Number 8 on your Feedback card

The Megaloop

Perfect for megalomaniacs.

by Stan Gibilisco W1GV

Have you ever wondered what would happen if you connected your HF transceiver via a transmatch to an infinitely longwire? Or to a wire 100 miles long? Or to a loop running all the way around the state line of, say, Kansas?

Most hams have heard old-timers tell stories of finding an unused telephone line a few miles long and using it as an antenna to work the world on a few watts.

A couple of years ago, following a serious accident, I returned to my parents' home to recuperate. I got on the air with the help of some old ham friends who donated time, muscle, and equipment. During that winter, I put up a longwire measuring 880 feet, and got great results. It was a good performer on all bands 80 through 10 meters, and wasn't bad on 160, either. Mel Larson KCØP had advised me to put up a longwire if there was any opportunity; he said I wouldn't regret it, and I didn't.

Nor do I regret my most recent experiment, a huge horizontal loop of wire that I call the megaloop.

A Far Out Concept

An infinitely longwire or loop, if either were possible, would have certain characteristics. First and most significant is that a change in frequency would make no difference whatsoever in the performance of the antenna in free space. It would have an infinite number of current loops, no matter what the wavelength of the signal applied to it. The impedance would be purely resistive; there would be no standing waves because no power could be reflected from the end of an endless antenna.

I've done some experiments that suggest that an antenna of about 50 wavelengths or more may be considered, in practice, infinitely long. As the electromagnetic field propagates from the feedpoint of such a longwire, the current and voltage loops diminish in magnitude the farther one gets from the station. See Figure 1(a). This is because the field radiates as it travels, and this radiation, along with ohmic loss in the wire itself, dissipates the signal. Even with a perfectly conductive wire, this effect would take place, solely because of the radiation resistance of free space. By the time the field has gone about 50 wavelengths, most of it is gone forever into the vacuum of space. If the longwire were a loop measuring, say, 100 wavelengths in circumference, you'd observe a similar effect. See Figure 1(b).

The vacant field to the north of my parents'

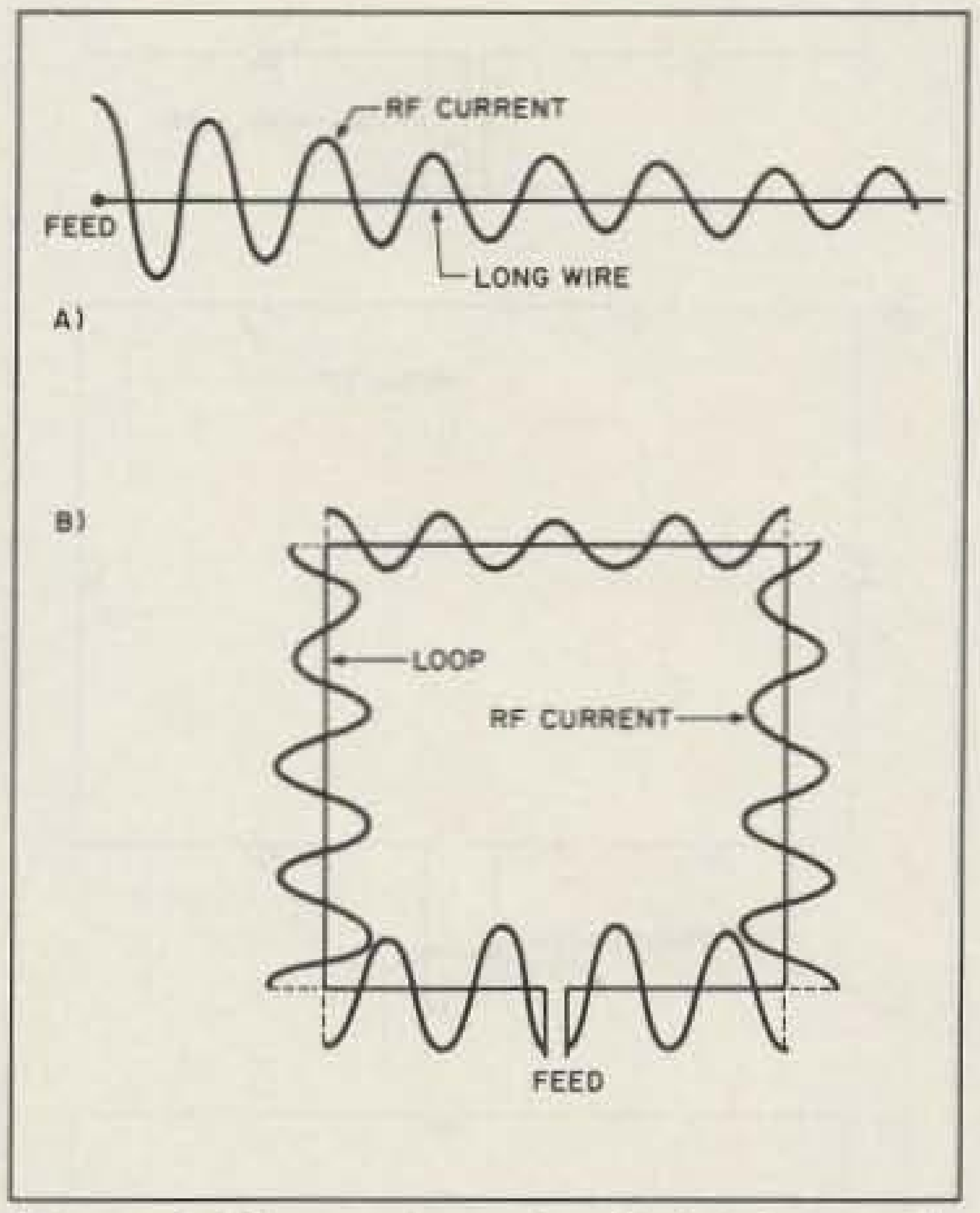

Figure 1. Current intensity diminishes as the electromagnetic field travels away from the feedpoint. (a) An antenna 50 wavelenghts long may, in practical terms, be considered infinite.... (b) A 100-wavelength loop with similar characteristics.

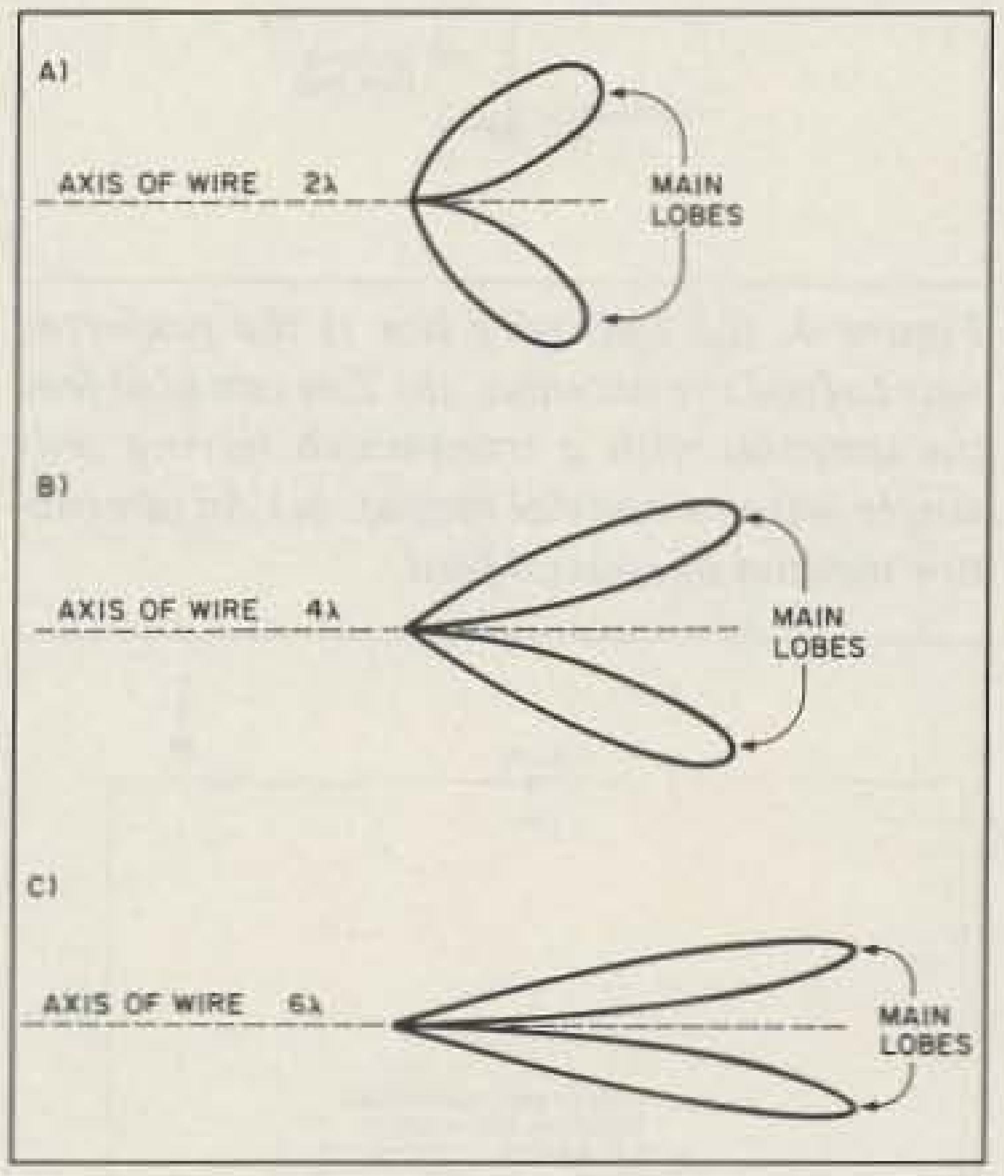

Figure 2. Main lobes for terminated longwires at different wavelengths.

house measured about 700' x 1200', the long way being east-west. In 1987-88, I ran the 880-foot longwire from the house to the west-northwest; in 1989, I ran a loop around as much of the field as I could manage. I don't know exactly what the circumference was, but it was probably about 3800 feet, or 0.7 miles.

Directional Effect

This is the second most important characteristic of an arbitrarily longwire. A large, strong lobe develops when a wire becomes more than a few wavelengths long. There is a limit to how much gain can be realized from this lobe. See Figure 2. This is because of the effect of radiation loss mentioned above; but certain long-wire configurations, like the terminated rhombic, can have around 30 dB of power gain relative to a half-wave dipole.

Minor lobes, now shown in Figure 2, also appear, and they become more numerous as the wire is made longer. An infinitely longwire would theoretically have infinitely many minor lobes. A wire 50 wavelengths long would have so many minor lobes that we might think of them as a single field; they would tend to blend together because of wire sag and ground effects from nearby objects.

Bending the wire into a loop might be expected to eliminate the directional effects and cause the minor lobes to more completely blend. The result would be a fairly uniform radiation pattern as long as the loop was small enough to allow some of the electromagnetic field to travel all the way around. A loop of infinite circumference, or many miles, would behave essentially as a straight longwire fed somewhere along its length and running off forever in opposite directions.

My loop was about 100 wavelengths at 10 meters, 50 wavelengths at 20 meters, and 25 wavelengths at 40 meters. Especially towards the top of the HF spectrum, the megaloop is like an infinitely long, straight wire. But at 80 and 160 meters, it is not so overwhelmingly large, and can be expected to have nearly omnidirectional characteristics. The polarization would be horizontal on all bands. The antenna height above ground would ideally be at least a quarter wavelength, or 33 feet at 7 MHz, 66 feet at 3.5 MHz, and 130 feet at 1.8 MHz. I was able to get most of the antenna up about 50 feet, the height of trees around the field. I got wires over the trees using kites of the inexpensive, dime-store variety (bat kites).

And the Third Characteristic...

Diversity! The antenna covers such a large area that if fading is taking place in one spot, reception may be good at another spot. This diversity effect is observed with all longwires or rhombics, and it works for the phasing type of fading, where different components of an incoming field arrive in phase some of the time, and out of phase some of the time.

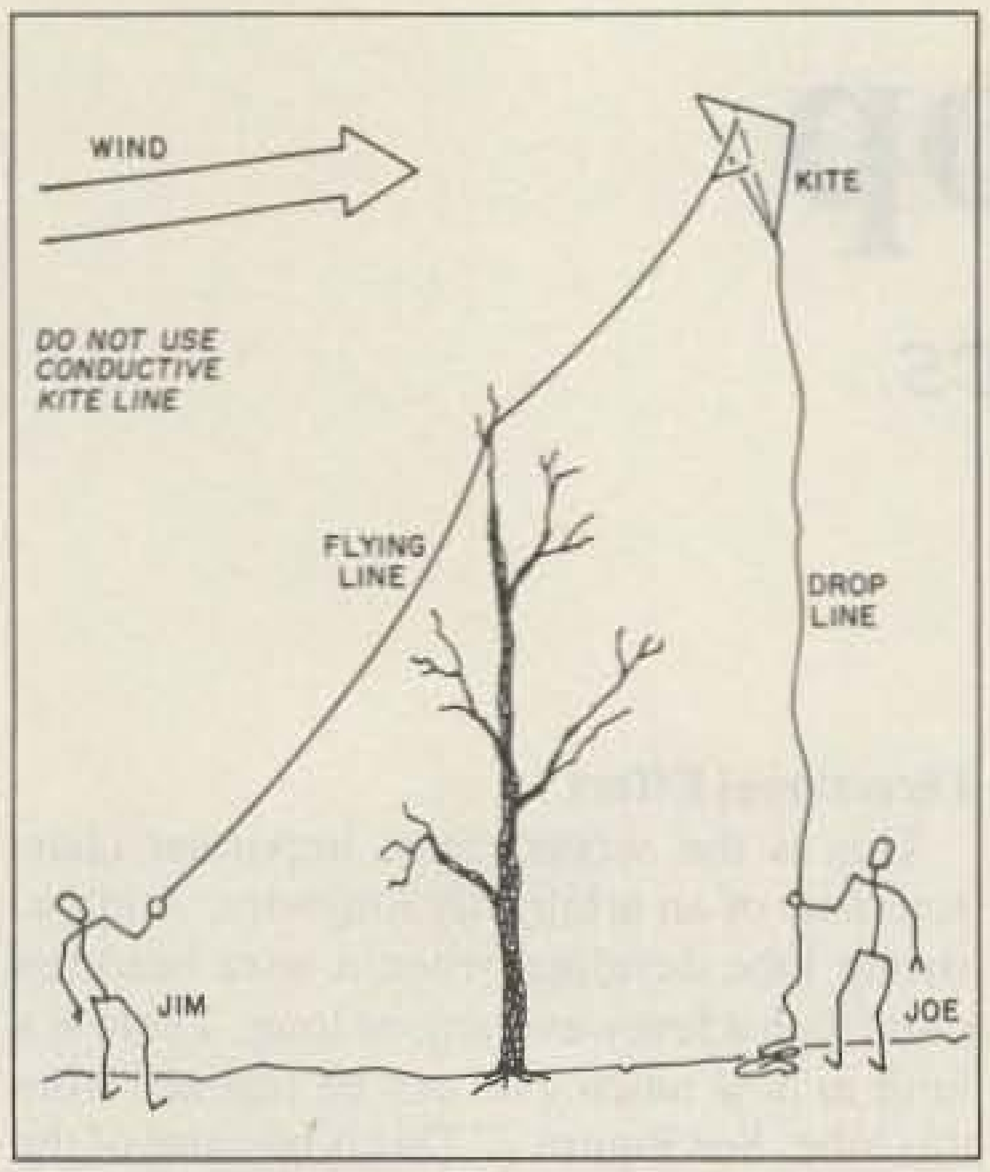

Figure 3. The kite technique works best with two people, so one can guide the flying line, and the other, the drop line. Only nonconductive line should be used for this operation.

Fading that occurs because of ionospheric absorption or a change in the maximum usable frequency (MUF) won't be reduced by diversity techniques. It's reasonable to expect that the diversity of the antenna would operate in transmit as well as in receive mode so that other stations would note less fading with the megaloop than with a small antenna such as a quarter-wave vertical, under conditions when multipath fading occurs.

The vacant field was scheduled for development, so the time was limited. I had to try out my idea of the megaloop during the winter of 1989–90, or never. This, plus the desire to grandly command the helm of such a device, motivated me to do it. Also, I hadn't heard much about anyone else having done it, though surely it has been tried before.

Materials

I used aluminum fence wire, Baygard®6 for the radiator. This six-strand wire, reinforced with nylon, is light and strong. It comes in rolls of a quarter-mile each. I bought three of these and used just about all of the wire for the megaloop.

With some nylon twine and a few old bat kites, I snagged the wires up in the trees, even though the wire is bare. In Minnesota, trees are fairly good insulators if it is below freezing. A good breeze, about 15 mph, facilitated the kite technique. See Figure 3. Also indispensable were warm mittens, as the temperature hovered around zero.

Feeding and Grounding

The megaloop can be fed in two ways. The preferable method is to bring the ends of the loop together into a parallel-wire line. See Figure 4(a). Then, to connect this line to the output of a transmatch equipped to deal with this kind of line.

If your transmatch does not have a two-wire line output, you may connect one end of the loop to the center conductor pin of the coaxial output, and the other end to chassis ground. See Figure 4(b).

Or you may leave one end of the loop free and connect the other to the center conductor pin or single-wire terminal. See Figure 4(c).

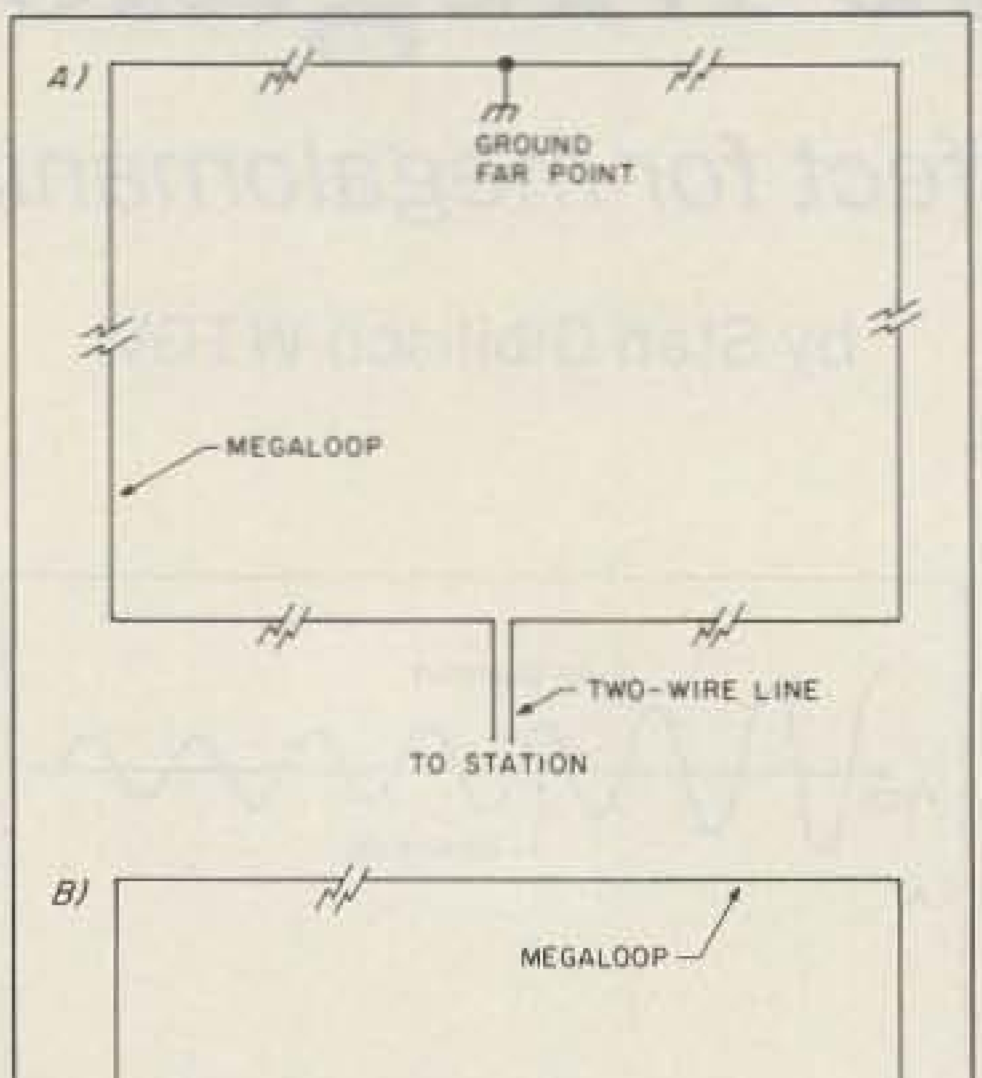

Figure 4. (a) Two-wire line is the preferred way to feed the antenna. (b) You can also feed the antenna with a transmatch having only single-wire or coaxial output. (c) An alternative method of coaxial feed.

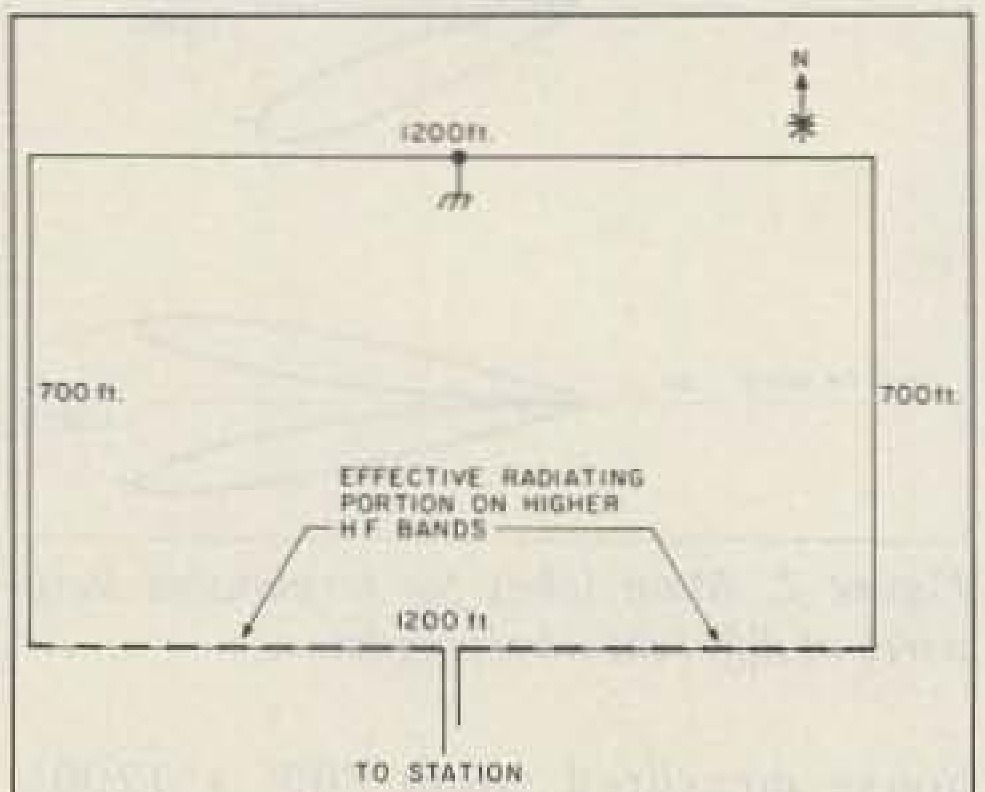

Figure 5. On the higher HF bands, only the southernmost leg of the loop at W1GV was really contributing to the radiation and reception in the megaloop antenna system. Nonetheless, the same basic advantages were realized.

In this case, the megaloop becomes a long wire bent into a circle.

I would recommend methods 4(a) or 4(b), but whichever method you use, a transmatch is necessary.

If the feed method at 4(b) is used, the loop is grounded for direct current, and this is good. Such a large antenna will develop electrostatic voltages because of atmospheric effects. It will actually be a hazard in or near thunder showers unless it is grounded for direct current. *Always, always disconnect the antenna from the rig when you are not on the air, winter or summer, storms or no storms. And never operate during thunder showers or lightning.*

With method 4(a), the loop should be grounded for direct current at a point opposite the station, or as nearly opposite as you can get. An eight-foot ground rod, driven into the earth well away from tree roots (copper can kill trees), and some buried radials, will ensure that you don't get clobbered when you touch the antenna wire. Some transmatches "ground" the antenna via the output of a two-wire feed balun. Do not rely on your transmatch for grounding, however, since some do not have this feature.

Putting It to the Test

Whatever theory may tell us, the way to decide how well an antenna works is to use it. Just because it will produce contacts does not mean that an antenna is a good radiator. I have worked stations over 1000 miles away by loading up a pair of ground rods spaced a quarter-wavelength on 20 meters. And you can work DX on a lightbulb.

Since I knew that a quarter-wave vertical with several radials is not a bad antenna, I compared the megaloop with a balloon-supported vertical on 40, 80, and 160 meters. A length of tubing was sufficient for a quarter-wave vertical on 20, 15, and 10 meters. (My radio doesn't cover the new WARC bands.)

The quarter-wave out-transmitted the megaloop on 160, and was comparable with the megaloop on 80 meters. Of course, that's no surprise. The megaloop did work better for close-in stations on 80; that may be attributed to the better high-angle radiation from the megaloop on this band.

As for reception, the megaloop was superior to the balloon vertical on 160 meters. The vertical was just too noisy. There was little difference on 80 meters, although some close-in stations were louder on the megaloop than on the vertical. The megaloop at W1GV was center-fed and grounded (marginally, because the earth was frozen) at the far side. This might be expected to reduce noise somewhat, along with the horizontal polarization and the comparatively low placement of the antenna (only 50 feet above the ground).

On 40 meters and above, verticals and the megaloop were just about equal for transmitted and received signal strength. This would be the expected result; both antennas are omnidirectional (essentially) and neither has any appreciable gain, except maybe on 10 and 15 meters. The feedpoint at W1GV was roughly in the middle of a long east-west run of wire,

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and it might be expected that much of the electromagnetic field would radiate off along this part of the loop before reaching the parts running north-south. See Figure 5. I tried testing this directional effect, favoring east and west on 10 and 15 meters, but I didn't get any conclusive results.

The primary effect I was looking for was the diversity in the presence of multipath fading. This I did indeed observe, especially on the higher bands. But I wasn't surprised. Contacted stations reported less fading from my signal on the megaloop, compared to the verticals. I have experienced this advantage of geographically large antennas in the past, with the 880-foot long wire that I put up, and also with various kite-supported sloping longwires.

So what's the great advantage of a megaloop? For me, it was a chance to satisfy my megalomania, to do something before the real estate was no longer available. It was a temporary, wintertime antenna, and I'm glad my parents let me do all this experimenting there. I took the antenna down as soon as I had established that it worked; I didn't want this huge lightning attractor giving my mother anxiety all summer long. Now all that wire sits in the basement, awaiting some other grand project such as the 3/4 mile kite sloper . . . maybe. 73

You may write Stan Gibilisco W1GV at 871 S. Cleveland Avenue #12, St. Paul MN 55116. Please include an SASE for a reply.

Software for the Ham Shack

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723 IF T$ = "" THEN 790
730 PRINT : PRINT : PRINT
731 PRINT "THE RESISTOR COLOR BANDS ARE: " F$"/ "S$"/ "T$
732 PRINT
740 PRINT "N - TRY AGAIN"
741 PRINT "M - MAIN MENU"
742 M$ = INKEY$
743 IF M$ = "N" THEN 700
744 IF M$ = "M" THEN 10
745 GOTO 742
751 IF X$ = "0" THEN C$ = "BLACK"
752 IF X$ = "1" THEN C$ = "BROWN"
753 IF X$ = "2" THEN C$ = "RED"
754 IF X$ = "3" THEN C$ = "ORANGE"
755 IF X$ = "4" THEN C$ = "YELLOW"
756 IF X$ = "5" THEN C$ = "GREEN"
757 IF X$ = "6" THEN C$ = "BLUE"
758 IF X$ = "7" THEN C$ = "VIOLET"
759 IF X$ = "8" THEN C$ = "GRAY"
760 IF X$ = "9" THEN C$ = "WHITE"
761 RETURN
771 IF T = 0 THEN M$ = "BLACK"
772 IF T = 1 THEN M$ = "BROWN"
773 IF T = 2 THEN M$ = "RED"
774 IF T = 3 THEN M$ = "ORANGE"
775 IF T = 4 THEN M$ = "YELLOW"
776 IF T = 5 THEN M$ = "GREEN"
777 IF T = 6 THEN M$ = "BLUE"
778 IF T = 7 THEN M$ = "VIOLET"
779 RETURN
790 PRINT : PRINT
791 PRINT "CANNOT PROCESS VALUE LESS THAN 10 OHMS"
792 GOTO 732
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Program Listing

HORIZON, and OHMS TO RESISTOR COLORS.

Next month, in Part IV, you'll add the last two modules of Ham System to your software. See you then! 73

You may write Bill Clarke WA4BLC at RD#2 Box 455-A, Altamont NY 12009. Please include an SASE in you request information.