If you have the room and the wire, here's an antenna that will give you many hours of fun ragchewing.

A 75 and 40 Meter Horizontal Loop Antenna

BY SIDNEY REXFORD*, W2TBZ

This antenna isn't for everybody. It requires a little more real estate than is available at every hamshack. However, if you have the room, it is a work horse capable of doing a real job for the ragchewer and those who need to get into traffic nets.

At best, antennas for any specific purpose will be a compromise, and this one is loaded with compromises. To begin with, the location at this station is undesirable, being about 250 feet from the shack and through the lawn and some brush area. The powers that be (the XYL) made it clear that there were too many wires in the backyard already. That meant an unobtrusive transmission line—coax feed, in this case a roll of ½ inch, 75 ohm TV hardline, the aluminum sheathed stuff the TV cable people use for their distribution system. It was on hand and free. For a single-band antenna this does not present much of a problem, but for an antenna that I desired to be resonant on both the 40 and 75 meter phone bands, the problem got stickier.

The best bet for the job appeared to be a horizontal quad loop. Horizontal loops have been described as "Cloud Warmers" and high-angle radiators. While the stigma is relatively true, it is the precise answer to the needs of a large portion of the amateur population. While I don't recommend horizontal loops to be used on bands higher than 40 meters, on the lower frequencies such as 160, 80, and 40 meters they perform as well as the "garden variety" dipole or inverted V for working DX, and outperform them on the short haul. Quads, both horizontal and vertical, have proven to be excellent performers in the past. I recommend them without any reservation.

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Using the standard formula for quads (1005 divided by the frequency in MHz), a loop was cut for about 3.850 MHz, or 65 feet on a side. Because the most convenient feed point was in the middle of the west side, a 4:1 garden-variety balun was installed at this point. This will probably raise a few eyebrows, because the anticipated impedance of a loop usually is expected to be in the neighborhood of 120 ohms, and a 4:1 balun would present an output impedance from the loop of roughly 30 ohms.

I determined that a quarter-wave section of 50 ohm coax from the 4:1 balun at the antenna to the TV hardline should give a ball-park match to the 75 ohm hardline. Checking with the antenna scope, I got a reading of 68 ohms at the end of the 50 ohm quarter-wave section—a satisfactory match, and one which should give about a 1:1.1 SWR at the design frequency of 3.850 MHz into the hardline.

This pretty well took care of the 75 meter operation of the loop. More on the general pattern expected later.

Now for the 40 meter operation of the loop. The grid dip meter now indicated a resonant frequency of about 7.6 MHz, somewhat removed from the desired resonant frequency of 7.2 MHz. From here an explanation of what happens to make the loop resonant on the 40 meter phone band without actually making the loop longer is in order.

To begin with, suppose we do actually make the loop longer by adding enough wire in the form of equal hairpin-shaped loops at each of the insulators (the anticipated 40 meter high-voltage points) to bring the loop into resonance at 7200 MHz. These hairpin loops should hang down from the corners of the loop. Remember, we are trying to keep the original dimensions of the loop as computed for 3.85 MHz from insulator to insulator. The entire loop now looks like fig. 1, and a half wave exists from the bottom of one hairpin to the bottom of the next hairpin. Close inspection of the voltage and phase relationships on both sides of the hairpin loops will show that the phase and voltages on both sides of these loops are identical. In all my electrical engineering classes I was always taught that adjacent points having the same phase and voltage relationship could be connected together. Antennas are no exception. Since both sides of the hairpin loops are identical, their entire lengths can be welded together into one single conductor which will be common to each adjacent half-wave section as we go around the entire loop.

A single piece of wire 3 feet long, dropped and left dangling, at each of the four points brought the 40 meter resonant point down to 7.2 MHz. This made no detectable difference in the 75 meter resonant frequency, since the

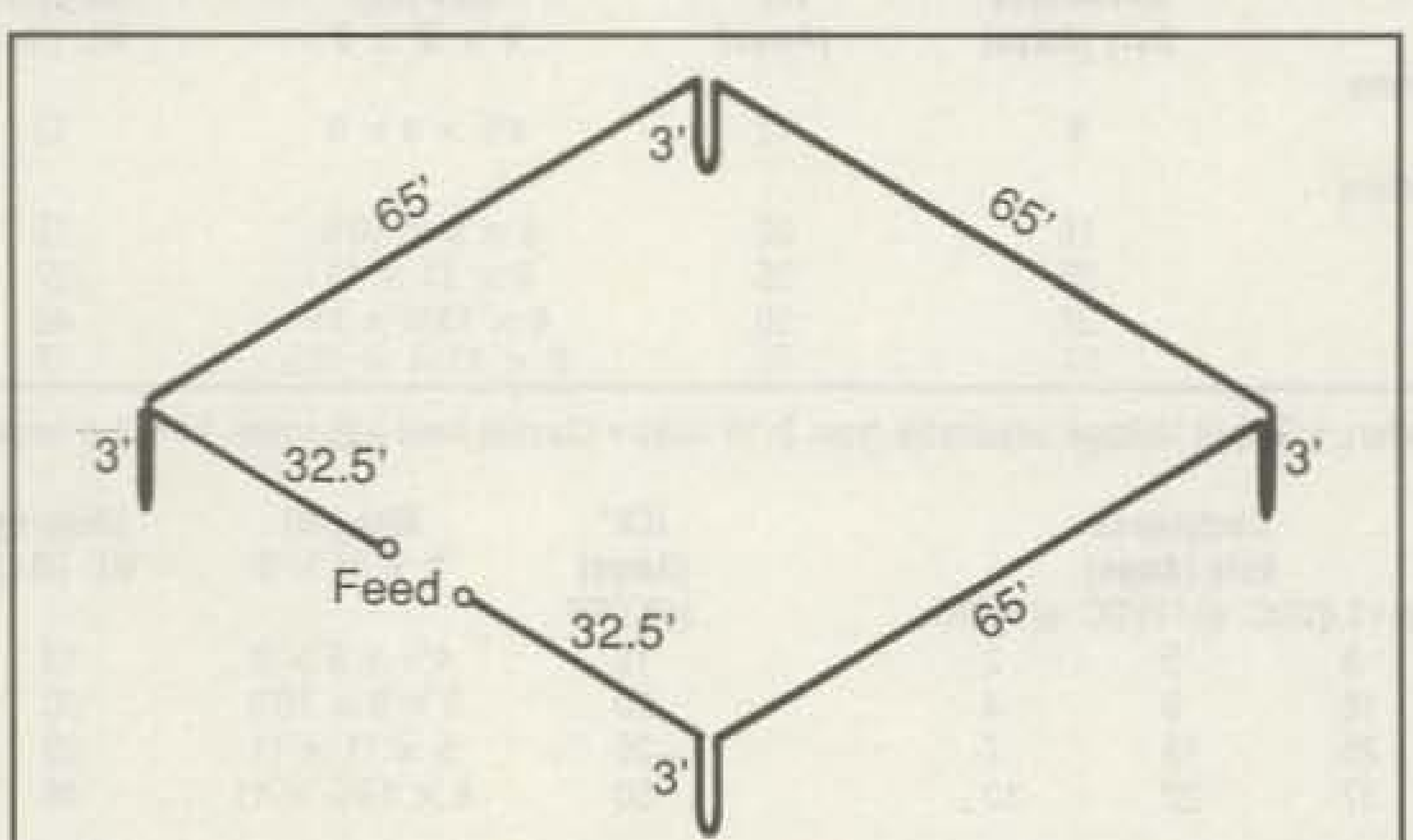

Fig. 1– Basic configuration of a two-band loop.

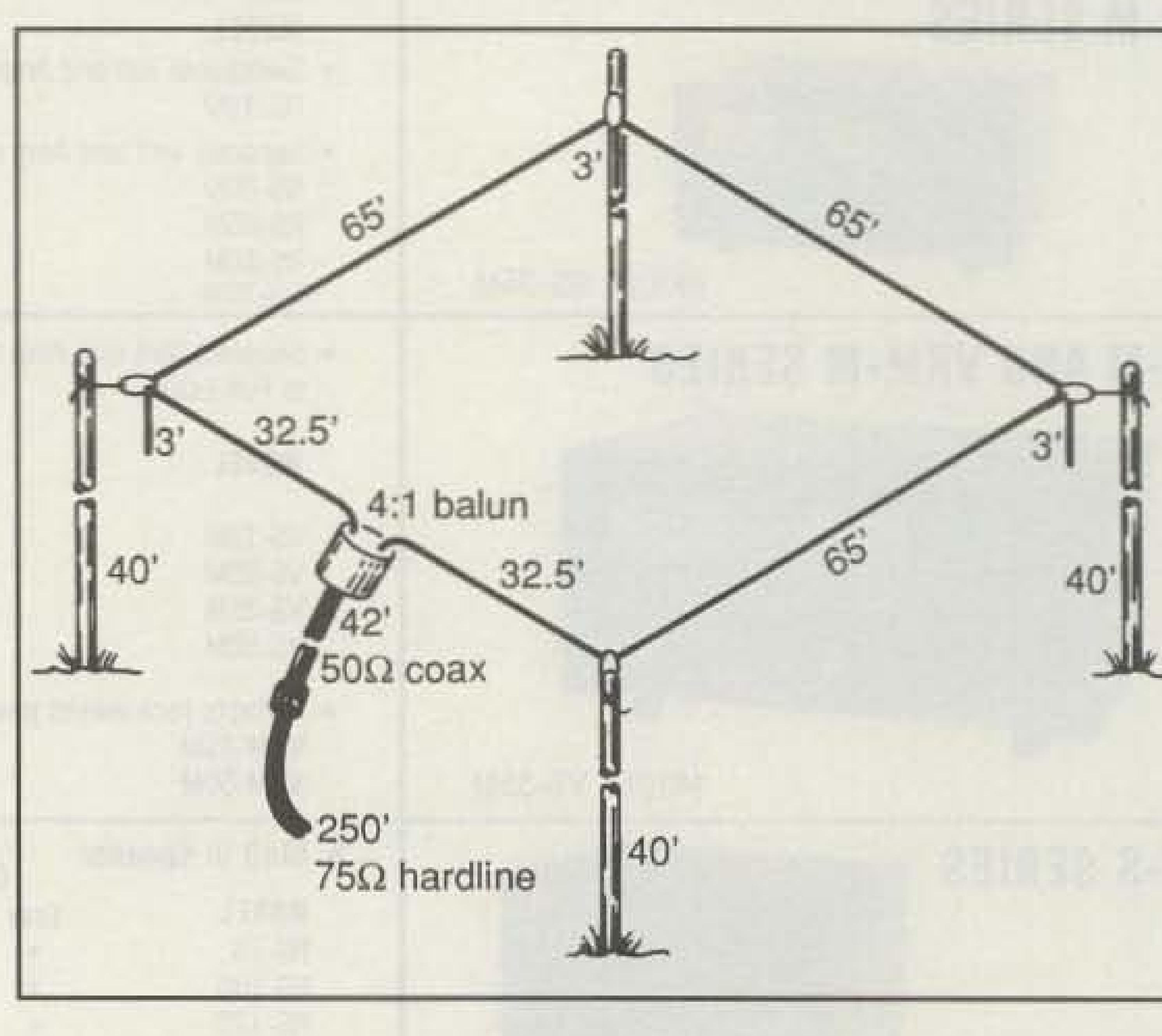

Fig. 2– Dimensions for the two-band loop described in the text.

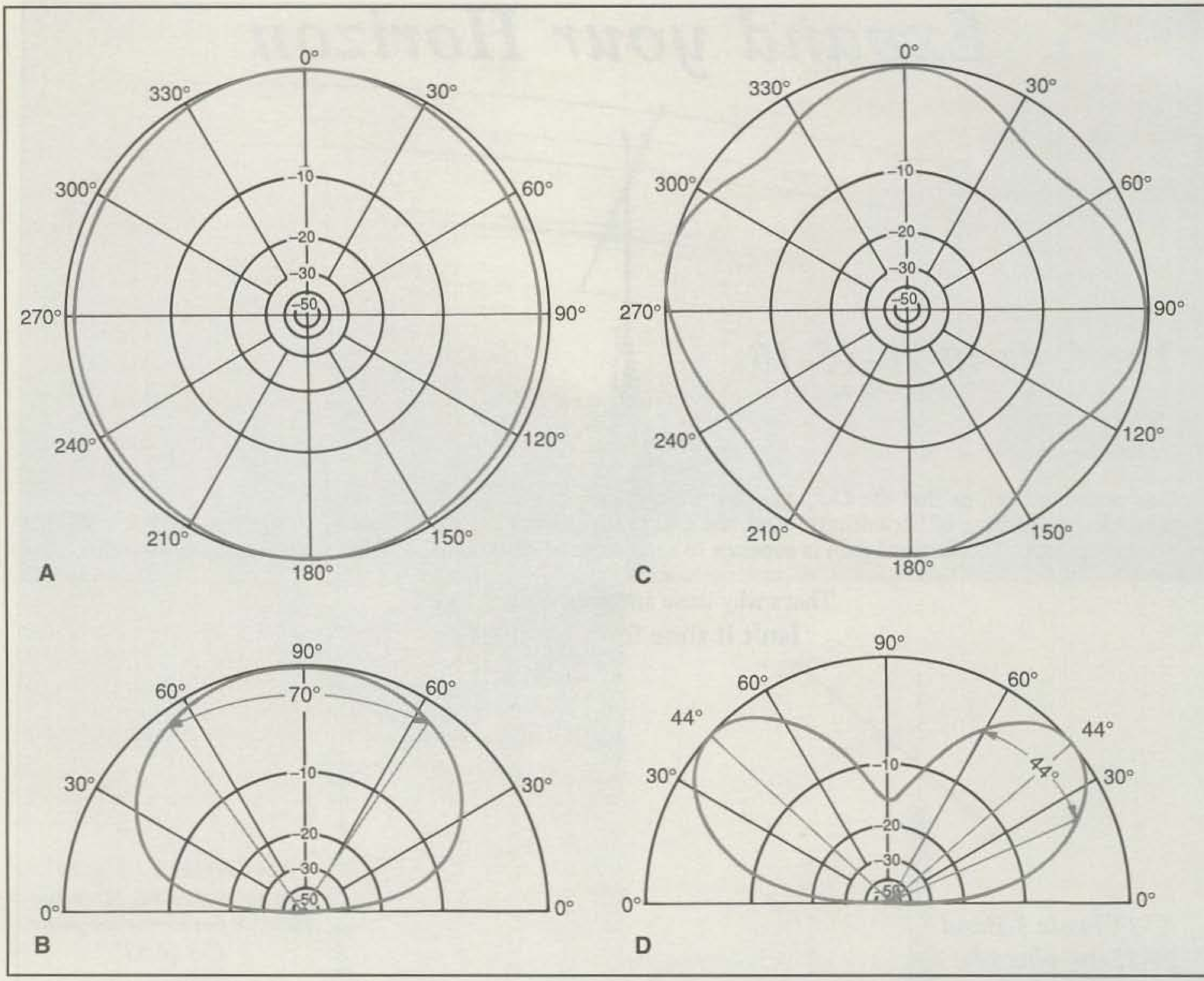

Fig. 3– (A) The horizontal pattern for the loop on 75 meters. (B) The 75 meter vertical pattern. (C) The 40 meter horizontal pattern. (D) The vertical pattern on 40 meters.

drop wires do not occur at points on the antenna on 3.85 MHz where they can add significant capacity to ground. The completed antenna is shown in fig. 2.

Not much is written about the impedance of a loop that is two wavelengths around. I picked a figure of about 300 ohms as a "seat of the pants" guess and proceeded fearlessly from there. (This figure was confirmed as "in the ball park" when a computer analysis was run later.) Assuming that the impedance would be in the 300 ohm range, the impedance presented by the 4:1 balun would be about 75 ohms. The quarter-wave section used as a match on 75 meters would now be about a half wave long on 40 meters, and as such should present close to 75 ohms to the terminal end and the TV hardline. Again, checking the impedance at the end of the matching section with the antenna scope, I got another reading of 68 ohms.

I think about here I should point out that a difference exists between the 75 meter length of a quarter-wave section and the 40 meter length of a half-wave section of 52 ohm coax. Using the standard formulas for determining matching sections, the 75 meter quarter-wave section should be 40.7 feet long and the 40 meter half-wave section should be 43.5 feet long. A compromise of 42 feet was chosen, and the aforementioned impedances were made at the end of this length of 52 ohm coax. No effort was made to run this dimension through the Smith chart route, but Lady Luck sometimes smiles on the lazy and things work out about the way they should. So you other lazy people take heart!

The proof of the pudding is in the eating, so I have been told. The SWR changed very little from one end of the 40 meter phone band to the other, and required no assistance from a tuner. However, the SWR rose as I expected, as the frequency was moved above or below the design frequency of 3.850, and a tuner was added to help out the exciter when operating "barefoot." The linear took the slightly higher SWR in stride and no tuner was necessary. A matching device to match the 75 ohm cable to the 50 ohm "barefoot exciter" might reduce the need for a tuner. There are several articles in amateur publications and at least one book written on such matching devices (see *Building and Using Baluns and Ununs*, by Jerry Sevick, W2FMI, available from CQ Communications, Inc.). So far I have not tried this route. I do know, however, that once the antenna tuner has been adjusted for a 1:1 SWR at 3.850 MHz, a 1:2 SWR across the entire width of the 75 meter phone band as a worse case is achieved without retuning the antenna tuner.

The question is always asked, "What about the other bands?" Operation on all the higher frequency bands was tried with the exciter "barefoot" and an antenna tuner in line. The results were encouraging, since good reports were received on all of them. A tuner was used on these bands, since the SWR was too high for the exciter without one. No effort was made to operate with the linear, since I had not made an analysis of what would happen to the 4:1 balun. I have burned out a couple of baluns in the past trying stunts like this, and wasn't anxious to lose another.

I can say, however, that good, solid contacts were made on all bands except 160 meters, and no problem matching with an MFJ901 tuner was encountered on any of the bands. True, the antenna turned out to be no match for a multi-element beam at the same height, nor was it expected to be.

For those who are unhappy without a computer readout (and I wonder how we ever got along before the computer!), I turned over the final design to WA4HTR (now a silent key) and W4TDI, who were computer literate. They ran off a series of charts for the several bands. The results confirmed the on-the-air results I had encountered in using the antenna.

"A picture," some ancient philosopher said, "is worth a thousand words." I believe it. Fig. 3 shows a rundown of the computer pattern of the antenna as promised earlier. You will notice that the 75 meter patterns as shown by fig. 3(A) and 3(B) are exactly as expected from other classic full-wave loop antenna articles published before—a high-angle, non-directional radiator capable of good local coverage and fair DX capability.

The 40 meter patterns, however, are a bit more interesting, showing a "not quite round" but generally nondirectional coverage as seen in fig. 3(C) and a somewhat lowered angle of radiation than that found in the 75 meter operation as shown by fig. 3(D).

Patterns for the other bands pretty much follow those published in numerous other articles for 80 meter full-wave loops mounted horizontal to the ground. To prevent redundancy they will not be shown here.

Anyone studying this antenna, or building one, will probably have some questions. While I have spent several weeks, and numerous rewrites, preparing this article, there is always some aspect that is either omitted or given the "broad brush treatment" and that requires a few well-chosen words to clarify. To those people who need more "dope," an SASE will bring the best answer I can give. Mail to: 62 East Higley Road, Colton, NY 13625. Even if you do not have a question, I would appreciate comments. ■