Twin Bisecting Loop Antenna

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Constructing an effective antenna for the lower frequency bands has always been a problem where space is limited. The author presents one approach to achieving directivity on these bands with simple construction.

DURING my time as a ham operator and experimenter I have held a lingering interest in antenna designs which would conserve space and yet perform with acceptable efficiency. This approach is often dictated in the case of mobile or portable installations or when the real estate isn't large enough to support a full scale antenna on the medium frequency bands. Since loop antennas seem to contain the greatest length of wire consistent with maintaining minimum physical dimensions many of my experiments have centered around this shape. Except for the bisecting loops none have yielded the desired results.

I am advised that the basic principle of this antenna is not new and is, in fact, in current use. However, I have not known of it being described or used by the amateur fraternity. It may have a proper name but I have called it twin bisecting loops because the description fits.

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As a matter of interest and to more clearly explain the concept, I will tell you how I happened across it. I began with two wooden cross members which afforded a winding size about two or three feet square. Placing one continuous turn of wire around the frame, I explored its characteristics with an antennascope and grid dipper at one corner where the two ends terminated. Resonant frequency 90 MHz, impedance 5 ohms. Replacing the single turn with two continuous turns I still measured 90 MHz but the impedance had increased to 20 ohms; understandable since the turns were very closely coupled.

I next separated the two turns physically and the resonant frequency dropped to 45 MHz. The solution was obvious, two loops in series, bisecting each other at right angles to minimize mutual coupling, would form a full

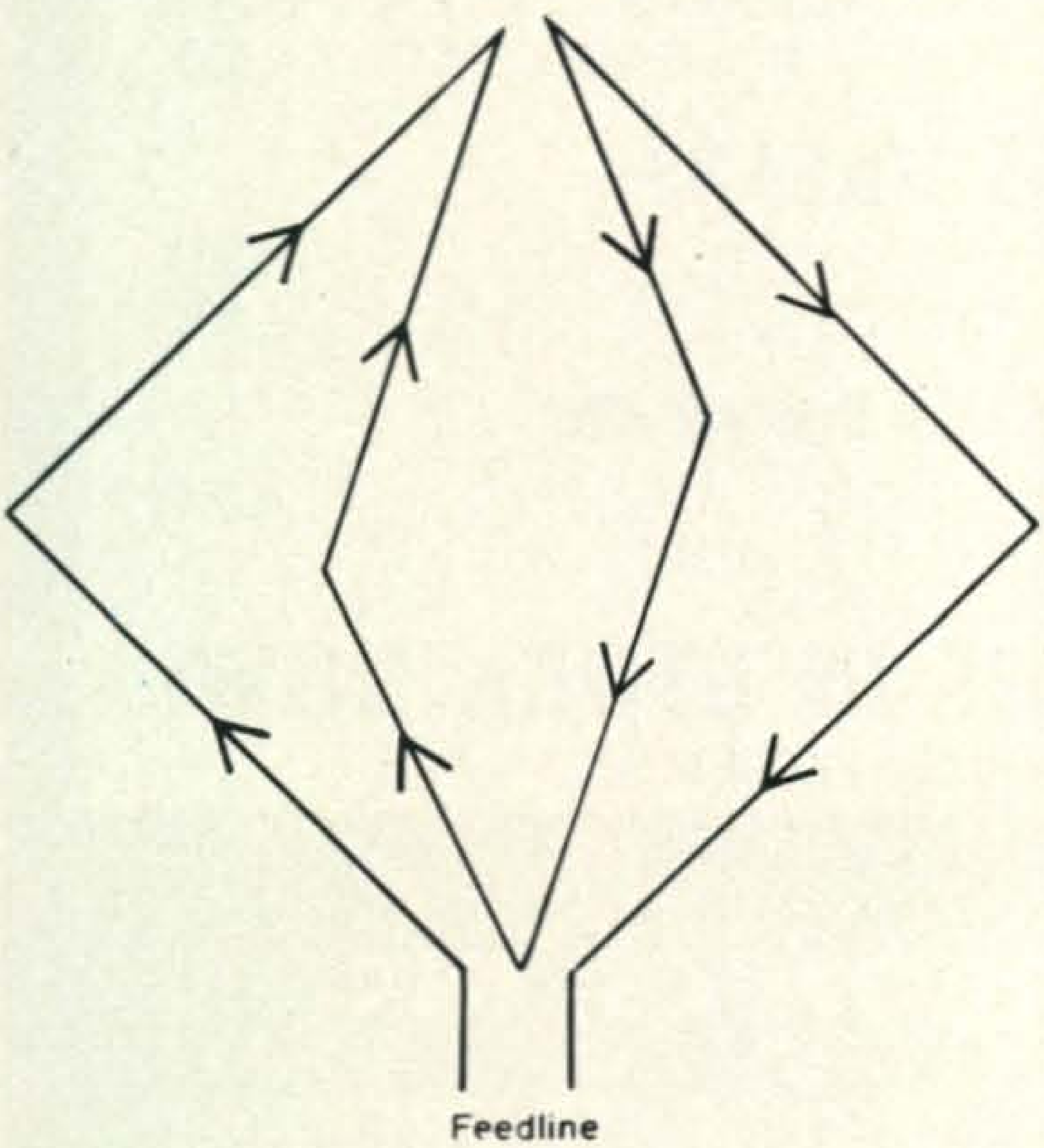

Fig. 1—Basic configuration of the square design Twin Bisecting Loop Antenna.

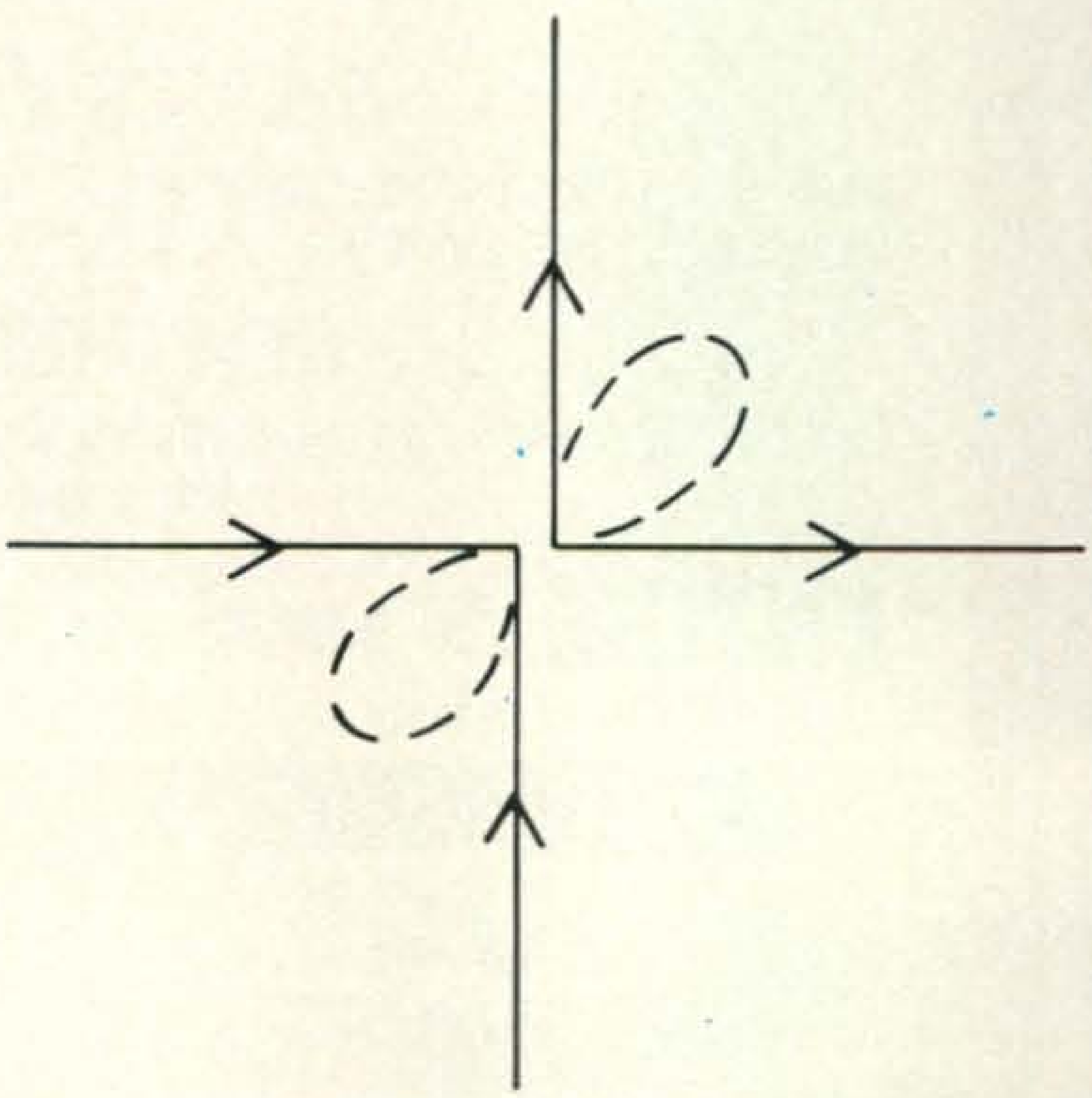

Fig. 2—Radiation from the antenna is sharply bidirectional from the apex of like-polarized elements.

wave antenna with no single leg longer than 1/8 wave length.

The Square Loop Antenna

The design is illustrated at fig. 1. Notice that the second loop begins its plane at the half way point in the first loop. Phasing will not be proper if you complete the first loop before changing planes. Notice the arrows indicating current flow. Each leg is 1/8 wave long, the voltage node of each loop appears at the top and the current node at the bottom. Limited tests here indicate that most of the energy is contained in a single doughnut pattern which cuts through the center of the antenna, vertically, half way between elements of the same polarity. See fig. 2. It appears somewhat elliptical with maximum field up and down in relation to fig. 1. The entire array may be placed on its side and rotated for horizontal or vertical polarization. Being a balanced system it does not rely on ground to complete its circuit. Impedance at the feed point is about 15 ohms.

Triangular Loops

Where space permits it appeared logical to reshape the loops into right triangles as shown in fig. 3. This lengthens the legs in which maximum current is flowing and shortens the vertical boom. I went one step further and built my 40 meter version upside down with the feed at the top. This gets the current nodes into the air and places the spreaders at the bottom. This is more easily constructed and not so top heavy. Spreaders are then not essential as the elements can be draped down from a single pole on four equally spaced guy ropes. With this arrangement the radiating sections somewhat resemble two Inverted V antennas mounted in perpendicular planes. The matching network is difficult to reach but it tunes broadly and can easily be pre-tuned before installation by loading it with a 15 ohm non-inductive resistor. The 52 ohm coax line drops down the center support. The frequency of the antenna may be lowered for spotting by adding some slight capacitance between the two voltage nodes or by moving the nodes closer together. The angle formed by the V at the current nodes has a pronounced effect on feed point impedance. A 90° angle results in a 15 ohm feed. Widening the angle raises the impedance. Closing the angle lowers the impedance.

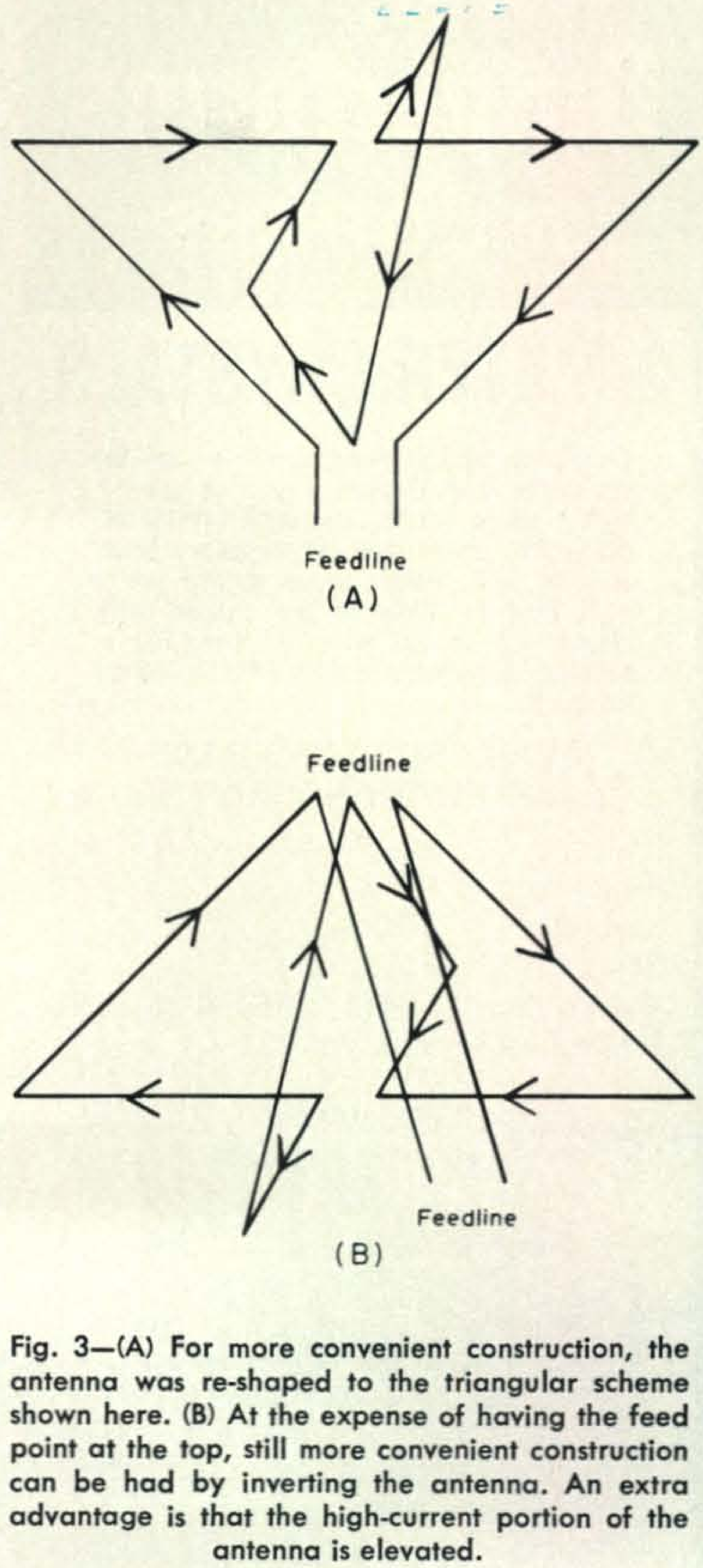

Fig. 3—(A) For more convenient construction, the antenna was re-shaped to the triangular scheme shown here. (B) At the expense of having the feed point at the top, still more convenient construction can be had by inverting the antenna. An extra advantage is that the high-current portion of the antenna is elevated.

Construction

The total length of the antenna wire is critical but runs about the same for either square or triangular loops. My 40 meter triangular antenna measures 136 ft. at 7300 kHz, and 137 ft. at 7250 kHz. For triangular construction the tip to tip length of the spreaders can be estimated by multiplying the total length of the antenna wire by the factor 0.2072. The distance from the tip of the boom to the point where it attaches to the spreaders is one half of this length. Use the multiplier 0.1464 to find the inclined leg of the V. In the square loop design the spreaders and

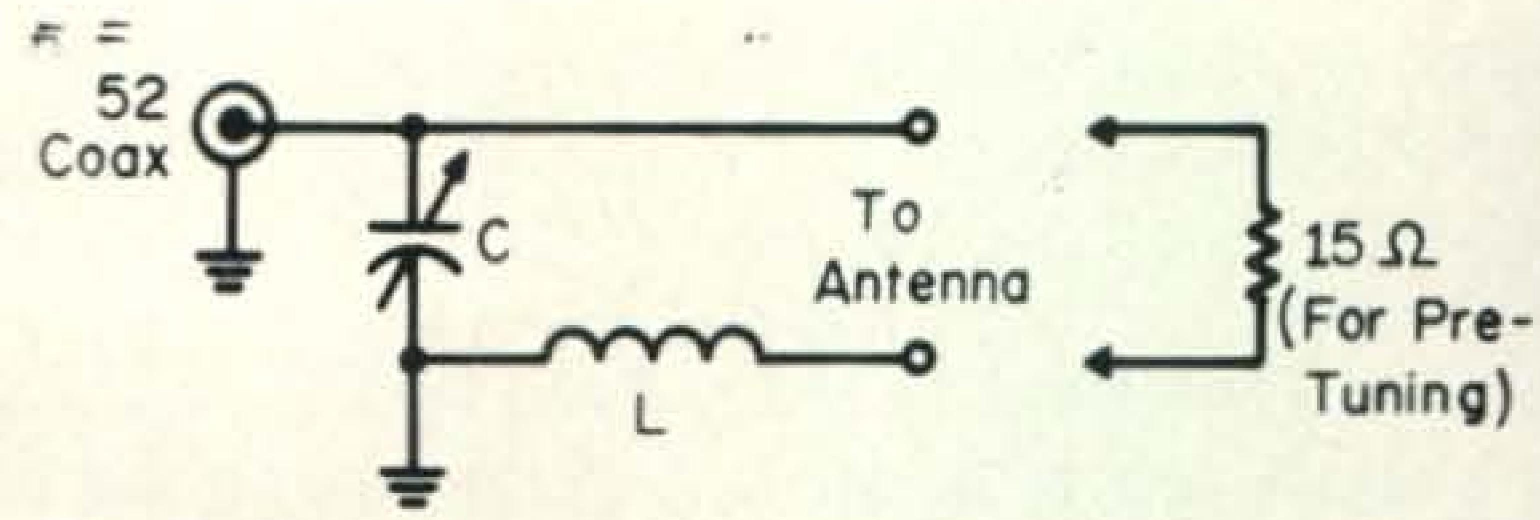

Fig. 4—Simple L-network matching unit may be built in a plastic box and mounted at the antenna feedpoint. Capacitor C need only be a mica compression trimmer since voltage at that point is low.

boom are all the same length. Use 0.1772 for the multiplier.

The matching network is slightly unconventional as shown in fig. 4. This arrangement, although not actually balanced, does uncouple the coaxial shield from the element. My network is built in a small plastic box. The joints and capacitor adjusting screw are sealed with glazers putty. The voltage is low at this point and I use a small Elmenco mica-compression padder condenser.

Tuning

The reactive values for *L* and *C* are 23 and 32.5 ohms respectively at the operating frequency. Table I lists the approximate values for several bands. I was able to pre-tune on the bench by cutting the transmitter drive as low as possible, using the s.w.r. bridge on the lowest range and applying power intermittently to avoid overheating the 15 ohm dummy load.

Antenna enthusiasts will enjoy working with this design and will find the results pleasing. It would seem that, properly spaced off the ground, it would provide a high angle pattern for short skip on the low bands. The 10 meter model is very interesting. In the square configuration each leg is about 4 ft. long, small enough to hand hold while you aim and rotate it to explore the directional features. On 2 meters it would be easy to stack several on one boom to study the effect on directivity. ■

Band	C (mmf)	*L* (uh)	*Coil*
10	175	0.13	6 t. B & W 3001
20	350	0.26	8 t. B & W 3005
40	700	0.52	8 t. B & W 3006
80	1400	1.04	16 t. B & W 3006

Table I—Approximate values for C and *L* in fig. 4 for typical h.f. bands.