Baby Loopy

A half-wave, inductively-loaded loop.

by Dean Frazier NH6XK

Did you ever experiment with a half-wave loop in the horizontal plane, loaded at the 1/4 and 3/4 points? They're easy to make, and give you 3 to 6 dB gain and about 20 dB side rejection by reducing the current in the sides. This results in greater current across the antenna along a line from the side opposite the feed point, through the feed point. They are ideal for beaming in a fixed direction, and on the higher frequencies they can be made so small that rotatability is entirely feasible. They mount easily on a rooftop. I've worked with them from 10 through 40 meters and without exception have had very good results, compared with my R5 vertical and 414-foot longwire. With this background in mind, my purpose in this article is to show you how to design and set up your own "Baby Loopy."

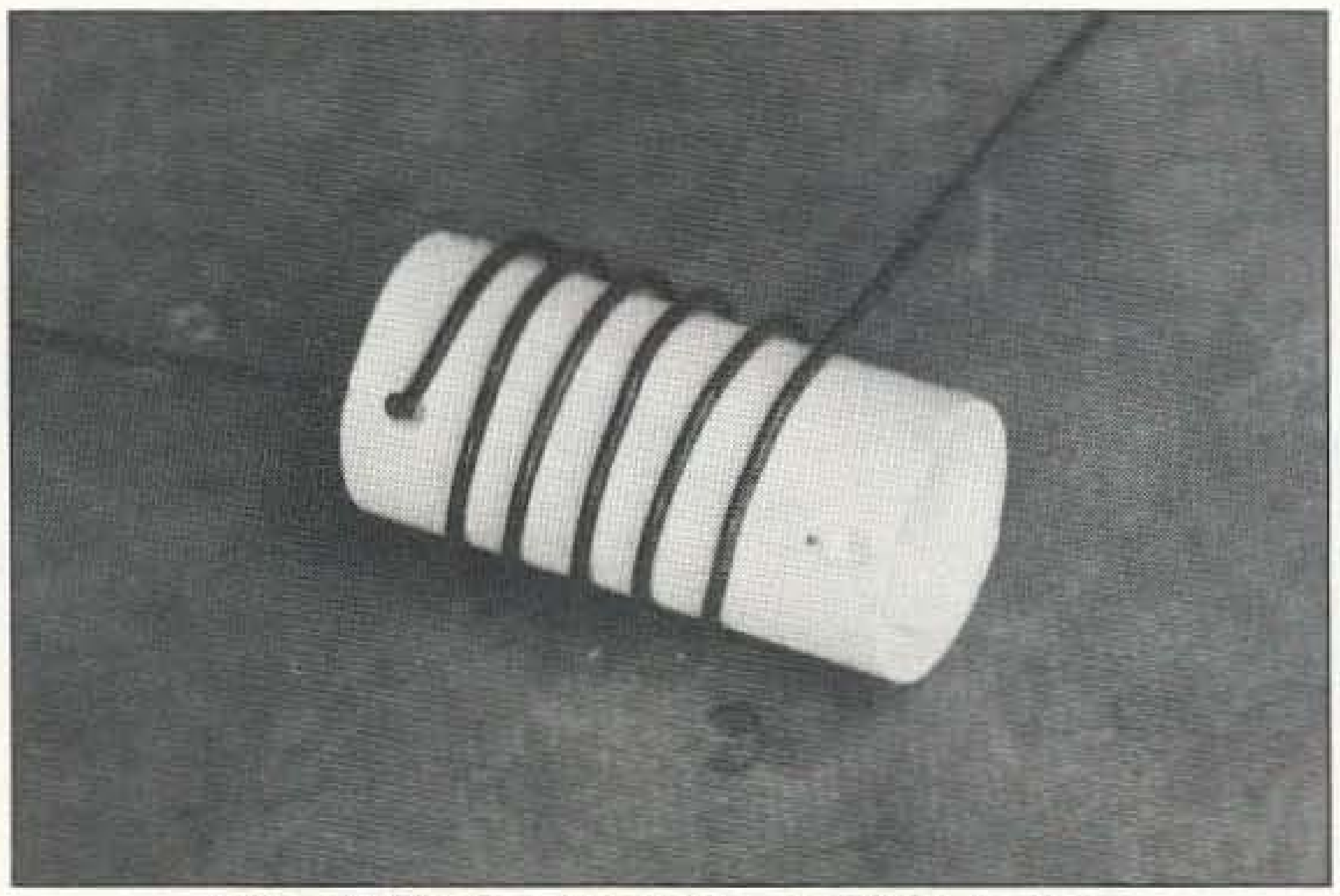

Photo A. Winding the coil on the PVC pipe form.

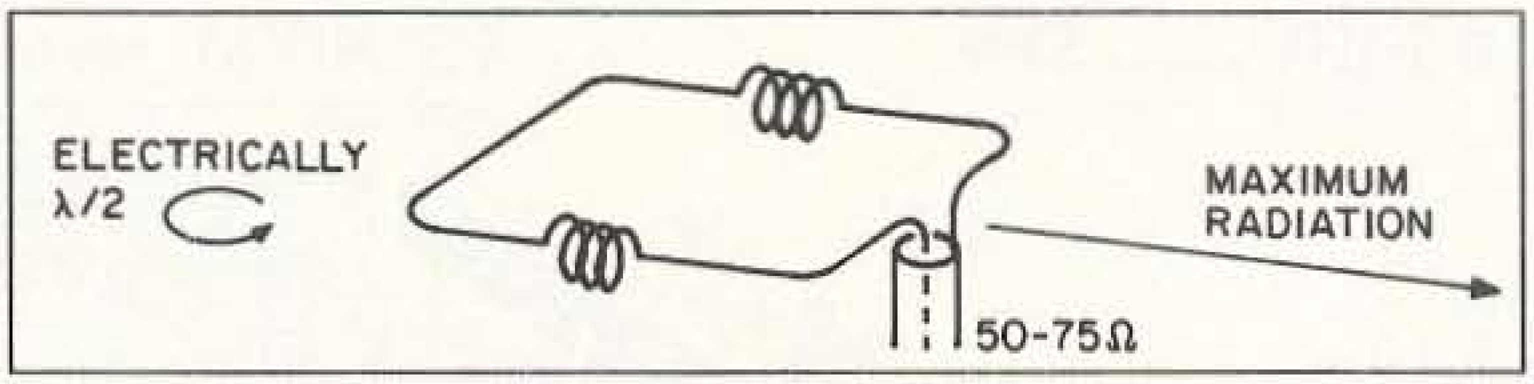

Figure 1. Diagram of the baby loop antenna.

Note: The loop is physically smaller than it would be as a half-wave antenna because a portion of the half wave's wire is used as loading coils. The loop is physically, not electrically, smaller. See Figure 1.

Construction

To figure the amount of wire (feet) needed for the half-wave loop, calculate as follows:

$$\frac{\lambda}{2} = \frac{1005}{2(f\ \text{MHZ})}$$

Example: $\frac{\lambda}{2}$ loop for 40 meters (7.2 MHz):

$$\frac{\lambda}{2} = \frac{1005}{2\ (7.2)} = 69.79 \text{ feet}$$

The 1/4 point (e.g., the center of the first coil) will be, measured from the feedpoint, 69.79/4 = 17.45 feet, and the 3/4 point (the center of the other coil, again, as measured from the feedpoint in the same direction) will be 3/4 x 69.79 = 52.34 feet. The center of the second coil should come out at 17.45 feet from the feedpoint, as measured in the opposite sense as the first coil was measured. See Figure 2.

Now, to achieve the gain and side rejection, we need to introduce about 360 ohms of inductive loading by coiling the wire at the 1/4 and 3/4 points on the wire:

$X_L = 2\pi fL$ where X_L = Inductive reactance (ohms),
$\pi = 3.14$ and f = frequency, (MHz)
$360\Omega = 2\ \pi(7.2)L$
$L = 360/2\ \pi(7.2) = 7.96\ \mu H$

Recall that for an air-wound coil, the following formula shows the connection between the coil diameter, "d" (in inches); the number of coil turns, "n;" the length of coil when wound, "ℓ" (in inches); and the inductance, "L," in microhenries:

$$L = \frac{d^2\ n^2}{18d + 40\ell}$$

Solving this equation for "n," the number of turns, yields:

$$n = \frac{\sqrt{L\ (18d + 40\ell)}}{d}$$

If, for example, we happen to have two-inch PVC pipe on hand on which to wind the coils, we calculate the number of turns required, "n," by estimating an appropriate coil length, "l":

l = 4 inches estimated

If, again for example, after some trial and error, we decide on a length of coil of 3-5/8 inch, we find about 19 turns of wire will give the desired inductance:

$$n = \frac{\sqrt{7.96\ [18\ (2) + 40\ (3.625)]}}{2} =$$

$$18.98 \approx 19 \text{ turns}$$

$$(3\ ^5/_8 \text{ inch} = 3.625)$$

By varying "l" we change "n," for a given (fixed) "L" and "d." We try to juggle "l" so that "n" comes out as a whole number, which is convenient to wind.

We have to check that in fact this many turns of wire will fit physically into a length of 3-5/8 inch. I find that keeping the number of turns of coil down to six or less per inch seems to work well.

$$\frac{18.98}{3.625} = 5.24 \text{ turns per inch}$$

Having passed this test, we realize that our coil will look like Figure 3. Now the question becomes, how much wire did we "use up" in winding the coils? The wire used per coil, in feet, is:

$$\frac{19 \text{ turns } (3.14)^2}{12 \text{ inches/ft.}} = 9.94 \text{ feet}$$

For 2 coils, this amounts to 19.88 feet.

The balance of wire in the antenna is 69.79 - 19.88 = 49.91 feet. Dividing this remaining wire into two halves, one half for the "front" and the other half for the "rear" of the antenna, we get a picture of our loop as shown in Figure 4.

Mount the loop horizontally. The maximum radiation as shown above is from the far side of the loop back towards the feed point. Run the feedline away from the loop perpendicular to the plane of the loop for at least a quarter wavelength.

Comment on winding the coils: Spot the

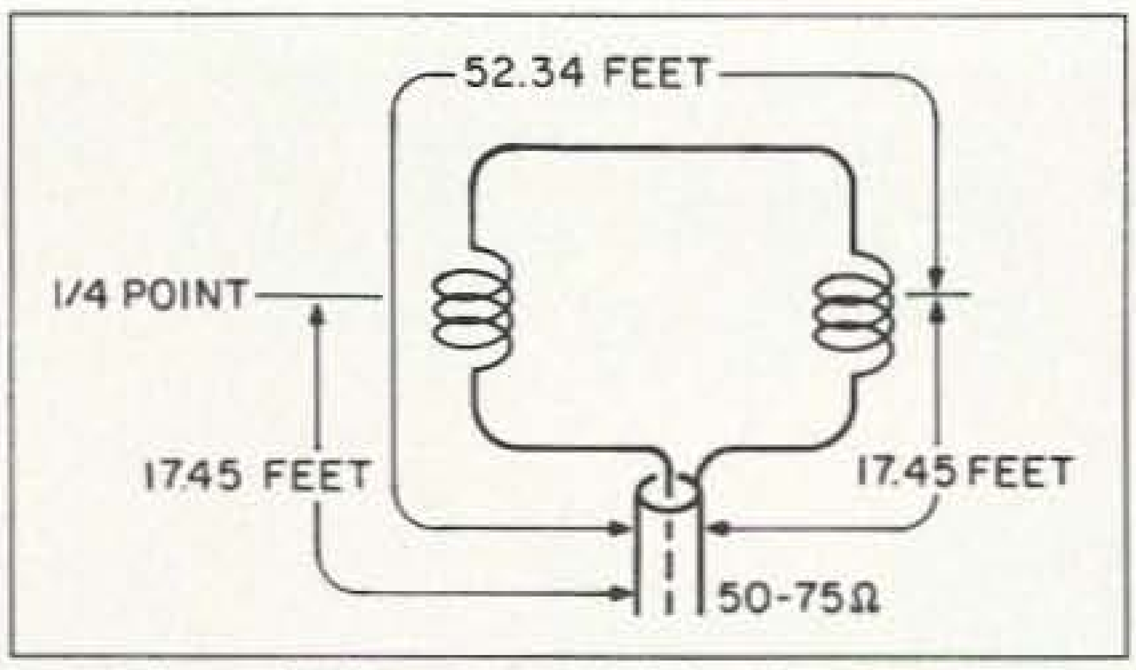

Figure 2. Dimensions of the 40m version.

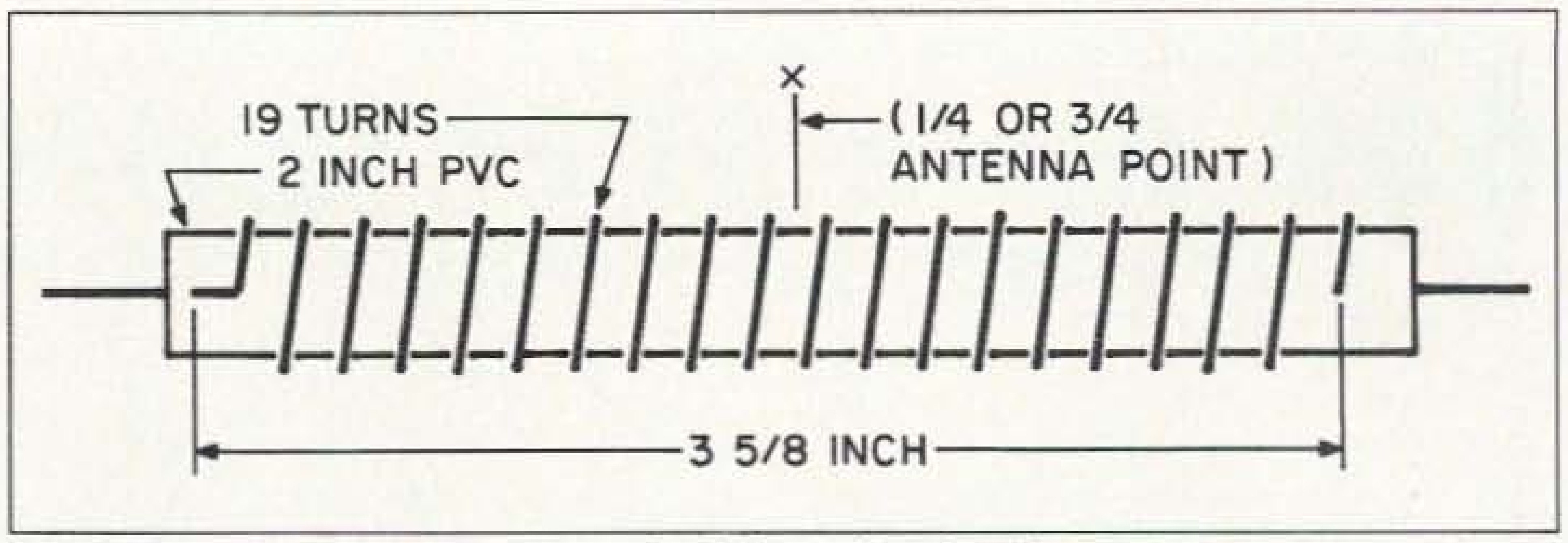

Figure 3. Coil winding details.

1/4 point (and again the 3/4 point) of the wire loop at the center of your coil form(s) and wind the coils in both directions onto the form to ensure that, when wound, the 1/4 point and 3/4 points on the antenna are, in fact, *exactly* at the center of the coils.

Comment on installation: The usual rules about installation apply. I've put my Baby Loops on the non-metallic roof of my QTH with barely a few inches clearance. My 12 meter Loopy faces ZL (from Hawaii) and I consistently receive reports one to two "S" units stronger in the desired direction, compared to my R5 (which, by the way, is a very effective antenna in its own right on 10 through 20 meters, including the WARC bands). The same loop gets me into the continental US, so evidently there is some side and high angle radiation.

Note that a half-wave loop for 40 meters will tune 10 and 20 meters as two- and one-full-wave loops respectively, with a preponderance of perpendicular (to the loop plane) radiation, and as multiples of a half-wave (in the plane) on 17, 15, and 12 meters. The former capability is useful for "short haul" (out to 2,500 miles) high angle radiation, while the latter shines on DX (low angle, long distance).

Regarding the Baby Loopy's size, as more wire is wound into the coils less is available for the remainder of the loop, resulting in a physically smaller and smaller loop. There will be some practicable limit to size reduction as a function of radiation efficiency, but I have yet to find that limit. (We're alluding here to a transition from use of the electric vector to the magnetic vector for radiation). My experience with the half-wave loops from 10 meters through 40 meters is that almost any size which is comfortable to build will work, as long as the inductive reactance of the coils is around 360 ohms. Varying the loop's physical size will of course alter the radiation pattern, which can best be modeled via computer program. Of direct concern to the amateur, however, is the resulting feed point impedance variation with change in loop size. However, the usual impedance matching methods apply (balun, series section transformer, etc.). A good ATU is the easy way out. Personally, I use nothing more than an L/C "Random Wire" tuner feeding coax to the loop.

So, if you have limited space, are unable to put up mega-arrays of antennas, and for whatever reason must erect low profile antennas, then the half-wave inductively loaded horizontal "Baby Loopy" may just be the answer. You'll realize gain, directionality, and some front-to-back and side rejection. They're easy to make, easy to install, and easy to tune. They work. 73

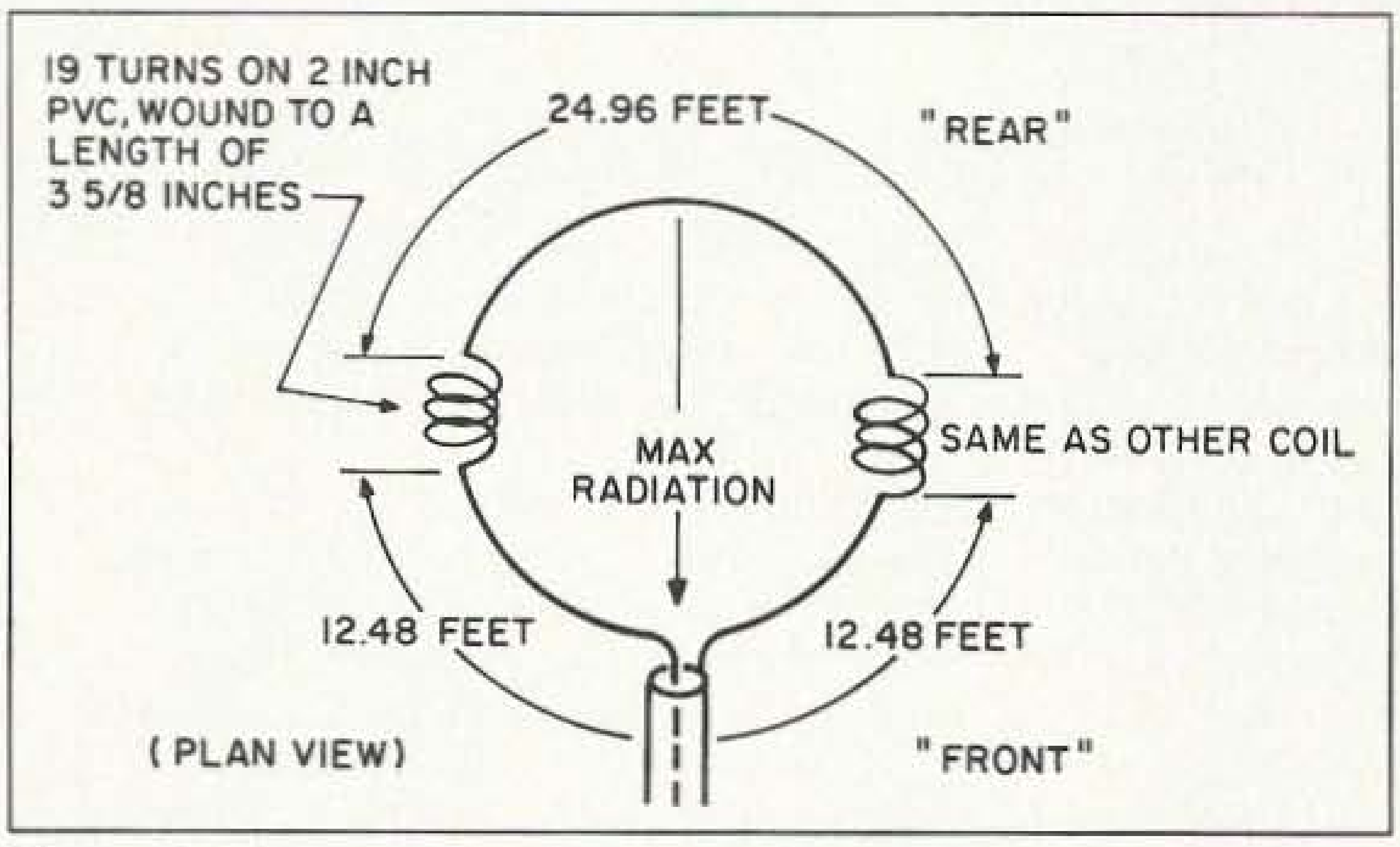

Figure 4. The baby loop can be thought of having a "front" and "rear" as shown.

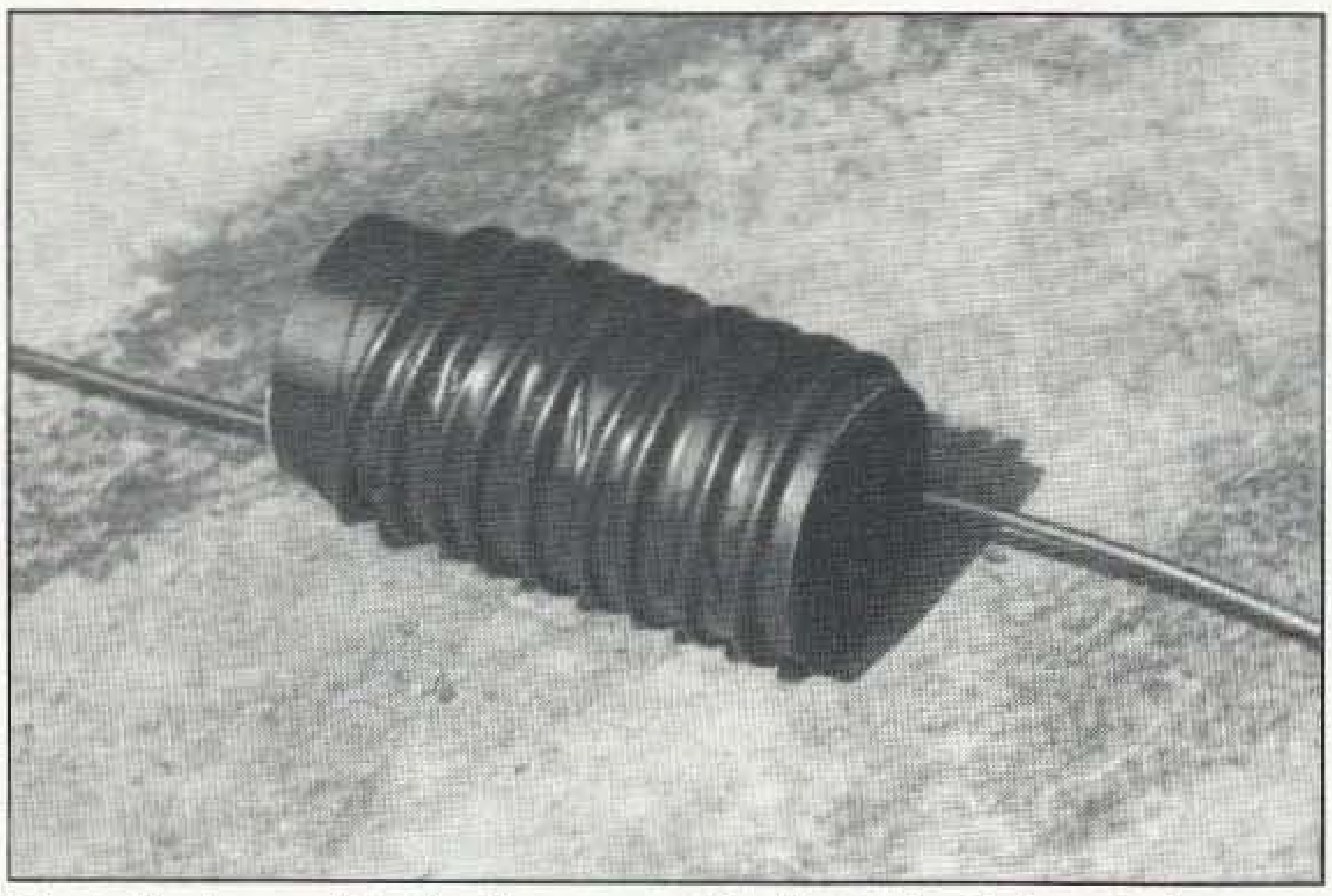

Photo B. A completed coil, wrapped in black vinyl electrical tape to hold the coils in place.

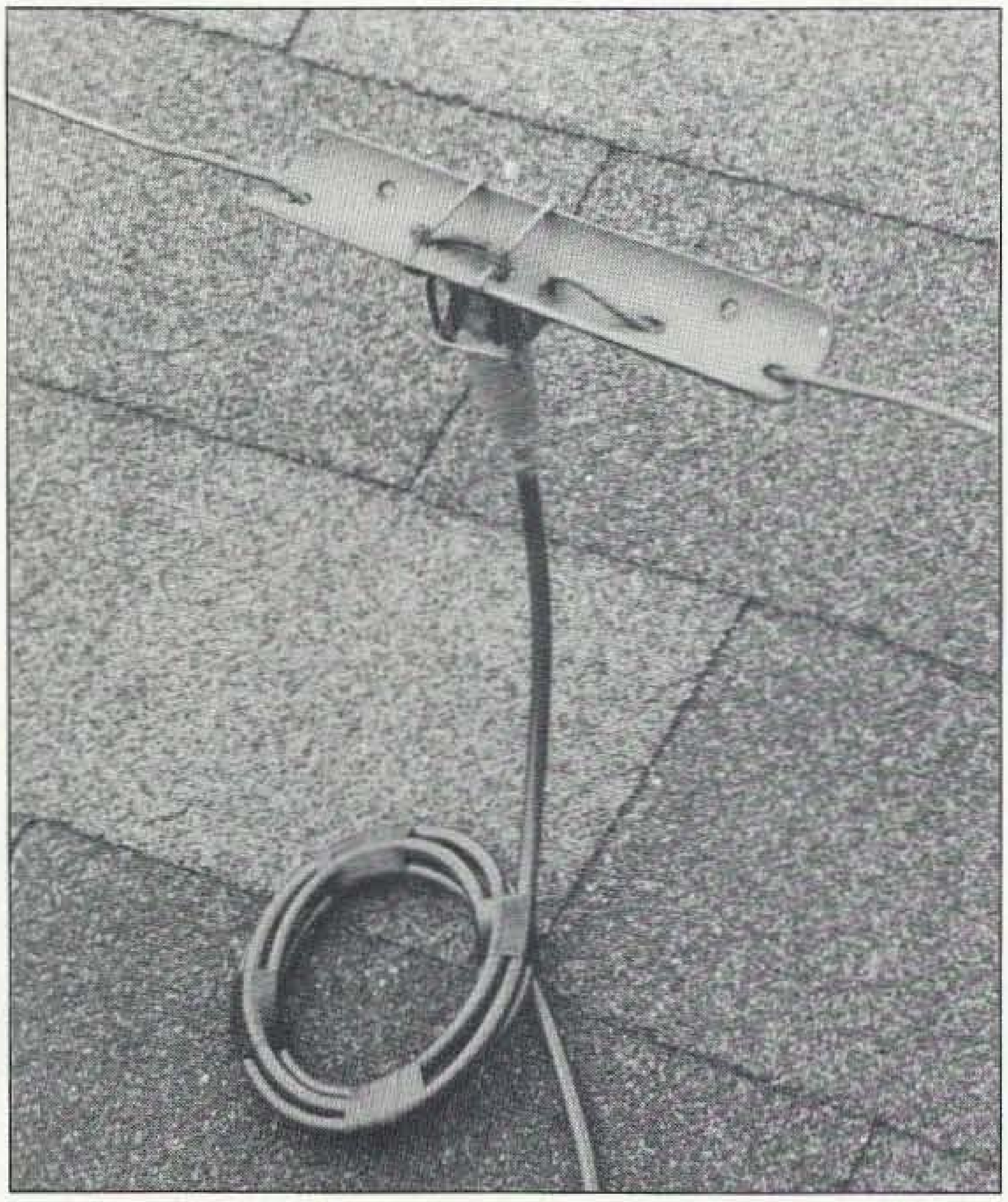

Photo C. The feed point of the baby loop antenna. A strip of PVC pipe (cut down the middle) was used to mount a SO-239 female connector and to support the antenna wire. Note also an RF air balun (1:1) formed out of coils of the feedline.