low-band converted-vee antenna

This trapped antenna provides low swr operation on 40, 75 and 80 meters–great for 5BDXCC

Bob Polansky, W6JKR, 1024 Green Lane, La Canada, California 91011

With the new 5-band DXCC award, interest in 40 and 80 meter operation has vastly increased. A number of W/K stations have completed, and many others are well on their way, to making the required contacts with one hundred countries on each of these bands. One could hardly avoid becoming intrigued with this challenge. Since my receiver and transmitter were already capable of covering these bands, my efforts turned toward a suitable antenna system.

dual-band inverted vee

With a central mast on my property and little chance of erecting other high poles the best compromise antenna appeared to be a combination 80- and 40-meter inverted vee patterned after the dipole described by Neil Handel, W1IR.[1] The 80 and 40 meter elements were separated with 1/4 x 6 inch wooden-dowel spacers simmered in a high-melting-point wax, as W1IR had done, for weather protection.

Since I operated for long periods of time on either cw or ssb I tuned the long legs of the inverted vee to 3.8 MHz for ssb operation and made provisions for connecting across egg insulators with shorting devices to lengthen each leg for 3.5 MHz cw operation. That way a relay and its associated wiring was avoided.

Clip wires could be used for shorting devices; however, they suffer several disadvantages. First, they can be inadvertently pulled off by branches or other physical obstructions. Second, it is possible that the clips may make poor electrical contact because they're connected onto a corroded spot on one of the wires. My solution was to use a shorted 83-1SP plug inserted into a receptacle soldered across an egg insulator.

The first combination antenna I used

is shown in **fig. 1**. The apex of this inverted vee was 55 feet above ground and the included angle between the antenna legs was approximately 120°. Length l_1 was chosen for the best compromise swr over the 7 MHz band, favoring the cw end; l_2 was chosen for the best compromise swr in the 3.8 MHz area, also favoring the lower ssb frequency with the shorting plugs removed; l_3 was chosen for the best compromise swr in the 3.5 MHz area again favoring the lower cw frequency with the shorting plugs in place. Note that these lengths will vary somewhat as a function of antenna apex heights, end heights and included angle.

MHz. The frequencies between 3.6 and 3.8 MHz were of no concern for transmitting purposes. With this in mind, my thoughts immediately turned toward a parallel LC trapped antenna scheme. Would it be possible to develop, with reasonably sized components, a trap with high enough Q to be effective at 3.8 MHz and not at 3.5 MHz? If it were, the wire inside the trap (toward the center of the antenna) would load well in the 3.8 MHz region, while the inductive reactance added by the trap itself plus a short length of wire outside the trap might load in the 3.5 MHz region. The idea sounded crazy enough to work.

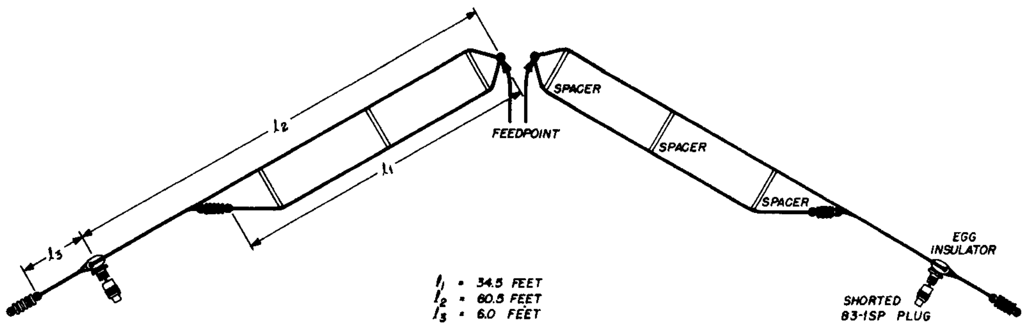

fig. 1. Initial 80-, 75- and 40-meter antenna system.

No interaction was noted between the 40- and 80-meter elements of this antenna system while experimenting with the lengths of each. The indicated swr for 40-meter operation was always less than 2:1 while on 80 meters it was possible to cover 300 kHz with an swr less than 2:1.

I soon found myself making numerous trips to the roof to remove and install the shorting plugs as exotic DX stations kept appearing in the 80 meter sub-band for which I was **not** set up. Certainly, I thought to myself, another solution, one not needing relays, clip wires, or other physical changes to the antenna system was possible.

converted vee

For planning purposes, operation was desired at an swr of less than 2:1 between 3.5 and 3.6 MHz, and between 3.8 and 4.0 MHz.

trap construction

Recent issues of the ARRL Radio Amateur's Handbook discuss the construction of such traps. Basically, it involves the following:

1. Two loops of the antenna wire you intend to use are passed through an egg insulator in the normal manner. Both ends are then wrapped, cut off close to wrap, and soldered, leaving the insulator with two loops of wire.

2. The tuning capacitor is soldered across the two independent loops.

3. A larger than necessary inductor is soldered across the insulator-capacitor combination.

4. The entire assembly is grid dipped, and the inductance trimmed until the dip occurs at the proper frequency.

5. The LC circuit is then disassembled, the actual antenna wire wrapped around the egg insulator as before, and the trap rebuilt and soldered.

The traps I built used 50 pF Centralab ceramic transmitting capacitors, part number 850S-50Z,* which are rated at 7500 Vdc. A greater safety margin could be obtained by using 15,000 Vdc capacitors, but the cost would have increased by a factor of more than three.

For the inductor, 2½-inch OD lucite tubing 5 inches long was used as a coil form. The form was slotted on a lathe at 10 turns per inch. To resonate the traps at 3.805 MHz, the design frequency, the required inductance was 33.7 microhenries. This was fabricated by winding 33 turns of number 14 wire on the pre-slotted lucite form. The LC combination was then fine-tuned to the proper frequency by trimming the inductance and observing the results on a well calibrated grid dip meter. The final coil ended up being 30 turns.

Another reasonable approach is to buy a 10 inch Air Dux coil, which is available from WRL. Either of two coils would suffice: the Air Dux 2010T (2½-inch diameter, 10 turns per inch number 16) or the Air Dux 2410T (3-inch diameter, 10 turns per inch number 14). These coils, when split in half, should provide more than enough inductance to build two traps.

A note of caution is in order here. When trimming the coils, monitor the grid-dip oscillator output on a well calibrated receiver—don't trust the oscillator's calibration. The grid-dip oscillator dial I used was more than 100 kHz out of calibration.

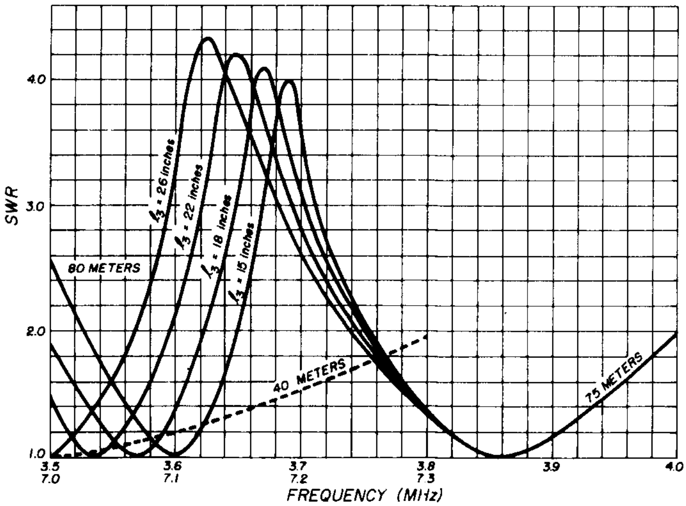

fig. 2. Standing-wave ratio performance of the converted-vee antenna.

weatherproofing

Since hollow lucite forms were used for my traps, end caps were fashioned on a lathe and cemented into the hollow ends of the forms to keep excessive moisture out of the soldered components of the traps. Drain holes were drilled in the low end of the traps to let trapped moisture drain out.

The traps have not yet been subjected to the rainy season, so I don't know how the wire wrapped around the outside of the forms will hold up. If Air Dux coils are used, a soft, flexible plastic container of some type should be used around the traps.

* The 50-pF Centralab 850S-50Z ceramic transmitting capacitors are available from Allied Electronics, 100 N. Western Avenue, Chicago, Illinois 60680. Order part number 43D1101, $2.70 each plus shipping.

performance

With the traps installed in both legs of the antenna in place of the shorting plugs various lengths of l_3 were tried. Success! Two nulls in swr were noted; one in the 3.8 MHz region and one around 3.5 MHz. Changing l_3 had little effect on the 3.8 MHz swr characteristics; however, it did move the swr null across the 3.5 to 3.6 MHz region, as shown in **fig. 2**. An l_3 of 18 inches produced an swr of less than 2:1 for a range of frequencies from 3.5 to 3.64 MHz.

The experimenter may wish to modify the characteristics of either the 7, 3.8, or 3.5 MHz portions of the antenna system. Since no interaction between the 80 and 40 meter elements was observed, each can be trimmed independently. Shortening l_1 to 33 feet moved the swr null to 7.3 MHz. Intermediate lengths will produce swr nulls at other frequencies in the 7 MHz band.

For the chosen 3.8 MHz parameters, the 3.5 to 3.7 MHz characteristics can be modified by selecting different lengths of l_3, as indicated in **fig. 2.** If a change in the 3.8 MHz characteristic is desired, both l_2 and the trap frequency will have to be changed simultaneously. These changes will undoubtedly modify the length l_3 required to achieve the same 3.5 MHz characteristic as before. No actual data were obtained on this.

One interesting observation should be noted here. The traps in my antenna were tuned on the bench to 3.805 MHz. When checked, installed in the antenna, their resonant frequency had lowered to 3.760 MHz. This was expected, due to the added inductance of the antenna; however, the swr null at 3.860 MHz came as a pleasant, but unexpected surprise.

The finished converted-vee antenna is shown in **fig. 3.** Note that the apparent capacitor value in each trap is 52 pF (50 pF from the capacitor itself and 2 pF from the antenna wire wrapped around the egg insulator). The antenna is fed with RG-8A/U coax.

No balun is used nor was one tried. The antenna readily accepts the full output of my SB-200 linear amplifier for all swr readings of less than 2.6 to 1, and has performed very competitively on the air.

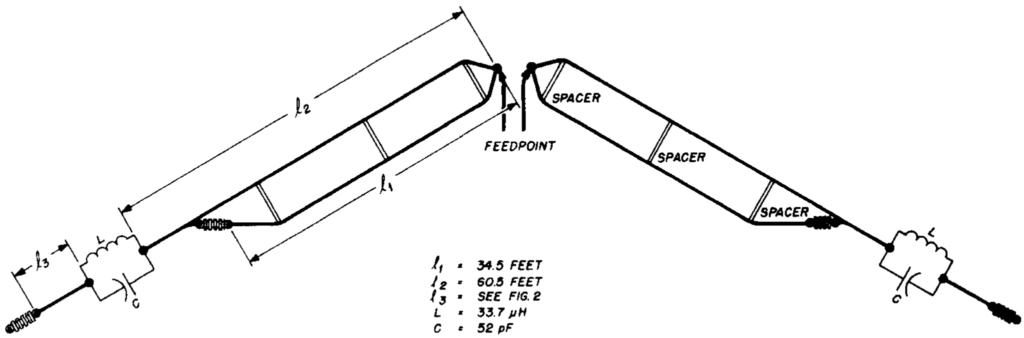

fig. 3. Converted-vee antenna system provides low swr operation on 80, 75 and 40 meters.

summary

This is the first time to my knowledge that parallel traps have been used to permit operation on two "in-band" frequencies. It is presumed that these results are applicable to horizontal antennas on 3.5 to 4.0 MHz although no data are on hand to illustrate this.

I wish to thank K6KA and W6EJJ for their encouragement, suggestions and assistance which contributed to the success of this venture.

reference

1. Neil Handel, W1IR, "A Novel Antenna for 80 and 40 Meters," *QST*, February, 1969, p. 40.

ham radio