W. Clem Small, KR6A, CET

When is Half an Antenna Actually a Whole Antenna?

The Half-Rhombic

Actually, many antennas are "half-antennas." For instance, the grounded quarterwave antenna was invented by Marconi by taking half of the Hertzian halfwave, horizontal dipole and placing it vertically above ground. Thus a grounded quarterwave is, in one sense, half a vertical dipole. A longwire V-antenna is just half a rhombic (but not the half we're about to discuss); indeed, the rhombic was devised by connecting two longwire V-antennas together "mouth to mouth."

This month we are going to take the rhombic antenna design and "cut" it in half to make a "half-rhombic" antenna. The military has long used an antenna similar to this month's design with good success on the VHF band. With its low angle radiation and vertical polarization it should also give excellent DX performance on HF if you happen to have enough space to put one up on that band.

Queen of Antennas?

Historically, the full-rhombic antenna has become a legend, sometimes known as the "queen" of antennas due to the excellent directionality and gain it affords across its very wide bandwidth. A full-rhombic is somewhat like a large diamond-shaped loop (rhombus) constructed horizontally to the earth (fig. 1A), or a distorted horizontal loop antenna.

The main reason the full-rhombic is not frequently utilized is that putting one up takes a lot of space. The half-rhombic takes much less space; it is as if we took a full rhombic, cut it in half lengthwise, and stood it on edge (fig. 1B). In this configuration the half-rhombic takes no more space on the ground than a long-wire antenna. But, in comparison to a simple long-wire beam antenna, the half-rhombic beam's radiation pattern is more compact, and has no null in the direction in which it points as does the long-wire beam.

The half-rhombic can easily be made unidirectional by connecting a resistor between the end opposite its feedpoint and ground (or counterpoise). Making the antenna unidirectional improves reception, not only by reducing interfering signals from the reverse direction, but also by improving the signal-to-noise ratio by reducing the received noise coming from the antenna's reverse direction. If you use this antenna for transmitting, the resistor should have a power rating equal to at least 1/2 of the transmitter's power output. Across its bandwidth the antenna should present a 2:1 or better SWR to a 50-ohm transmission line.

Let's Make One

1. For this particular rhombic design each leg is one wavelength long at the antenna's lowest operating frequency. Choose the lowest operating frequency which you wish the antenna to cover: the antenna's highest operating frequency will then be three times this lowest frequency. For example, if your lowest operating frequency is 150 MHz, the antenna's bandwidth will be from 150 MHz to 450 MHz. Of course the antenna will perform to some degree at frequencies outside its bandwidth, but its performance progressively drops beyond these limits. Calculate the length of each leg of the antenna as follows:

LEG LENGTH (in feet) = 936/lowest frequency in MHz
LEG LENGTH (in meters) =285/lowest frequency in MHz

For an antenna that would cover from 150 MHz to 450 MHz, the leg length would be 936/150, or 6.24 ft (6 ft 2-7/8 in).

2. To find the antenna height, multiply the leg length by 0.625. At 150 MHz this would be 0.625 x 6.24 ft, or 3.9 ft (3 ft 10-7/8 in). This gives the antenna's peak height above ground or above the counterpoise (radials which create an artificial ground), if one is used. Obviously, if the antenna is only 3 ft 10-7/8 in above ground it will be too low for much coverage so, at VHF or higher frequencies, a counterpoise should always be used to allow elevating the antenna above ground. For a 150 MHz to 450 MHz antenna, if your counterpoise is 10 ft above ground, the antenna's peak height will be 10 ft plus 3.9 ft, or 13.9 ft.

If a counterpoise is used it should be at least 3 ft or higher above ground (the higher the better) for VHF or above. If you use a counterpoise on HF, elevating it at least 10 ft is recommended, but in practice that may not be possible.

3. The length of the counterpoise is determined by multiplying the leg length by 1.56. Thus our 150 to 450 MHz antenna would have a 6.24 x 1.56, or 9.73 ft (9 ft 8 3/4 in), counterpoise length.

4. Cut the antenna wire to be two leg-lengths long. Add about 4 or 5 inches to this length to allow wire for wrapping around the insulators which are attached at each end of the wire. Slip the cut wire through the hole in one end of an antenna strain insulator. Then attach a strain insulator to each end of the antenna as pictured in fig. 1B. Adjust the wire at the insulators to make the antenna the correct length before soldering the wires together.

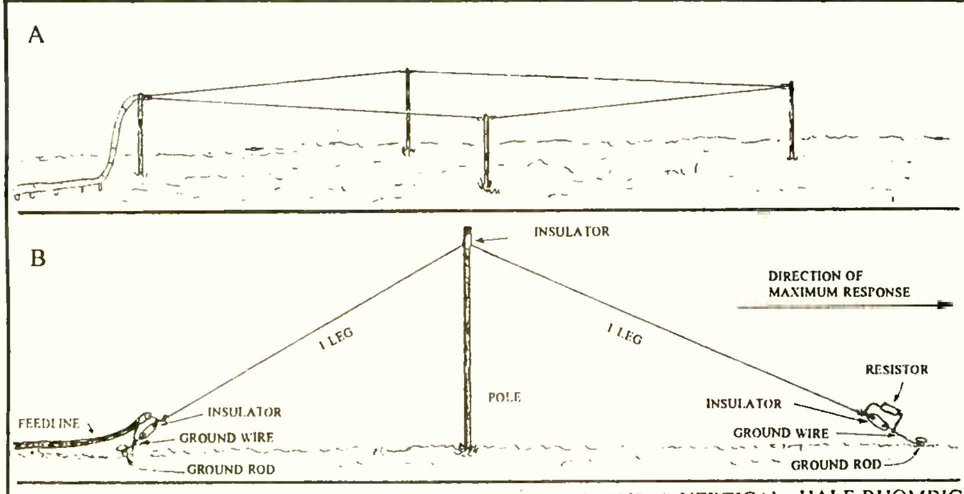

FIG. 1. A HORIZONTAL FULL- RHOMBIC ANTENNA (A), AND A VERTICAL HALF-RHOMBIC ANTENNA (B).

5. Cut the counterpoise to length, adding 4 or 5 in for attaching the insulators. Add a strain insulator to each end of the counterpoise and adjust for length and solder the ends as for the antenna wire.

6. Select an appropriately high tie-point for the antenna's middle insulator and mount the antenna to form an inverted-V shape with the dimensions given for height and counterpoise length. If you use a counterpoise, keep it free of touching vegetation or other conductors. Mount the antenna on a straight line with one end pointing in the direction from which you wish to receive signals.

7. Attach the center conductor of a length of 50-ohm coax to the antenna wire and the coax shield to the counterpoise or ground as shown in fig. 1.

8. If you want the antenna to be unidirectional, connect a 500-ohm to 600-ohm noninductive resistor from a good ground (or the counterpoise if it is used) to the other end of the antenna (fig. 1B). The end of the antenna with the resistor attached must point in the direction from which you wish to receive signals.

For complete cancellation of interference from the antenna's reverse direction you can use a 1000-ohm carbon (not wirewound) potentiometer for the resistor and adjust its value for minimum signal while listening to a signal coming *from the antenna's reverse direction*. Solder all connections and seal the potentiometer and end of the coax with coax sealer.

9. If you live in lightning country be sure to use protection against lightning-induced damage. At a minimum, never use the antenna in weather likely to produce lightning and both disconnect and ground the antenna when it is not in use.

RADIO RIDDLES

Last Month

Last month I asked you, "If the earth, or at least radio ground, is a conductor of radio currents, then is it possible in some way to make an antenna out of earth? How could you go about such a strange task? Do you suppose this has ever been attempted or even actually done? And if water is conductive also, how about a "water antenna"?

Well, believe it or not, there has been at least one earth antenna designed and used. In 1962, the *Proceedings of the Institute of Radio Engineers*, Morgan reported experimental utilization of—get ready for this—an *entire island* as an antenna. And it worked! As for a "water antenna," the great radio pioneer Aubrey Fessenden used pumps to shoot a stream of water skyward to form a grounded vertical antenna over which he actually held communications.[1]

This Month

One famous radio pioneer, when he was a teenager, used to frighten his neighbors by swinging high above the ground in a bosun's chair from his tall, experimental antenna-mast just for the fun of it. Later, to the delight of the public and the chagrin of RCA officials, he swung from an element of a large RCA TV transmitting antenna high atop a skyscraper. Who was this daring radio engineer and what do you suppose that his mother told a neighbor who complained that it frightened her to watch this teenage radio nut swing from his tall antenna?

We'll have the answer to this month's riddle in next month's issue of *Monitoring Times*. 'Til then, Peace, DX, and 73. MT