Build This Novice Four-Band Vertical

Basic Amateur Radio: Putting your first amateur station together can be an expensive proposition. One way to cut costs is to keep the antenna simple. Here's how I shaved the price and provided four-band operation.

By Marian Anderson,* WB1FSB

Is operation with one antenna acceptable if it covers the 80-, 40-, 15- and 10-meter bands? For a new Novice that's a reasonable approach, I decided. My backyard is smaller than that of most urban homes, so full-size dipole or inverted-V antennas were out of the question. I don't own a tower (yet!), so it seemed that a ground-mounted vertical antenna would be worth trying.

After reading the *ARRL Antenna Book,* I decided that a ground-mounted vertical antenna would be easiest to build. Some radial wires could be buried, and the metal fence which encloses the backyard could also be hooked up to enlarge the ground system. I preferred this type of antenna to one installed above ground, because radials of specific lengths for each of the four bands would have been needed for a roof-mounted, groundplane type of vertical. The buried wires for the ground-mounted antenna could be any convenient length, as long as the available space would permit. From what I have read about these antennas, I believe that reasonable performance can be had even if the ground radials aren't numerous and long, although generally the more you have, the better.

With the help of W1FB I purchased some used aluminum tubing that would telescope together and give me a 25-foot (7.62-meter) antenna. The wall thickness of the tubing is 0.058 inch (1.5 mm). Three 10-foot (3.1-m) sections are used. The largest diameter is 1 inch (25.4 mm). The center telescoping section has a diameter of 7/8 inch (22.2 mm) and the top piece of tubing has a 3/4-inch (19-mm) diameter. This material, plus hose clamps for holding the sections together, came to $8. An old ceramic rotary switch, a coaxial connector, a feed-through bushing, and a piece of Air Dux coil stock were acquired at a flea market for an additional $3. Two medium-size, ceramic standoff insulators were donated by W1FB. He said they cost him 50 cents each at a swap session. All that remained to collect was a weatherproof box for the loading coil, some 50-ohm coaxial cable and six U bolts. My OM, Bob, found some used 1-1/2-inch steel pipe (38 mm) which is 7 feet (2.13 m) long. It is used as a support for the vertical.

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Constructing the Antenna

A lawn-edger tool was used to make slits in the lawn, out from the base of the antenna toward the edges of the backyard. The slits were cut to a depth of 2 inches (51 mm). A total of 10 radials were buried in the slits. Some are only 15 feet (4.57 m) in length, while others are 25 feet (7.62 m) long. The metal yard fence was bonded together as needed, using wire jumpers between the fence sections. A single buried wire joined the fence to the common ground point at the base of the antenna.

My OM drove the steel pipe into the ground to a depth of 4 feet (1.22 m), leaving 3 feet (0.91 m) above ground for attaching the vertical antenna and weatherproof box. Construction details are shown in Fig. 1.

Although a wooden box could have been used to house the loading coil, switch and other hardware, I used an old electrical housing that my OM had in his junk box (Fig. 2). It was drilled and punched on the bottom surface to hold the feedthrough bushing, coaxial connector, switch and ground terminal for the radials.

W1FB designed the antenna, but he wasn't sure that an acceptable impedance match could be had on all four bands without a complex matching network. We decided to try his idea, so the installation was completed.

Adjusting the Vertical

I helped my OM install the antenna, then called W1FB for some assistance in tuning the system. He thought we could tune the vertical for 40 meters and make it work okay as a 3/4-wavelength vertical on 15 meters. For use on 80 meters it would be fairly short (63 feet or 19.20 m is the correct length for 3.7 MHz). With base loading it should offer adequate service out to a few hundred miles on 80 meters. Finally, it would operate as a 3/4-wavelength vertical on 10 meters.

We hooked a homemade SWR indicator in the coaxial line at the base of the vertical.[1] A small amount of transmitter power (5 W) was applied at 3725 kHz and the 80-meter switch lead was touched on the turns of the coil until minimum reflected power was indicated (Fig. 3). An SWR of 1:1 was obtained. The wire was then soldered in place on the coil. Next we fed power to the antenna on 7125 kHz and touched the 40-meter switch lead to the coil turns until an SWR of 1:1 was read. While using the same coil tap we fed power to the antenna on 21.1 MHz and checked the SWR. It was approximately 3:1. By moving the coil tap just one turn we were able to get an SWR of 1.5:1 on 15 meters. A recheck on 40 meters followed. The SWR for that band was less than 2:1 — not a bad compromise! The coil was bypassed entirely for operation on 10 meters: An SWR of 2:1 was indicated at 28,100 kHz. The length of the overall antenna for operation on 28,100 kHz should be 25 feet or 7.62 m (3/4-wavelength radiator). However, the switch leads inside the coil housing add to the antenna length. If an SWR of less than 2:1 is desired, break the 10-meter switch lead and insert a 100-pF air variable capacitor. The unwanted reactance can be tuned out by this means and a low SWR will result.

Opening and closing the cover of the metal box had only a minor effect on the SWR. We were ready at last for an on-the-

[1] DeMaw, "A QRP Man's RF Power Meter," *QST*, June, 1973.

Fig. 1 — Dimensional drawing of the four-band Novice antenna. The top ends of the two lower tubing sections are slit four times each by means of a hack saw. This permits a tight joint when the hose clamp is compressed. The vertical is attached to one metal plate with U bolts. The large standoff insulators with metal feet connect this plate to a pair of small ones. The latter are attached to the steel support pipe by means of two U bolts. The metal box is also affixed to the steel pipe with two U bolts. The band switch is a single-pole three-position ceramic wafer type. L1 can be a 5-inch (127-mm) length of B & W 3029 Miniductor, 2-1/2 inches (64 mm) in diameter, 6 turns per inch of no. 12 wire. See text for alternative mounting methods.

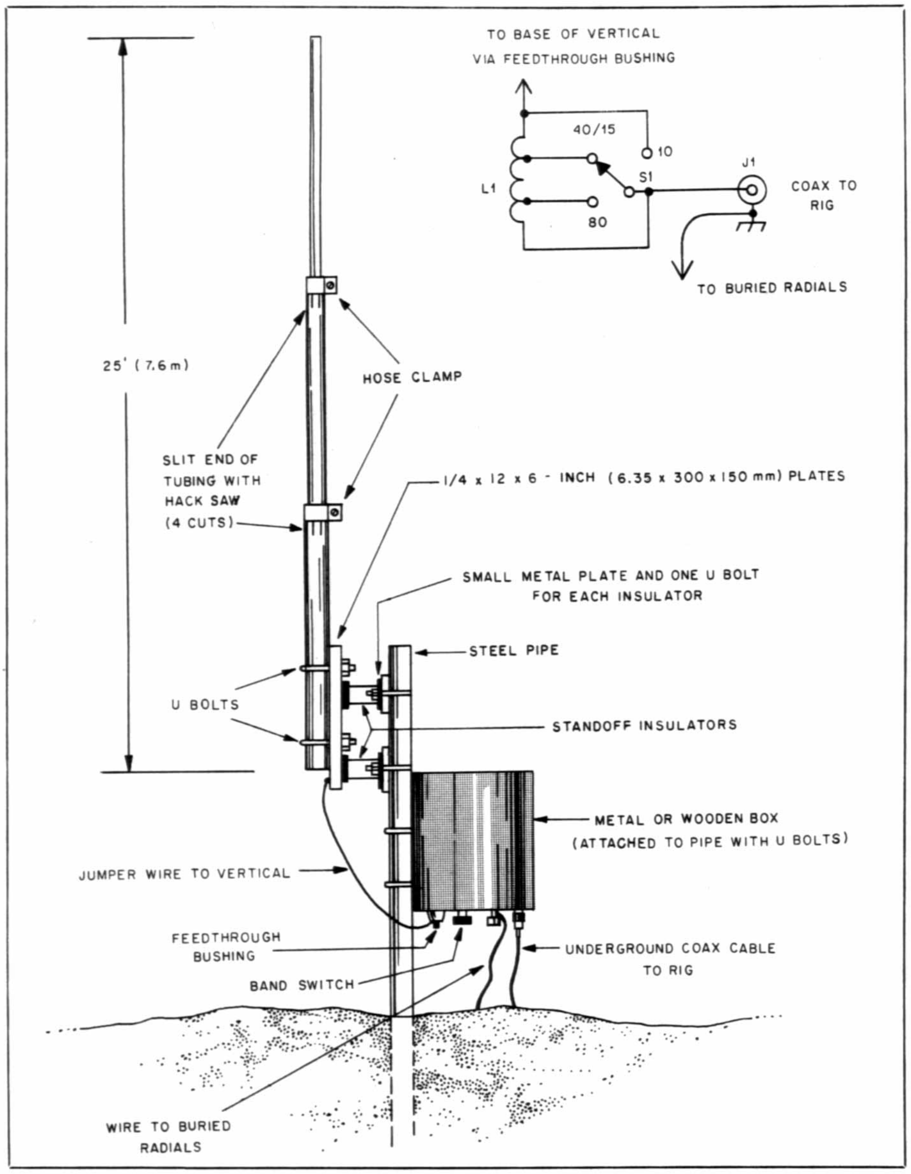
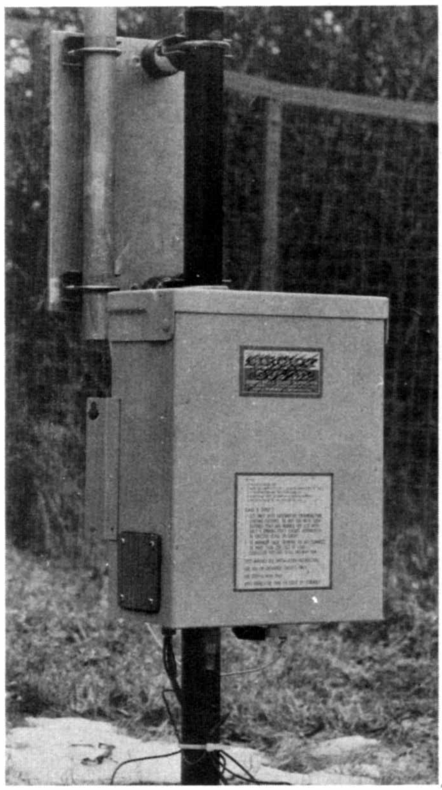


Fig. 2 — Closeup view of the base of the vertical. The aluminum tubing is affixed to a metal plate. The latter is attached to the iron support pipe by means of two surplus standoff insulators. Small aluminum plates are attached to the ends of the insulators to permit them to be fastened to the iron pipe by means of U bolts. The radial wires are connected to the bottom of the coil-housing box.



air test of the system. Fig. 4 shows the interior of the coil and switch housing.

Results

Good signal reports have been received on all bands. The first QSO on 40 meters netted an RST 599 report from North Carolina and many similar reports followed on 80, 15 and 10 meters. I feel that my WAS award is not too far away now that this antenna is in operation.

An Alternative

There are many ways you can duplicate this design using substitute materials. For example, electrical conduit with couplers between the sections should be satisfactory in place of the aluminum tubing. The entire structure could be made from 2 × 4 (50 × 100 mm) lumber. If that is done, the radiator could even be a 25-foot (7.62 m) piece of no. 10 wire, supported on the side of the wood with standoff insulators.

Instead of the mounting method shown in Fig. 1, the vertical pipe could probably be inserted into a 2-foot (0.61-m) length of PVC tubing, then clamped to the mounting plate. This would eliminate the need for the two standoff insulators. Better still, four or five wraps of Teflon sheeting (10 mil or 0.25 mm thickness) could be placed over the bottom end of the vertical before clamping it in place on the mounting plate. Teflon can be purchased at most plastic-supply houses.

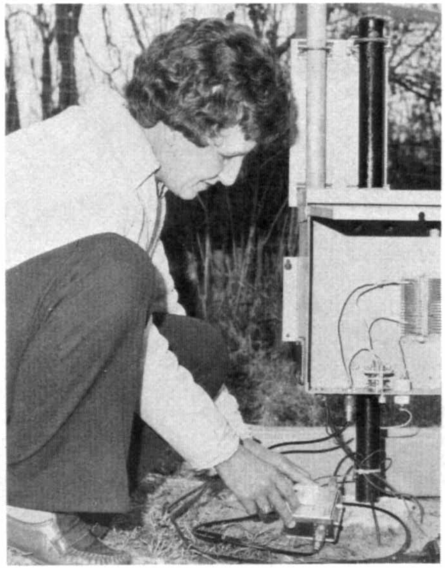


Fig. 3 — The author checks the SWR of the antenna during final adjustment of the system.

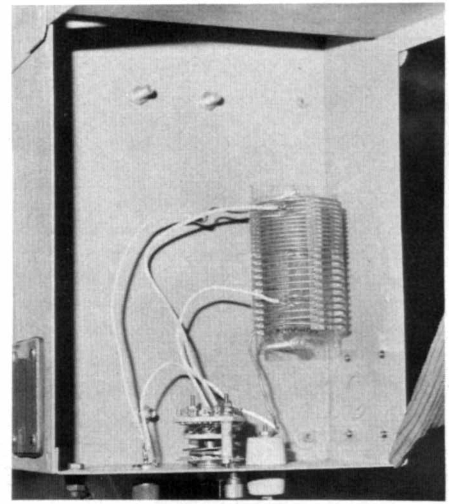


Fig. 4 — Interior view of the coil housing showing the switch, feedthrough bushing, coaxial connector, and ground post for the radials. The coil shown is a piece of Air Dux stock with a tapered pitch. It was obtained at a flea market.

I hope this idea is useful to other Novices who are trying to keep the budget within reasonable limits. I like the way my antenna is working. Others should have good luck with this antenna also. Oh, by the way, the ground radials are made from various scraps of wire. The size isn't important, and they can be insulated or bare. I have quite an assortment of wire types buried in my lawn!