Evolution of an Antenna

Build a new version of the classic "Lazy H" antenna.

by Sidney Rexford W2TBZ

Not much is new in the design of antennas, and most of the new can be traced to the old. After all, almost 100 years of antenna experimentation has exhausted most of the configurations imaginable. The antenna described in this article is a case in point. Basically, this antenna is a "Lazy H," a vintage workhorse which has an impeccable reputation as a stellar performer.

Let's review the old before going on to the newer version. The classic "Lazy H" is shown in Figure 1. It consisted of four half-wave radiating elements, two side by side over two more also side by side, with all four elements fed in phase. The array's gain will vary as the spacing between the upper and lower elements is varied from a half wavelength to a quarter wavelength, with the greater spacing giving slightly more gain than the lesser spacing. In practice, few hams could get sufficient height while erecting their antennas to make much more than quarter-wave spacing practical, so the evolution of this new version is based on quarter-wavelength spacing. By removing the old feed system and leaving just the radiating portions of the antenna, we find that just the four half-wave elements shown in Figure 2A will do the job.

In electrical circuits (and antennas are no exception), when two points exist with the same polarity and phase relationships, these two points can be connected together. The ends of both the upper and lower pairs of half-wavelength radiating elements fit this condition, so the ends of the lower half-wave elements can be bent up and those of the upper half-wave elements bent down to meet. They are then fastened together. This forms two loops separated by a quarter wave, as shown in Figure 2B.

Our antenna now has become two quad loops in phase and will be treated as such. It is important to realize that the end effects taken into consideration in the original "Lazy H" antenna computations to determine the length of the elements have been altered and the current formula for the overall length of the loops is now 1005 divided by the frequency in MHz. This is the standard formula used in determining the overall dimension of full-wave loops.

Obviously, the feed system used in the original "Lazy H" antenna is no longer practical to feed the new loops. The old phasing lines and the tuned feeder were located high in the air and were difficult to work with. A newer and more modern feed system is necessary. If the loops are opened in the center of the bottom of the loop, and you check the radiation resistance, you will find that it is 100 to 130 ohms, depending on height and ground conductivity under the loops. These points on the loops must be fed in phase and with equal voltages to come up with a working antenna. The most difficult part of the problem is in choosing the manner in which this is done.

A half-wavelength piece of transmission line of any type will act as a 1:1 transformer and reflect the terminating impedance at both ends, so a half-wavelength of transmission line (any transmission line) attached to the loops will appear to have an impedance equal to the impedance of the loop itself. A little experimenting with various types of lines determined that either standard 300 ohm ribbon or 450 ohm ladderline worked best. Coax was tried, but unless a 1:1 balun was used at each loop, radiation from the braid became a problem. The ribbon or ladderline was self-canceling and did not present any distortion of the antenna pattern.

A half-wavelength line from the center of each loop, brought together and fastened in parallel so that the loops are fed in phase, provides an impedance of 50 to 60 ohms, and a 50 ohm coax feed from antenna to hamshack will give an excellent match without a tuner. To prevent radiation from the coax braid, a 1:1 balun should be used. A W2DU balun was used on this antenna. Ferrite core baluns were also used successfully. The use of air core baluns proved disappointing and they are not recommended. Construction details are shown in Figure 3, and dimensions for the loops and the phasing lines are shown in Table 1. As long as the termination (ends) of the ladderline or ribbon phasing lines are mechanically constructed so that flexing is distributed over at least a foot, the lines can be left to swing in the breeze.

This is a single-band antenna, and it is bidirectional. For the 40, 17, 20 and 15 meter bands rotation to provide full directional coverage would be a real challenge, but for 10 and 12 meters, a rotatable framework is feasible.

While the theoretical gain of this array is about 3 dB over a dipole, on-the-air results are better. The antenna is a lower angle radiator than the dipole at the same maximum height and, in the tradition of the "Lazy H," it does a fine job in DX contacts. Radiation patterns for the "Lazy H" can be found in just about any antenna handbook, but for those who do not have one handy, I have included a computer readout prepared by WA4HTR (now a Silent Key) and W4TDI, using the W7EL ELNEC program (Figures 4A and 4B).

Good luck to anyone who builds one of these antennas. I will be glad to answer any questions you may have, just include an SASE (RFD 1, Box 583, Colton NY 13625). And, if you have the space to build one for 40 or 80 meters, I would appreciate a report on the results. Fortune has never smiled on me—I have never had sufficient height to construct one of these.

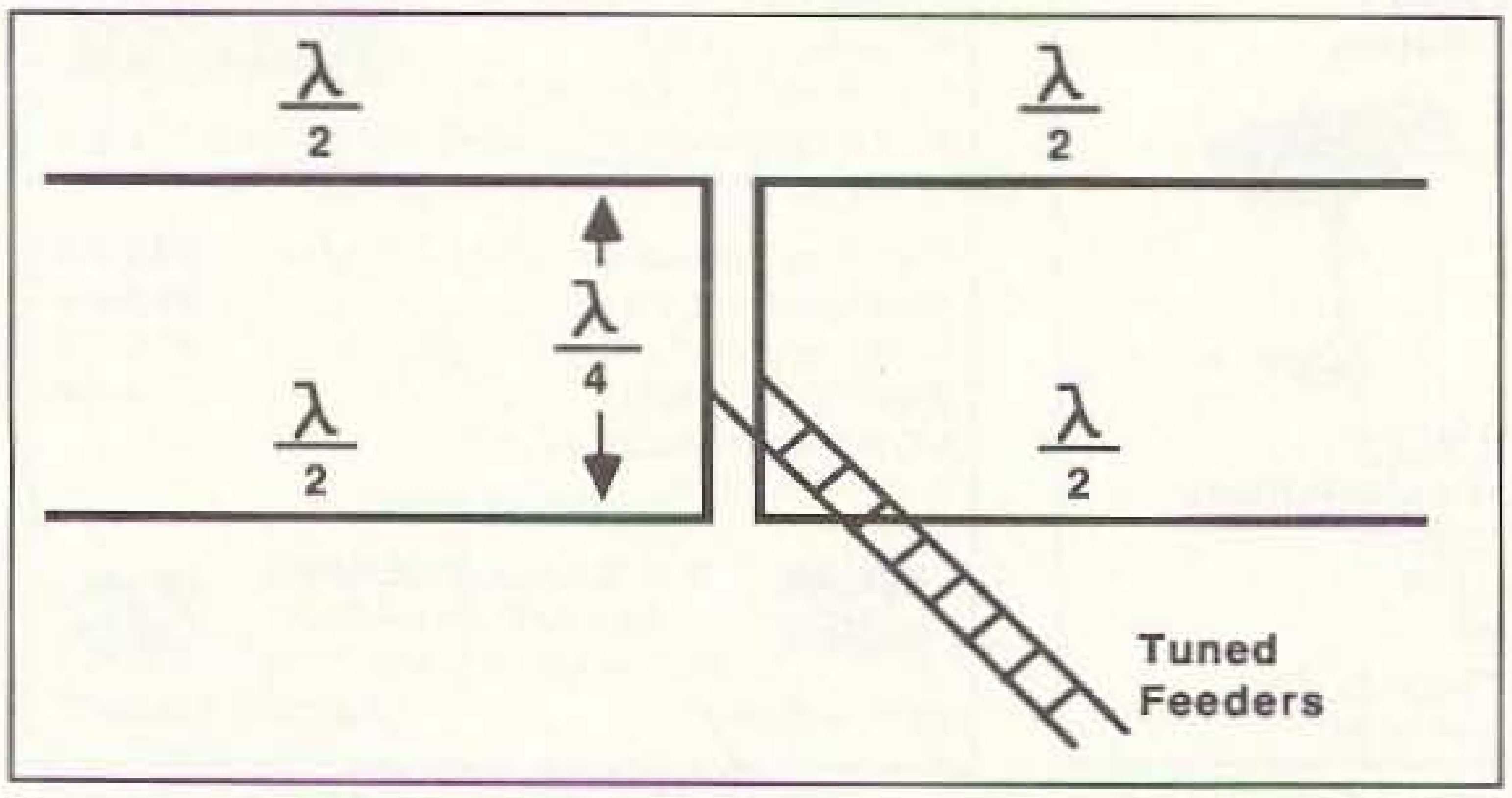

Figure 1. The classic "Lazy H" antenna.

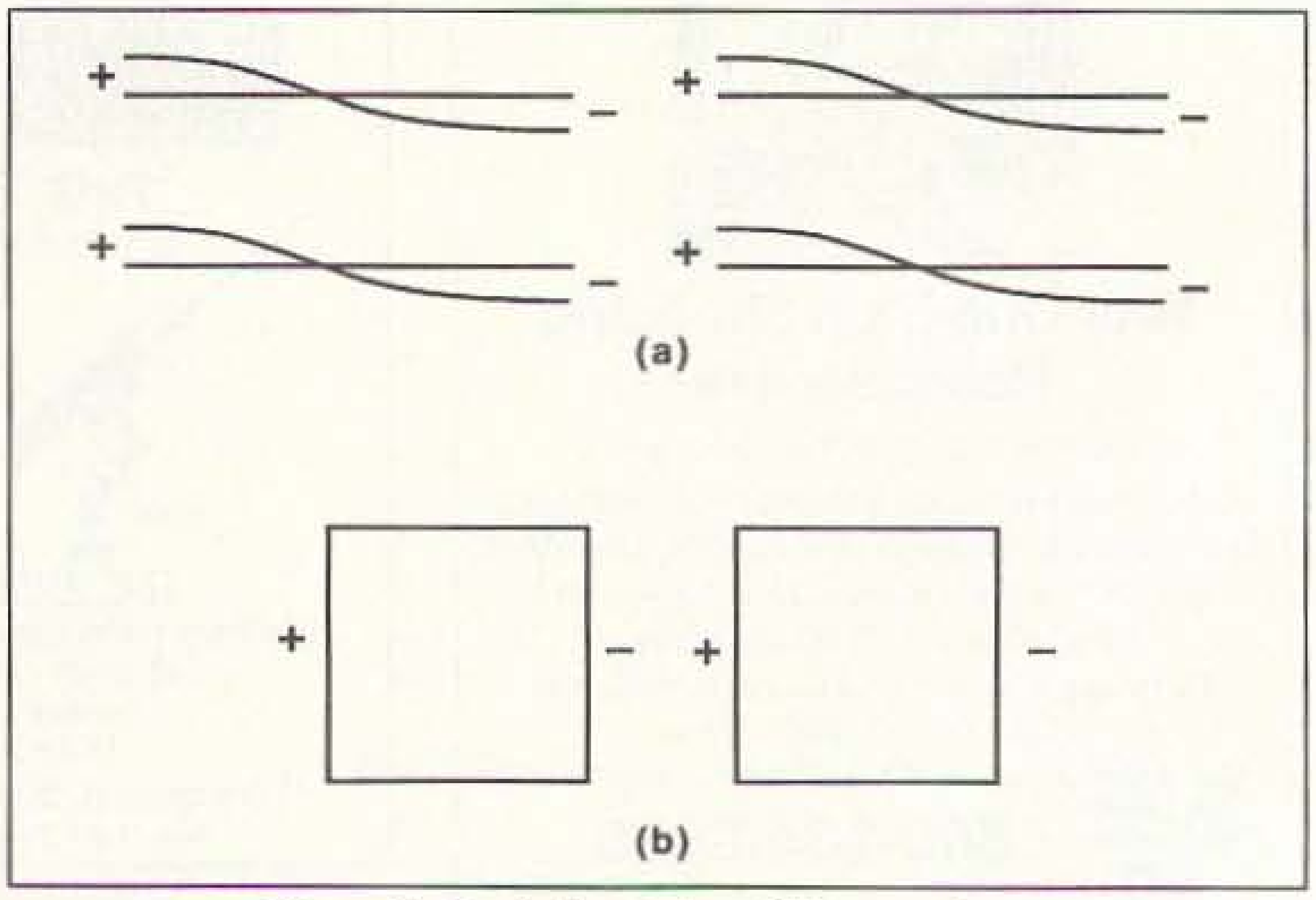

Figure 2. Evolution to two full-wave loops.

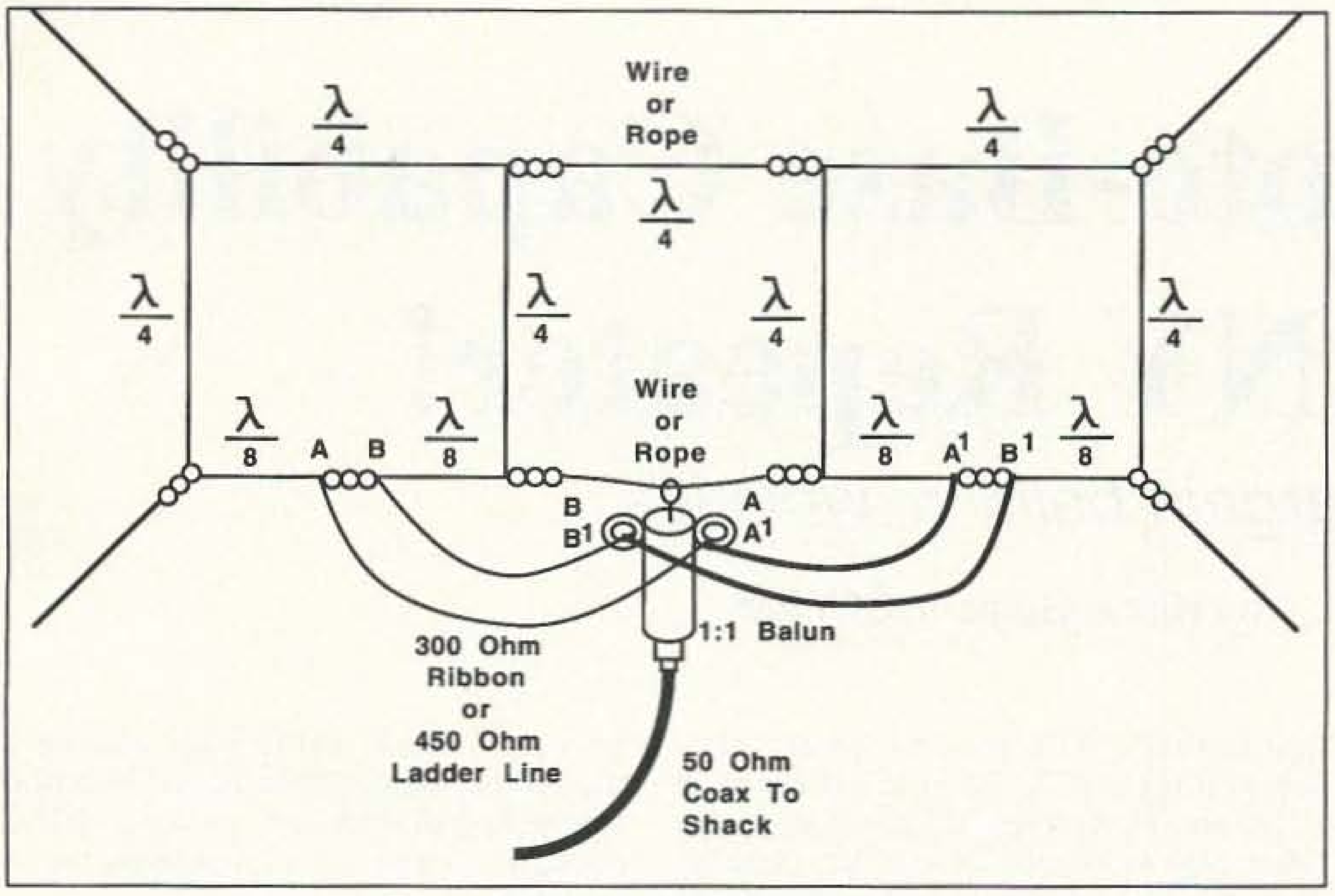

Figure 3. Construction of phased loops.

	λ/4	λ/8	300Ω Ribbon	450Ω Ladderline
40m	34.9 ft.	17.5 ft.	53.3 ft.	62.2 ft.
20m	17.6 ft.	8.8 ft.	27.0 ft.	31.2 ft.
17m	13.9 ft.	6.9 ft.	21.2 ft.	25.2 ft
15m	11.8 ft.	5.9 ft.	18.1 ft.	21.97 ft.
10m	8.67 ft.	4.33 ft.	13.2 ft.	15.33 ft.

Table 1. Dimensions for the sections of the loops and phasing lines.

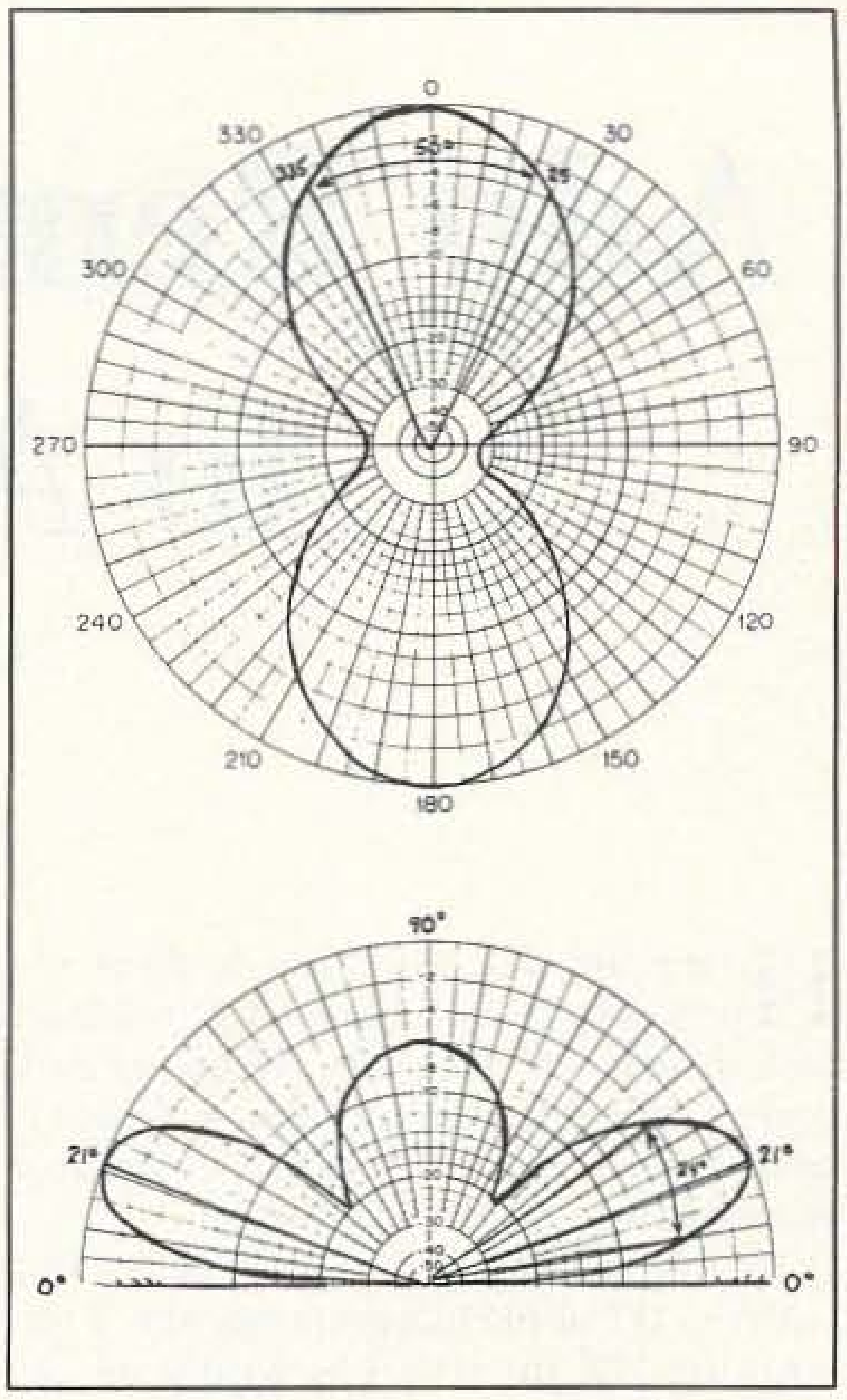

Figure 4. Radiation patterns. Max gain: 11.095 dBi @ 18.1 MHz (typical). Impedance (per loop): 133.404 + j0.040 (using W7EL ELNEC). Bandwidth: 50° -3dB, 65° to 115°.