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IMPROVING THE PERFORMANCE OF TRAP-TYPE VERTICAL ANTENNAS

The addition of another element can considerably improve the performance of multiband vertical antennas such as the Hy-Gain 12AVQ or 14AVQ models. The added element can be automatically bandswitched and a transmission line system used which allows simple changeover from an omnidirectional to a directive radiation pattern.

Multiband trap-type verticals such as the Hy-Gain 12AVQ or 14AVQ (or homebrew types) provide many amateurs with a multiband antenna system in a limited space. Provided that a good ground system is used, such antennas can prove to be very effective for DX work. The disadvantage to such antennas is that their radiation pattern in the horizontal plane is omnidirectional. If one is interested in DX in any specific area, it is discouraging to realize that only a fraction of the total radiated power available radiates in any specific direction. One solution to this problem is to use another element with the basic antenna. Such an element should be economical, provide an effective directional radiation pattern, automatically bandswitchable on desired bands, and not require any major change to the transmission line system used with a multiband vertical antenna.

This article describes such an add-on antenna element which will provide automatic bandswitching from 20 to 10 meters, develop a directive pattern with at least 3 dB gain, and not require any change to the transmission line system to the trap antenna. Basically, it is a stub bandswitched element properly spaced from the main antenna and fed in such a manner that the current distribution between the main and secondary antenna is such as to effect a directional pattern on the desired bands. Since the scheme used employs direct feed of the secondary antenna or element, rather than a parasitic-type excited element, it is really applicable to a wide range of multiband antennas including horizontal multiband trap dipoles. Of course, when considering a horizontally oriented antenna, the secondary or add-on element would also have to be horizontally oriented.

Basic Scheme

Figure 1 shows the basic antenna arrangement. Either antenna 1 or 2 can be considered to be the trap antenna and the

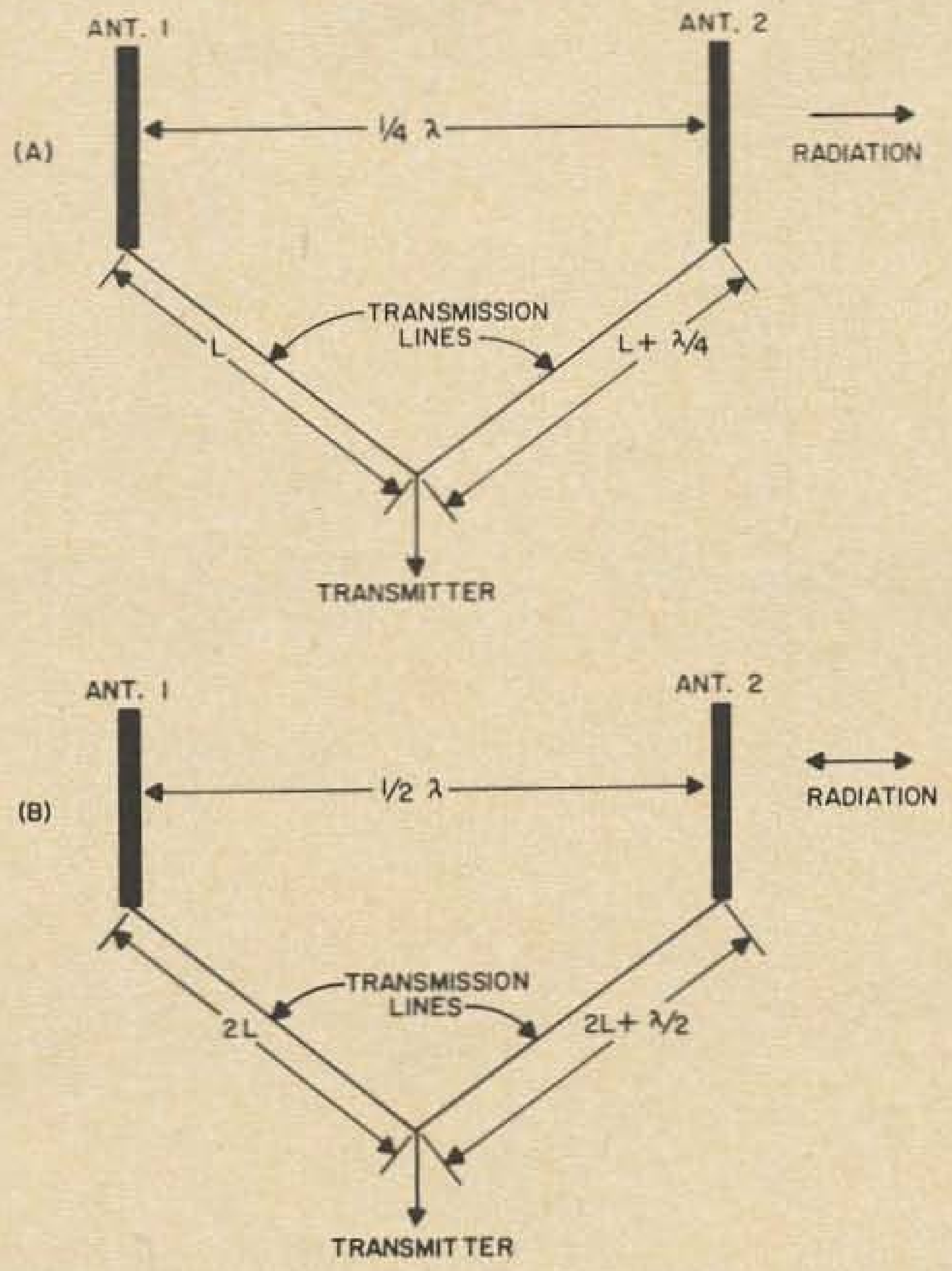

Fig. 1. Two-element antenna spaced ¼λ and fed 90° out of phase (A) automatically becomes ½λ spaced 180° out-of-phase array (B) on second harmonic frequency without changing feedline lengths.

other antenna the secondary antenna. Figure 1(A) shows the antennas separated by ¼λ. The transmission line to the secondary antenna is chosen so that it is ¼λ longer or shorter than that going to the main trap antenna, depending on the direction in which the main radiation is desired. Fed in this manner (90° or ¼λ out of phase) and spaced ¼λ, a cardioid directivity pattern results in the horizontal plane with the direction of radiation as indicated in Figure 1(A). Assuming that each antenna still properly matches its transmission line on the 2nd harmonic frequency, Figure 1(B) shows the spacing and phasing relationships. The antennas are now electrically spaced by ½λ and the one transmission line is ½λ (180°) longer than the other. Under these conditions, the antennas will develop a bidirectional radiation pattern in the horizontal plane as shown by the arrows in Figure 1(B).

The transmission lines are simply paralleled together at the transmitter. This results in a resultant impedance of about 25–26 ohms which the transmitter has to load into, but such an impedance is well within the loading range of almost any transmitter with a *pi* network and variable

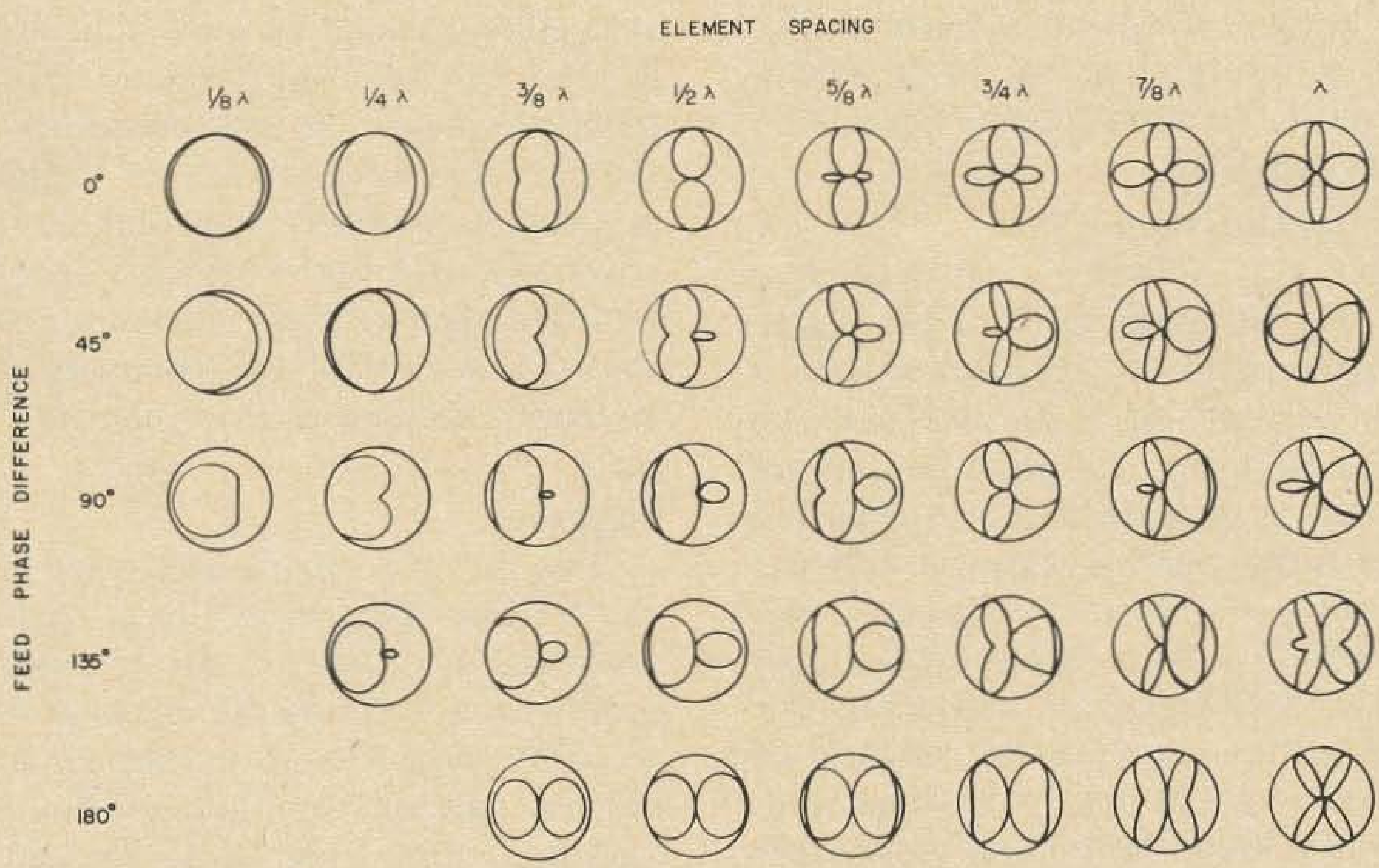

Fig. 2. Besides the usual in-phase (0°) or out-of-phase (180°) current feed systems that appear in antenna designs, a very wide selection of radiation patterns can be obtained by different phasings of two antennas. The patetrns shown are the horizontal radiation patterns. In all cases, the amplitude of the currents to both antennas is equal.

output loading. This is especially true on the higher frequency bands. In order to revert back to omnidirectional operation, the secondary antenna is disconnected at the transmitter and the transmitter reloaded.

The spacings and phasings shown in Figure 1 are conventional ones well known by any amateur acquainted with driven, phased antenna arrays. Many amateurs, however, falsely think that there are only a small number of spacing and phasing combinations that provide useful directional patterns for a driven array with two antenna elements (e.g., ¼λ or ½λ spacing, in-phase (0°) or out-of-phase (180°) feed, etc.). Actually, there are a great many more combinations that can be used, as illustrated in Fig. 2.

From all the combinations shown, it should certainly be possible to develop a useful directive pattern no matter how restricted one may be in the physical placement of the antennas. If the spacing and feedline lengths are chosen correctly, as illustrated in one case by Fig. 1, an effective directional pattern will be obtained without changing transmission line lengths or one or more bands harmonically related to the band for which the antenna array is designed. If there is any difficulty in interpreting Fig. 2, one should first locate the combinations illustrated by Figs. 1(A) and 1(B).

Practical Construction

Figure 3 shows how a secondary antenna was installed with a basic multiband trap vertical in order to provide a directive pattern on both 10 and 20 meters. The spacing and phasing used are those shown in portion of the antenna and the lower approximate 8 ft section acts as a ¼λ vertical on 10 meters. The antenna used was constructed from telescoping aluminum tubing with 1¼ in. o.d. tubing used for the base section. Any similar method of construction can be used but some provision should be made to allow adjustment of the length of the antenna and the stub. The secondary antenna should first be used alone and the transmission line to it checked for low swr (of at least 1.5:1 or less on both bands).

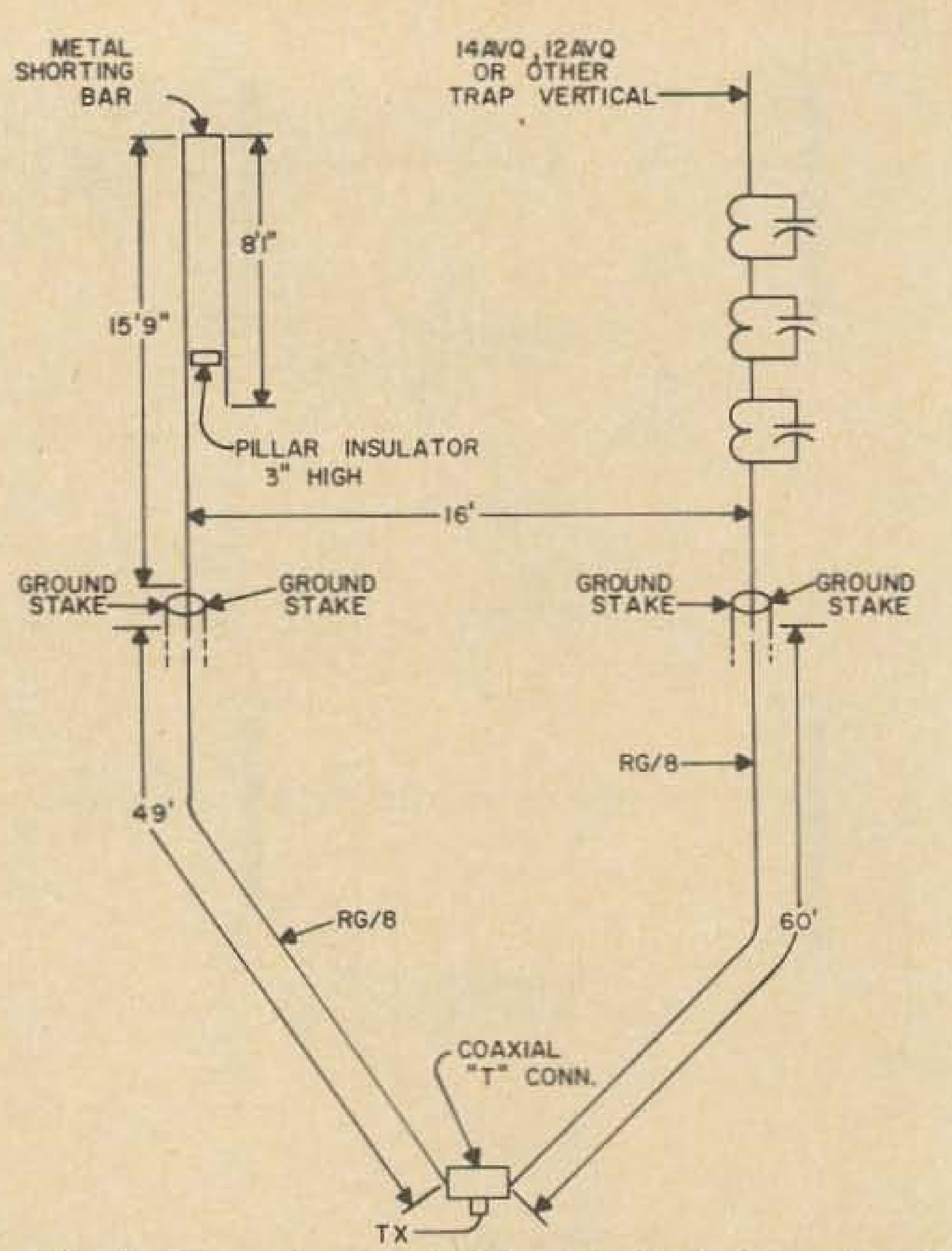

Fig. 3. Secondary stub-bandswitched antenna used with 14AVQ antenna on 10 and 20 meters to form directive array. Feedline system is based on Fig.1.

The transmission line to the secondary antenna is cut to be ¼λ shorter on 20 meters than the line going to the trap antenna. Note that the velocity factor for coaxial transmission line (.66) must be used when calculating the ¼λ difference in length. The two coaxial lines are joined together via a coaxial tee connector which mounts directly on the coax output jack on the transmitter. For omnidirectional coverage or for operation on a band where the secondary antenna does not resonate, the coaxial plug for the secondary antenna is simply unscrewed from one side of the tee.

Summary

The use of a simple secondary antenna can increase the gain in almost any desired direction by usually 3 dB or more when used with a trap vertical. There is no need to limit oneself to conventional antenna element spacings or phasings. One should carefully study Fig. 2 to decide which spacing and phasing suits a given situation. Then, one can proceed with usage of the secondary antenna in the manner shown for the specific construction example shown in this article. . . . W2EEY/1 ■