Think you don't have enough room for a good 160 meter vertical? Think again, says KK7DP, whose small vertical can still put out a big signal on "Top band."

The Conix Class 160 Meter Vertical Antenna

BY DAVE JACOBS,* KK7DP

Are you an operator who is interested in trying 160 meter operation with a vertical antenna but is precluded from erecting a 60 ft. vertical in your backyard? How does the possibility of having a 31 ft. 9 in. high antenna that fits into a corner of most backyards and covers at least a 130 kHz bandwidth at the 2:1 SWR points sound to you? That is exactly what I use at my QTH, and this article will describe how you can replicate this antenna.

The basic configuration is an inverted cone (photos A and B), hence the name I gave the antenna: the "Conix Class 160," or CC-160. With four radials installed and 425 watts of power, I worked 225 stations in 15 hours in the 2003 CQ World-Wide 160 Meter Contest. This may not sound like a very successful contest performance until you consider that my QTH is Montana, the original black hole of propagation. The path from my station to Europe or Japan is completely blocked by the polar auroral zone, and we are so far north that the ionization levels that support propagation have decayed to very low levels. Nevertheless, I received several 5-9 +30 signal reports, copied CT2 stations at S-7, and worked Caribbean stations at the +20 level.

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All that having been said, the antenna is still a physically shortened radiator with gain figures to match. Do not expect it to be a giant killer; it is a compromise that will fit into a limited space but still function very satisfactorily. It is very quiet in the receiving mode, because it is a closed loop similar in design to the cubical quad and is operated at DC ground potential (which additionally gives some degree of lightning protection). This design effectively shorts

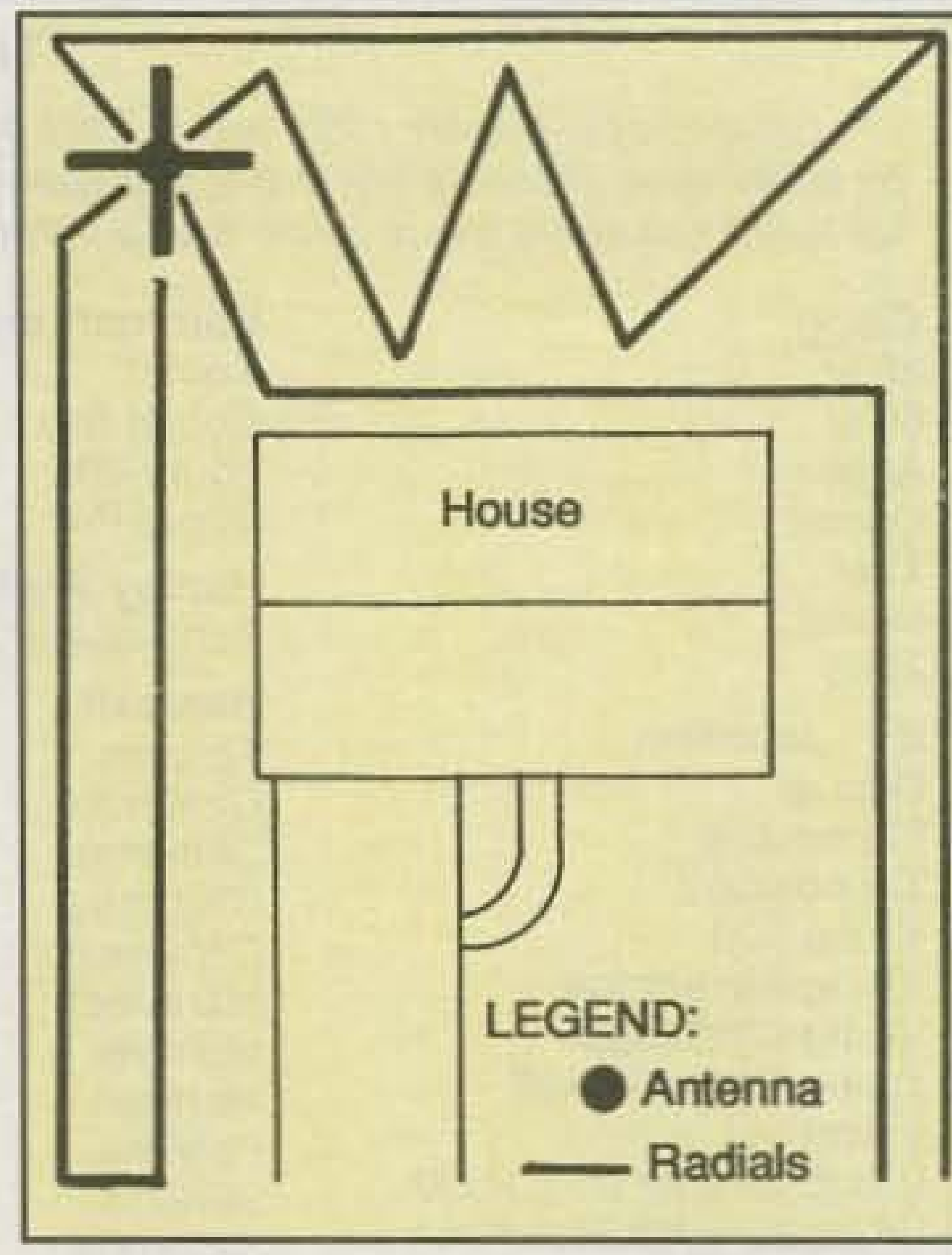

Fig. 1– Possible installation of antenna with four radials on a small lot. Note that the radials do not have to be straight to be effective.

Photo A– Top section of the Conix Class 160 vertical.

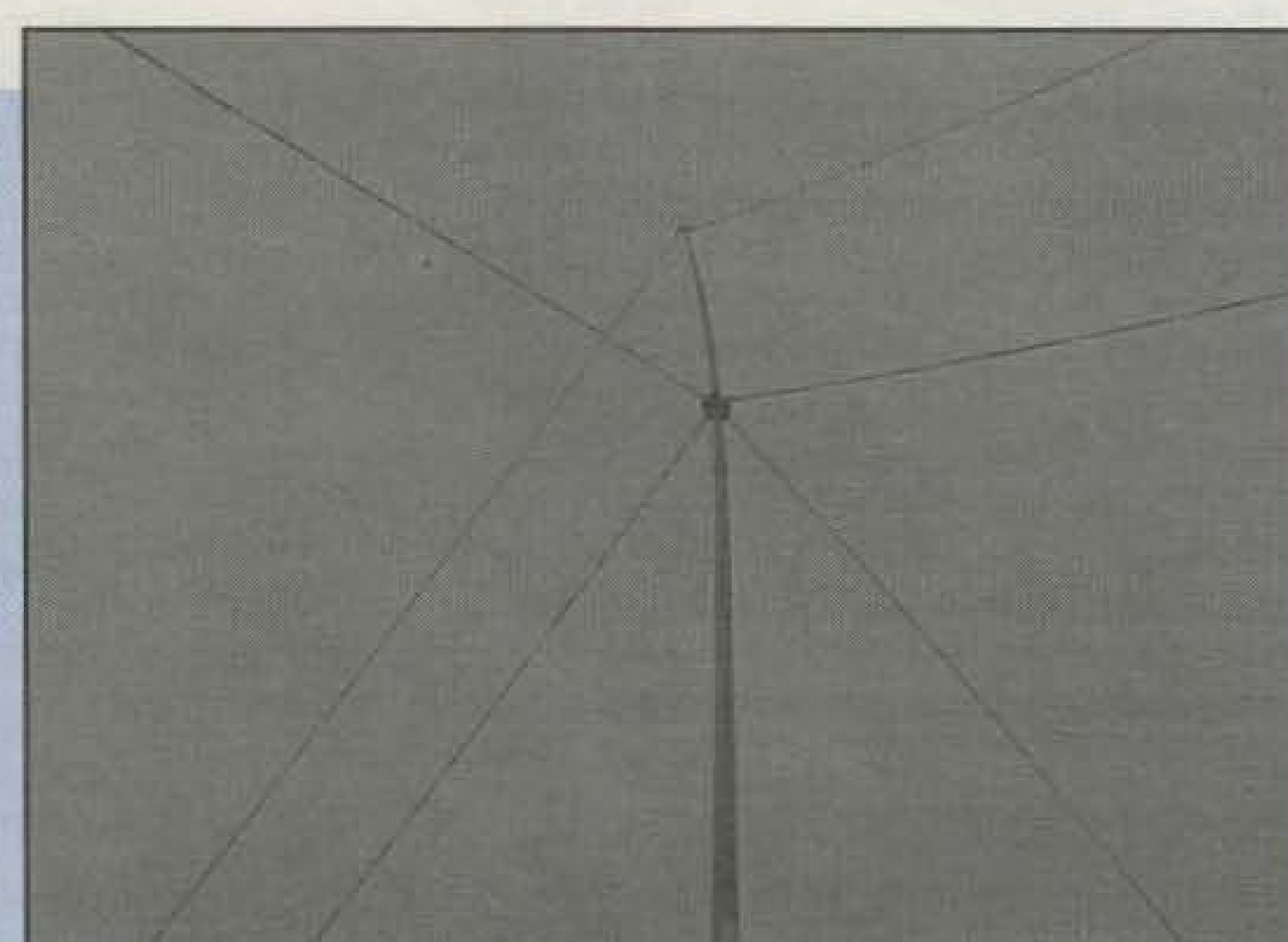

Photo B– Another view of the top section, looking up. Note the diagonal wires coming off the upper mast section.

out static voltages and couples them to ground before they can cause a noise-generating arc. This should be of great benefit to amateurs living in the south who experience a great deal of static-induced QRN.

Since this vertical antenna is non-symmetrical, a good ground is required. My current configuration utilizes four radials, each one 130 ft. long and surface mounted on the ground. The antenna will actually work without any radials, because the ground braid of the coax acts as a first radial. However, a minimum of two is highly recommended. What is important is to decrease the effective ground loss by installing a sufficient number of radials to electrically couple the antenna to ground. With four radials installed, the ground loss reduction is 1.2 dB, or an increase in the effective radiated power of 1.2 dB. Every time the number of radials is doubled, the effective radiated power increases by an additional 0.6 dB, with 4.2 being the maximum gain for 120 radials. That is why adding a few radials to an existing installation provides only a little improvement unless the installation has no or few radials to start with. While it may not be feasible to expect an average backyard to support 20 radials, almost any backyard can support at least two 130 ft. radials if they are installed in a bent pattern. Additional radials of that length, or even shorter ones, can be installed into whatever space is available. Fig. 1 is a possible layout of four radials in an average yard. A full acre is required to install 120 radials, and yet the effective radiated power will only be 4 dB higher than that of a station with only two radials.

The antenna is resonant and will cover the entire 200 kHz of the 160 meter band if it is erected in the open and if you spend sufficient time fine-tuning the antenna. Even without fine-tuning, the antenna will cover 130 kHz of the band within the 2:1 SWR points. The purpose of the series capacitor (see detail in fig. 2) is to tune out the +j inductive reactance that the antenna possesses, making it a pure resistive load.

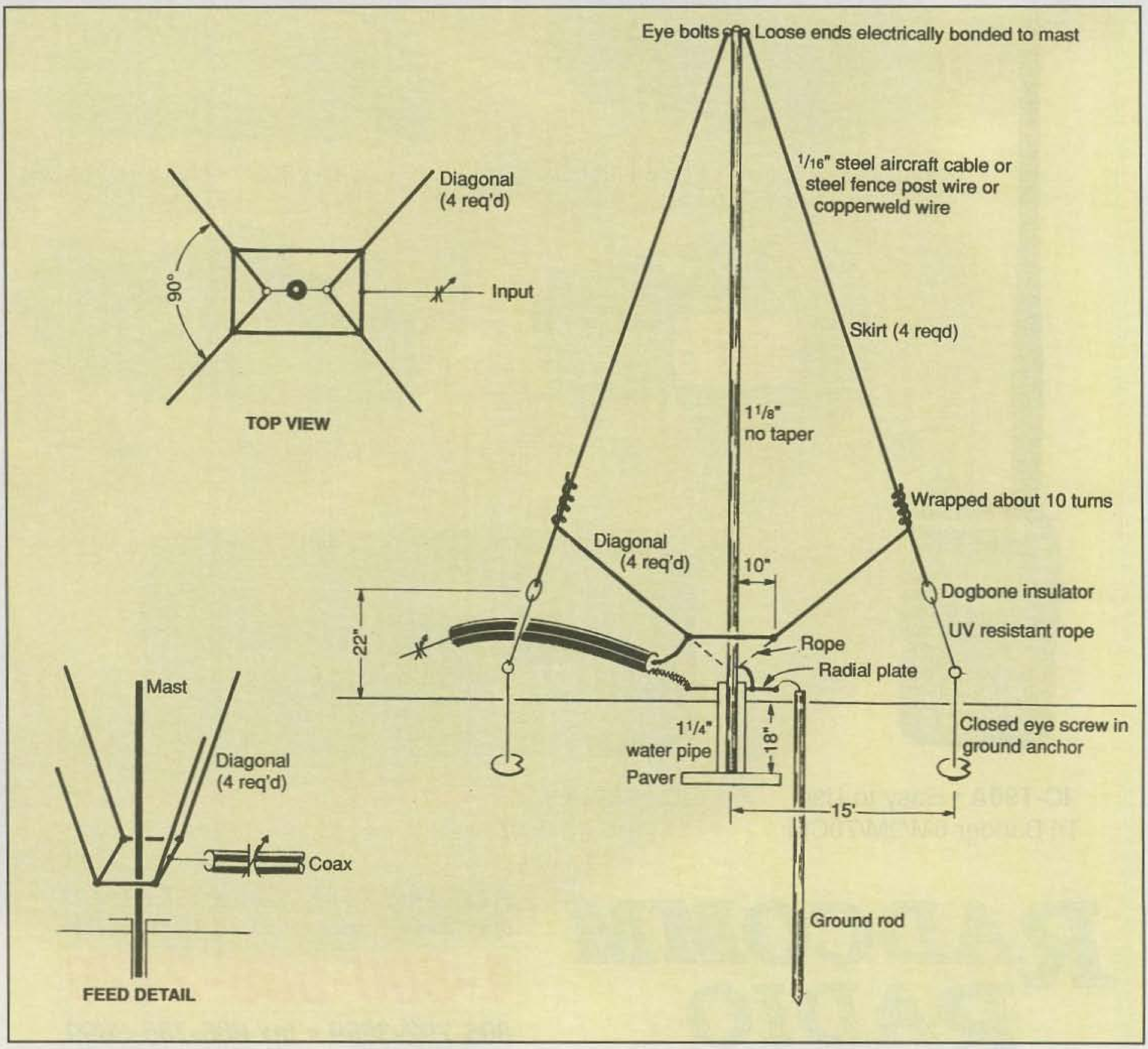

Fig. 2– Construction details of the Conix Class 160 antenna.

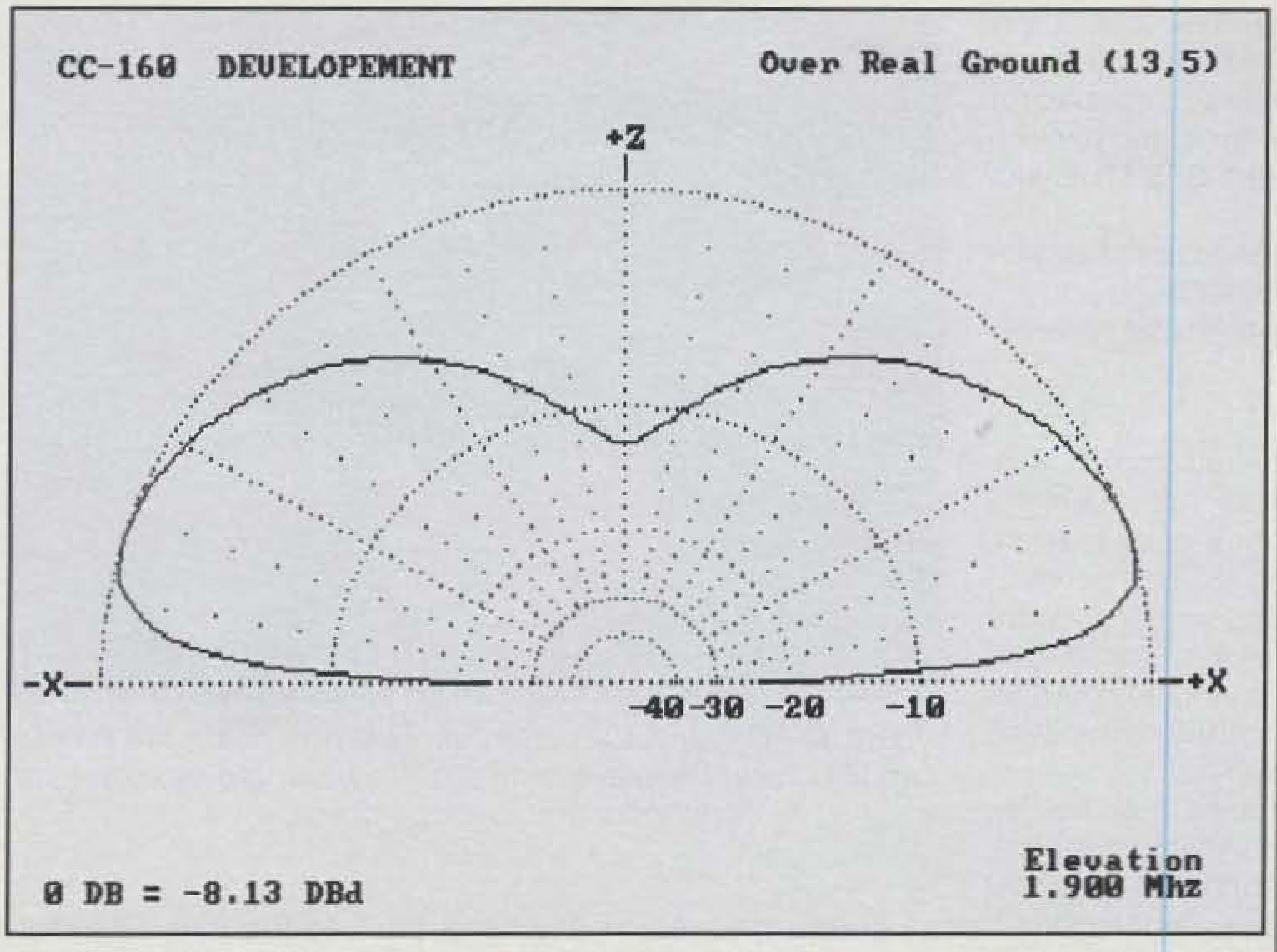

Fig. 3– Mininec© plot of elevation pattern for the CC-160 antenna.

Antenna resonance is a function of antenna height and skirt length, and fine-tuning is accomplished by varying the length of the skirts. I use 1/16 in. steel aircraft cable for my skirts, looped through dog-bone-style insulators and secured at the 6 ft. level. This technique makes the adjustment of the skirt length very simple. The impedance will usually fall between 45+j400 and 75+j475.

The design uses a 500 pF variable capacitor with 0.125 plate spacing for

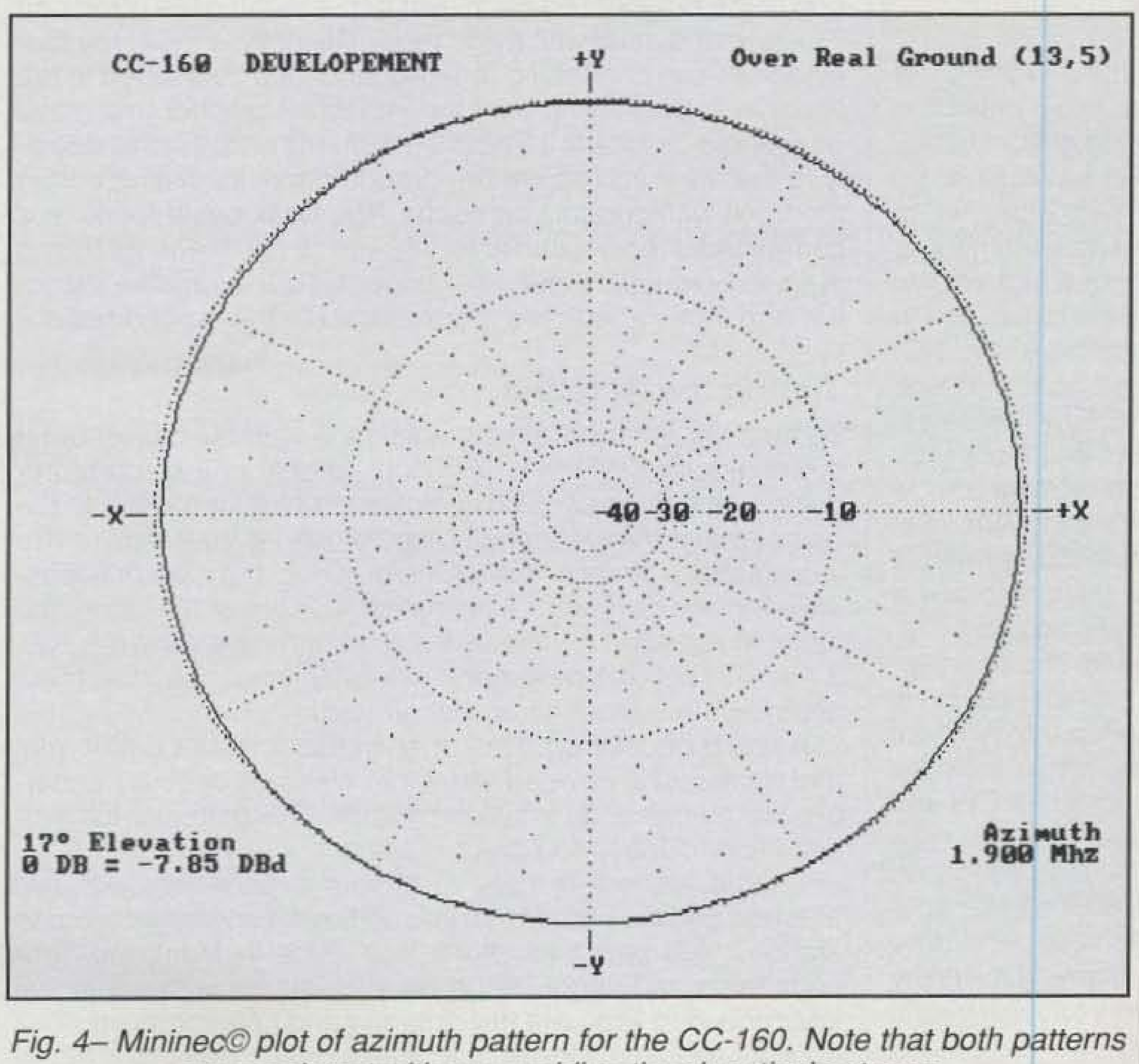

Fig. 4– Mininec© plot of azimuth pattern for the CC-160. Note that both patterns are consistent with an omnidirectional vertical antenna.

full 1 KW operation; however, any variable that covers this range will work if the spacing between the plates is adequate to handle the proposed power output. Tuning the capacitor changes the +j inductive reactance component, and cancellation of reactance usually occurs at about 1.875 MHz with an SWR of 1.2:1.

As a plus, even though the antenna has been optimized for 160 meter operation, it also covers the 40 meter band and will out-perform a full-size quarter-wavelength 40 meter vertical.

Construction

The mast section of the antenna is constructed from 1 1/8 in. aluminum tubing with a 0.058 wall thickness. The tubing is not tapered, and sections are fastened together by a 12 in. section of the next smaller diameter tubing. Silicon conductive grease is applied to this 12 in. connecting section in order to ensure good electrical conductivity between sections of the mast. The total mast length is 33 ft. 9 in., including 18 in. buried below ground level. No insulator is required, because the antenna is operating at DC ground potential.

To support the antenna, bury an 18 in. length of 1 1/4 in. galvanized water pipe and drop the mast down into this pipe. If the characteristics of your ground are such that the mast may continue to sink, insert a concrete paver at the bottom of the hole to prevent this from happening. Lay a 12 in. radial ground plate over the 1 1/4 in. pipe (see fig. 2) and insert the mast through the center hole. All of the radials and the ground wire from the coax are attached to this plate by stainless-steel screws.

Two inches below the top of the mast, drill two holes to hold two closed eyebolts as shown in fig. 2. Attach four skirts as shown and electrically bond them to the mast. As indicated earlier, I use aircraft cable for my skirts, but copperweld or equivalent material is suitable. At my location I experience intense winds, so not only is aircraft cable required for support, but I also add nylon rope at the 16 ft. level for additional strength. For ground anchors I use screw-in type bolts available at most hardware stores.

Photo C– Base of the antenna. The box holds the tuning capacitor and the plate to which it is mounted attaches the capacitor unit to the antenna.

Next, install the four antenna diagonals using No. 12 copperweld wire as shown in fig. 2. The antenna diagonals are connected to the skirts by tightly wrapping 10 turns of one end of the diagonal on each skirt and attaching the other end 7 in. from the mast with nylon rope. The mast ends of the four diagonals are connected together and then connected to the variable capacitor. I mount the variable capacitor in a metal box (photo C) to seal it from the elements and attach it directly to the mast just above the ground plate, insulating it from the mast with ceramic standoffs. The coax-cable feedline is connected directly to the antenna (via the capacitor) as shown in fig. 2. Solder the inner wire conductor to the variable capacitor and firmly attach the ground braid to the ground plate.

Tuning the Antenna

To tune the antenna, simply adjust the variable capacitor for the minimum SWR that will occur at only one discrete frequency. If the lowest SWR point is too high or too low in the band, adjust the skirt length accordingly. It may require two individuals to simplify this tuning process, but it is not impossible for one person to accomplish it. Plots of elevation and azimuth radiation for a four-radial antenna are shown in figs. 3 and 4. This plot was made using Mininec© and the characteristics are those over real ground.

A word of caution: Do not erect this antenna under or in the vicinity of overhead electrical wires or over an underground electrical distribution system. The potential for serious injury is much too great.

I would appreciate hearing of your experiences with this antenna and the results that you achieve, especially for those stations with better locations than mine in Montana. Your comments and suggestions will provide me with additional information to evaluate this antenna and to perhaps improve upon its design. I hope to hear your signal in one of the future 160 meter contests. Good luck! ■

On the Cover

"It's middle-aged stuff," says Bob Beaudet, W1YRC, of Cumberland, Rhode Island, whose vintage radio collection graces our cover this month. "You always try to get the equipment you couldn't afford" when you started out. Bob's classic gear would have been a dream station in the mid-1950s, when he started out. On the very top shelf, second from the right, is an Eldico TR-75TV, Bob's first transmitter not built from the junkbox. To the left are several vintage antenna tuners and to the right is a National speaker, which is hooked to the NC-183D receiver just below it. Moving to the left on the second shelf is a Hallicrafters S-38C receiver with an RME preselector on top of it, a 1920-vintage RME LF-90 low-frequency (100 600 kc) receiver, and a Hammarlund HQ-150 receiver. Below the 150 on the bottom shelf is a Collins 32-V3 transmitter, followed by a Collins 75-A2 receiver and, behind Bob's head, a Heathkit DX-100 transmitter. Not seen in the photo are a Hammarlund HQ-140 and Collins 75-A4, both receivers.

Bob says he's not a serious collector, yet all of that equipment works and is regularly used. He says his real passion is DX. "I'm a shameless DXer," he admits, noting that his "real station," next to the vintage rigs and out of the photo, includes a Yaesu FT-1000D and Henry 2K amplifier used for CW and SSB, plus an ICOM IC-765 for digital modes. Bob also runs the DX Cluster packet node for eastern Rhode Island and southeastern Massachusetts, and is ARRL Section Manager for the Rhode Island. He's retired from Raytheon, where he worked for 42 years, finishing up as the company's University Relations Manager. Bob also writes a monthly tutorial column for two radio club newsletters.

(Cover photo by Larry Mulvehill, WB2ZPI)