End-Fed Copper Dipole

Why buy when you can build?

by Mike Gray N8KDD

I needed a good 2 meter antenna which would be suitable for both stationary mounting and remote-site use. I could have purchased an antenna which would meet the requirements, but that wouldn't satisfy the burning desire to build something, and I can build eight antennas for the price of one commercial vertical.

This project is easily constructed from parts found in any plumbing supply store. It can be tuned to any frequency, but the overall distance from the lower coupler to the top of the upper element should be less than 40 inches. Wind may cause problems with a longer antenna.

See the "Components List" for this project. Most of us have some scrap plumbing in the garage. The pieces are too short to use but too good to throw away. Drag it out—you saved it for a project just like this! You will also need a propane torch, a tube cutter, and a bottle of PVC pipe cement.

Tubes

Start by cutting two copper tubes to the proper length for the frequency at which you intend to operate. Make them a little longer if you like, and shorten them during the tuning phase.

¼-wave element (inches) = 2808/frequency(MHz)

File the inevitable burrs from both ends of each tube and polish them bright with sandpaper. While you have the sandpaper in hand, polish the inside of one end of each tube to prepare it for solder.

Heating the outside of the copper tube with a torch, tin the inside of one end of each copper tube with rosin-core solder. Cut the PVC pipe to length. Make it a minimum 12 inches, but not longer than 30 inches. If the PVC pipe is much longer the force imparted to the lower coupler during a wind storm may be more than the coupler can take.

Cement a coupler to one end of the PVC tube, and slide one of the copper tubes into the coupler. Don't cement the copper tube to the coupler yet.

Cable

Feed the coaxial cable through the PVC pipe, and through the copper pipe. The cable should come through the tinned end of the copper pipe.

Strip ¼-inch of jacket from the cable. Separate the braid from the center dielectric, then twist it together to form a conductor equal in length to the center conductor. Tin the center conductor and the twisted braid no more than ¼-inch from the end. (The braid needs to remain flexible for this to work).

Bend the braid into a "J" shape and solder it to the inside of the tinned end of the copper tube. Heat the outside of the tube—don't burn the cable.

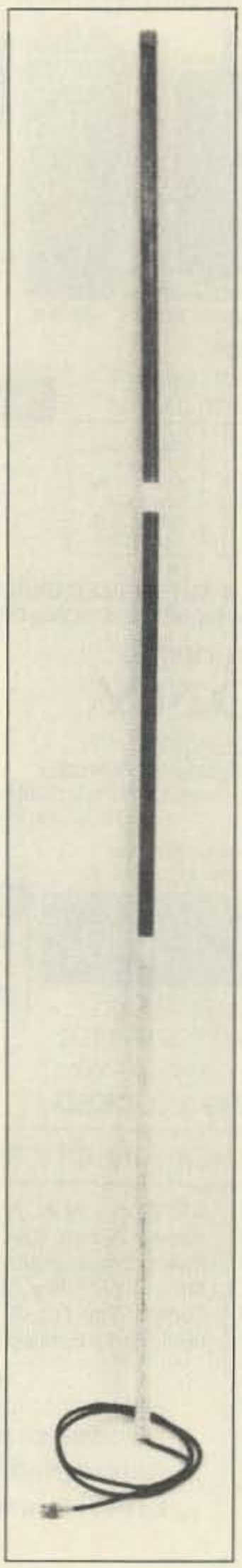

Photo A. The completed antenna.

Once the braid is soldered to the lower tube, pull the coax through the tube as far as the braid will allow it to go. Slide a coupler over the coax and onto the copper tube. Solder the center conductor to the inside of the upper tube in the same way that you soldered the braid to the lower tube.

Slide the upper element into the coupler and seat it gently. If it won't slide all the way in, polish the copper tube with sandpaper.

Measure the resistance between the upper and lower elements. If the meter indicates that the elements are connected electrically, pull the assembly apart and track down the short. Do not attempt to tune the antenna unless the meter indicates infinite resistance between the copper elements.

Tuning

You originally cut the copper to approximate lengths. Now you need to cut them to resonate at the frequency you intend to use most often.

Clamp the PVC tube to a suitable support, keeping the copper as far as possible from any objects which might reflect. Measure the SWR above and below the target frequency.

Using a tube cutter, remove about ¼-inch from the top element, then check the SWR. More copper will probably have to be removed. If so, it should be removed from the lower element this time.

Gently pull the lower tube from the coupler and cut the same amount from the lower tube that you removed from the upper tube. If there is a connector on the feedline, the waste copper ring will not slide off, so cut the ring of copper with a pair of diagonal cutters. Reassemble the antenna and check the SWR.

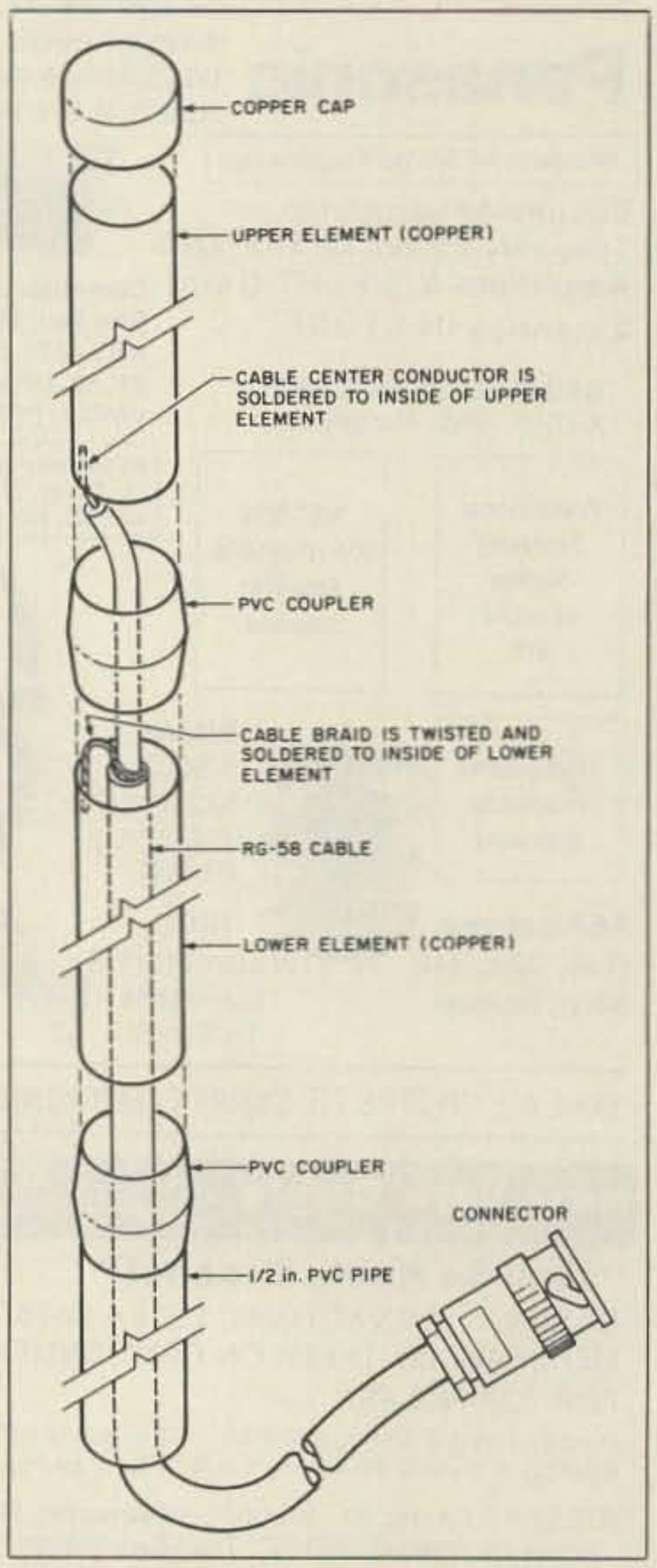

Figure 1. The end-fed dipole.

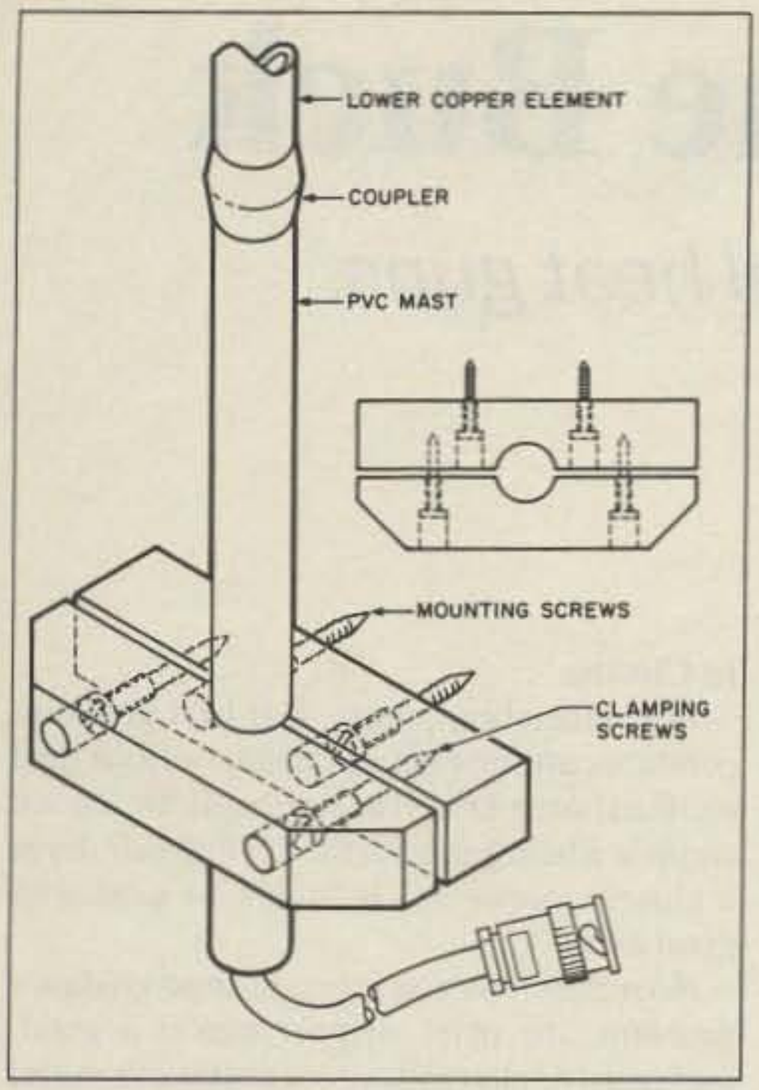

Figure 2. Detail of the clamp

Repeat this process as many times as necessary to obtain the lowest SWR. If you are working inside a building you may not get lower than 1.5:1 until the antenna is mounted outside.

If you cut too much copper from the antenna (this almost always happens) install the copper pipe cap on the upper element. The cap will fit tightly, and can be adjusted vertically for the lowest SWR.

Pretty Work

Once the antenna is working properly, solder the copper cap to the upper element. Pull the copper tubes apart and apply a liberal amount of cement to the couplers. Reassemble the components, making sure the tubes are seated just as they were during tuning.

Place the assembly on a flat surface and roll it to reveal any misalignment. If it isn't straight, bend it gently until it rolls smoothly, then allow the cement to dry for at least four hours. Fill the bottom tube with caulk or similar material to relieve strain on the coax and keep the spiders out of your new project. When the cement has dried, install a BNC or PL259 connector on the coax (if it has not already been done). Sand the antenna lightly and paint it with enamel. Paint is necessary because the copper will corrode in time without protection.

Mounting

You probably won't be able to convince the spouse to hold your new antenna at arms length while you engage in a long conversation, so you will need to mount it somehow. The PVC pipe can be clamped to an upright member of nearly any material without affecting the performance, but keep metal objects at least eight inches from the elements.

I built a clamp for my antenna from a piece of scrap two-by-four. The clamp is screwed to a fascia board on the backside of the house. To make this clamp, cut a piece of two-by-four about five inches long (length isn't critical). Bore a ⅝-inch diameter hole through the middle with a paddle bit. Cut the board through the center line of the ⅝-inch hole. Drill and countersink two screw holes in each piece of wood to fit your installation. Make sure that the holes are offset because two of them hold the fixture and two hold the clamp. (See Figure 2.)

Holy Toledo! It Works!

You will notice an improvement in performance over a quarter-wave ground plane antenna while transmitting, and a huge improvement in reception. The reason for better reception may be due to the greater "capture area" afforded by the tubing.

Build a few more of these. The second one takes much less time than the first. 73

Components List

2	Quarter-wavelengths of ½-inch hard-copper pipe 146 MHz: 19.23 inches 222 MHz: 12.65 inches 440 MHz: 6.38 inches
2	PVC couplers (the type used to join pipe end-to-end)
1	½-inch PVC pipe, at least 12 inches long
1	½-inch copper pipe cap
1	length of RG/58 coax