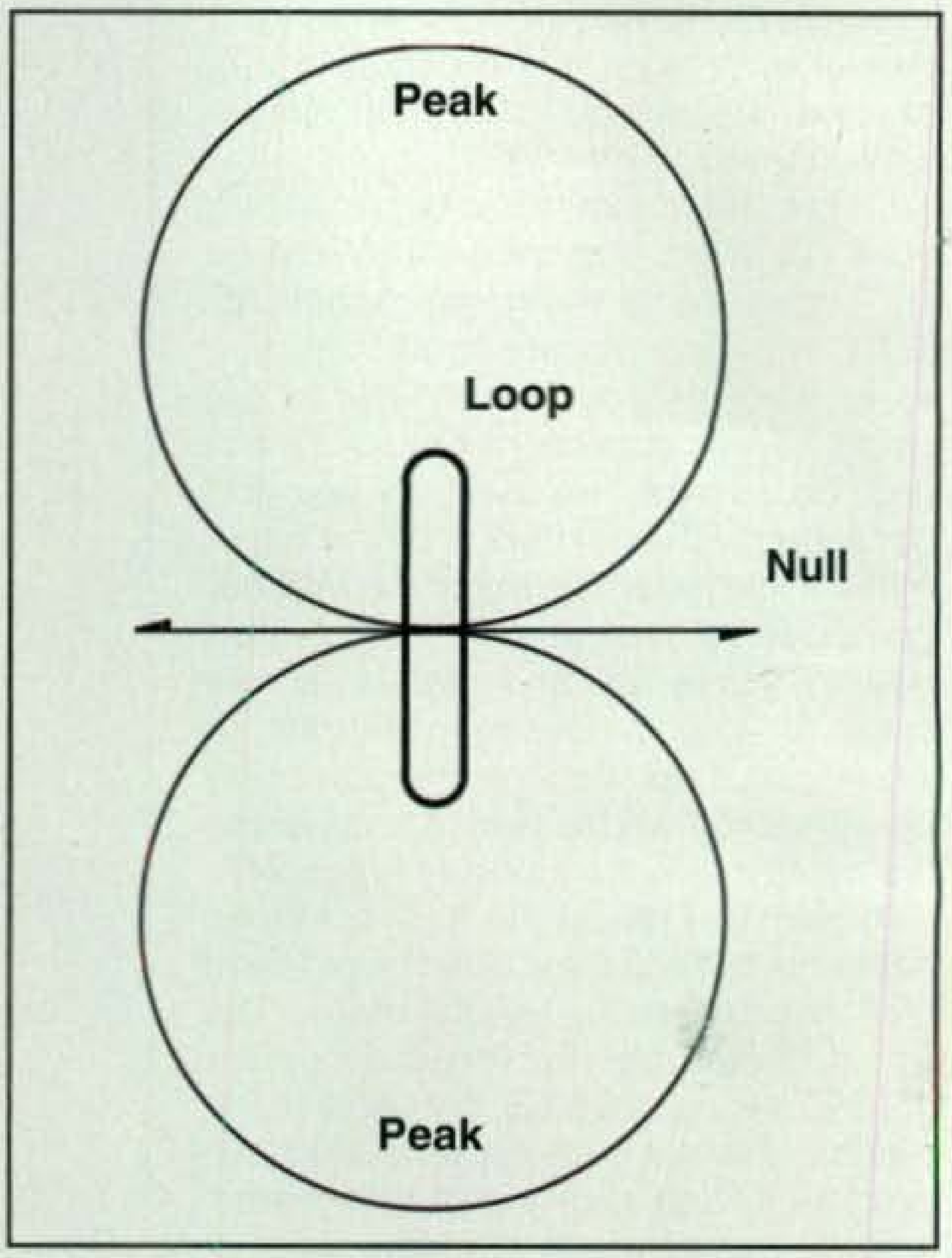

Fig. 1– The small loop antenna and its figure-8 pattern.

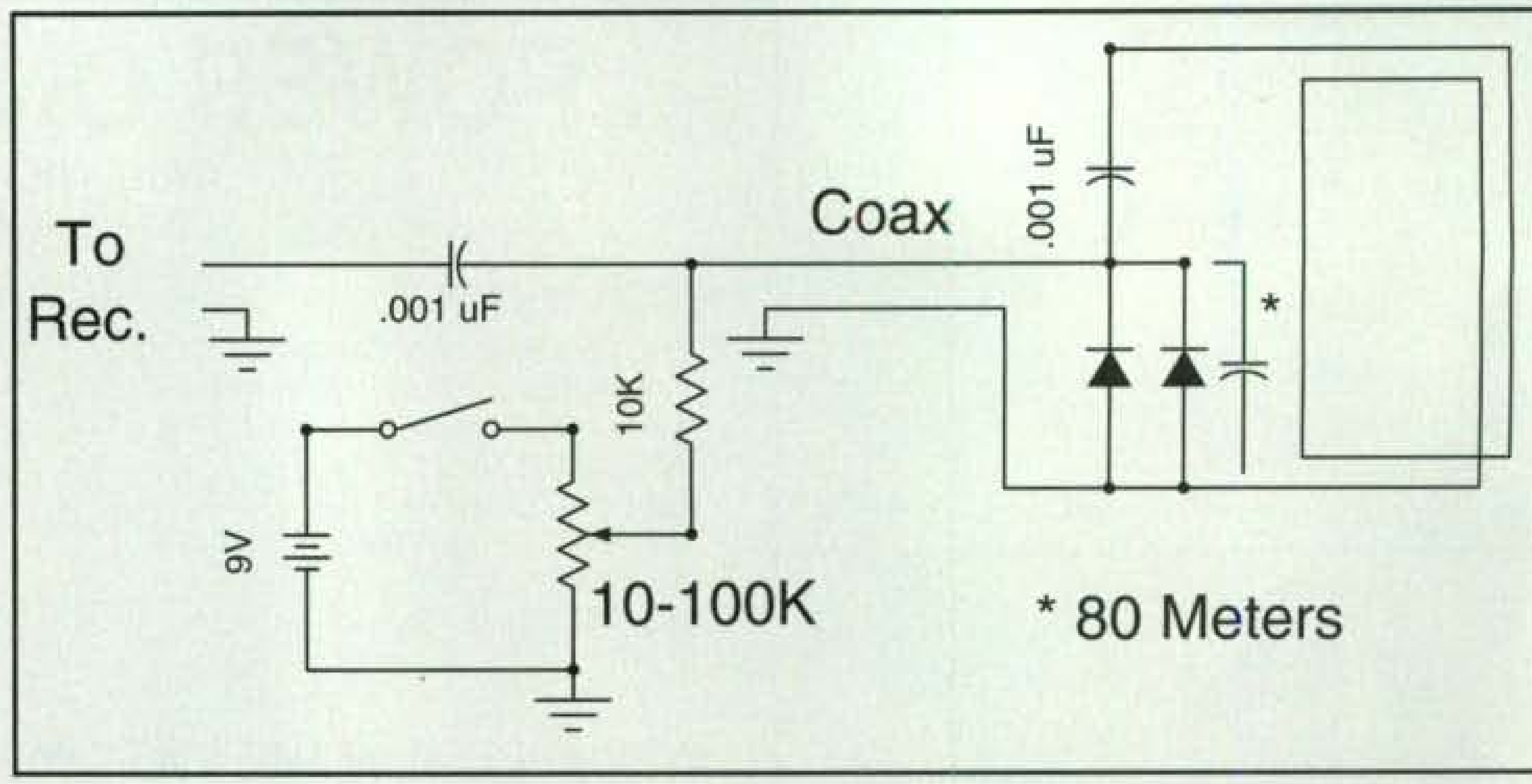

Fig. 2 Schematic of the loop and its diode bias supply.

Parts List

Diodes: 1N4001–1N4007
Capacitors: .001 µF (two)
Potentiometer: 10–100 K ohms
22-gauge wire was required

40 Meters
Five turns, three diodes

60 Meters
Five turns, three diodes, 47 pF across the three diodes

80 Meters
Eight turns, four diodes, 100 pF across the four diodes

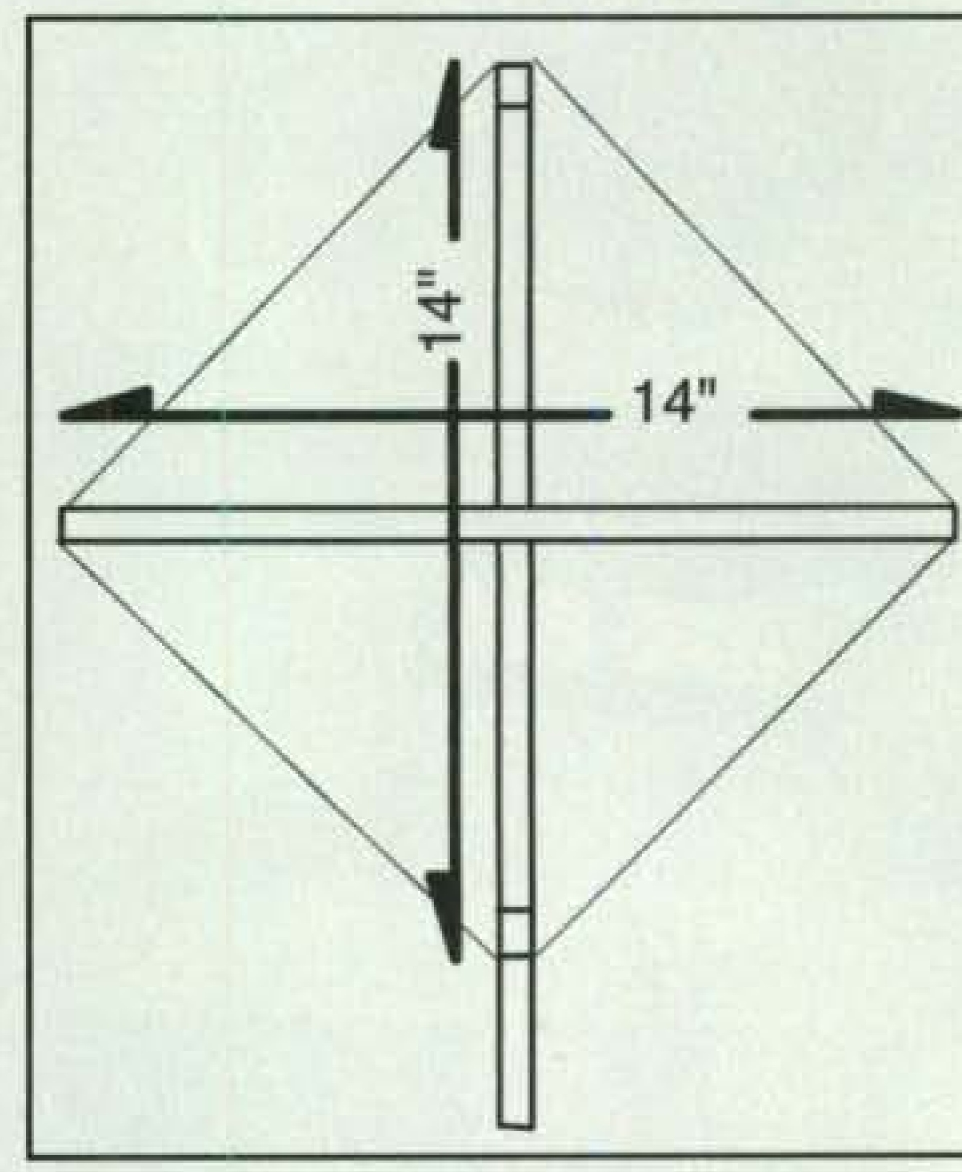

Fig. 3– Dimensions for all three versions (40, 60, and 80 meters) of the loop antenna. Yes, all three are the same.

There are a lot of ways to use your loop antenna. For years I had mine fixed in the attic. I cranked up the volume on the rig pretty high so I could hear the noise, went up into the attic, and rotated the loop for lowest noise. It stayed in that position for the next 10 years.

Power

The power supply shown in photo B is quite simple. I ran my tuner off a single 9-volt battery, but there are several advantage to increasing the voltage to, say, 18 volts using two 9-volt batteries. However, try to avoid using an AC power supply. The whole idea is to get away from power lines and their noise, and now you want to connect the AC power line directly to your antenna?

For the coupling capacitors you want to use something between 10,000 pF and .001 µF. For those of you who are into nano-Farads, that would be between 10 nF and 100 nF. The coupling capacitor is not critical for the tuning, but when using very very high values for the tuning potentiometer, it took a while for a .1-µF cap to charge and discharge. Thus, I turned the pot, but it took a while for the antenna to change frequency as the two coupling caps charged and discharged. Another learning experience: More capacitance for a lower impedance is not necessary a good idea. You want just enough to do the job, and a good old .001-µF cap works fine. The tuning pot can be most any value from 5 to 500K. For my first version I used a 500K-ohm pot and didn't even install a power switch. The theoretical life of an alkaline battery in that circuit is well over a year. Heck, I'll probably forget and leave it on anyway.

The diodes in photo C can be most any diode in the 1N400X family. There are many variable caps available in the 50-pF range. Three seemed to work best on 40 and 60 meters, but an extra one helped down on the 80-meter band.

What Next?

This is a simple project, but there are also many ways to improve a loop

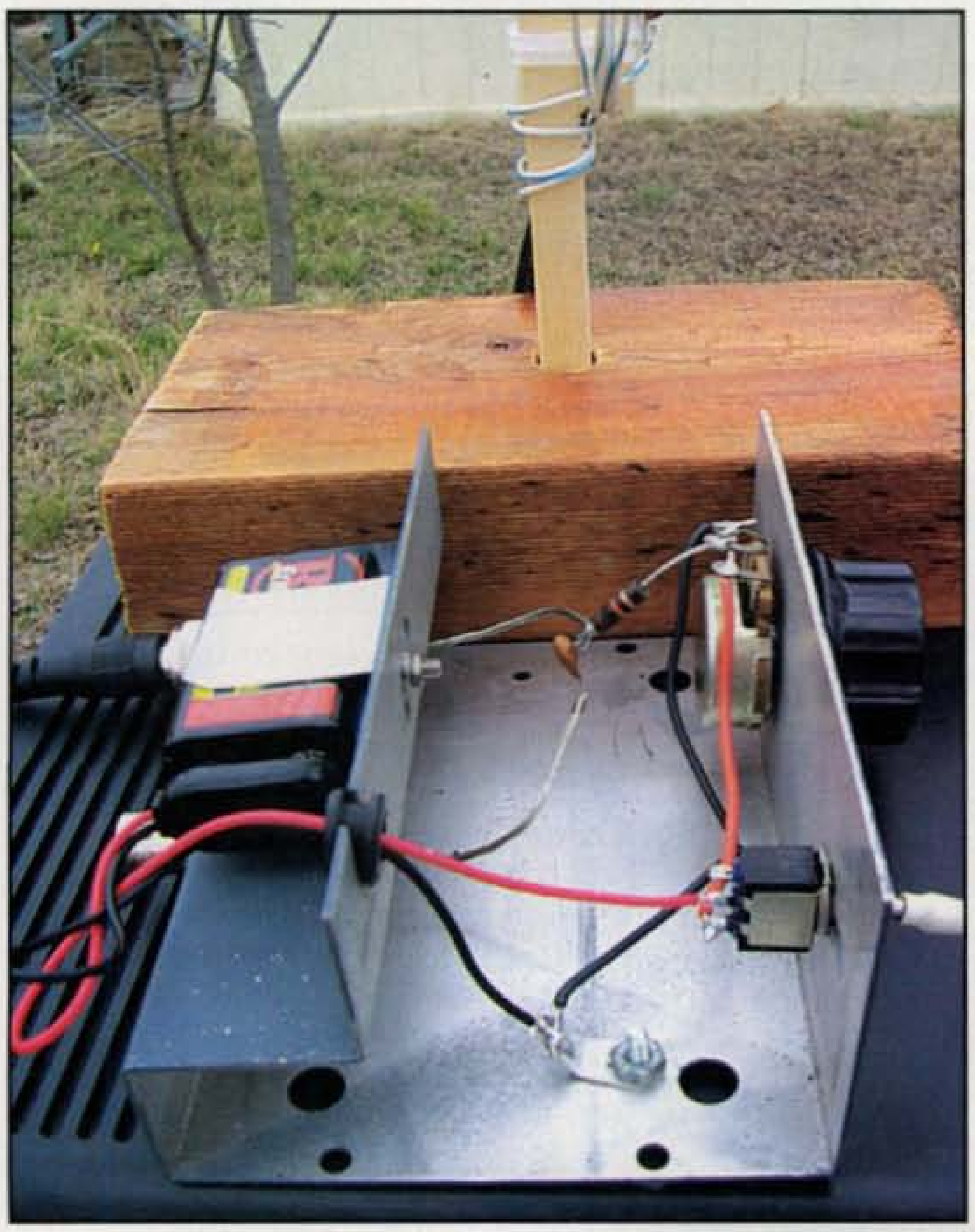

Photo B– The HF loop diode bias power supply.

antenna. Building the loop with a Faraday shield will reduce noise pickup even more. Winding the coils in a more spread-out manner, using bigger wire, improved impedance matching, and high-impedance preamps will also improve the Q (quality factor) of this antenna. The efficiency of the loop as an antenna is directly related to its Q, as is the loop's ability to help filter out nearby strong signals. We will see what kind of feedback we get from you, our readers, on your interest in reading about more advanced loop antennas.

Increasing the Q

After the last column, I received an excellent e-mail from G3RZP. Peter went into some of the more exotic ways of

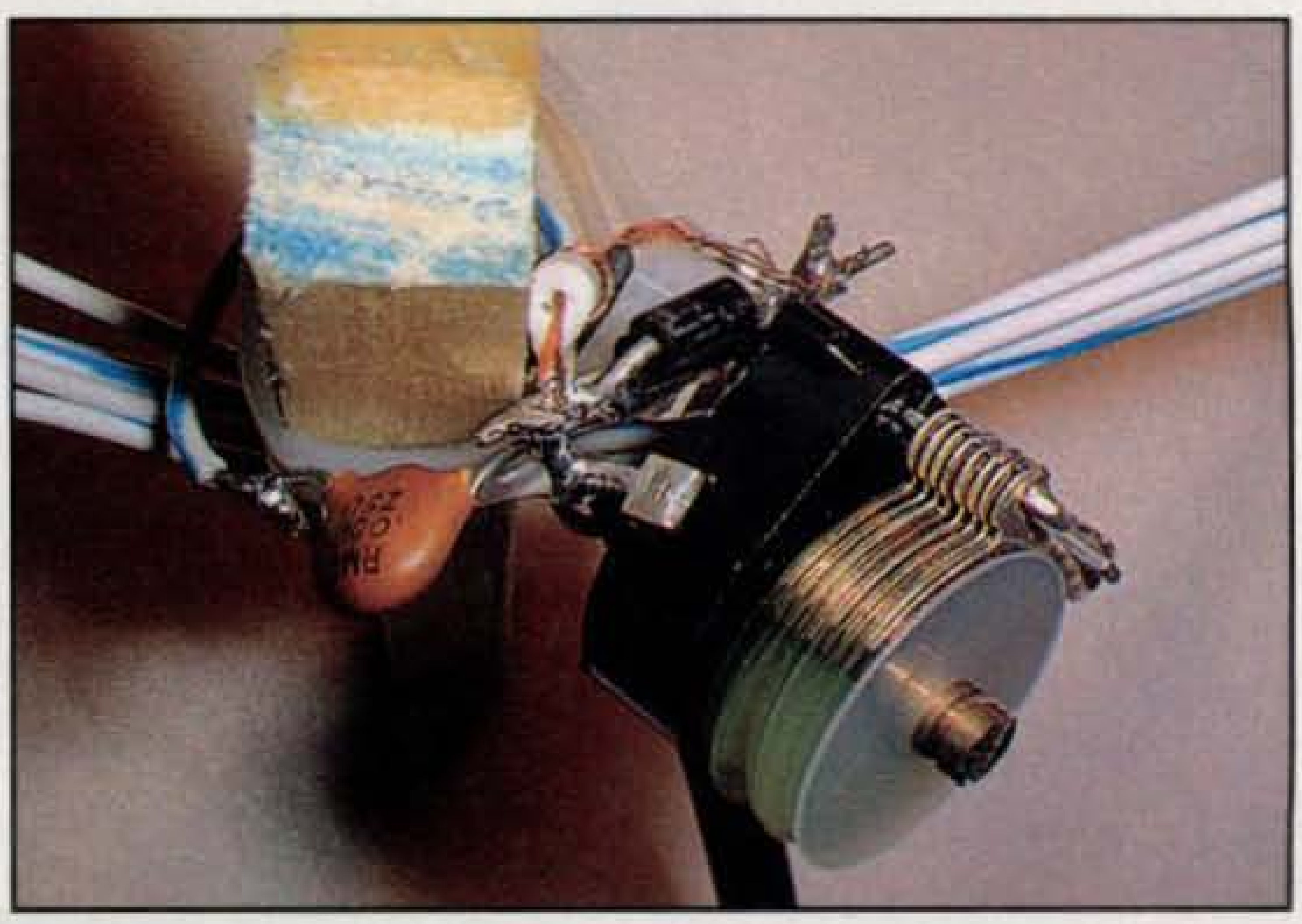

Photo C– The HF diodes and trimmer capacitor.

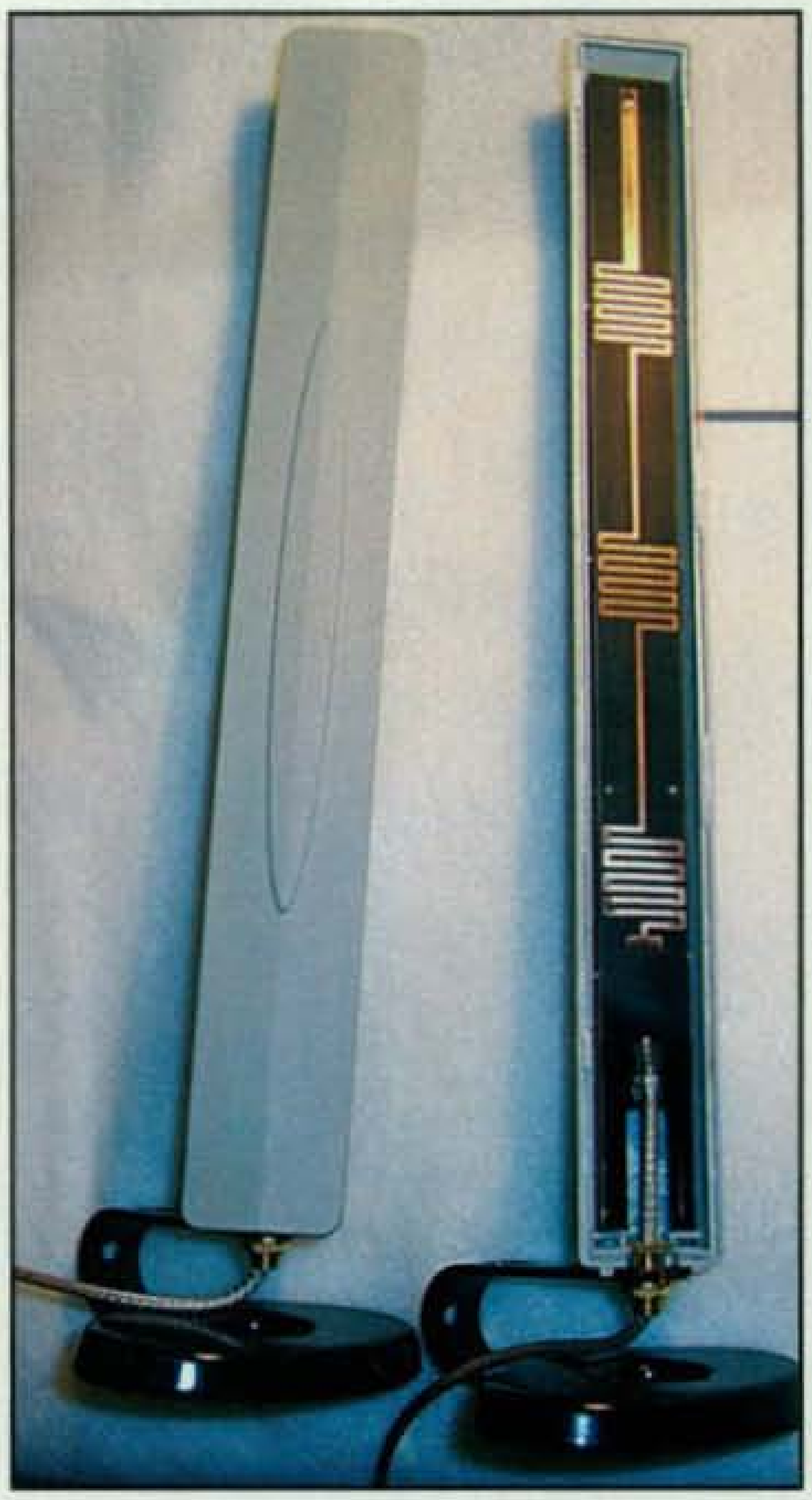

Photo D– the inside of a WiFi vertical collinear antenna.

increasing the Q of a loop antenna. One was by using a 6922 valve, or as we say in the U.S., a vacuum-tube preamp. The 6922 is an excellent high-impedance, low-noise tube used in thousands and thousands of Tektronix oscilloscopes as the probe preamps. However, I'm a little reluctant to recommend tube circuits these days. On the other hand, the high input impedance of a tube will greatly increase the Q of the antenna, and tubes will easily withstand high voltages from nearby transmitters.

Peter also uses a small electric motor to remotely drive his trimmer caps. Mechanical capacitors have a much higher Q factor than the varactor capacitors I used in this project.

WiFi Antennas

Now for something quite different. Ever wonder what is in some of those WiFi antennas? Photo D shows a vertical collinear antenna for 2.4 GHz etched on PC board. The antenna had two layers of black solder mask on the board to hide the antenna pattern, but 20 minutes with light sandpaper brought out the traces.

The straight-line sections are $1/2$ wave long. The meandering line delay sections are almost, but not quite, $1\,1/2$ wavelengths in length and physically $1/4$ wavelength from top to bottom. This forms a vertical collinear antenna not unlike the Cushcraft Ringo Rangers for many of the common mobile wire verticals such as the one shown in photo E.

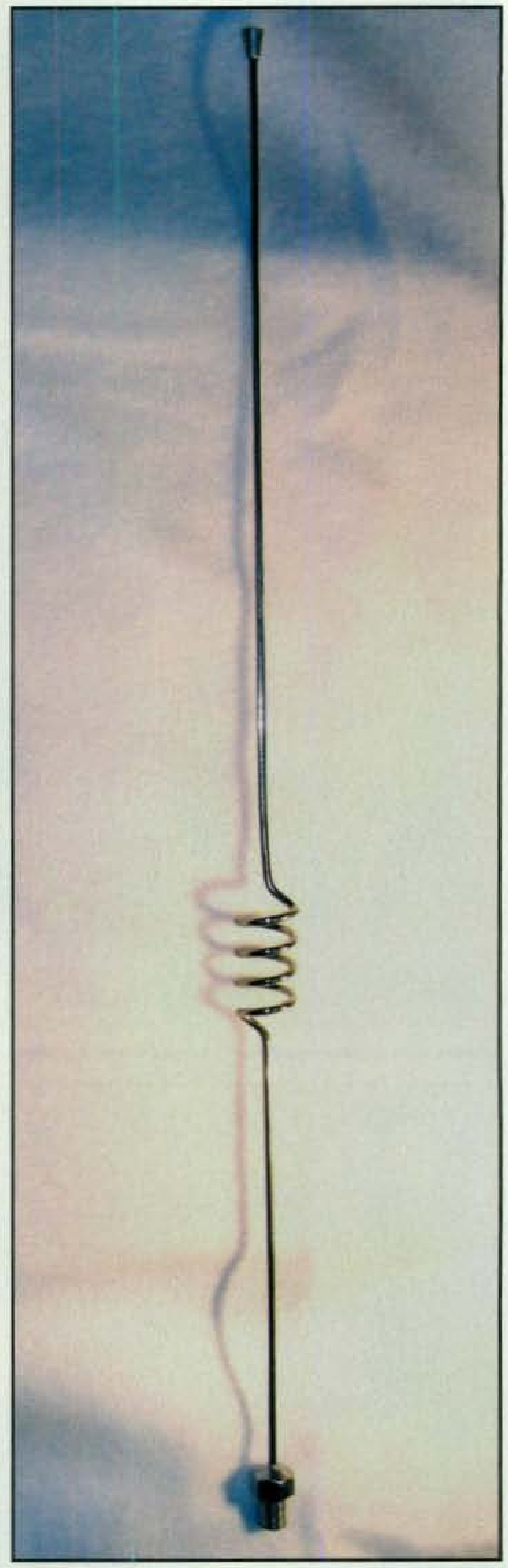

Photo E– The common wire vertical collinear antenna.

The Dayton Hamvention® is later this month, so if you make it out to the Hara Arena, I hope to see you there. I'll be at slot #915 in the fleamarket and also at the CQ booth. Now to get some more antennas in the air!

73, Kent, WA5VJB