Try Out a Low-Level Lazy Loop

It may be only 10 feet up, but this aerial is no worm-burner. Better still, it will fit almost anywhere.

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The loop antenna is well known, with many variations including the quad loop, the delta loop, and the twin loop. Loops have a reputation of being easily tuned, forgiving of slight mismatch, broadbanded, balanced, and immune to QRN. Many antennas are really loops in disguise; if you don't believe it, consider such diverse examples as the folded dipole and the rhombic.

The "lazy loop" is basically a standard loop antenna arranged horizontally above ground, but at an unusually low height—less than one-tenth of a wavelength, for example. Before you protest that such antennas are earthworm warmers, let me recount some of my experiences.

About two sunspot cycles ago, give or take several years, I was blessed with a typical suburban lot measuring about 75 feet by 200 feet, ideal for a longwire or a collinear, antennas that need little "width" to perform their function. However, I was unsatisfied because I couldn't have that antenna farm we all dream about. You know the one: rotatable rhombics on 160 meters and that kind of thing.

Financial limitations, physical restrictions, and neighborhood censure all discouraged tall towers, large supporting structures, and *wires* (*visible* wires, at least). A lot of digging and poking in the literature kept bouncing me back to the original concept of a horizontal loop, but I could find very little information available on full-wave horizontal loops. Rhombics, yes; full-wave loops, no.

I reasoned that a full-wave loop, horizontally arranged, would use the earth as a reflector of rf energy, and the better the ground, the better the reflection. After all, vertically-mounted loops use other loops, screens, and even linear elements as reflectors, so why not the ground itself? The only drawback I could see was that my soil conductivity (which determines the quality of the "image" antenna or the reflective quality of the earth) was very, very poor. Dry, sandy soil is a poor conductor but a good absorber of rf energy. The only hope I had was that the water table was close to the surface and might provide the needed reflection before too much energy could be absorbed by the earth.

It seemed to me that by squirting the signal skyward I could maximize the amount of rf reaching the ionosphere directly overhead and increase the amount re-reflected earthward to enhance my signal at my friends' receivers. Thus the 80-meter horizontal loop was born, with 70-foot sides, supported by TV-mast tubing at about 30 feet above the ground.

Various antenna books quoted the feedpoint impedance of a full-wave loop as being close to 110 Ohms. A quarter-wave transformer of 75-Ohm coaxial cable would change that value to about 50 Ohms, or close enough for my transmitter output impedance. So, a quarter-wave piece of 75-Ohm coax (okay, maybe it was 72-Ohm) of the RG-59/U persuasion was cut to the desired operating frequency.

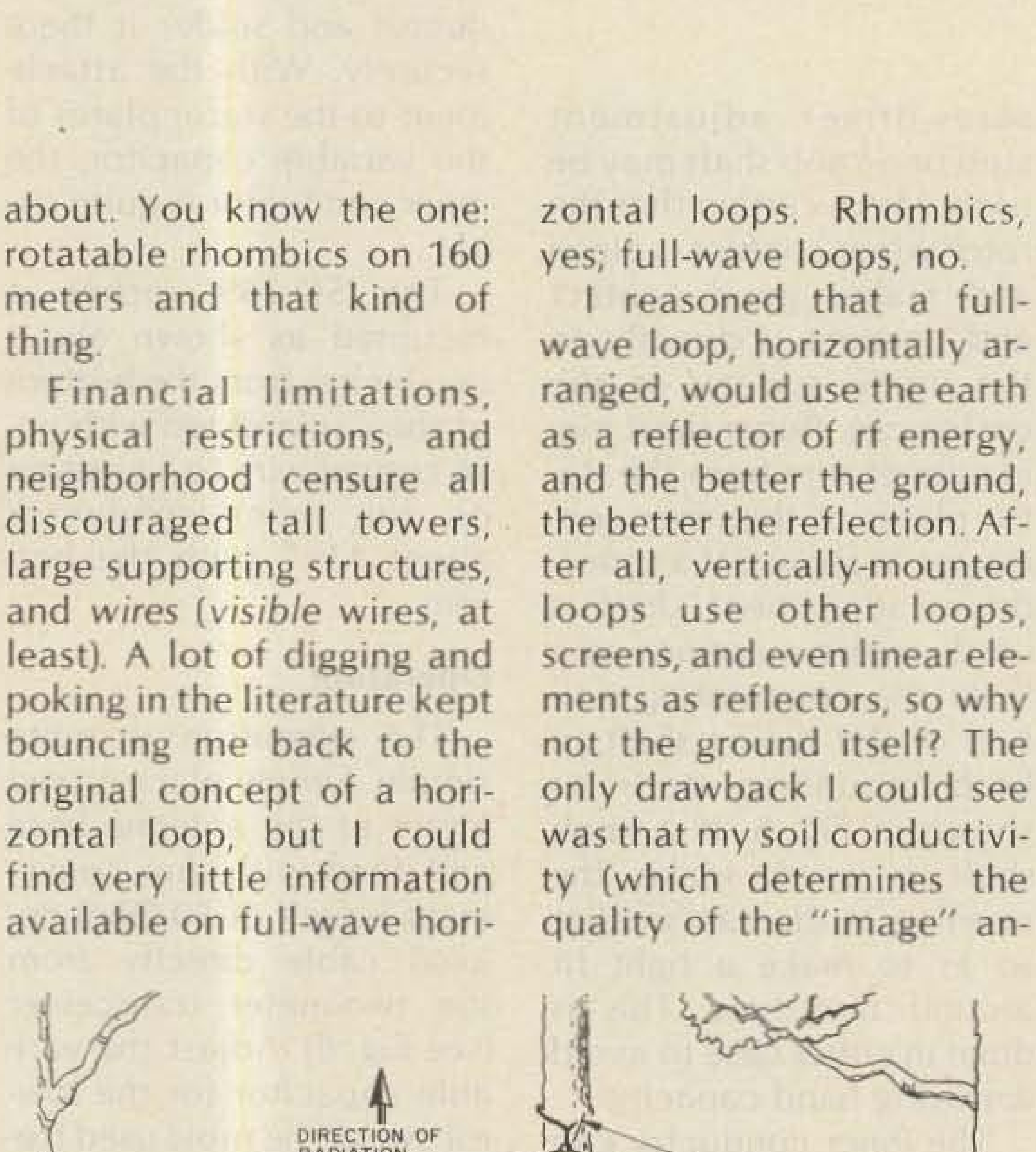

Fig. 1. "Lazy loop" 40-meter loop antenna. $A = B$ if loop is square; $2A + 2B$ must equal a full wavelength (see text for formula). X = any convenient length of 50-Ohm coax to the shack. The proper 50-Ohm, non-reactive load appears at the end of the quarter-wave section of the 75-Ohm coax. Note: If nylon cord is used to support the loop at the corners, an insulator is needed only at the feedpoint.

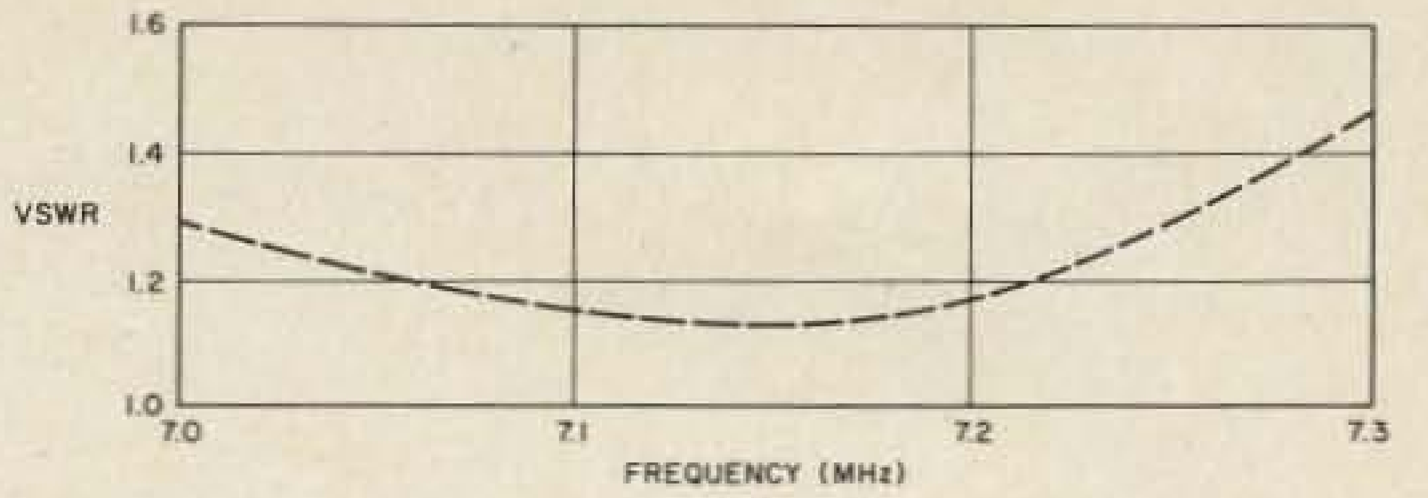

Fig. 2. Vswr at the transmitter end of quarter-wavelength, 75-Ohm matching section. (Measurement made with "MARS" bridge.)

The reflected power turned out to be very slight and the finals (a tube-type rig) were well-pleased. What about the forward (upward) power? Well, it seemed to come back enhanced as expected because I received lots of reports that my signal was the best ever put out by my Viking Ranger on AM phone; many reports later, I was forced to conclude that the antenna was a huge success. Stations from about 300 miles around all told me that I had greatly improved my signal and that they had noticed much less fading. I, too, noticed a big difference: The band was much more quite. On 75 and 80 meters in the summertime, you know what that means.

Everything seemed to work better than I had hoped, so I tried loading the antenna on other frequencies and bands . . . but without much success. Then I exchanged the coaxial feedline for open-wire feedline and through a tuner loaded on other bands without much difficulty. The antenna proved to have bidirectional properties and even some gain on fifteen and twenty meters. I tried changing the loop configuration (but not perimeter length) from a square to a triangle and even to a rough circle, all without any noticeable difference in performance or loading on the fundamental frequency.

I decided to bring some of the ideas along to a new homestead with a larger lot, but a set of new limitations: It is covered with trees! Not wishing to destroy the natural beauty of the place, I decided to put up the loop and use the trees themselves for support. This time, a loop for forty meters was indicated. The trees made nice, conveniently-located supports, and I was able to achieve a reasonable facsimile of a quad loop, horizontally arranged about ten feet above the ground. A possible advantage of this location was better soil conductivity, and while the trees represented a possible source of signal absorption, I hoped that the advantages and disadvantages would balance each other out, yielding a net positive result.

And so it turned out. The quarter-wave matching section was cut, trimmed, and installed, and the first calls made. Results are uniformly good out to a distance of about 600–700 miles. (I have a 40-meter roof-mounted groundplane antenna for direct, switchable comparison.)

Why, then, use a loop? Well, to me, the reasons are manifold. It is easy to put up—takes maybe an hour, if you're slow. It is unobtrusive—invisible to neighbors. It gives great local performance, with reduced noise pickup. It has balanced feed and a balun is not necessary. It has simple impedance matching, and the low height means a minimum of support structure is required. Finally, it has a low cost.

Building Your Own Loop

You will need some wire, some coax, and enough room to put up the loop of your choice. Here's how you calculate the loop size (remember that you can make a square, triangle, or other polygon, regular or irregular). Use the formula $1005/f_{(MHz)}$ = total wire length in feet.

Example: You wish to put up a loop for 7.1 MHz. The formula gives a length of 141.54 feet. If you cut it to 141 feet 6 inches, you will be close enough.

The coax length is calculated by the formula: $246vf/f_{(MHz)}$ = length in feet. The vf is the coax velocity factor, which simply means that radio frequency energy travels at a different velocity in coax than it does in free space. The effect of this is that the electrical length of a quarter-wavelength of coax is different than the physical length. A common value for coax is vf = .66, and this is the value I used to cut mine. (It would be better to use a grid-dip meter to "prune" yours to the exact length needed.)

The formula for a 40-meter antenna, then, is $(246 \times .66)/7.1 = 22.87$ feet. If you cut it to 22 feet 11 inches, you'll be close enough. If that length is not enough to reach from the antenna to your transmitter, you can add any needed amount of 50-Ohm coax in series.

The coax you have cut is known as a quarter-wave matching section; it matches the impedance of the loop (110 Ohms) to the impedance of the source (50 Ohms). The quarter-wave matching-section technique requires that the matching impedance be the "mean" value between the "extreme" values. It is calculated as: $M=\sqrt{S \times L}$, where M is the impedance value of the matching section, S is the source impedance, and L is the load impedance. Thus, $M=\sqrt{50 \times 110}$, or 74.16 Ohms. As you can see, either 75-Ohm or 72-Ohm coax (or other) line would provide a good match.

Performance of the Loop

In my own loop for forty meters, I find that the swr is less than about 1.4:1 over the entire band! I know this sounds phenomenal, but I cannot measure *any* reflected power at the design operating frequency! For stations within about 500 miles or so from my QTH, reports are always in favor of the loop over my comparison vertical (Hy-Gain 14AVQ, roof-mounted with two radials per band—except 40 meters, where I use 4 radials). The signal strength difference has been from nothing to as much as 2 or 3 S-units.

For close-in stations, the loop is clearly superior; for medium-distance stations, it is sometimes better and sometimes worse than the vertical. For long-distance stations, the vertical is always better by an S-unit or two. However, there is a very interesting phenomenon, even at night or at long distances: Selective fading often drops the received signal strength, and it is nice to be able to switch antennas and bring the signal up again in strength to its former level. In fact, diversity reception is a big advantage of using a loop with another type of antenna.

As far as DX is concerned, another antenna would probably be better, although I have worked European DX with the loop and have received good reports.

All in all, the antenna is advantageous for its low cost, simple construction, and excellent performance. This weekend I plan to put up an 80-meter version. Why not try one yourself? I know you'll like it. ■