Here's the antenna to dream about, or at the very least to wish you had been there to pick up the same bargain. Rumor has it that there are still about 100 of them out there somewhere, so there is still hope.

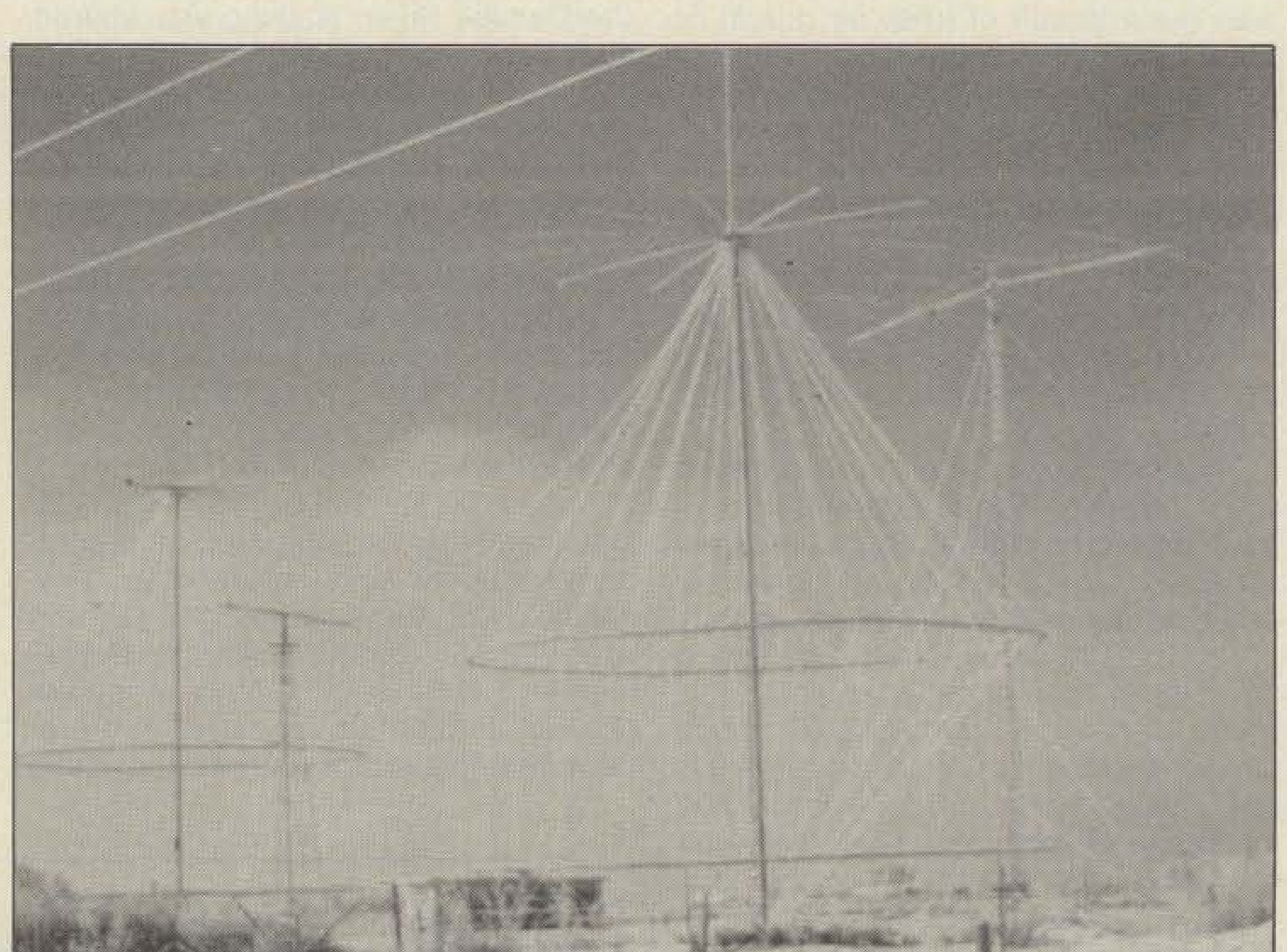
What Looks Like A Birdcage For A 2000 Pound Canary?

(A 3.5 to 30 MHz Discage Antenna, That's What)

BY LARRY STRAIN*, N7DF

When every third operator contacted in a contest asks what antenna is being used one begins to get that nice feeling that at last a good antenna system has been found.

This was, essentially, what was realized within the first few months after erecting a military-surplus antenna that had been acquired, through a Department of Defense direct bid sale, at the QTH of N7DF, in Utah. The antenna was designated in the accompanying technical manual as: "Antenna 237W-1X . . . a transportable, omnidirectional antenna that covers the frequency of 3.5 MHz to 30 MHz and combines an elevated discone antenna and a folded cage monopole antenna into one structure." The description is relatively straightforward, for a military technical manual, but the "portability" of a 55 foot tall, 48 foot diameter antenna that weighs nearly a ton is a matter of opinion!



This is what the discages look like in place at the N7DF contest station in Utah. Note that the near discage has a trapped vertical mounted on the top.

Since there were adequate monoband Yagis already up for 40 through 10 meters, the upper region of the antenna's range was of little interest. The technical manual indicated that "the folded cage monopole mode of operation covers the frequency range of 3.5 MHz to 6 MHz," so plans were made to concentrate its use on 80 meters.

For the folded cage monopole mode of operation, the disc on the top of the cage was originally shorted to the top of the cage via a 55 foot length of coax that was switched to ground at the bottom of the mast. This resulted in poor operation of the antenna, in practice, and it has been reported that an Air Force advisory bulletin prohibited use of the antenna in folded cage monopole mode after several 20 kw transmitters had been "smoked" at missile bases when this mode of operation was used. The best solution for use of the antenna in folded cage monopole mode turned out to be simply to strap the top hat disc directly to the top of the cage. By doing this, any phase problems that might have been present due to the length of the coax were eliminated. It was also found that this permitted extension of the lower usable frequency to include the 160 meter band.

The antenna, as modified, presented a relatively good direct match on 80 meters with the 400 pF fixed shunt capacitor provided. Replacement of the fixed capacitor with an air variable of 600 pF maximum capacitance permitted adjustment to a perfect 1:1 v.s.w.r. match over the

*P.O. Box 125, Holton, KS 66436

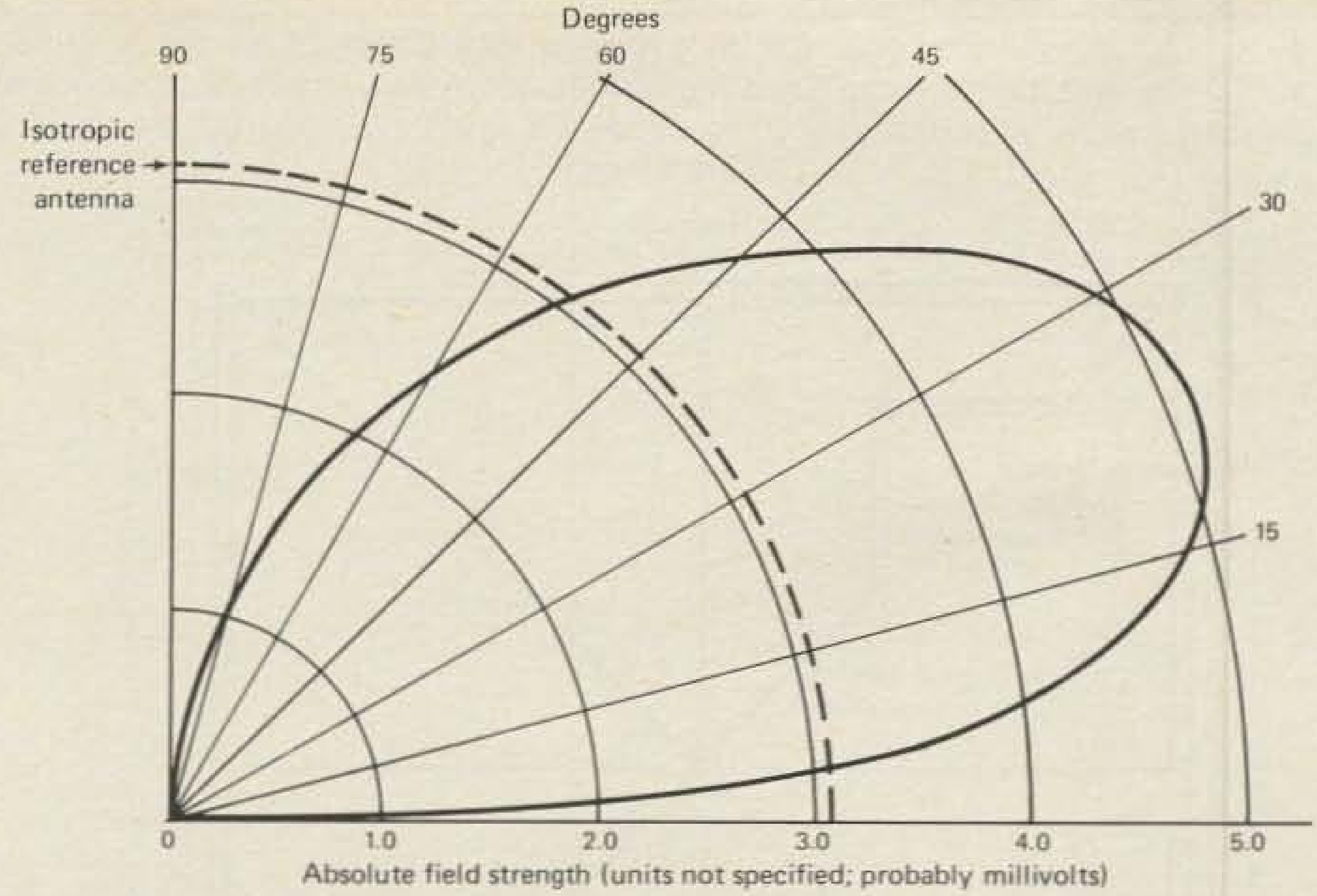


Fig. 1– A voltage pattern plot at 3.5 MHz as supplied by the manufacturer. The lobe is shown centered at 20°.

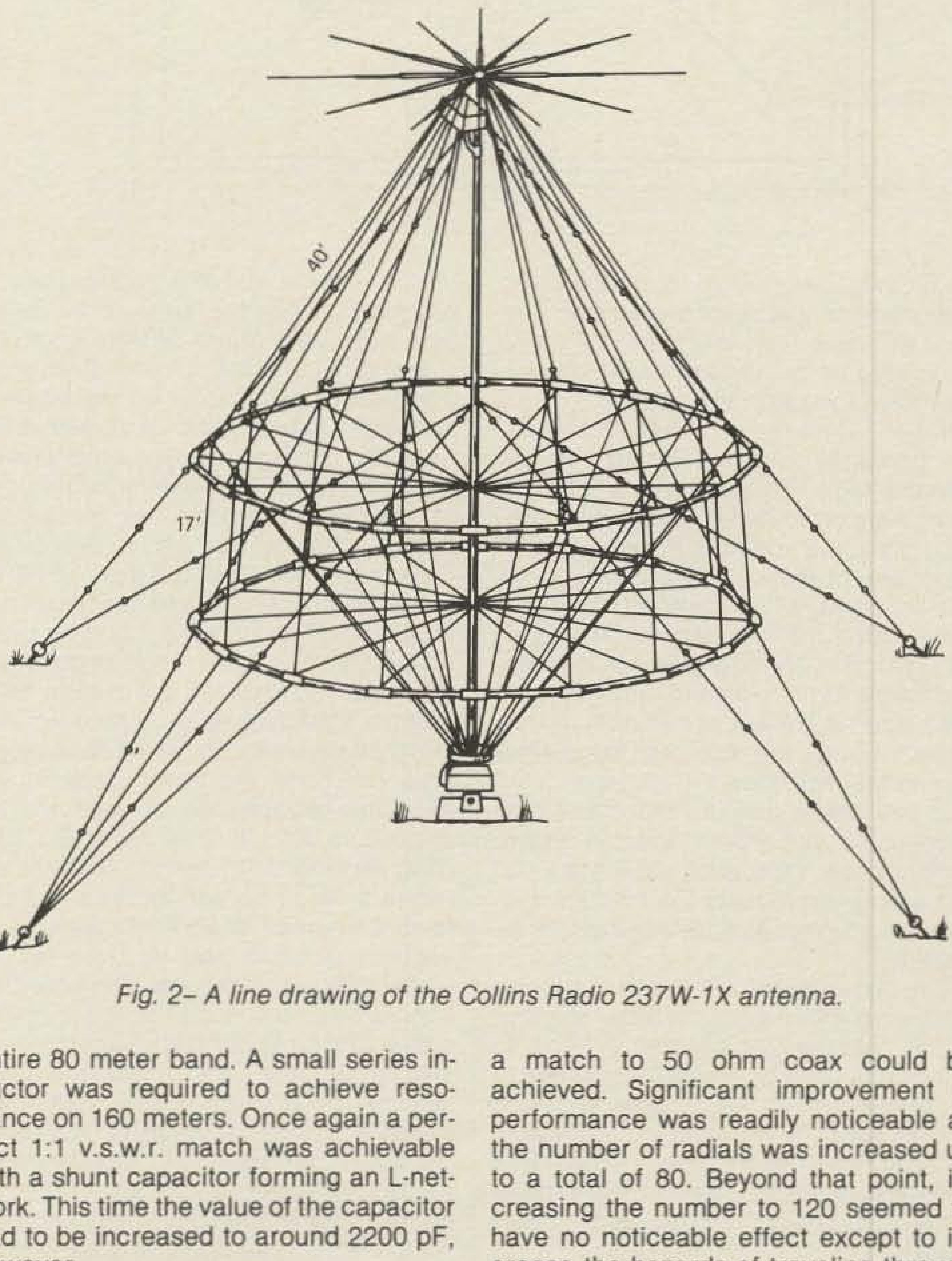


Fig. 2– A line drawing of the Collins Radio 237W-1X antenna.

entire 80 meter band. A small series inductor was required to achieve resonance on 160 meters. Once again a perfect 1:1 v.s.w.r. match was achievable with a shunt capacitor forming an L-network. This time the value of the capacitor had to be increased to around 2200 pF, however.

In both cases of operation the presence of an extensive ground-plane system was mandatory. At least 10 quarter-wavelength radials were required before a match to 50 ohm coax could be achieved. Significant improvement in performance was readily noticeable as the number of radials was increased up to a total of 80. Beyond that point, increasing the number to 120 seemed to have no noticeable effect except to increase the hazards of traveling through the backyard.

The antenna evidences a single, very low-angle radiation lobe in the vertical plane. Collins Radio, the manufacturer,

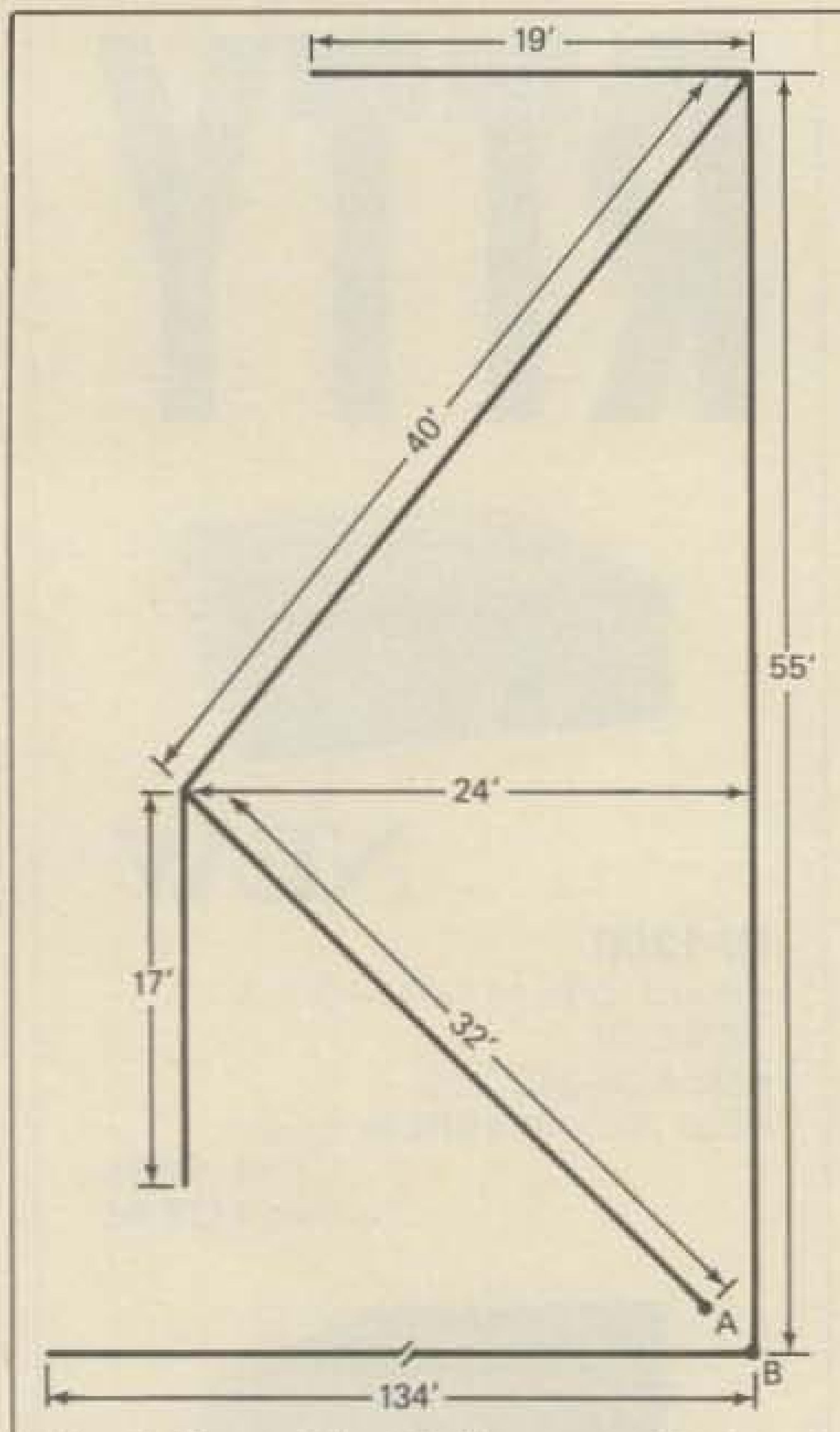
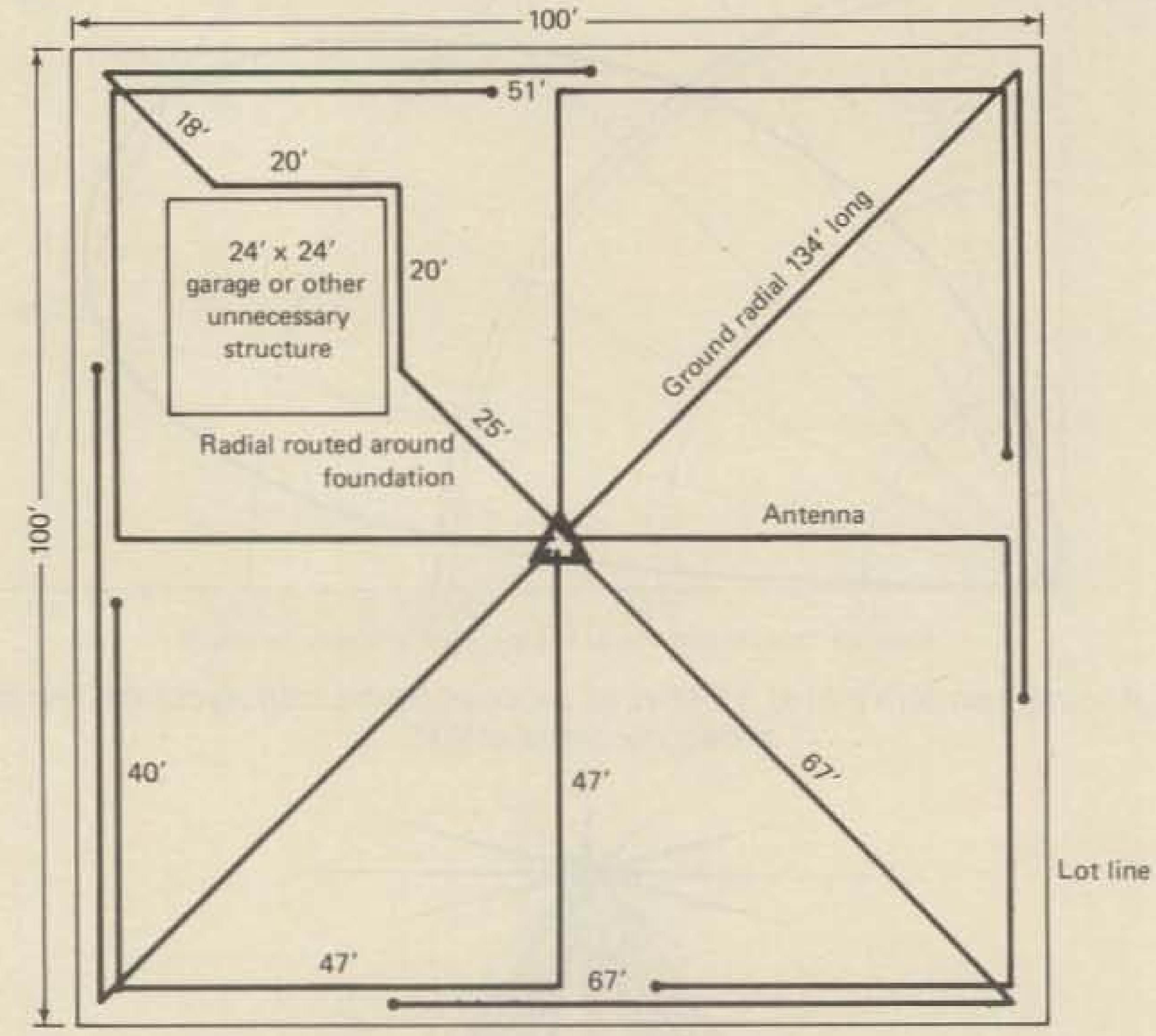


Fig. 3– One of the 24 discage radiating elements. The feedpoints are between A and B.

Fig. 4– A diagram showing how 134 foot ground radials can be folded to fit on a 100' × 100' lot. The author assures us that unnecessary structures such as houses and garages may not even need to be removed if the radials can be routed around the foundations.



provides a voltage pattern plot (fig. 1) that shows this lobe as centering on 20 degrees above the horizon. Tests have confirmed this pattern, but indicate that the actual lobe for the modified antenna may be somewhat lower and narrower. It is significant to note that there are no minor lobes at higher angles, whatsoever. From this information, and actual on-the-air tests, the antenna has been proven to be a superlative DX performer on 80 and 160 meters.

Unfortunately, only a total of twelve of these antennas have been saved from the salvager's scrap furnaces. Although over 2000 were built by Collins Radio for the military, at a final cost of over $30,000 each, all but a dozen were sold for scrap metal. Of these few remaining antennas only five remain in operational condition. Fortunately, these are owned by amateurs and are currently being used in contest stations and for DXing. (Note: There are unconfirmed reports that the military still has about 100 antennas of this type in use in various spots around the world.)

Since the lack of availability and high cost of these antennas makes it impossible for other amateurs to acquire them, an effort has been made to redesign one so it can be built by the average amateur out of readily available materials. Fig. 2 shows a line drawing of the commercial antenna. In this view the antenna itself can be seen to consist of two cones fitted together base-to-base with a set of spacers holding the cage open. Phasing stubs hang from the joining point for the two cones and are held open by a second set of spacers. There are 20 four-cage wires in all, each consisting of three parts. The top hat "disc" consists of 12 pipes mounted on a round plate which is insulated from the top of the cage.

In fig. 3 is shown, in schematic detail, one complete radiating element of the antenna with dimensions. As can be seen, the ground radial system is an integral part of the antenna. In order to construct one of these antennas (which we call a "discage" to contract the complete name of "discone-cage monopole") for the average amateur, the only requirements are a 55 foot tall tower with a fair-size Yagi beam, or tribander, on top and a lot large enough to string out the ground radials. In tests it has been found that the radials can be folded back on themselves with little noticeable loss in performance. Thus, a lot 100 feet by 100 feet can accommodate the antenna. Fig. 4 shows a typical plan view of such an installation.

The cage itself is composed of copperweld wires attached at the top of the tower and held out by plastic rope. Polypropylene hay-baler twine has been found to serve very well for the purpose of guying out the wires, and it is much more economical than nylon rope in the large quantities needed. (One-half mile of baler twine costs about $12.50 at a farm supply store.)

In fig. 5 a detail of one of the cage elements as staked out is shown. The wire down the side of the tower is very important. The tower itself does not provide an adequate ground return path for the antenna currents, and at high power arcing will occur inside the joints of the tower legs if separate return wires are not provided. Similarly, the ground strap from the center of the boom on the beam is necessary to avoid placing r.f. across the rotor and damaging it by internal arcing.

The feed for this antenna couldn't be simpler; a shunt capacitor across the base is all that is required. Voltage on the capacitor is very low, but since it will be outdoors, at least 600 volt spacing is recommended even when it is enclosed in a watertight housing. A range of up to 600 pF is required to permit use of either 50 or 75 ohm coax to feed on 80 meters. For 160 meters a roller coil and a capacitor of around 2200 pF are needed. Up to 1000 pF of this capacitance can be fixed, but capacitors used must be capable of handling very high r.f. currents. Transmitting micas or fixed air capacitors should be used. Of course, a single air variable (or vacuum variable) can be used for the whole 2200 pF if desired. The roller coil should be 3 to 4 inches inside diameter with 6 to 8 turns per inch. Such coils are readily available from surplus electronics retailers or at most amateur radio fleamarkets. In this size range 6 to 10 turns of the coil will be required to tune the antenna for 160 meters at the low end of the band. Tapping a fixed coil for the proper match is possible but is very tedious. By careful adjustment of the coil and capacitor combination, which is a simple L-match configuration, a useful bandwidth of at least 75 kHz is possible with a single setting.

A double-pole double-throw relay can permit bandswitching from 80 to 160 meters by remote control (see fig. 6). The control line should be shielded and bypassed to prevent r.f. from being carried back into the shack where it can cause all kinds of havoc.

Tuning the cage for 160 can be a bit tricky. First the 600 pF variable connected to the coax center conductor should be adjusted to a 1:1 match at the center of the band segment on 80 meters where most operation will take place. A bandwidth of 150 kHz with 1.5:1 or lower should be possible on 80 meters with 40 or more radials out. The relay must be in the normally open position for this adjustment. To switch the antenna to 160 meters, the relay must be energized. With the roller coil set at 8 turns in the circuit, the second air variable is adjusted for lowest v.s.w.r. at the center of the band segment on 160 where operation is desired. The coil is then adjusted for lowest v.s.w.r., as is the capacitor once again. This back-and-forth adjustment is repeated as many times as needed until a match is achieved. At the proper match point the v.s.w.r. will dip very sharply to 1:1. Often as little as 1/10 turn of the coil will make a significant change. This should give a usable bandwidth of 75 kHz with the values specified. Do not attempt to extend the range by tuning out high v.s.w.r. with an antenna tuner at the transmitter. This can cause arcing of the coil with accompanying harmonic and spurious radiation.

Now the antenna can be switched from 80 to 160 simply by switching the relay on or off from the house.

If the tower to be used as a support is more than 55 feet high, the cage should be located at the top of the tower. In this case the ground plane under the cage will become an elevated cone of wires. Of course, the stake-out points for the cage wires will be different. Although this configuration has not been tried out by the author, theory indicates that its performance might surpass that of the ground-level cage.

In all cases of guyed towers, the guy wires must be insulated from the tower and the ground and broken up into nonresonant lengths by insulators. Collins Radio used 8½ foot spacing between their insulators on the guy wires on the commercial antenna. The best solution, however, would be use of Phillystran® or other nonconductive material for guy lines.

Placing the 80/160 meter discage on a tower with high-band beams on top has shown no noticeable effect on the operation of the beam antennas. CQ

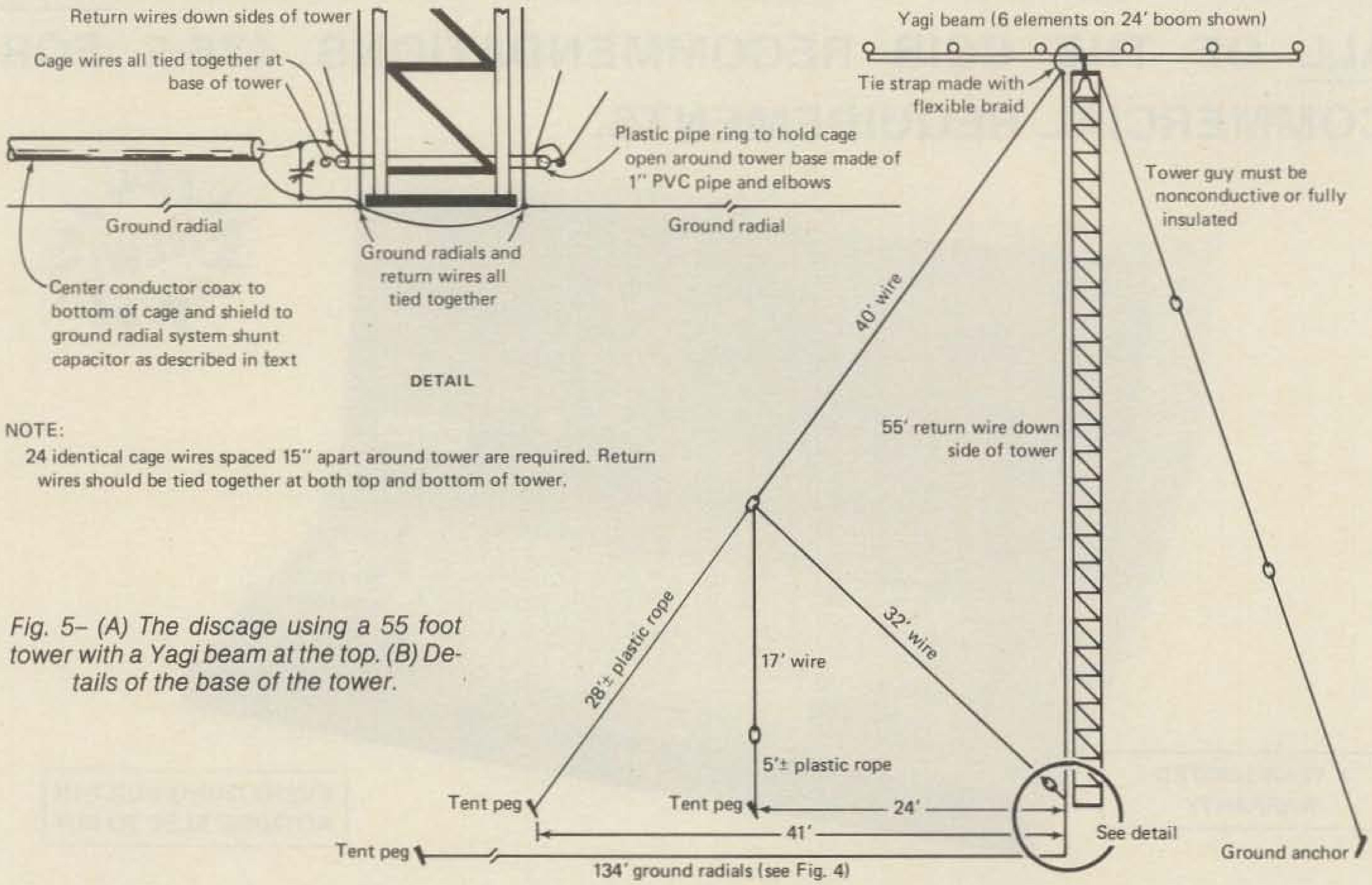


Fig. 5– (A) The discage using a 55 foot tower with a Yagi beam at the top. (B) Details of the base of the tower.

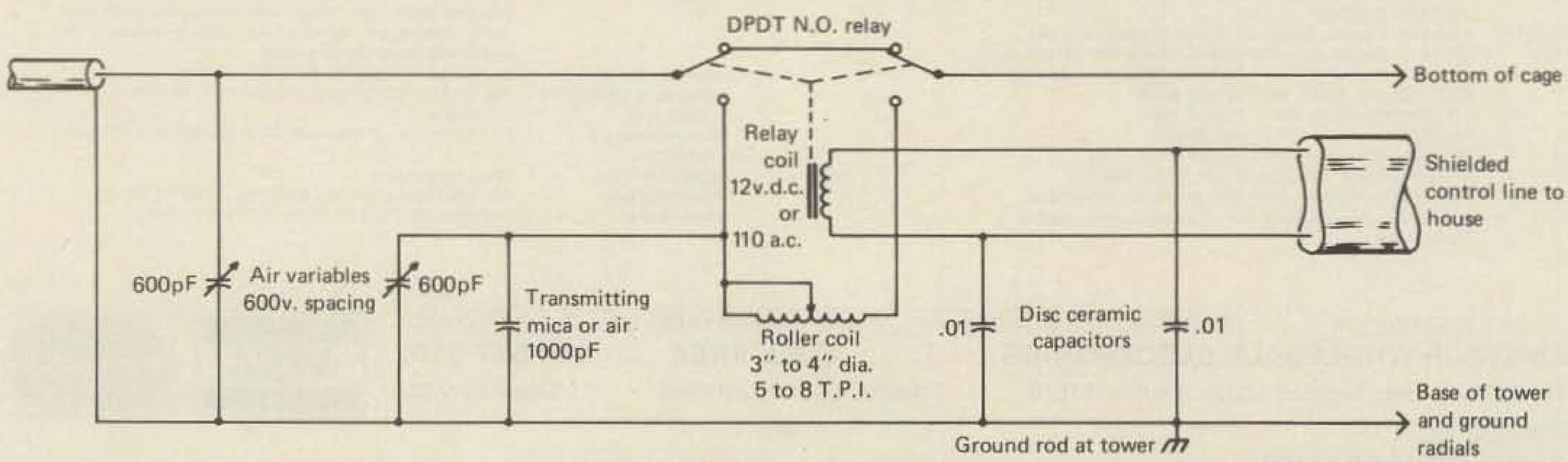


Fig. 6– The circuit for the bandswitching antenna matcher. The relay is shown in the 80 meter position. The entire assembly should be in a watertight box placed at the tower base.