73 Magazine *Staff*

Squaring the Conical

If you don't mind having an antenna in your yard which looks a bit like a piece of modern art, the conical monopole has some extremely interesting advantages. The form described here can be constructed inexpensively from TV masting and lots of wire. It is extremely rugged and stormproof since, as will be seen later, it is practically the equivalent of having a 30' high TV mast guyed by about 200 small guy wires!

The conical monopole as such is not a new form of antenna. It has been widely used on VHF and sometimes on the HF bands, formed in its usual circular shape as shown in Fig. 1. It is a vertically polarized antenna and offers extremely broad bandwidth while maintaining a low swr. In a sense, it is similar to the wide-band discone antenna, although it does not have the large "top-hat" element required of the discone. The antenna functions over a broad frequency range because the circumference of the cone-shaped monopole becomes resonant at different frequencies as determined by the extent of the circumference variation from top to bottom of the monopole. Within the frequency range for which the antenna is constructed, therefore, it is continuously in resonance rather than just being resonant in certain distinct bands. A typical frequency range spread for such an antenna is about 4:1 although this will vary a bit depending upon the exact design used.

The design presented in this article covers basically from 80 through 20 meters. However, it will show good performance up to about 19 MHz or so. So, if the 18 MHz band ever becomes a reality in the distant future, the antenna would, in fact, continuously cover 5 amateur bands (80, 40 and 20 plus the proposed 12 and 18 MHz bands). The antenna is fed directly with 52 Ohm coaxial cable and requires no additional tuning devices. A simple loading coil can be switched in at the base of the antenna to extend its range to 160 meters, if desired, and it should show very creditable performance on this band – especially if a reasonable ground radial system is used. If one has the real estate available, more than one antenna could be used to form a directional array by proper phasing of the current fed to each antenna. Since the spacing of the antennas would be fixed physically but vary electrically on the different bands, this would mean, however, that the phasing lines between antennas would have to be changed on each band.

The basic conical antenna as shown in Fig. 1 would seem to present some almost impossible constructional aspects on the lower frequency bands if the classic formula dimensions of the antenna were maintained. For instance, for basic 80-20 meter coverage the overall height has to be 32 feet. This dimension is not impossible, of course, but the upper and lower rings of the monopole have to be about 6 and 18 *feet* in diameter, respectively. Constructing an 18 diameter ring of lightweight tubing is

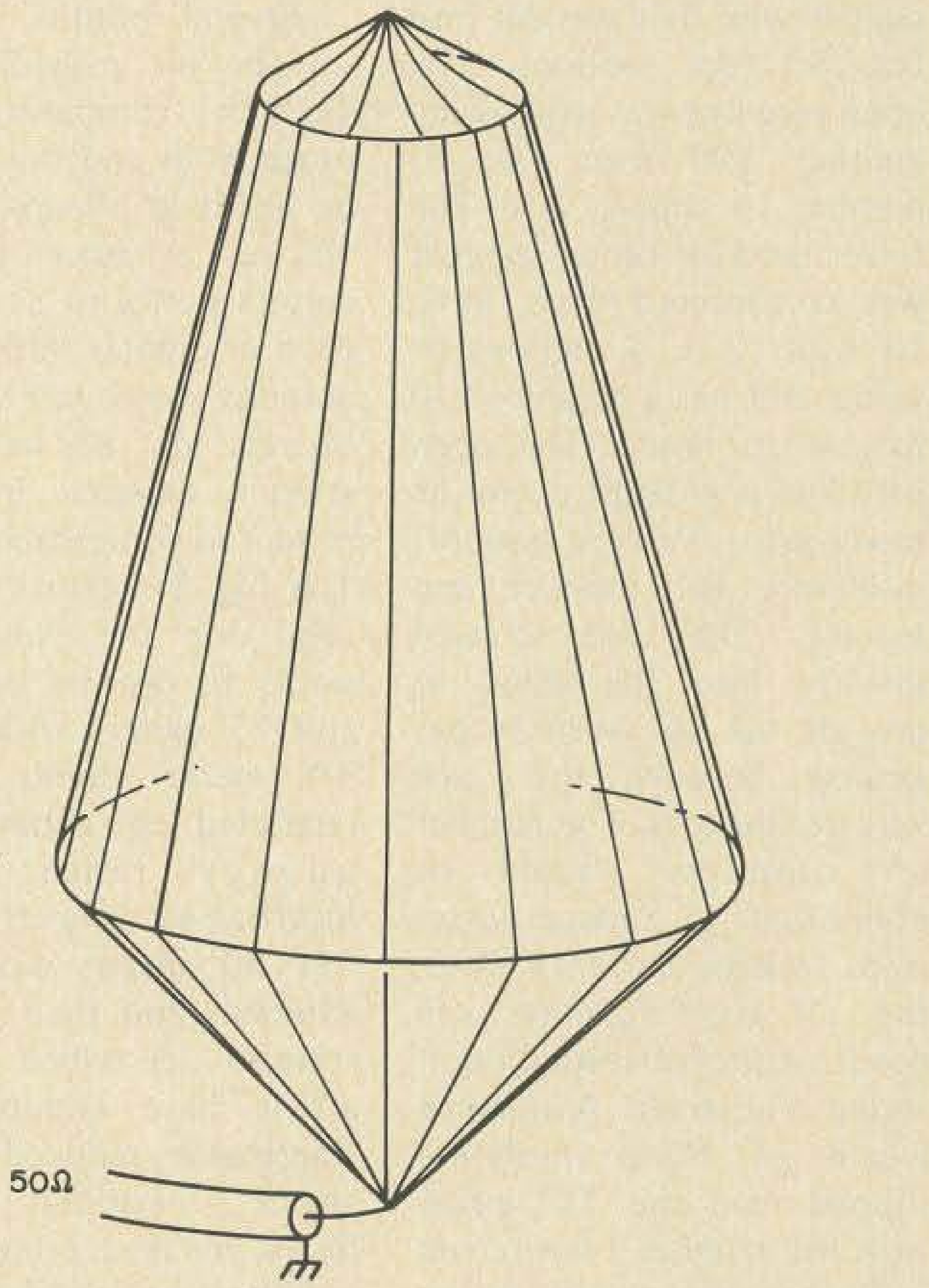

Fig. 1. Basic discone monopole antenna is frequency independent over about a 4:1 frequency range.

hardly a simple matter for the average amateur.

The circular form of the antenna is important if absolutely omnidirectional radiation characteristics are to be achieved. But, only a slight deviation from this characteristic will result if the antenna is made square in shape instead of perfectly circular. The radiation from the corners of the antenna will suffer a bit (perhaps 3-5 dB down), but it should not be difficult for any amateur to orient the antenna with the aid of a great circle map centered on his QTH such that these points fall into areas which are of minor preference. The other advantages of this form of antenna should far outweigh this disadvantage.

A "squared-off" conical monopole for 80-20 meters is shown in skeleton form in Fig. 2. Not every wire is shown for the sake of clarity. The total mast height above the base insulating section is 30 feet and may consist simply of telescoping TV mast sections. The height from ground to the insulating section may be 2-3 feet. The upper square is located about 2 feet from the top of the mast. Each side of this square is 6 feet long. The square can be constructed from metallic tubing, but a better choice is probably PVC plumbing type tubing using the right angle fittings easily available for this type of tubing to form the square. Holes are drilled through the tubing for each wire element and a fixing wire placed around the entry and exit points of each wire to keep the overall square in place. At the top of the mast, each wire element is secured to a ring which metallically connects it to the mast.

At the base of the antenna, four approximately 6 foot tall guy posts are installed spaced 16 feet apart and centered around the central mast. The lower ring of Fig. 1 is simulated by an *insulated* wire ring running around between the four guy posts. This wire should be particularly taut, and it may be advisable to guy each guy post in two directions, depending upon the type of soil encountered. Each wire element from the top of the antenna is run through the upper square, then to the lower wire ring (where it is soldered or clamped to the wire ring), and then to a collector ring just above the insulating section on the central mast. The spacing between the wires as they reach the lower wire ring should be about 3 inches. Belden copper-bronze antenna wire is particularly suitable, but any good antenna wire of the copper-bronze or copperweld variety will more than adequately suffice.

The conical monopole is a vertically polarized antenna that offers extremely broad bandwidth while maintaining a low swr . . .

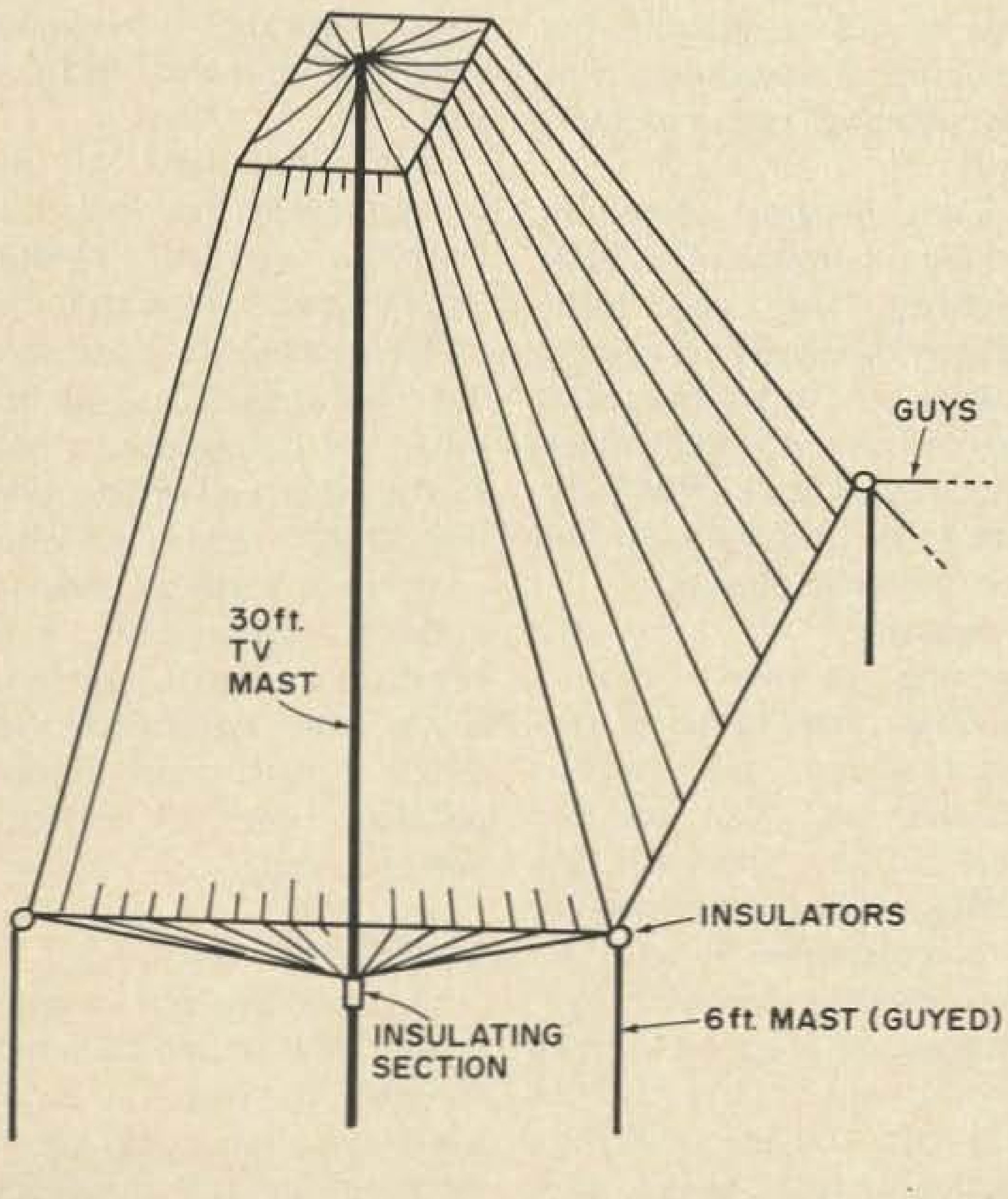

Fig. 2. Squared form of antenna form shown in Fig. 1. Distance between 6 foot masts is 16 feet. Other dimensions are discussed in text.

The center conductor of the coaxial feed line should be connected to the wire collector ring above the insulating section on the central mast. The shield is connected to the mast support pipe going into the ground. Although this type of antenna is less dependent upon ground radials than the usual type of single element vertical antenna, ground radials will improve its performance. But, again because of its unique design, the antenna does not require ground radials of the usual length as single element quarter-wave vertical antennas. A group of 10-12 radials, each being 16-17 feet long, will suffice for normal operation, although numerous experiments have shown that a greater number of radials will improve the low angle radiation characteristics for DX purposes. Experiments have also shown that ground radial extension in the direction of desired DX performance will considerably improve performance in that direction. For instance, say one does have room to bury 16-17 foot radials all around the antenna but one's particular DX interest is South America. By making the radials pointing in the South American direction as long as possible (34 feet to infinity), considerable improvement in low angle DX radiation in that direction will occur. A rough estimate is that radials one wavelength long in the desired direction result in a 3 dB gain at the low vertical angles useful for DX purposes.

The squared conical monopole is certainly not the overall answer to HF antenna problems, but it does offer reasonably omnidirectional coverage and coverage of the main HF bands usable during the present sunspot cycle. Since the swr to the antenna also remains less than 2:1 over its design range, it also serves as an excellent antenna companion to the various solid state transceivers on the market which have broadband transmitter output circuits (non-tunable). These circuits demand for maximum power output that the antenna transmission line they work into presents a very uniform low swr pattern on each of the bands involved if the "instant" bandswitch advantage of these rigs is to be a realistic operating convenience. ■