Terry Conboy N6RY
2631 S.W. Orchard Hill Place
Lake Oswego OR 97034

The Center-Fed Bizarre

—would you believe an indoor antenna for 80?

More and more of us find that the acreage for that dream antenna farm with phased verticals, rhombics, and giant monoband yagis just isn't available on a lot size within the bounds of our meager earnings. Even when a tidy home on a reasonably roomy lot is found at an attractive price, city ordinances or deed restrictions may make it impossible to erect tall towers or any outside antennas at all. My situation falls into the second category. Not even TV antennas are permitted in my area.

After two years at this address, I finally decided that operating only on two meters with a magnetic-mount mobile antenna in a window wasn't my idea of the ultimate ham station. I grew up as a ham on the 80-meter band and wanted to keep in touch with the friends that I had made over the years. I did have access to the club station at my place of business, but

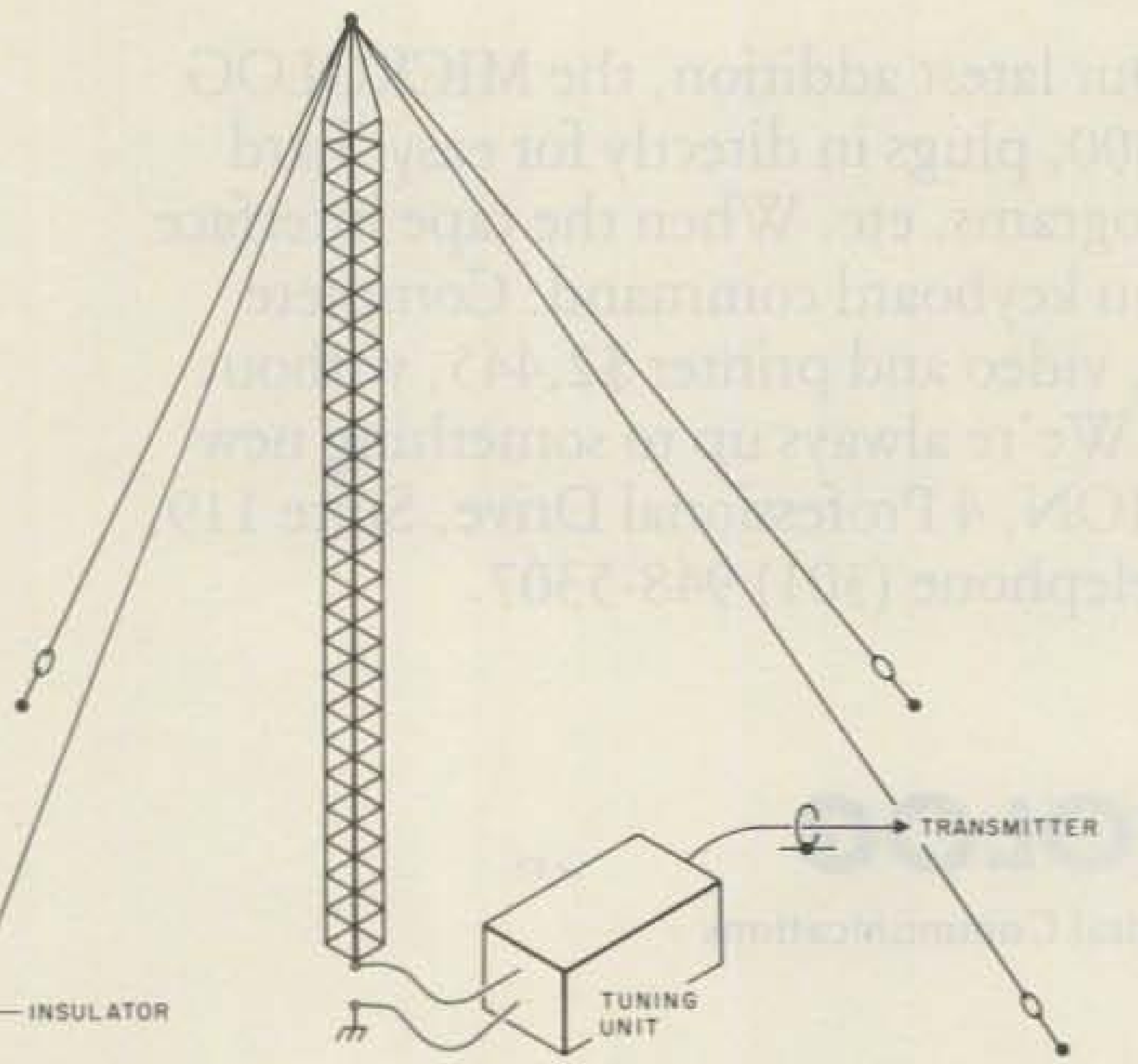

Fig. 1. A common configuration for a VLF antenna using the guy wires for top-loading capacitance.

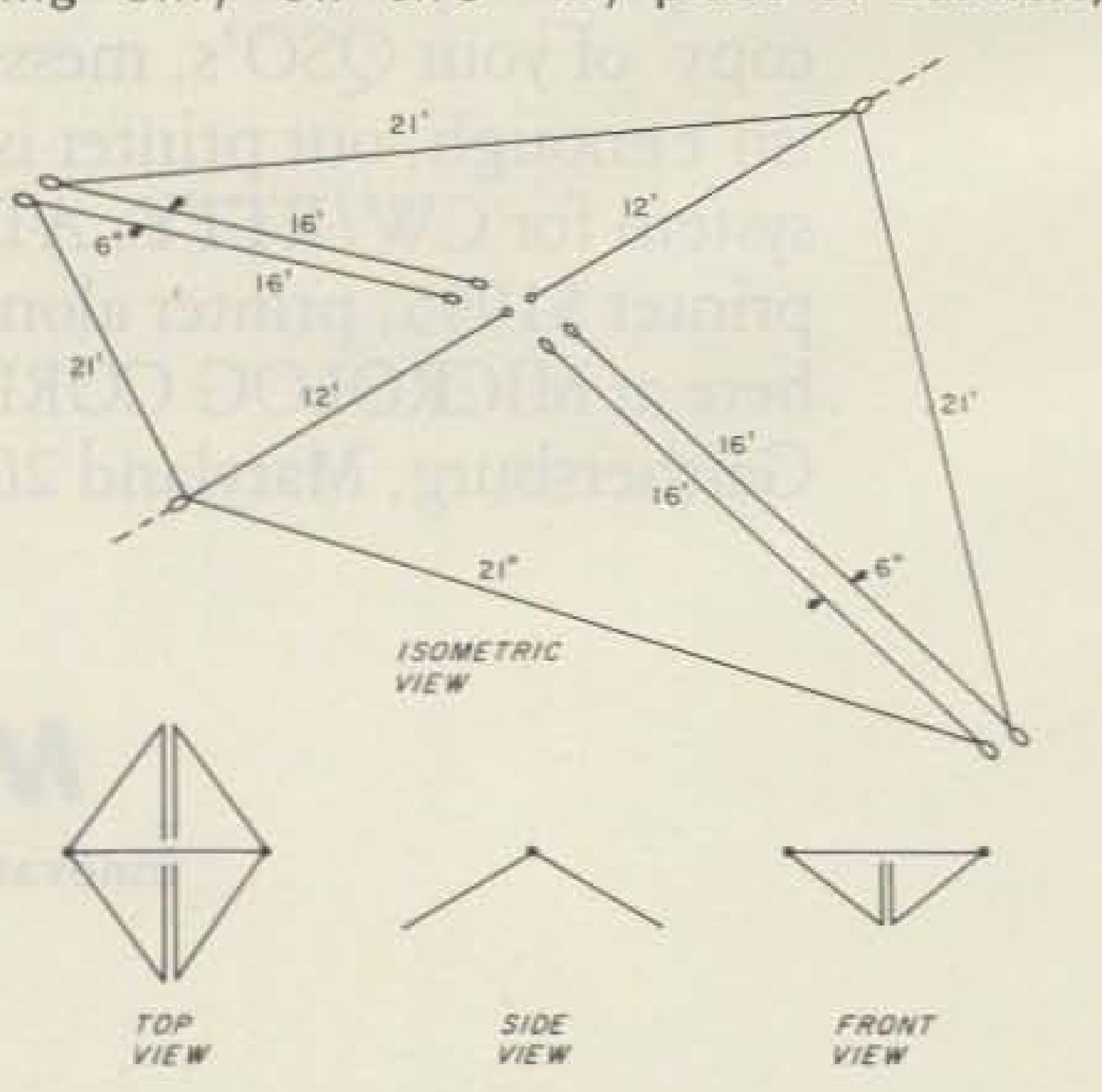

Fig. 2. Final configuration of the attic antenna.

that often proved to be an inconvenient arrangement.

There seemed to be three reasonable alternatives. Put up an inconspicuous outside antenna, load up a flagpole, or try to put something in the attic. The outside antenna was ruled out, since a leading figure in the local homeowners association was my next-door neighbor. Decent flagpoles aren't cheap, and I was advised by a lawyer that I still might be subject to legal action in which it would cost me hard-earned dollars to prove that it was a flagpole. So I crawled up my ladder and made friends with the spiders and the insulation.

Mobile Attenuators

I had acquired a well-respected mobile antenna with a 75-meter loading coil a few years ago, but never used it. As a result, my first attempt at an indoor antenna was to erect it in the center of the attic. Several wires were run around the rafters for a ground system. I was pleased when the swr meter read 1-to-1 near the frequency of interest. I was not at all pleased when most of the stations that I tried to work were barely capable of moving my normally hyperactive S-meter and seldom able to copy me. Some rough calculations showed that I really couldn't expect more than 2% efficiency, since the radiation resistance of the antenna had to be less than 1 Ohm and the other 49 Ohms came from the resistance in the loading coil.

I was generally leery of vertically-polarized antennas in the attic anyway. There were a large number of metal vent pipes and chimneys that were nearby. Most of them had friction joints which could certainly create harmonics or at least be lossy, further soaking up the meager radiated energy.

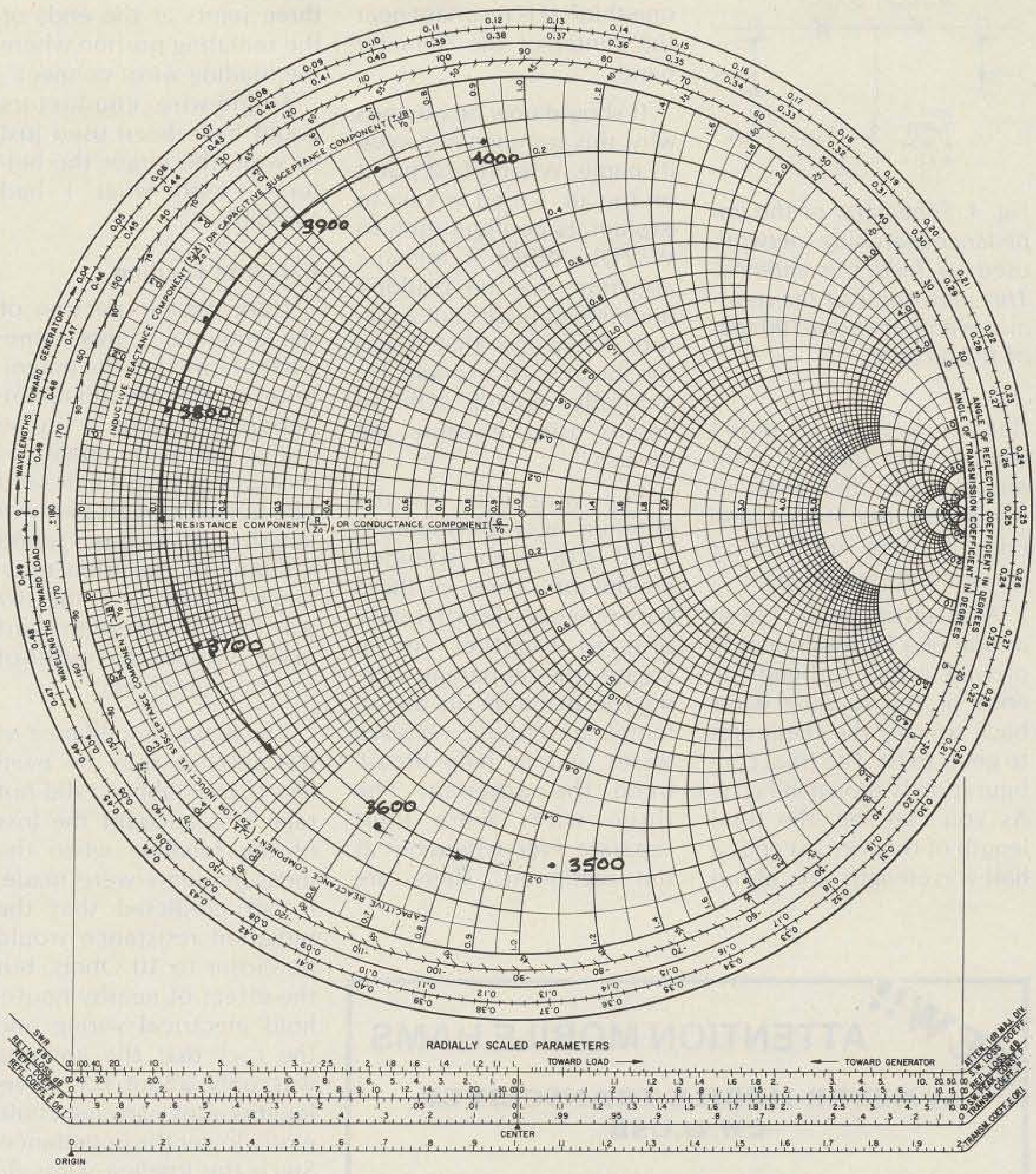

Fig. 3. Measured impedance of the attic antenna. Reference impedance for the Smith chart is 50 Ohms.

Taking a Lesson from the VLF Boys

Compact antennas are nothing new in high-power transmitting installations for use below 100 kHz. A quarter wavelength is well over 2000 feet in this part of the spectrum. Looking at the types of antennas used showed the popularity of top loading. This is no surprise. Placing the loading away from the feedpoint helps keep the base impedance up to reasonable values.

As a rough rule of thumb, the radiation resistance of a base-loaded antenna changes as the square of its length, when the antenna is less than a quarter-wavelength tall (for a vertical). For top-loaded antennas, it changes almost directly in proportion to the length. For example, if the antenna is one-fifth of full size, the base-loaded antenna impedance will look like about one twenty-fifth of its full-size impedance, or about 2 Ohms. The top-loaded antenna will be about 10 Ohms. For very short antennas, this can give a significant increase in efficiency and bandwidth.

One popular configuration for a VLF vertical antenna is shown in Fig. 1. The top guy wires are used as a capacity hat to increase the electrical length of the radiator. I saw no reason why this configuration couldn't be adapted to a balanced horizontal arrangement, since I wanted to avoid vertical radiators.

Wire Everywhere

My attic is about 24 feet wide across the highest part, which is where I wanted to place the main radiating portion of the antenna. The loading wires were bent back at about a 55 degree angle from the

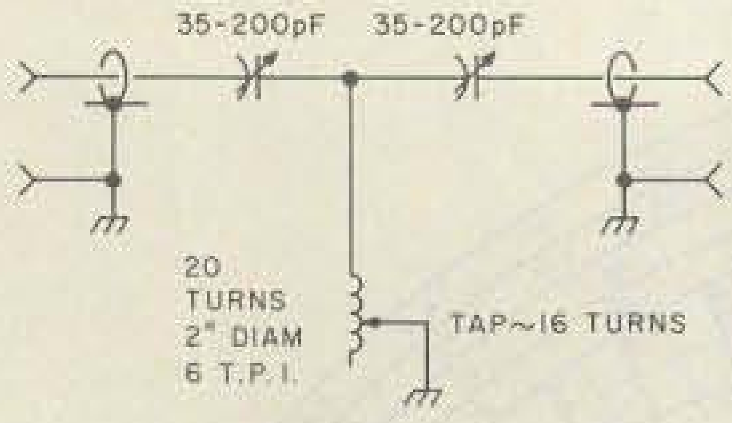

Fig. 4. Schematic of the impedance-matching network used to feed the antenna. This network is at the transmitter end of about 100 feet of RG-8 cable.

flat-top section. I didn't want to run them at right angles, since the walls of my house are stucco and contain wire mesh that could create problems.

As a starting point, I used a total of a half-wavelength of wire. I had to bend the ends of the loading wires back toward the feedpoint to get it to fit. The final configuration is shown in Fig. 2. As you can see, the total length of the wire exceeds a half-wavelength by about one-third. It is resonant near the center of the 80-meter band.

It should now be obvious why this antenna received its name. When I first put it on the air, I tried in vain to explain its configuration to W7ZUL. When it became apparent that he couldn't understand it without a picture, I told him that it was too bizarre to explain. He naturally replied, "Oh, so you're using a center-fed bizarre."

The wire used in the antenna was plastic-insulated #18 with stranded conductors. Three of these wires were laboriously braided together to increase the apparent conductor diameter in an attempt to reduce resistive losses and to help broadband the antenna. The three wires were kept separate everywhere but at the feedpoint. There are three joints at the ends of the radiating portion where the loading wires connect.

Single-wire conductors could have been used just as well, the larger the better. I used what I had available.

Care and Feeding

Upon first inspection of the antenna, I was somewhat alarmed at the magnitude of the feedpoint impedance. Using a noise bridge that was capable of measuring resistance and reactance through a known length of RG-8 coax, I found 5 Ohms of radiation resistance. That's right, the swr was 10 to 1. The Smith chart in Fig. 3 shows the results of my measurements.

The *actual* impedance of the antenna may be even less than 5 Ohms. I did not take into account the loss of the feedline when the measurements were made. I had predicted that the radiation resistance would be closer to 10 Ohms, but the effect of nearby household electrical wiring and the fact that the antenna was only about 0.1 wavelengths above ground could easily lower the impedance. Since the loading wires do not run at a 90-degree angle to the radiating wire, a partial cancellation of the field also results in a lower antenna impedance. In an antenna of this type, a high impedance is sure to indicate undesirable losses.

There certainly are hams who consider a 10-to-1 swr unthinkable. There is salvation for you, but first give thought to this: At 4 MHz, 100 feet of RG-8 (or RG-213) has a loss of about 0.3 dB and the additional loss caused by a 10-to-1 swr is 1.0 dB. A total of 1.3 dB or about 25% of your power is lost in the coax. Foam dielectric coax will be about 1.2 dB, and shorter lengths give proportionately less loss.

No one would think of trying to feed such a mismatch directly from the output of his transmitter. Almost any of the "universal transmatches" will reduce this to an acceptable level.

The matching network I use is shown in Fig. 4. The capacitors are from old ARC-5 equipment. They are adequate for power levels up to 400 Watts PEP or CW input. By the use of a logging scale on the capacitor dials, I can rapidly QSY anywhere within the 80-meter band and still present a 50-Ohm load to my transmitter.

A second method of matching may appeal to those of you who are squeamish about high swrs. There are several nice wideband impedance step-up transformers available that are designed for use with mobile antennas. Using one of them will raise the impedance to nearly 50 Ohms so that the main feedline operates with a reasonably low swr. The catch is that this will only allow operation over a narrow band of frequencies, since the antenna has a fairly high Q.

On the Air

Just because it looks funny, it doesn't mean that it works that way. Stations report respectable signals. Comparisons were made with one local station whose transmitter power is about 3 dB below mine. He uses a normal inverted vee about 40 feet high. No perceptible differences were noted in signal strength, both on close-in (30-mile) and longer-haul (1000-mile) paths. I found this hard to believe at first, too. However, repeated comparisons and several months of successful operation bear out the solid reliability of this indoor radiator. ■