adding 160-meters

to a

40-meter vertical

Making an inexpensive multi-band antenna with excellent 160-meter performance and hidden benefits

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It is a myth that only lighthouse keepers *and cattle ranchers can get on 160 meters* because of the real estate needed to erect a really effective 160 meter antenna. *Anyone* can get up an inexpensive and effective 160-meter antenna in a limited space. For my first operating on 160, I used my 80-meter doublet with the feed end shorted and worked against ground as a T antenna. An improvement over this was an end-fed L run out my basement window, up the side of my house and across my yard. It also was operated against ground – provided by a convenient cold water pipe in my basement station.

outline

As I started working real DX with this last scheme – 8's and 9's – I noticed that the best signals on the band invariably were using verticals. I decided to try adding 160 capability to my reliable 40-meter vertical standing in my back yard. The basic plan was to add a 40-meter trap at the top of the existing vertical, add a piece of plastic pipe wound with a 160-meter loading coil and top this combination off with an 8-foot section of aluminum tubing as a top load. I could drive a ten-foot ground stake and use the antenna for both 40 and 160.

40-meter vertical

My 40-meter vertical consists of some World War Two surplus mast sections, labeled AB-85/GRA-4. Each section is 36-inches long, 1 5/8-inch diameter and has a wall thickness of 1/8-inch. One end of each section is swedged down to 1¼-inch diameter for about a six-inch length where the sections join together. The female ends of each section also have four wiper springs that help to insure electrical continuity. These were selling quite inexpensively and I picked up several hundred feet of them one Field Day. While these sections might be hard to find, almost any type of aluminum or galvanized steel pipe will work for the lower 32½-foot mast section. I do not recommend aluminum tubing with less than 1/8-inch thick walls (12 gauge). Most of the aluminum TV mast sections I have seen look pretty skimpy, but could probably be used with proper guying and support.

construction

The first order of business was to find the plastic pipe for the loading coil. I called several warehouses that stock this item, but they have a $25 minimum order gimmick. I finally found a local plumbing supply house that had one piece of 1¼-inch PVC pipe twenty-feet long. I had to take the whole piece (for $7.80), but they cut it into three equal pieces for me. The 1¼-inch inner diameter of this plastic pipe made a nice tight telescopic fit to the swedged end of my mast section.

If you have trouble getting the proper inside and outside diameters of the plastic pipe and tubing, I would suggest that you get the plastic pipe with a larger inside diameter than your top and bottom mast sections. By wrapping several bands of tire tape spaced about 4- to 6-inches apart, you can adjust the diameter of the masts for a snug telescopic fit into the plastic pipe. Once fitted, secure the joints with a bolt.

Assembling the mast material should not be difficult. Remember to install a bolt and solder lug at the top of the 32½-foot mast, one about three inches above the bottom of the plastic pipe (jumper these two lugs), one about three-inches higher (for the 40-meter trap), one at the top of the plastic pipe and one at the start of the 160-meter loading coil (jumper these last two lugs).

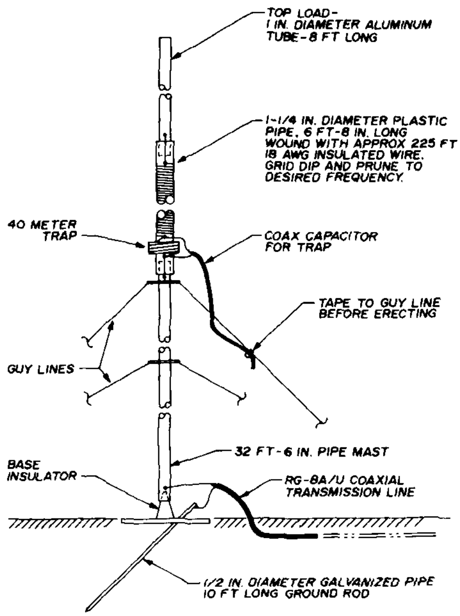

fig. 1. The arrangement of the 40- and 160-meter antenna.

The lugs and jumpers provide the electrical continuity between the masts and the coils.

40-meter trap

I had a few 40-meter traps left over from an old Field Day antenna. The traps were originally described in an old *QST* article and they used sections from commercially available air-wound coil stock. The coil in one trap consists of nine turns of number twelve wire with a 2½-inch diameter and with the turns are spaced about 1/8-inch apart. The coil was shunted with a 100-pF high-voltage type TV capacitor.

Feeling that these capacitors might not weather well, I decided to use a piece of RG-8/U as the capacitor. RG-8 has a capacitance of 29.5-pF per foot and RG-II has a capacitance of 20.5-pF per foot. I cut a piece of RG-8 about four-feet long, dressed one end and soldered the shield to one end of the coil and the inner conductor to the other end of the coil. The grid-dip meter indicated resonance too low, so I trimmed the coax until I zeroed in on 7250 kHz. Be sure that the shield does not short to the inner conductor while you are trimming the cable. When you are finished, seal both ends of the coax with plastic cement to waterproof the cable.

Mount the trap concentric with the plastic pipe between the two lugs spaced at three inches, and just below where the 160-meter coil will go. Before erecting the antenna, tape the coax to one of the guy wires – allowing a little slack. Do not make the mistake I made of using RG-58 or RG-59 for the trap capacitor. It will work well with low power, but mine simply went *poof* when I fired up my linear on forty meters.

160-meter loading coil

Now for the fun of winding the 160-meter loading coil. *The ARRL Handbook* states that a helically-wound vertical antenna needs twice as much wire length as a normal quarter wavelength. Since my bottom section and top section added up to about forty feet, I figured I would need some 167 feet of wire in the trap to hit 1812 kHz. I had a new 175-foot roll of plastic-coated number-18 wire. I decided to wrap up the whole roll on the PVC pipe and grid dip it out to see where it resonated. The coil was more or less scramble wound and both ends were soldered to the lugs.

The next step was to check the assembly with a grid-dip meter. I leaned the antenna up against my garage, and using a step ladder, checked the coil for resonance. I was quite surprised that it tuned high. I then added another fifty feet of wire to the coil, and now I was too low. I began to prune ten turns at a time, then five and finally one turn at a time until I zeroed in on the desired frequency. This step requires patience, but for a good antenna, it is the most critical operation of all.

installation

The antenna is not too difficult to raise with a few helpers. The base, of course, should sit on a suitable insulator and foundation. I use two sets of non-conducting guys. One set is connected to a guy ring close to the top of the bottom mast section just below the PVC pipe and another set is connected half-way down the mast. I already had three 34-foot radials buried in the ground for the 40-meter vertical, but I added the ten-foot long half-inch diameter pipe as an extra ground for 160. We have a very heavy shale strata here about six feet below the surface, so I flattened one end of the ground rod and ground it sharp and drove it in at a 45-degree angle to get better exposure. I feed the antenna in the normal manner with RG-8/U buried under the turf.

operation

For some reason, this antenna works very well on all other amateur bands, including two meters. I also find that contrary to my expectation, it picks up less man-made noise than the inverted L, which is basically horizontal. I put this antenna up in the fall of 1970 and it has done a terrific job for me ever since. My basic feelings regarding the vertical versus the inverted L are as follows: Locally, the inverted L is stronger by several S points. From 400 to 800 miles I get conflicting reports. Over 1000 miles, however, the vertical vastly out-performs the horizontal. A final sneaky report, would be to state that the inverted L gives my wife some BCI, but I can be on the air all night with the vertical without a bit of BCI.

ham radio